A RECOVERY PLAN FOR

THE WESTERN MOUSE

(*Pseudomys occidentalis* Tate, 1951)

by

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A report submitted to
World Wide Fund For Nature (Australia)

October 1993

PREFACE

In 1989 the World Wide Fund for Nature adopted and funded a proposal to research the status and conservation of the Western Mouse (P 145 The status and conservation of the Western Mouse). This project ran initially from January 1990 to October 1992 but was later extended to May 1993. A consultant, Mr Leigh Whisson was employed to undertake the work required under the supervision of Mr Keith Morris, Dr Andrew Burbidge and Mr Ken Wallace. Progress reports were submitted to WWF every six months. Normally a final report is also prepared at the conclusion of such projects. As one of the outcomes of this project was to prepare a Recovery Plan for the Western Mouse, it was considered appropriate that this document would also met the requirement for a final report.

Because circumstances change and new information becomes available, it is often necessary to modify actions and costings of recovery plans within the first 12 months of their implementation. The recovery team reserves the right to make

such changes to this recovery plan as it sees necessary.

SUMMARY

Current Species Status:

Vulnerable (ANZECC, 1991), likely to become extinct, or is rare (W.A. Wildlife Conservation Act 1950) and listed as Vulnerable in the Action Plan for Australasian Rodents (Lee *et al* 1993). The Western Mouse is endemic to W.A. and is presently known from only 12 conservation reserves in the southern wheatbelt region. Sub-fossil records indicate a more extensive former range across the Nullarbor and onto the Eyre Peninsula and Kangaroo Island, S.A. It is also known from sub-fossil deposits at Devils Lair, near Margaret River, and near Jurien Bay, W.A.. There is some evidence to suggest that the decline has continued in historic times. It is estimated that the total population does not exceed 10 000 and these are considered vulnerable to local extinction as populations are isolated and restricted to certain habitat types.

Habitat Requirements and Limiting Factors:

The Western Mouse is found in a range of semi-arid mallee shrub and woodland habitats. Most habitats have a dense shrub or heath understorey on sandy clay loams or sandy loams with a high gravel component. Often they occur in these habitats near granite outcrops and in areas which have not been burnt for 30-50 years. Much of this type of habitat has been cleared for cereal cropping and grazing over the past 100 years. Competition for food with rabbits may limit the Western Mouse, particularly near granite rocks. Frequent burning and introduced predators, particularly cats, may also limit this species.

Recovery Plan Objectives:

Down listing to Susceptible (ANZECC) within five years. Some protection may still be required after this time.

Recovery Criteria:

(1) Present distribution is retained.
(2) Abundance at three monitoring sites maintained or increased.

Actions Needed:

A recovery team comprising members from CALM Wheatbelt and South Coast Regions, CALM Science and Information Division, ANCA, WWF and other organisations as appropriate, will be established to coordinate and supervise the following actions:

(1) Continue monitoring populations at Dragon Rocks, Rock View, and Anderson Lake Nature Reserves, commence monitoring at Fitzgerald River National Park and Ravensthorpe Range.
(2) Continue fox baiting at Dragon Rocks NR., and implement cat baiting programs when appropriate techniques become available
(3) Determine the effect of fire on Western Mouse populations.
(4) Confirm the identification of the *Pseudomys* species on Woody Island.
(5) Continue opportunistic surveys of suitable habitat on public and private land.

Estimated Cost of Recovery:

Total cost (TC) and External Funds (ext) required. (=TC-CALM contribution)

Actions	(1)		(2)		(3)		(4)		(5)		Total	
	TC	**ext**	TC	**ext**	TC	**ext**	TC	**ext**	TC	**ext**	TC	**ext**
1994	6500	**2500**	4500	**3000**	5000	**2000**	600	**500**	2500	**1000**	19100	**9000**
1995	5500	**1500**	4500	**3000**	3000	**2000**	600	**500**	2500	**1000**	16100	**8000**
1996	5500	**1500**	4500	**3000**	3000	**2000**			2500	**1000**	15500	**7500**
1997	5500	**1500**	4500	**3000**	3000	**2000**			2500	**1000**	15500	**7500**
1998	5500	**1500**	4500	**3000**	3000	**2000**			2500	**1000**	15500	**7500**
TOTAL	**28500**	**8500**	**22500**	**15000**	**17000**	**10000**	**1200**	**1000**	**12500**	**5000**	**81700**	**39500**

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1. INTRODUCTION

1.1 Description of the species

The Western Mouse (*Pseudomys occidentalis*) was first described from a specimen collected at Tambellup, Western Australia, in 1930 (Tate 1951) and is one of four species of native rodent found in the southern wheatbelt of W.A. Its fur colour above is a mixture of dark grey and yellowish-buff, with black guard hairs. Below, its fur is greyish-white. A dark stripe is present on the top of the tail for about half its length. Feet and hands are white. Tail length is about 20 percent longer than the head and body length. It is sometimes confused with the Ash-grey Mouse *Pseudomys albocinereus* in the eastern wheatbelt. Males and females have an average body weight of 35-38 g. Females can attain 68 g during the latter stages of pregnancy.

1.2 Distribution and abundance

Sub-fossil remains indicate that the Western Mouse formerly occurred in a band from the mid-west coast of W.A., across what is now the southern wheatbelt and Nullarbor Plain to the Eyre Peninsula and Kangaroo Island in South Australia (Baynes 1987, Baynes *et al* 1976, Lundelius 1963).In 1841, a rodent described as *Pseudomys occidentalis* was collected in the vicinity of King George Sound (Albany), but has not been recorded from this area since (Kitchener 1992). It is now found only in the southern wheatbelt of W.A. (Figure 1).

The Western Mouse is presently known from only 12 conservation reserves in this area (Table 1). Populations within these reserves are patchily distributed and are at low densities. At Dragon Rocks NR, mouse densities range between 0.06 - 0.44 per hectare and at Rock View NR mouse densities average 0.26 per hectare. At Anderson Lakes NR numbers of mice trapped were extremely low (0-1 mice per 200 trap nights) making estimates of density difficult to obtain. Present total numbers probably do not exceed 10 000 and it may still be declining on some of the smaller nature reserves.

1.3 Habitat requirements and life history

1.3.1 Habitat:

The Western Mouse is found in a range of vegetation types, including low shrub lands, tall dense shrub lands, sparse to dense shrub mallees, mid-dense woodlands and very open woodlands (Kitchener *et al* 1976, 1977, McKenzie *et al* 1973). Often an understorey of dense shrubs to 2.5 m is also present. Dominant plant species include *Eucalyptus*, *Isopogon*, *Petrophile*, *Acacia*, *Allocasuarina*, *Melaleuca*, *Calothamnos*, the Quandong (*Santalum acuminatum*) and various sedge species. These vegetation types typically occur on sandy clay loams or sandy loams, frequently with a gravel matrix. This species is most often found in these vegetation types that have not been burnt for 30-50 years and in dense shrub lands around granite outcrops. These areas of dense vegetation may be important for protection from introduced predators.

1.3.2 Movements and home range:

The Western Mouse is nocturnal and moves up to 600 m linear distance in a night, occupying a home range of up to 150 ha. The home ranges of individuals overlap and several individuals may move about together and share feeding sites (see 1.3.4: Diet and foraging activity).

1.3.3 Burrows:

During the day the Western Mouse occupies a burrow (Figures 2 and 3). These are up to 40 cm deep and consist of a single vertical entrance shaft or "pop hole"

connected to a horizontal tunnel which may form a broad loop up to two meters in diameter. A nesting chamber (10-15 cm in diameter) is sometimes located near the pophole. Nesting material consists of loose fibrous plant material. Burrows are used communally, with ten or more individuals occupying one system. Individuals may use four or more burrows within their home range and over a series of nights.

Burrows are usually located in areas of dense vegetation, where the sandy clay and sandy clay loam soils are covered with a thick layer of fallen leaves and other vegetation litter.

Burrow systems are constructed using two tunnels and entrances. One is used to remove excavated soil from the burrow and the other is dug vertically from below through to the surface, leaving no visible evidence of burrow construction. The initial burrow is backfilled and the entrance sealed.

1.3.4 Diet and foraging activity:

The Western Mouse feeds mainly on the ground, although they will also climb small shrubs and bushes. Underground tubers, seeds, fruits, flowers and various insects (including beetles and insect larvae) comprise the bulk of their diet.

In the northern part of the Western Mouse distribution, collections of up to 400 chewed Quandong (*S. acuminatum*) nuts have been located under dense shrubs and grasses. The Quandong flowers in January and fruits in September to November. Fruits fall to the ground when ripe and remain edible for 12 to 18 months, providing a year round food source for the Western Mouse. The kernels contain approximately 20-25% protein and 70% oils making them an important dietary source for them (Sedgley 1984)

The nuts typically have their kernels extracted through a small chewed hole in the hard seed casing. These collections of nuts accumulate over time and can be used to indicate the presence of native rodent species in the southern wheatbelt.

1.3.5 Social behaviour:

Western Mice are colonial and up to ten adults of both sexes have been found occupying the same burrow system. Burrows are shared by different individuals on consecutive days. In captivity, adults also huddle together during the day.

1.3.6 Reproduction and mortality:

The breeding period extends from July to November. The gestation period is unknown but is probably similar to that of other *Pseudomys* species and between 28-35 days (Watts and Aslin 1981). The average litter size is three or four and the young are carried around by the mother attached to the teats until weaned at

about 40 days old. Juvenile animals (10-15g in weight) appear in the population from early September to late November. They grow between 3.5-5.0 g a month for four months and 1-2 g a month until maturity at 10-11 months of age. Adults weighs 34-38 g, although females may reach 65 g during pregnancy. Older females may breed twice a year. The life span of individuals appears to be at least 3 years.

1.4 Response to feral animal control programs

1.4.1 Fox control:

It has been demonstrated elsewhere that where fox control has been implemented in the south-west of W.A., populations of medium sized marsupials have increased and expanded their range (Friend 1990, Kinnear 1990, Morris 1993). The effect of the fox on smaller mammals (below 40 g) has not been demonstrated. An experiment to examine the effect of fox predation on the Western Mouse was undertaken at Dragon Rocks Nature Reserve. From May 1991, the southern part of this reserve was baited with dried meat baits impregnated with sodium fluoroactetate (1080). An adjacent reserve, Rock View Nature Reserve was left unbaited. Pre-baiting trapping at both sites resulted in trap success rates of between 0 and 2% (Figures 5, 6 and 7). Post-baiting trapping at six weekly intervals at Dragon Rocks and Rock View showed that trap success rates increased at both sites (to 5 - 9%), suggesting that the population increase was due to factors other than fox control. It was interesting to note, however, that the Heath Rat *Pseudomys shortridgei,* a larger species (70 g), was found at Dragon Rocks NR after two years of fox baiting. This species was previously unknown from this area. The Common Brushtail Possum *Trichosurus vulpecula* was also sighted some time after fox control had been implemented. Trap success rates at Anderson Lakes NR continued to be low during this period (Figure 4).

The feral cat was not controlled during this experiment, suggesting also that this species is not limiting the Western Mouse where it inhabits dense vegetation. It is possible, however, that both the fox and cat may contribute to restricting the Western Mouse to these vegetation types. The expansion of the Western Mouse into other, more sparse vegetation types under a fox and cat control regime needs to be tested.

1.4.2 Rabbit control:

In the south-west of W.A. rabbits are controlled through the use of 1080 or Pindone poisons impregnated into oats and laid in feeding trails. These trails are often laid in open areas around granite rocks where rabbits congregate. A trial to test whether the Western Mouse was susceptible to such poisoning programs was undertaken at Dragon Rocks Nature Reserve. Dye-impregnated,

unpoisoned oat trails were laid in spring and autumn and the movements and behaviour of radio-collared Western Mice followed. These oats were not eaten by the mice and it is believed that poisoning rabbits in this way in open areas does not pose a problem for Western mice. If poisoning programs were to occur among dense vegetation where Western mice occur, this would need to be reassessed.

1.5 Reasons for listing

The Western Mouse is listed as Vulnerable by ANZECC (1991) and the Action Plan for Australasian Rodents (Lee et al 1993), and as fauna likely to become extinct, or is rare in W.A.(Wildlife Conservation Act, 1950). It is known from only 12 conservation reserves in the south-west of W.A. Within these reserves, it is confined to specific vegetation types. Populations, both within and between reserves, are isolated.

Sub-fossil deposits suggest a wider distribution and it is possible that this species had declined to some extent before European settlement. However it is believed that some populations have become extinct in recent times (e.g King George Sound, Nyabing, and Hatters Hill) and this decline may be continuing. The clearing of vegetation on sandy loam soils for cereal cropping and grazing in the southern wheatbelt has contributed to the isolation and decline of populations. Competition for food by rabbits, predation by foxes and cats, and more frequent fire regimes may have also contributed.

It is believed that the greatest threats to remaining Western Mouse populations on conservation reserves are:

a) the degradation of suitable habitat through inappropriate use of fire and weed invasion.
b) the restriction of populations to dense vegetation types by introduced predators.

1.6 Existing conservation measures

Most Western Mouse populations are located within conservation reserves managed by the Department of Conservation and Land Management (CALM), however only a limited amount of survey, monitoring and fox baiting can be undertaken with existing resources.

1.7 Strategy for recovery

This recovery plan will run for a term of 5 years from 1994 to 1998 inclusive. Five primary strategies will be pursued concurrently during this term and are shown below.

(1) Continue with the population monitoring studies at Dragon Rocks, Rock View, and Anderson Lake NR and commence monitoring at Fitzgerald River NP and Ravensthorpe Range (proposed NR)

(2) Continue the fox baiting program at Dragon Rocks NR and implement a cat baiting program when techniques are developed.

(3) Undertake research to determine the effect of fire on Western Mouse populations.

(4) Confirm the identification of the *Pseudomys* species on Woody Island. If this proves to be *P. occidentalis*, it may be necessary to implement Black Rat and Grey Kangaroo control programs.

(5) Continue opportunistic surveys of suitable habitat on public and private land and use the Western Mouse to promote public awareness of native rodent conservation issues.

A Western Mouse Recovery Team will be established to coordinate the research and management of the species as outlined in this recovery plan. The team will comprise representatives of CALM Scientific and Information Division, Nature Conservation Division and Operations Division, the Australian Nature Conservation Agency, and World Wide Fund for Nature, and any other organisations that become involved with the program in the future.

2. RECOVERY OBJECTIVE AND CRITERIA

The objective of this recovery plan is to achieve down listing of the Western Mouse status from Vulnerable to Susceptible in five years. This will be achieved when it can be demonstrated that

(1) the present distribution is maintained, and
(2) the abundance in at least three monitoring sites is maintained or increased.

3. RECOVERY ACTIONS AND BUDGET

Recovery actions for the Western Mouse are presented below. Costings have

been calculated in 1993 prices.

3.1 Monitoring:

Monitoring of the Western Mouse at Anderson Lake NR commenced in May 1990, at Dragon Rocks NR in July 1990 and at Rock View NR in April 1991. One trapping grid was established at Anderson Lake NR comprising a 5x5 pit and Elliott trap combination. Two trapping grids were established at Dragon Rocks NR, each comprising 10x10 Elliott traps. One similar grid was established at Rock View NR. The location of grids is shown in Figures 8, 9 and 10. All grids were trapped at six weekly intervals until January 1993.

It is necessary to continue this monitoring at a reduced frequency. Annual monitoring is adequate and late spring /early summer (October-December) is the best time for this to occur as breeding will be detected and young are starting to appear in the population. Annual monitoring at Fitzgerald River NP and Ravensthorpe Range also needs to commence to provide population assessments with time throughout most of the range of the Western Mouse.

CALM's contribution includes salary for Operations staff, vehicle standing fees and provision of some of the traps required. External funds are required for vehicle running, some equipment and consumables.

	1994 $	1995 $	1996 $	1997 $	1998 $
CALM	4 000	4 000	4 000	4 000	4 000
External	**2 500**	**1 500**	**1 500**	**1 500**	**1 500**
TOTAL	6 500	5 500	5 500	5 500	5 500

3.2 Feral predator control programs:

A fox baiting trial started at Dragon Rocks NR in March 1991 to test the effect of fox control on Western Mouse populations. Rock View NR was left unbaited and monitored as a control. Although no increases in Western Mouse occurred at Dragon Rocks compared to Rock View NR (Figures5, 6 and 7), fox baiting and monitoring needs to be continued at both these sites to determine whether the Western Mouse expands its niche to occupy other habitats when foxes are controlled. Cat control should also be implemented when suitable techniques are developed.

The laying of fox baits needs to be continued every three months (rather than every 6 weeks) and the monitoring for niche expansion can be undertaken during the routine monitoring outlined above. External funds are required for bait costs,

signs and vehicle running.

	1994	1995	1996	1997	1998
CALM	1 500	1 500	1 500	1 500	1 500
External	**3 000**	**3 000**	**3 000**	**3 000**	**3 000**
TOTAL	4 500	4 500	4 500	4 500	4 500

3.3 Effect of fire:

It appears that the Western Mouse prefers habitat that is long unburnt (30-50 years). Research is required to demonstrate the effect of fire on the species. It is proposed to burn approximately 2 000 ha of Dragon Rocks NR in spring 1994. The area to be burnt covers one of the monitoring grids and this would provide the opportunity to examine the response of a well known Western Mouse population to a fire event.

CALM will fund the implementing of the burn. External funds are required for more intensive monitoring than that described above, to be undertaken every 8 weeks for 6 months following the fire and then bi-annually.

	1994	1995	1996	1997	1998
CALM	3 000	1 000	1 000	1 000	1 000
External	**2 000**	**2 000**	**2 000**	**2 000**	**2 000**
TOTAL	5 000	3 000	3 000	3 000	3 000

3.4 Woody Island *Pseudomys*:

A *Pseudomys* has been recorded on Woody Island and identified as *P. albocinereus.* No specimen was taken and the only record is a line drawing in Goodsell et al (1976). This drawing bears a resemblance to *P. occidentalis* and two trips undertaken in September 1991 and 1992 (each 1000 trap nights, sampling all habitats) have been undertaken since to try to confirm the identification. Unfortunately no *Pseudomys* were trapped and this question remains unresolved. If it were the Western Mouse it would greatly enhance the conservation prospects of the species and a further survey is required.

External funds are required for travel between Perth and Esperance, and for time on Woody Island.

1994	1995

CALM	100	100
External	**500**	**500**
TOTAL	600	600

3.5 Opportunistic surveys and public relations:

CALM Wheatbelt regional staff are involved in biological surveys of conservation reserves and vacant crown land within the range of the Western Mouse. Suitable Western Mouse habitat occurs on Silver Wattle Hill NR (north of Lake Magenta), Dunn Rock NR, Heath land NR (east of Lake Grace), Benyon NR, Harris NR (west of Dragon Rocks NR) and Lake Bryde NR. In addition, characteristic accumulations of Quondong nuts have been found in these reserves, suggesting the presence of the Western Mouse. Considerable scope exists for the public to be involved in these surveys and for the level of public awareness about native rodent fauna, to be increased through this work.

CALM will provide the salary of staff to undertake these surveys. External funds are required to assist with vehicle costs and travel.

	1994	1995	1996	1997	1998
CALM	1 500	1 500	1 500	1 500	1 500
External	**1 000**	**1 000**	**1 000**	**1 000**	**1 000**
TOTAL	2 500	2 500	2 500	2 500	2 500

4. IMPLEMENTATION SCHEDULE

Task	Priority	Feasibility	Responsible Party	Funding	1994	1995	1996	1997	1998	**Total**
3.1 Monitoring	1	100%	CALM Wheatbelt	CALM	4000	4000	4000	4000	4000	**20000**
				ext	2500	1500	1500	1500	1500	**8500**
3.2 Feral predators	1	100%	CALM Wheatbelt	CALM	1500	1500	1500	1500	1500	**7500**
				ext	3000	3000	3000	3000	3000	**15000**
3.3 Fire	1	75%	CALM SID Wheatbelt	CALM	3000	1000	1000	1000	1000	**7000**
				ext	2000	2000	2000	2000	2000	**10000**
3.4 Woody Island	2	75%	CALM SID	CALM	100	100				**200**
				ext	500	500				**1000**
3.5 Survey/PR	2	75%	CALM Wheatbelt	CALM	1500	1500	1500	1500	1500	**7500**
				ext	1000	1000	1000	1000	1000	**5000**
TOTAL			CALM		10100	8100	8000	8000	8000	**42200**
					9000	8000	7500	7500	7500	**39500**
				TOTAL	**19100**	**16100**	**15500**	**15500**	**15500**	**81700**

4. ACKNOWLEDGEMENTS

The acquisition of the current knowledge necessary for the development of this Recovery Plan would not have been possible without the support of World Wide Fund for Nature and an anonymous sponsor. The National Parks and Nature Conservation Trust Fund also provided funds for this work. Mal Graham, CALM Katanning District, and other District staff undertook the Anderson Lakes monitoring program. Our thanks to Jeff and Diane McDonald of "Okalahoma" near Newdegate for their interest and support of the field work at Dragon Rocks NR, and assistance with vehicle recovery from time to time. The assistance and company of Peter Speldewinde, Peter Orell, Neil Coy (jr), Marion White, Kyle Armstrong and other volunteers was appreciated.

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Table 1. Summary of Western Mouse surveys in conservation reserves within the southern wheatbelt area of Western Australia.

Reserve name	Area (ha)	Last record (date)	Surveyed this study	W.m. recorded
Anderson Lakes	224	1986	yes	yes
Bendering	1 601	1976	yes	yes
Dragon Rocks	32 218	1973	yes	yes
Fitzgerald River	329 000	1986	yes	yes
Flat Rocks	1 467	1975	no	-
Frank Hann	50 000	no record	yes	no
Harris	3 609	1984	no	-
Hatters Hill	n/a	1953	yes	no
King George's Sound	n/a	1841	no	-
Lake Grace	19 825	1972	yes	no
Lake Magenta	94 170	no record	yes	no
North Karlgarin	5 186	1976	yes	yes
North Tarin Rock	1 415	no record	yes	no
Nyabing	4	1953	no	-
Ravensthorpe Range	n/a	1983	no	-
Rock View	1 732	no record	yes	yes
Roe	1 246	no record	yes	no

Tarin Rock	2 010	1972	yes	yes

Figure 1. Past and present distribution of the Western Mouse.

1 - Bendering Nature Reserve
North Karlgarin Nature Reserve
Roe Nature reserve.
2 - Tarin Rock Nature Reserve
North Tarin Rock Nature Reserve
3 - Dragon Rocks Nature Reserve
4 - Frank Hann National Park
5 - Lake Magenta Nature Reserve
6 - Dunn Rock Nature Reserve
7 - Fitzgerald River National Park
8 - Ravensthorpe Range (proposed nature reserve)
9 - Lake Grace Nature Reserve
10 - Anderson Lakes Nature Reserve

Figure 2. Line drawing of a burrow occupied by Western Mice at Dragon Rocks Nature Reserve. (Note: burrow depth of 0.2-0.3 metres).

Figure 3. Line drawing of a burrow occupied by Western Mice at Anderson Lakes Nature Reserve. (Note: burrow depth of 0.3-0.5 metres)

Figure 4. Trap success rates (mean %, SE) for the Western Mouse at Anderson Lake Nature Reserve (not fox baited).

Figure 5. Trap success rates (mean %, SE) for the Western Mouse at Dragon Rocks Nature Reserve - trap grid 1. (fox baited).

Figure 6. Trap success rates (mean %, SE) for the Western Mouse at Dragon Rocks Nature Reserve - trap grid 2 (fox baited).

Figure 7. Trap success rates (mean %, SE) for the Western Mouse at Rock View Nature Reserve (not fox baited).

Figure 8. Location of Anderson Lakes Nature Reserve showing trapping grid.

Figure 9. Location of Dragon Rocks Nature Reserve showing trapping grids, other unsuccessful trapping sites and extent of fox baiting.

Figure 10. Location of Rock View Nature Reserve showing trapping grid.