Woylie Recovery Plan

by Tony Start, Andrew Burbidge and David Armstrong
for the Woylie Recovery Team

1995

Wildlife Management
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Department of Conservation
and Land Management

WESTERN AUSTRALIAN WILDLIFE MANAGEMENT PROGRAM NO. 16

WOYLIE RECOVERY PLAN

Second edition
1994 -1995
revised June 1995

by

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for the Woylie Recovery Team

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by Jane McRae

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1995

FOREWORD

The Western Australian Department of Conservation and Land Management (CALM) publishes Wildlife Management Programs to provide detailed information and management actions for the conservation of threatened or harvested species of flora and fauna.

Recovery Plans are Wildlife Management Programs that delineate, justify and schedule management actions necessary to support the recovery of a threatened species or ecological community. The attainment of objectives and the provision of funds is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views nor official positions of any individuals or agencies represented on the Recovery Team. In Western Australia, this Recovery Plan has been officially approved by the Department of Conservation and Land Management, the National Parks and Nature Conservation Authority and the Minister for the Environment. In South Australia, the Recovery Plan has yet to be approved by the Department of Environment and Natural Resources. Approved Recovery Plans are subject to modification as dictated by new findings, changes in species' status and completion of recovery actions.

The first edition of this Recovery Plan was written in 1990 (Hall *et al*. 1991), with financial support from the Australian Nature Conservation Agency, and was used as the basis for recovery work on the species by the Woylie Recovery Team during 1992 and 1993. Early in 1993 it became evident to the Team that the plan needed revision because:

1. Additional populations of Woylies have been discovered or established in Western Australia.
2. Woylie populations have been discovered in areas of State Forest in Western Australia which are zoned for sustainable timber harvesting.
3. Proposals for widespread fox control in south-west forests (Operation Foxglove) provide an opportunity to markedly increase the range of the species.
4. The South Australian Department of Environment and Natural Resources (SADENR) found it necessary to employ a person to carry out work in that State. That increased the costs of implementing parts of the Recovery Plan.
5. Techniques for re-introduction to the mainland in South Australia have been revised.

Evidence now suggests that the status of the species in Western Australia is significantly better than thought when the first edition was prepared; further, there are excellent prospects for further improvement. Coupled with the successful establishment of Woylies on South Australian islands, this evidence suggests that the conservation status of the species requires review. However, before this can be done, additional work and information is needed: a better understanding of the conservation status of some of the populations, better knowledge of the genetic status of translocated populations (particularly the South Australian island populations) and the development of management guidelines for timber harvesting so that Woylies are able to expand their range in State Forest in Western Australia, and additional translocations. Given satisfactory outcomes it may be possible to recommend a change in status of Woylies from Endangered to Vulnerable, or even its removal from threatened species lists, and shorten the period that this Recovery Plan need operate. Such a decision might allow scarce threatened-species funds to be redirected to higher priority areas.

This Second Edition of the Recovery Plan contains detailed costings for 1994 and 1995. The criteria (and other minor items) were modified in June 1995 to ensure they are realistic in the light of new information on population density in some habitats as reflected by trap success (detailed in the minutes of the Recovery Team meetings). The conservation status of the Woylie will be reviewed in December 1995 and a further edition of this Recovery Plan will be prepared if necessary.

The Recovery Team acknowledges the efforts and hard work of the authors of the First Edition of this Recovery Plan, which provided the basis for work carried out during 1992 and 1993.

Information in this Recovery Plan is accurate to December 1994.

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SUMMARY

CURRENT SPECIES STATUS: Endangered (ANZECC 1991). Threatened (Western Australian Wildlife Conservation Act); Endangered (S.A. National Parks and Wildlife Act); Endangered (Action Plan for Australasian Marsupials and Monotremes); Endangered (Commonwealth Endangered Species Protection Act). Formerly abundant and widespread, but now known from five mainland populations in W.A. (three natural, two translocated) and four translocated island populations and one translocated population in a fenced sanctuary in S.A.

HABITAT REQUIREMENTS AND LIMITING FACTORS: Woylies formerly inhabited a wide range of vegetation from desert spinifex grasslands to forests. The major, current limiting factor on the mainland is clearly predation by introduced foxes and, possibly, cats.

RECOVERY PLAN OBJECTIVES. By the end of 1995:

1. Determine the current wild distribution of the Woylie in W.A.
2. Establish a population of Woylies on a mainland area in S.A. without using predator-proof fences.
3. Develop prescriptions for the maintenance and extension of Woylie populations in multiple-use forest in W.A.
4. Ensure that translocated Woylie populations maintain genetic variability.
5. Review the conservation status of the Woylie, using internationally accepted criteria and recommend changes if necessary.

RECOVERY CRITERIA:

Western Australia

1. At least six populations of Woylies, each occurring in areas of at least 1 500 ha of suitable habitat and each increasing in density (and area where there is contiguous suitable habitat) or plateaued with a trap-success rate greater than 7.5%.
2. Clarification of the status of the Woylie in conservation reserves and State Forests of the south-west of W.A.
3. Establishment of experiments to determine the effects of timber harvesting (at Kingston Forest) and fuel-reduction prescribed burning (at Batalling Forest) on Woylies and commitment in a Wildlife Management Program to modify forest management prescriptions, if necessary, to ensure compatibility with maintaining Woylie populations.

South Australia

1. Maintenance of two island populations, on Wedge and St Peter Islands.
2. Establishment of at least one mainland population in addition to the Yookamurra population.

Both States

1. Establishment of monitoring programs (to include genetic diversity) and action plans to address any adverse trends detected.

ACTIONS NEEDED: The following actions will be overseen by a Recovery Team composed of people from CALM, SADENR, ANCA and other organisations relevant to the recovery process.

1. Exotic predator control.
2. Population survey and monitoring.
3. Range expansion (where feasible) and translocation.
4. Determine the effects of forest management practices.
5. Genetic assessment and re-stocking.
6. Employment of Scientist, S.A.
7. Education and publicity.

ESTIMATED COST OF RECOVERY: $000's/year, 1993 dollars.

Total Cost (TC); Endangered Species Program (ESP); ESP = TC -(CALM and SADENR)

Year	State	Action 1		Action 2		Action 3		Action 4		Action 5		Action 6		Action 7		TOTAL	
		TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1994	W.A.	30	0	20.5	15.5	10.5	7.5	75	0	0	0	0	0	1	0	137	23
	S.A.	5.5	3.5	24.8	17.8	17.9	17.9	0	0	1	1	39.8	39.8	0	0	89	80
1995	W.A.	30	0	11	6	6.5	3.5	65	0	0	0	0	0	1	0	113.5	9.5
	S.A.	5.8	3.8	15.6	8.6	9	0	0	0	0	0	40	40	0	0	70.4	52.4
Total	W.A.	60	0	31.5	21.5	17.0	11	140	0	0	0	0	0	2	0	250.5	32.5
	S.A.	11.3	7.3	40.4	26.4	26.9	17.9	0	0	1	1	79.8	79.8	0	0	159.4	132.4
	ESP	-	7.3	-	47.9	-	28.9	-	0	-	1	-	79.8	-	0	-	164.9
	$																**409.9**

BIODIVERSITY BENEFITS: Recovery actions, particularly exotic predator control, will benefit other endangered and vulnerable animals as well as aiding reconstruction of fauna communities. Soil disturbance caused by Woylies may aid regeneration of several species of threatened flora.

1. INTRODUCTION

1.1 Description of species

The Woylie (or Brush-tailed Bettong), *Bettongia penicillata* Gray 1837, is grouped with potoroos and other bettongs into the family Potoroidae within the superfamily Macropoidea.

Sharman *et al*. (1980) and Strahan (1983) recognised three subspecies of *B. penicillata*: *B. p. ogilbyi*, which still occurs in the south-west of Western Australia, *B. p. penicillata* from eastern and southern regions of Australia, which is presumed extinct (although unconfirmed sightings of the subspecies have been reported on Eyre Peninsula in South Australia, Saunders and St John 1987), and *B. p. tropica*, which is still present in low numbers in north-east Queensland. Subspecies names have not been applied to the forms that were once extremely widespread in central Australia.

A recent study has shown the Tropical Bettong *(B. p. tropica* of Sharman *et al*. and Strahan), the Woylie (*B. p. ogilbyi* from Western Australia) and the Tasmanian Bettong (*B. gaimardi*) are genetically equidistant from each other. It is now widely accepted that the Queensland population is a full species *B. tropica* and it is being managed as such with its own Recovery Plan in preparation.

This Recovery Plan, therefore, deals with *Bettongia penicillata ogilbyi*, which still occurs naturally in the south-west of Western Australia, and which has been re-introduced to other sites in that State and introduced into parts of South Australia.

1.2 Past distribution

Troughton (1957), Burbidge and Fuller (1984) and Burbidge *et al.* (1988) provided evidence that *B. penicillata* was once the most common and widest ranging of all potoroids with a distribution covering most of the mainland south of the tropics. Finlayson (1958) produced a map describing its distribution from south-west Western Australia, across southern Australia to the Great Dividing Range, and northward through much of Queensland (he included *B. tropica*), eastern Northern Territory and northern South Australia.

Oral history research involving Aboriginal people has confirmed that Woylies were distributed even more broadly in the central deserts than suggested by Finlayson; they ranged over much of the Gibson Desert in central Western Australia and into the southern region of the Northern Territory (Burbidge and Fuller 1984, Burbidge *et al.* 1988).

Wood Jones (1925) mentioned that animals belonging to a species of *Bettongia* (later verified as *B. penicillata* in Finlayson 1958) were "swarming" on Saint Francis Island off the coast of South Australia in the 1880s. They were also common over most of South Australia at the beginning of the century and were sold "by the dozen at about nine pence a head for coursing on Sunday afternoons" (Wood Jones 1925).

1.3 Present distribution

Woylie numbers and geographic range have decreased dramatically during this century. Finlayson (1958) listed north Queensland (now regarded to have *B. tropica*), the 'western centre' and the south-west of Western Australia, as the only localities in which the species was still extant. It occurred over a very wide area in central Australia, but had disappeared from there by 1960 (Burbidge *et al.* 1988). The St Francis Island population became extinct sometime between the 1920s and 1971, apparently because of predation by feral cats. Despite unconfirmed sightings on Eyre Peninsula (Saunders 1986; Saunders and St John 1987) it is believed that Woylies survive naturally only in Western Australia. Figure 1 outlines the approximate past distribution and Figure 2 the present distribution.

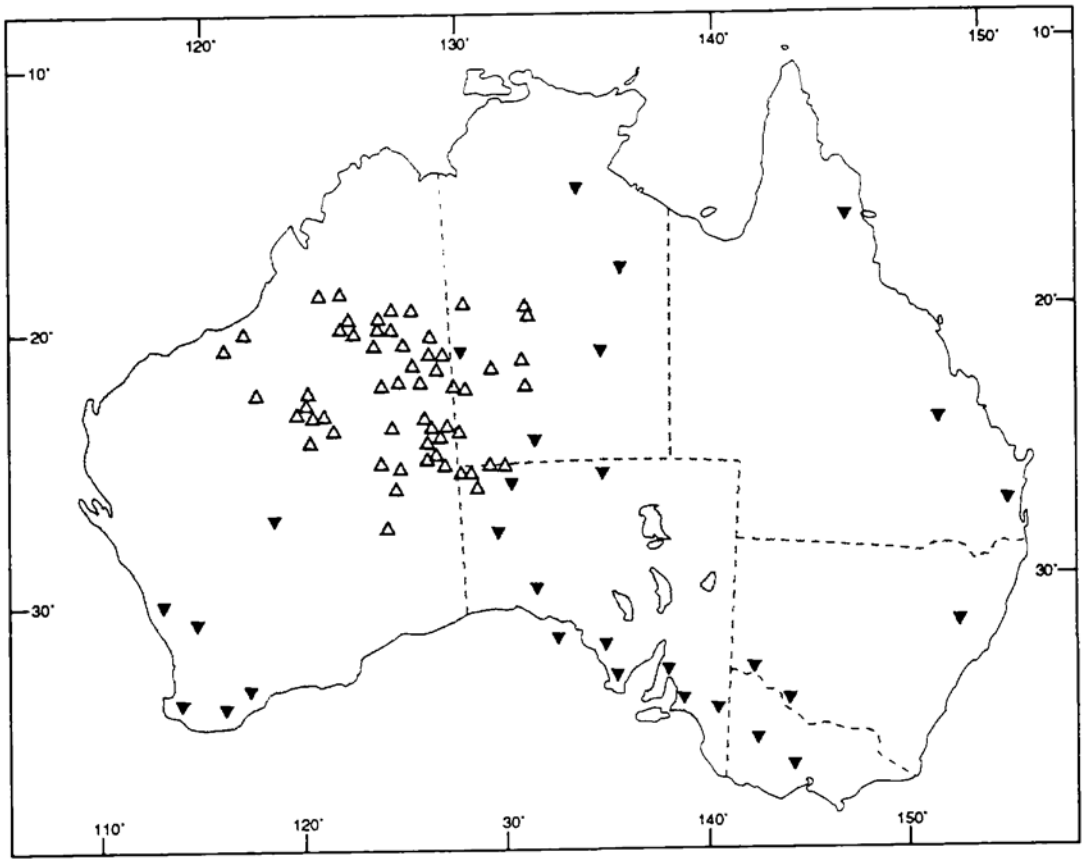

Figure 1
Historic Distribution

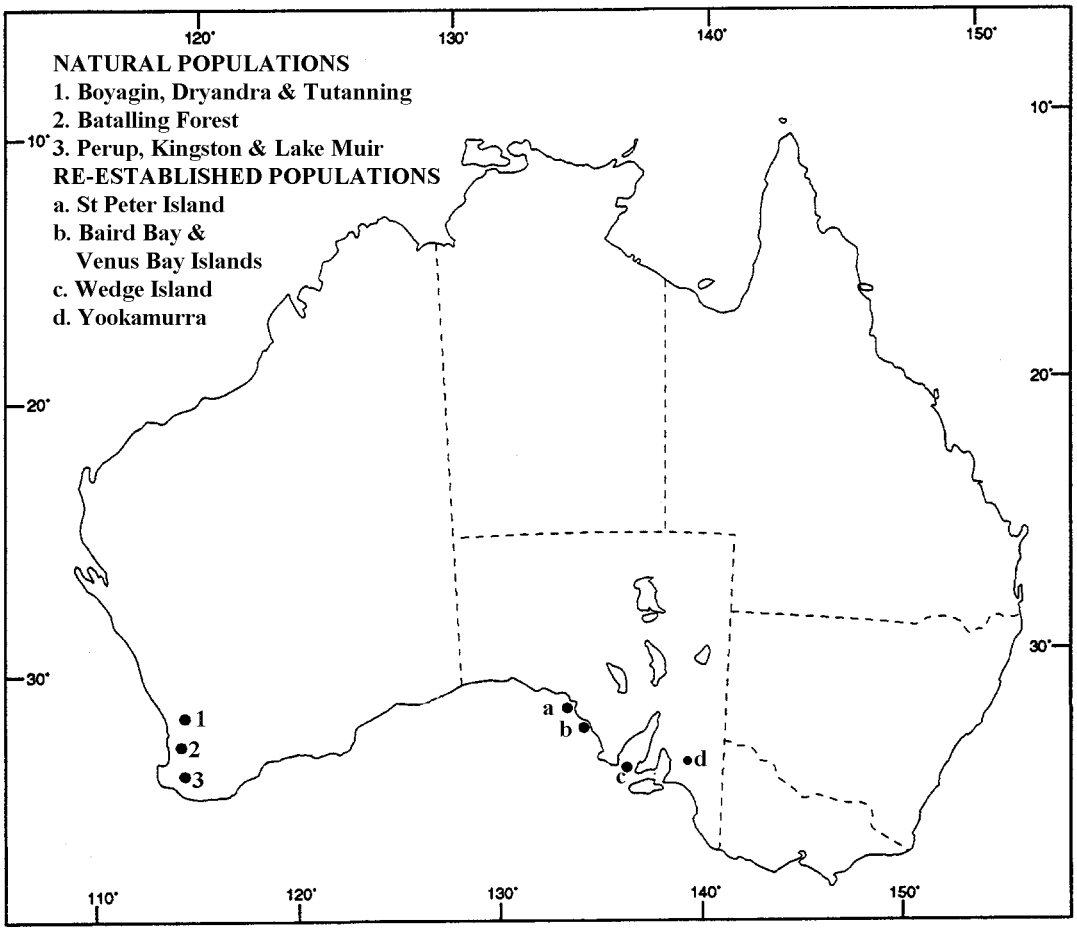

Figure 2
Distribution 1994

1.3.1 Western Australia

Natural populations remain at Dryandra Woodland, (proposed) Perup Nature Reserve (and adjacent areas at Kingston Forest and Lake Muir), Tutanning Nature Reserve and, possibly, Fitzgerald River National Park. Translocated populations occur at Batalling Forest and Boyagin Nature Reserve.

Since the first edition of this Recovery Plan was prepared, Woylies are now known to occur at four new locations.

1,2. *Kingston Forest/Lake Muir* (respectively 20 km west and 20 km south of Perup). These animals may be part of an expanded Perup population; additional trapping is necessary to establish whether Woylies occur in intervening areas.

3. *Batalling Forest* Woylies were translocated from Perup to the Batalling area in 1983 (Christensen and Leftwich in press). Monitoring between 1983 and 1986 resulted in trapping success rates of between 2 and 4%. Trapping was discontinued until October 1990, when a survey revealed the persistence of a low density population (trap success <1%). Fox control was implemented in part of the area in February 1991 and the population in that area is now a healthy and apparently expanding one; trap success rate in October 1993 was about 10%. In an adjacent unbaited area, Woylies were not trapped for a year after baiting commenced at Batalling. Woylies are now being trapped in this area; they may be emigrants from the baited area (Morris, unpublished). Trap success rates have remained below 0.5%.

4. *Boyagin Nature Reserve* Forty Woylies were translocated from Dryandra to Boyagin in 1992. They appear to have established successfully (J. Kinnear, *pers. comm.*). Numbats were translocated from Dryandra to Boyagin each year from 1985 to 1987. The population has increased substantially and it is anticipated that Woylies will do the same.

1.3.2 South Australia

There are currently four translocated island populations and one translocated mainland population. All stocks originated from Western Australia.

1. *Venus Bay Island A (17 ha)* and
2. *Baird Bay unnamed island (13 ha)*

These two populations are dealt with together as they are both small and have a poor prognosis for long-term viability (Nelson *et al.* 1992).

The Venus Bay Island A population is descended from seven captive bred animals introduced in 1980. Since an initial boom-crash cycle the population has stabilised at between 25 and 35 individuals. For example on the latest annual monitoring trip (February 1993) 31 animals were caught. Only four of them were new (unmarked in previous years). The trap success rate was 39 captures for 89 trap nights (44%). Eight of the 22 animals caught on the second night were recaptures from the first night. It seems the population has reached equilibrium with the available resources and juveniles survive only on the demise of an adult.

The Baird Bay island population is descended from ten animals translocated from Venus Bay Island A in July 1982. A monitoring trip over two nights in March 1993 yielded 28 captures from 70 trap nights (40% trapping success). However only seven new animals were trapped and one third of the animals taken on the second night had been caught on the first night too. It seems that, like Island A, there is a stable population of 15 to 20 individuals which is at equilibrium with the available resources.

3. *Wedge Island (947 ha)*

In May 1983 eleven Woylies from the South Australian Department of Environment and Land Management (SADENR) captive breeding colony at Monarto were introduced to the island. Systematic repeatable monitoring was carried out for the first time in May 1993, 10 years after the original introduction, although trapping had occurred twice before on a less formalised basis. In 1993, 120 trap nights resulted in 59 captures, 41 males and 17 females (one escaped before sexing), almost 50% trap success. This male bias was also evident in the results of the two previous trapping efforts.

4. *St Peter Island (3 439 ha)*

During September and November 1989 a total of 113 Woylies were released. They came from a number of captive colonies with most from two sources; 52 were the remainder of the SADENR captive breeding stock at Monarto and 44 were from the CSIRO Division of Wildlife and Ecology in Canberra. This population is well established and growing rapidly. On the latest annual monitoring trip (March 1993) 150 trap nights yielded 56 captures (37% trapping success) of which 50% were new (unmarked) animals. Whilst permanent monitoring trap sites are within 2 km of the release site, all areas of the island that were visited, apart from the large mutton bird rookery covering the southern 20% of the island, showed numerous signs of recent Woylie activity. Nevertheless trapping results clearly showed a preference for denser shrublands.

5. *Yookamurra Sanctuary (1 100 ha)*

Approximately 83 Woylies have been released into Yookamurra over the last two years. Two releases of animals from the S.A. Museum Evolutionary Biology Unit (EBU) took place during the second half of 1991; 25 (8 males, 17 females) on 28 November 1991 and 12 (3 males, 9 females) on 18 November 1991. Yookamurra staff state that approximately 40 Woylies have been translocated from Warrawong Sanctuary since July 1991. Six more (3 males, 3 females) fitted with radio transmitters were introduced from Warrawong on 25 August 1992.

Formalised monitoring by trapping commenced on 24 August 1993. Twenty five traps were set for four consecutive nights giving 100 trap-nights. Twelve Woylies were captured (12% trap-success) consisting of 5 males 4 females (all carrying pouch young) and 2 unknown (escaped while transferring from trap to bag). Yookamurra staff intend to continue the same trapping format at least biannually. All captured animals will be marked with individually numbered ear tags. Standard information on weight, condition and reproductive status will be recorded.

This trap success rate indicates that a population has established despite at least three occasions when foxes entered Yookamurra since the first Woylie release (and possibly some Woylies were poisoned unintentionally by strychnine baits laid during the first fox incursion in early 1992).

Three of the six Woylies released with radio collars were still alive a year later (24 August 1993). One was found dead and partly eaten (probably by a fox), one died of injuries from an unknown source and one appeared to have died of old age but it could have taken an old strychnine bait.

1.4 Biology and ecology

Most studies on the biology and ecology of *B. penicillata* have occurred in the south-west of Western Australia (Sampson 1971, Kinnear *et al.* 1979, Christensen 1980a, 1980b), but Nelson (1989) examined the biology of the species in South Australia. The little that is known of the species' requirements in central Australia is summarised in Burbidge *et al.* (1988).

B. penicillata is a continuous breeder under suitable conditions and, in captivity, females first breed at 6 months and males at 9 -12 months (Christensen 1980b, M. Smith unpublished). The animals consume a variety of foods including roots, tubers, underground fungi and insect larvae. Sporocarps from hypogeous fungi are considered to be the major food item throughout the year at Perup in Western Australia (Christensen 1980b). Sampson (1971) and Christensen (1980b) suggested that Woylies do not drink; it is probable that adequate water is obtained from their food.

Woylies construct a nest in a shallow scrape dug in the soil, usually concealed under a shrub or fallen branch in low dense scrub (Sampson 1971, Christensen and Leftwich 1980). An inner lining, usually of grass, is formed. It is covered by a second layer of material. Nests are usually occupied by a solitary animal, although an "at heel" young may occupy a nest with its mother. Each animal has a small nesting area and a larger feeding area, which overlaps the feeding areas of other animals (Christensen 1980b).

1.5 Reasons for the decline

Many Australian mammal species have declined drastically, some to extinction, since European settlement. Numerous people have proposed hypotheses to explain the causes of the declines. For example, Finlayson (1961) and Calaby (1971) suggested that the decline was a response to long-term climatic changes, leading to increased temperatures and aridity.

Finlayson (1961) proposed that the impact of stock trampling plants, rather than competition for food, placed considerable stress on bettongs. He suggested that direct competition for food from rabbits and vulnerability to predation by foxes and feral cats, placed additional pressure on the species.

Burbidge *et al.* (1988) suggested that some Aboriginal land management practices acted to conserve mammals in desert areas. They noted that the time of disappearance of many species from the deserts coincided with the movement of Aborigines to European settlements and hypothesised that, when the mosaic burning of the Aborigines' tribal lands ceased, the fire regime changed to one of more sporadic, extensive wildfires often ignited by lightning. The changed fire regime exacerbated the effect of introduced predators by enabling them to eliminate remnant, fragmented populations.

Burbidge and McKenzie (1989) showed that almost all Australian mammals that have become extinct or have significantly declined fall within a Critical Weight Range (CWR). The CWR is now recognised as 35g to 5 500g mean adult body weight. Arid zone species have declined significantly more than those from better watered areas. The Woylie lies within the CWR and has followed the typical pattern of disappearing from the more arid parts of its former range.

Several authors (eg, Troughton 1957, Christensen 1980a, King *et al*. 1981, Kinnear *et al*. 1984, 1988, Christensen and Maisey 1987) implicate the fox as a predator of Woylies and this is now supported in the south-west of W.A. by experimental data (Kinnear *et al*. 1988). At Dryandra Woodland, sightings of Woylies increased 400% after two years of predator control (J.E. Kinnear, unpublished) and they are now an attraction at the Lions Village where up to 40 come to the caretaker's cottage to eat wheat that is thrown to them in the evening.

At Tutanning Nature Reserve there was a nine-fold increase in trap success in five years from the start of a fox control program (J.E. Kinnear pers. comm.).

At Batalling Forest the capture rate was <1% before baiting commenced in February 1991. It rose to about 2% in November 1991, 9% in October 1992 and 14% in October 1993 (K.D. Morris pers comm*).* It has risen a little above 1% in adjacent unbaited areas, probably boosted by immigration from the baited area.

Calaby (1971) suggested that *B. penicillata* survived in south-west Western Australia because it inhabits vegetation, particularly thickets of *Gastrolobium* species, containing sodium monofluoroacetate ('1080'), which is poisonous to domestic stock and consequently has not been grazed. Sodium monofluoroacetate is highly toxic to all exotic mammals but indigenous mammals (and other animals) of the south-west have evolved a high degree of tolerance.

Gastrolobium thickets are a feature at Perup, Dryandra and Tutanning. Secondary poisoning of feral predators eating animals that have ingested *Gastrolobium* may account for the phenomenon. Foxes eating rabbits poisoned with 1080 have died (D. Algar *pers. comm.*). However, Woylies metabolise the active ingredient of 1080 rapidly. It seems it is not available in the tissues of native prey species but may be so in their digestive systems. In addition, rabbits are rare in this unaltered habitat and do not constitute a major source of competition for Woylies, nor a prey base to maintain fox numbers at high levels.

Nevertheless it is clear that Woylies almost vanished from their last stronghold, the south-west of W.A. and are only recovering where foxes are controlled. It seems likely that the relict populations survived where poison shrubs of the genus *Gastrolobium* provide suitable shelter, reduce competition from rabbits and stock and, perhaps via secondary poisoning, reduce the impact of foxes.

The Woylie is declared as "rare or likely to become extinct" pursuant to Section 14(2)(ba) of the Western Australian Wildlife Conservation Act, and in South Australia is listed on Schedule 7 (Endangered Species) pursuant to the National Parks and Wildlife Act. The species is listed as endangered nationally by ANZECC (ANPWS 1991) and is included in Schedule 1, Part 1 (species that are endangered) of the Commonwealth Endangered Species Protection Act. The 1992 Marsupial and Monotreme Action Plan (Kennedy 1992) listed the Woylie as Endangered.

1.6 Existing conservation measures

1.6.1 Western Australia

In Western Australia management is directed towards exotic predator control in known Woylie habitats. Predator control is achieved with the regular distribution of dried meat baits impregnated with 1080.

Christensen (1980b) has shown that Woylies can maintain fairly dense populations in Perup Nature Reserve in the absence of fox control if the habitat is sufficiently dense and that such habitat can be achieved within 4-6 years after a high intensity fire. The area needs to be re-burnt after a further 10-15 years.

Accordingly, prescribed fires are used, particularly at Perup, to create a mosaic of habitats and regenerate *Gastrolobium* thickets that are favoured by Woylies (and another threatened species, Tammar Wallaby *Macropus eugenii*). This work is conducted by staff from the Department of Conservation and Land Management.

However, the relative effectiveness of predator control and habitat management by fire for population recovery and persistence have not been quantified. It seems likely that Woylies are unable to utilise areas with more open vegetation because of fox predation. Woylies have increased in numbers and expanded their range following fox baiting at Dryandra and Batalling, demonstrating that habitat restoration with fire is not necessary for Woylie conservation in these areas. The former distribution of the Woylie suggests that it is adaptable to various habitats ranging from arid spinifex to mesic woodlands and habitat manipulation is not necessary in many cases, provided foxes are controlled.

1.6.2 South Australia

In South Australia the conservation of the Woylie is being achieved by re-introducing and introducing populations to islands.

An expedition to Nuyts Archipelago in 1971 found fragments of *B. penicillata* skulls on St Francis Island (Robinson and Smyth 1976). As cats were no longer present on the island, it was recommended that Woylies be re-introduced.

In 1975 a captive breeding program, based on three females and two males, was initiated by the South Australian National Parks and Wildlife Service. Western Australian animals were the only ones available. The founders were obtained from the Perth Zoo and Gorge Wildlife Park, South Australia (which also obtained its animals from Perth Zoo). Woylies from that colony have since been released on six islands in South Australia (Nelson *et al.* 1992).

Three of these are small islands. They were used largely as trials prior to placing animals onto larger islands more distant from the mainland. They were:

Bird Club Island, 7.8 ha, May 1979 (failed to establish)

Island A, Venus Bay, 17 ha, May 1980 (successful)

Un-named island in Baird Bay, 13 ha, July 1982 (successful)

Subsequent translocations to larger islands were:

St Francis Island, 809 ha, May 1981, April 1984, September 1987 (failed to establish)

Wedge Island, 947 ha, May 1983 (successful)

Saint Peter Island, 3 439 ha, September and November 1989 (successful)

Of these island populations only Wedge and St Peter are considered to be potentially viable in the long-term. Annual monitoring is carried out on these and the smaller Venus Bay Island A and Baird Bay Island. The future status of the privately-owned Yookamurra Sanctuary (1 100 ha) is also considered secure. Currently, emphasis is being placed on a vermin control program on Venus Bay Peninsula in preparation for an attempt at the first unfenced reintroduction to the mainland in South Australia.

1.7 Strategy for recovery

Coordination of the recovery of the Woylie is supervised by a Recovery Team. Membership of the Team is:

Tony Start (CALM Science & Information Division, Chair)
David Armstrong (SADENR, primary duty is Woylie recovery in S.A.)
Andrew Burbidge (CALM Western Australian Threatened Species and Communities Unit)
Sally Stephens (ANCA)
Gordon Wyre (CALM Wildlife Branch)
Brian MacMahon (CALM Wheatbelt Region)
Bob Hagan (CALM Southern Forest Region)
John Skillen (CALM Central Forest Region)
John Watson (CALM South Coast Region)
Keith Morris (CALM Science & Information Division)

This revised (2nd edition) Recovery Plan has five strategies, all of which can be run concurrently.

The Recovery Team will report annually on the implementation of the Plan to CALM's Corporate Executive, and funding agencies, including SADENR and ANCA.

1.7.1 Protection of existing populations

For Woylies to maintain viable populations in the south-west of W.A., numbers of exotic predators such as the fox (and, possibly, the cat) have to be substantially reduced and then maintained at a low level. In the short-term this is achieved through the regular distribution of 1080-impregnated baits, but in the longer-term may be achieved by a combination of biological control and baiting. All known populations of the Woylie must be protected in this way, although the Perup population can be maintained by habitat manipulation with prescribed fire.

Populations on S.A. islands are protected by isolation. Their security is regularly monitored. The Yookamurra translocated population is within a fenced area, designed to prevent foxes and cats from entering.

1.7.2 Population monitoring

The effectiveness of management needs to be monitored using techniques that give data that are comparable over time such as standardised spotlighting of fixed transects and trap success rates based on standard trapping techniques. The Yookamurra population is recognised as a significant population and will be monitored. Other captive populations are probably highly inbred and should not be relied on for recovery of the species.

1.7.3 Range extensions and translocations

Once the above strategies are in place, animals can naturally extend their range, subject to suitable habitat being available and foxes being controlled. They will also be translocated to additional sites. Post-release monitoring of translocation must be conducted to ensure that translocations are successful and to ensure that any problems are addressed.

1.7.4 Determine effects of forest management practices on Woylies

Populations of Woylies are now known to exist in the Kingston and Warrup blocks of State Forest to the west of (proposed) Perup Nature Reserve. It is a long-term aim of CALM to greatly extend the range of Woylies through State Forest in Western Australia through the control of introduced predators under "Operation Foxglove" (CALM 1992), which aims to control foxes over 500 000 ha of the northern jarrah forest by 2000. If this project is successful, Woylie distribution will extend through areas of State Forest managed for multiple use, including sustainable timber harvesting, and which will be subjected to periodic fuel-reduction prescribed burning.

The presence of the Kingston Forest and Batalling Forest populations provides an opportunity to study the effects of current forest management practices on Woylies, and to recommend any modifications necessary to ensure the survival of Woylies in multiple-use State Forest.

1.7.5 Genetics and re-stocking

Research into the effects of bottle-necking and small population size on the genetic make-up of Woylie populations needs to be undertaken. The molecular technique known as DNA fingerprinting allows the estimation of relatedness within and between populations. Because the South Australian populations apparently originated from a very small founder stock it is important to discover whether a loss of genetic diversity has resulted. This can be achieved by comparing the genetic diversity of the South Australian populations with the source population(s) in Western Australia. If the South Australian populations have suffered a loss of genetic diversity, re-stocking from Western Australia is an option that should be pursued. The Yookamurra population should be included.

2. RECOVERY OBJECTIVES AND CRITERIA

2.1 Objectives

The objectives of the Woylie Recovery Plan are to:

1. Determine the current wild distribution of the Woylie in Western Australia.

2. Establish a population of Woylies on a mainland area in South Australia without using predator-proof fences.

3. Develop prescriptions for the maintenance and extension of Woylie populations in multiple-use forest in Western Australia.

4. Ensure that translocated Woylie populations maintain genetic variability.

5. Review the conservation status of the Woylie, using internationally accepted criteria and recommend changes if necessary.

2.2 Criteria

The criteria for successfully achieving the objectives are:

Western Australia

- At least six populations of Woylies, each occurring in areas of at least 1 500 ha of suitable habitat and each increasing in density (and area where there is contiguous suitable habitat) or plateaued with a trap-success rate greater than 7.5%.

- Clarification of the status of the Woylie in conservation reserves and State Forests of the south-west of W.A.

- Establishment of experiments to determine the effects of timber harvesting (at Kingston Forest) and fuel-reduction prescribed burning (at Batalling Forest) on Woylies and commitment in a Wildlife Management Program to modify forest management prescriptions, if necessary, to ensure compatibility with maintaining Woylie populations.

South Australia

- Maintenance of two island populations, on Wedge and St Peter Islands.

- Establishment of at least one mainland population in addition to the Yookamurra population.

Both States

- Establishment of monitoring programs (to include genetic diversity) and action plans to address any adverse trends detected.

3. RECOVERY ACTIONS

3.1 Exotic predator control

Exotic predator control is fundamental to sustained recovery of the Woylie on mainland Australia. Therefore the successful 1080 baiting program within Woylie habitats in Western Australia will continue and be expanded to areas of proposed range extensions.

The costs of an exotic predator control program depend on three variables; frequency of baiting, area to be baited and the method (vehicle / aircraft) of dispersing the baits. Data from experimental fox baiting trials in Western Australia suggest that dried meat baits distributed twice yearly (in September to control denning females and in April to control dispersing animals) is adequate for large areas of bushland. Smaller areas have to be baited more frequently, since re-invasion by foxes is more rapid.

Note. CALM, under a project codenamed Operation Foxglove, is baiting foxes in an area exceeding 0.5 million ha in the northern jarrah-wandoo forest. Much of it is probably suitable habitat for Woylies. The effectiveness of the operation is being measured by CALM in conjunction with the Cooperative Research Centre for the Biological Control of Vertebrate Pest Populations (VBC) and ANCA. This will provide opportunities, additional to the Recovery Plan actions, to expand the current range of Woylies (see section 3.2 and 3.3.1)

In South Australia a combined rabbit and fox control program is being carried out on Venus Bay peninsula. Rabbits have been controlled with 1080 and excluded from the area by fencing across the narrow isthmus. Fox baiting, using dried meat baits treated with 1080, is underway, with baits being renewed at two month intervals. The program has been successful and a monitored trial translocation will be undertaken.

It is intended also to translocate Greater Stick-nest Rats (*Leporillus conditor*), and possibly Tammar Wallabies (*Macropus eugenii*), to the peninsula. Thus the cost of vermin control may benefit a number of species.

Western Australia

Responsibility: Predator control. Dryandra, Boyagin, Tutanning: CALM Wheatbelt Region; Batalling: CALM Central Forest Region; Perup and outliers: CALM Southern Forest Region.

Cost:	*1994*	*1995*
CALM	*$30 000*	*$30 000*
ESP	*0*	*0*
Total	*$30 000*	*$30 000*

NB. These are costs for baiting all areas. Many species besides Woylies benefit. Annually $25 000 Tutanning, Boyagin, Dryandra; $2 000 Batalling; $3 000 Southern Forest Region.

South Australia

Responsibility: SADENR Biological Conservation Branch.

Cost:	*1994*	*1995*
SADENR	*$2 000*	*$2 000*
ESP	*$3 500*	*$3 800*
Total	*$5 500*	*$5 800*

3.2 Population monitoring and survey

Known populations will be monitored annually to assess the success of management actions and determine rate of recovery. Blood will be collected from animals for genetic analysis (one set per population) at the same time as monitoring, thus achieving an economy of operation. Reports of additional populations will be followed up with trapping. Research is needed to establish the range and abundance of the populations at Kingston/Warrup, Lake Muir and Fitzgerald River. Cost of monitoring at Yookamurra will be met by the Yookamurra Sanctuary and carried out with assistance from SADENR staff

Data relevant to Woylies that is gathered while measuring the efficacy of Operation Foxglove will be monitored by the Recovery Team and taken into account when reviewing the status of Woylies.

Western Australia

Responsibility: CALM Science and Information Division and CALM Central and Southern Forest Regions.

Cost:	*1994*	*1995*
CALM	*$ 5 000*	*$ 5 000*
ESP	*$15 500*	*$ 6 000*
Total	*$20 500*	*$11 000*

1994: ESP $1000 each for Batalling, Dryandra, Boyagin, Tutanning; Perup complex $3500, plus contract person for 3 months $7 500 = $15 000.
1995: $1 000 per area except Perup complex which will be $2 000 = $6 000.
CALM will input all other salaries.

South Australia

Responsibility: SADENR Biological Conservation Branch.

Cost:	*1994*	*1995*
SADENR	*$ 7 000*	*$ 7 000*
ESP	*$17 800*	*$ 8 600*
Total	*$24 800*	*$15 600*

3.3 Range extensions and translocations

3.3.1 Western Australia

Translocation of Woylies to Julimar Conservation Park, about 80 km north east of Perth is proposed and, if approved after the preparation of a Translocation Proposal, will be carried out in 1995. Fox control is already in place at Julimar and a population of Chuditch (*Dasyurus geoffroii*) is being established under the Chuditch Recovery Plan (Orell and Morris 1993). Sympatric Chuditch and Woylie populations are both expanding at Batalling Forest in an area where foxes have been controlled.

Note. Because Woylie populations, protected from foxes, can recover faster than populations of any other similar sized mammal which occurred naturally in the area of Operation Foxglove, CALM will translocate Woylies to many sites where the efficacy of the operation is being measured (pilot translocations have already occurred). These will be additional to the actions necessary to effect recovery of Woylies as specified in the Recovery Plan's Criteria. Nevertheless the project will be very valuable and its progress will be monitored by the Recovery Team.

3.3.2 South Australia

Since the translocations to Wedge and Saint Peter Islands have been successful, the translocation proposed for Saint Francis Island (see 1st Edition of Recovery Plan) has now been cancelled.

The program for translocation to South Australia consists of: In 1995 (assuming fox control has been successful see 3.1), 12 to 15 animals to be translocated from Western Australia to Venus Bay and released. This trial group to be monitored with radio collars. One additional person and vehicle are required plus more radio-tracking equipment to supplement that purchased last year.

Assuming all goes well in the trial, fifty animals from a wild population in Western Australia to be translocated to Venus Bay six months later. That is the time when potential food availability and weather should be optimal. In addition, foxes are denning at this time so likelihood of re-incursion is minimal giving the Woylies several months to establish before fox cubs disperse in late summer. Costs of monitoring these translocations are additional and are included under 3.2 above.

Western Australia

Responsibility: CALM Science and Information Division. To be carried out in conjunction with work on the Chuditch Recovery Plan.

Cost:	*1994*	*1995*
CALM	*$ 3 000*	*$ 3 000*
ESP/Other	*$ 7 500*	*$ 3 500*
Total	*$10 500*	*$ 6 500*

South Australia

Responsibility: SADENR, Biological Conservation Branch.

Cost:	*1994*	*1995*
SADENR	-	*$ 9 000*
ESP/Other	*$17 900*	-
Total	*$17 900*	*$ 9 000*

3.4 Determine the effects of forest management practices

An experiment has been designed to test the effects of timber harvesting and fuel-reduction prescribed burning in the Kingston and Warrup forest blocks. The effects of timber harvesting will be evaluated in Kingston, where normal pre- and post-harvest silvicultural burning will also take place, while Warrup Block will be an unburnt, un-harvested control. All areas will be subject to fox control. An experiment to test the effects of spring and autumn prescribed burning patterns on Woylies and other CWR mammals commenced in 1994 at Batalling. The results of these experiments will be used to determine the effects of these operations on populations of several species of CWR mammals, including the Woylie. Forest management prescriptions will be varied if necessary to optimise the conservation of Woylies and other threatened mammal species.

Western Australia

Responsibility: CALM Science and Information Division and Central and Southern Forest Regions.

Cost:	*1994*	*1995*
CALM	*$75 000*	*$65 000*
ESP	*-*	*-*
Total	*$75 000*	*$65 000*

3.5 Genetic assessment and re-stocking

Blood samples have been collected from 28 Woylies from Tutanning, 20 from Batalling, 10 from each of Venus Bay Island A, Baird Bay Island and Wedge Island populations and 15 from St Peter Island. Samples have been collected from Perup and Dryandra. If any of the translocated populations show significantly reduced genetic variability (< 90% founder variability), re-stocking will be conducted. This will involve introducing animals from a Western Australian population to the translocated population and monitoring to ensure that they establish and breed. DNA fingerprinting of available samples has been carried out.

These data will assist in selecting founder stock for further translocations (particularly within South Australia) by identifying populations with different levels of genetic variability and will enable decisions to be made about re-stocking. It is anticipated that re-stocking of South Australian populations will be needed and this is included in the costs given below.

Western Australia

CALM will meet any costs of re-stocking in Western Australia.

South Australia

Responsibility: *SADENR Biological Conservation Branch*

Cost:	*1994*	*1995*
SADENR	*-*	*-*
ESP	*$ 1 000*	*-*
Total	*$ 1 000*	*-*

3.6 Employment of Scientist, South Australia

SADENR is unable to carry out the actions provided in this Recovery Plan unless it receives external funds to employ a scientist. The cost of two trips per year to Western Australia to attend Recovery Team meetings and confer with W.A. scientists and managers is also required. These additional costs have not been allocated to the above actions and are shown here separately.

Cost:	*1994*	*1995*
SADENR	*-*	*-*
ESP	*$39 800*	*$40 000*
Total	*$39 800*	*$40 000*

3.7 Education and publicity

The Recovery Plan described here is expensive in terms of both staff and finance and the support of the public is essential if the Woylie is to be conserved.

The W.A. Department of Conservation and Land Management and the S.A. Department of Environment and Natural Resources, in cooperation with other relevant organisations, will coordinate a public education program about the Woylie and about the measures being undertaken to prevent its extinction.

Responsibility: CALM and SADENR

Cost:	*1994*	*1995*
CALM	*$1 000*	*$1 000*
SADENR	-	-
Total	*$1 000*	*$1 000*

4. IMPLEMENTATION SCHEDULE

	Task	Priority	Feasibility	Responsibility	Funding	Cost estimate ($000s/year 1994 dollars) 1994	1995	Total
3.1	Exotic predator control	1	100%	CALM	a	30	30	60
				SADENR	b	2	2	4
					c	3.5	3.8	7.3
								71.3
3.2	Population monitoring and survey	2	100%	CALM	a	5	5	10
				SADENR	b	7	7	14
					c	33.3	14.6	47.9
								71.9
3.3	Range extensions and translocations	2	75%	CALM	a	3	3	6
				SADENR	b	0	9	9
				SADENR	c	25.4	3.5	28.9
								43.9
3.4	Determine effects of forest management practices	2	100%	CALM	a	75	65	140
								140
3.5	Genetic assessment and re-stocking	2	75%	SADENR	c	1	0	1
								1
3.6	Employment of Scientist, South Australia	1	100%	SADENR	c	39.8	40	**79.8**
3.7	Education and publicity	2	75%	CALM	a	1	1	**2**
ANNUAL COST OF WOYLIE RECOVERY				CALM		114	104	**218.0**
				SADENR		9	18	**27.0**
				ESP		103	61.9	**164.9**
				Total Cost		**226**	**183.9**	**409.9**

a = WADCALM contribution
b = SADENR contribution
c = ESP funds required

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