WESTERN AUSTRALIAN WILDLIFE MANAGEMENT PROGRAM No.17

DJOONGARI (SHARK BAY MOUSE) RECOVERY PLAN

1992-2001

by

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FOREWORD

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of a threatened species or ecological community. The achievement of objectives and the provision of funds is subject to budgetary and other constraints affecting the relevant parties, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views nor the official positions of any individuals or agencies represented on the Recovery Team. They represent the position of the Department of Conservation and Land Management only after approval by the Executive Director, the National Parks and Nature Conservation Authority and Minister for the Environment. Approved Recovery Plans are subject to modifications as directed by new findings, changes in species' status and completion of recovery actions.

In 1991 a draft Recovery Plan was prepared for the Djoongari (Shark Bay Mouse), *Pseudomys fieldi* (Orell and Morris 1991), and a recovery team established to oversee the implementation of the plan. During the first year, changes to the schedule for translocations were considered necessary. To enhance the conservation of this extremely restricted native rodent, it was considered that the first translocation should be to another island, rather than to a mainland site. A eight year time frame to implement the recovery actions was also considered too short and this has been extended to 10 years. IUCN (1994) categories have listed the Djoongari as Critically Endangered and this recovery plan aims to downlist the species to Endangered, the original plan was to downlist the species from Endangered (ANZECC 1991) to Vulnerable (ANZECC). This revised Recovery Plan reflects these changes with some increase to the budget. Information in this plan is accurate at February 1997.

SUMMARY

Current Species Status:
Endangered (Commonwealth *Endangered Species Protection Act 1992);* Rare or likely to become extinct (WA *Wildlife Conservation Act 1950*), Critically Endangered (IUCN 1994). Prior to European settlement, the Djoongari occupied most of the south-west quadrant of Australia. It became extinct on the mainland by the late 19 th century and until 1993, was restricted to Bernier Island, in Shark Bay, Western Australia. Population size was estimated at *c.* 6000-7000 animals in 1992. In 1993 and 1994 the Djoongari was translocated to two other sites; Doole Island and Heirisson Prong.

Habitat Requirements and Limiting Factors:
On Bernier Island, the Djoongari inhabits coastal dune vegetation dominated by beach spinifex and coastal daisy bush but also occurs at lower densities in inland *Triodia/Acacia* heath. Its preferred habitat on the mainland, especially inland, is not known. Reasons for the decline of the Djoongari and its extinction on the mainland are also unknown but the process may have begun prior to European settlement due to a subtle climatic change. It is also possible that its habit of using above ground nests rather than deep, complex burrow systems has made the Djoongari vulnerable to the physical effects of overgrazing and trampling by domestic and feral stock and to predation by foxes and feral cats, and this may be the primary factor responsible for its decline.

Recovery Plan Objective:
Down listing to Endangered (IUCN 1994) by 2001.

Long Term Objective:
Down listing to Conservation Dependent (IUCN 1994)

Recovery Criteria:
(1) Current (1992) distribution and abundance retained on Bernier Island.
(2) A self-sustaining population established on Doole Island.
(3) Two self-sustaining populations established on the Shark Bay mainland.
(4) Viable captive breeding population established at Perth Zoo.

Actions Needed:
A Recovery Team comprising members from CALM, CSIRO, Useless Loop Community Biosphere Project Group, Inc. Perth Zoo and Environment Australia has been established to coordinate and supervise the following actions:
(1) Research into abundance, distribution and biology of the Djoongari on Bernier Island.
(2) Translocation to Doole Island.
(3) Translocation to Heirisson Prong.
(4) Control of introduced predators, rabbits and goats on Peron Peninsula.
(5) Captive breeding.
(6) Translocation to Peron Peninsula.

Estimated Cost of Recovery: 1992-6:1991 prices in $000 s / year. 1997-01: 1996 prices in $000 s /year.
Total cost (TC) and Endangered Species Program (ESP) funds required (= TC - CALM + other agency contributions).

Action	1		2		3		4		5		6		Total	
Year	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1992	71.6	62.1											71.6	62.1
1993	2.2	2.2	57.4	51.5									59.6	53.7
1994	2.2	2.2	37.2	31.1	64.3	16.2							103.7	49.5
1995	2.2	2.2	2.0	2.0	97.3	49.8	190.0	40.0					291.5	94.0
1996	2.2	2.2	2.0	2.0	94.4	46.7	190.0	40.0					288.6	90.9
1997	10.5	9.0	6.5	4.0	46.0	5.0	54.0	4.0	3.5	1.5	64.0	53.5	184.5	77.0
1998	10.5	9.0	6.5	4.0	5.0	4.0	54.0	4.0	3.5	1.5	60.9	50.4	140.4	72.9
1999	10.5	9.0	6.5	5.0	6.5	5.5	54.0	4.0	3.5	1.5	61.7	51.2	142.7	76.2
2000	10.5	9.0	6.5	4.0	5.0	4.0	54.0	4.0	3.5	1.5	61.7	51.2	141.2	73.7
2001	10.5	9.0	6.5	4.0	5.0	4.0	54.0	4.0	3.5	1.5	61.7	51.2	141.2	73.7
Total	132.9	115.9	131.1	107.6	323.5	135.2	650.0	100.0	17.5	7.5	310.0	257.5	1565.0	723.7

Biodiversity Benefits: Control programs for introduced predators and competitors will facilitate re-introductions of other threatened fauna in the Shark Bay area. Translocations of the Djoongari will become part of the reconstruction of the original mammal fauna on the Shark Bay mainland.

1 INTRODUCTION

1.1 Description of species

The Djoongari (Shark Bay Mouse) *Pseudomys fieldi* Waite 1896 (= *P. praeconis* Thomas 1910) is a robust, long-haired pseudo-mouse of *c.* 30-50 g in weight (Ride and Tyndale-Biscoe 1962; Watts and Spencer 1978; Watts and Aslin 1981). The dorsal fur is a mixture of pale yellow-fawn underfur and dark guard hairs, giving a grizzly appearance, and the coat colour grades from a delicate buff shade on the sides to white underneath. The feet are white. The tail is slightly longer than head and body, and is bicoloured grey and white with a dark tuft of hairs at the end (Watts and Aslin 1981).

The common name, Djoongari, was adopted as a replacement for Shark Bay Mouse following publication of a recommended list of Australian names for Australian rodents (Braithwaite *et al* 1995). The use of this nomenclature for native rodents follows a recent trend to use relevant Aboriginal names for marsupials in Australia.

P. fieldi was first described by Waite in 1896 from a specimen collected near Alice Springs during the Horn Expedition in 1895 (Watts and Aslin 1981). The skull was badly crushed and until recently this was thought to be the only record of the Alice Springs Mouse *P. fieldi*. However *P. fieldi* and *P. praeconis* have recently been synonymised following many years of examining sub-fossil remains from cave surface deposits at sites from Shark Bay across to Uluru in the Northern Territory (Baynes 1987b; Baynes 1990). Thomas (1910) described *P.* (*Thetomys*) *praeconis* on the basis of a specimen collected at Herald Bight on Peron Peninsula in Shark Bay, Western Australia, in 1858 and a skull collected on Bernier Island, also in Shark Bay, in 1906. Mouse specimens collected from the Victoria Plains near New Norcia, Western Australia, in 1843 were identified by Mahoney (1969) as *P. gouldii* but have since been re-identified by Baynes (1990) as *P. praeconis* (= *P. fieldi*). Although *P. fieldi* has been trapped on Bernier Island on several occasions since (Watts and Aslin 1981), the specimens collected in 1843 (south west WA), 1858 (Shark Bay mainland) and 1895 (central Australia) were the last collected on the mainland

1.2 Distribution and abundance

P. fieldi once had an extensive distribution occupying much of the south-west quadrant of Australia (Figure 1). Examination of cave surface deposits have indicated that the species once occurred throughout the Shark Bay region, including Dirk Hartog Island (Baynes 1990), south along the west coast to Cape Leeuwin (Archer and Baynes 1973; Chapman and Kitchener 1977), across the upper Gascoyne, northern goldfields and Gibson Desert of Western Australia (Baynes 1990), at Uluru, Northern Territory (Baynes 1987b), and the Nullarbor Plain, Western and South Australia (Baynes 1987a). There is no evidence that it occurred in what is now known as the wheatbelt region of WA.

Prior to June 1993, *P. fieldi* was known to be extant only on Bernier Island, a 4 200 ha island 50 km west of Carnarvon in the Shark Bay region of WA. A search for mainland populations was carried out in 1989 with funding from World Wide Fund for Nature, but this failed to detect the presence of the species at selected mainland survey sites in the Shark Bay area (Sanders and Harold 1989). This survey included the Herald Bight area on Peron Peninsula where the Djoongari was last collected in 1858. In June 1993, the Djoongari was translocated to Doole Island in Exmouth Gulf, and in November 1994 it was translocated to Heirisson Prong on the Shark Bay mainland as part of this Recovery Plan (see Sections 3.2 and 3.3).

Abundance of Djoongari on Bernier Island has varied considerably over the period 1992 - 1996 (Speldewinde 1996). Using Lincoln indices and Schumacher estimates (Seber 1973) it was determined that between 300 and 18 000 individuals occur on the island, however these estimates must be viewed cautiously because of low recapture rates.

1.3 Habitat

On Bernier Island, *P. fieldi* inhabits coastal dune vegetation dominated by *Spinifex longifolius* and *Olearia axillaris* (Ride and Tyndale-Biscoe 1962; Robinson *et al.* 1976). Recent surveys suggest that the species occurs in most coastal sandy areas around the island (Morris *et al.* unpublished). It also occurs at lower densities in inland *Triodia/Acacia* heath (Robinson *et al.* 1976). Nothing is known of the preferred habitat on the mainland, though it is likely to have included deep sandy soils supporting *Spinifex* and *Triodia* species. On the Shark Bay mainland it was last collected in coastal *Spinifex longifolius* at Herald Bight. Translocated animals on Doole Island also appear to prefer coastal habitats.

Djoongari do not appear to use burrows as commonly as most other *Pseudomys* species. They are known to construct tunnels and runways in heaps of seagrass piled up on Bernier Island beaches during winter storms (Robinson 1983) and use above ground nests as diurnal refuges. More use of burrows is made during the breeding season (Morris and Speldewinde, 1992). Animals translocated to Doole Island used hollows located above high water level in mangrove (*Avicennia marina*) trees as well as sites among rocks and under *Triodia* for daytime refuges.

1.4 Diet

Little is known about the diet of the Djoongari. Scats collected from four individuals on Bernier Island contained petals and anthers from flowers, possibly of *Olearia*, leaf fragments of *Olearia*, leaf or stem parts of a fleshy dicot and insect fragments (Robinson *et al.* 1976). Stomach contents from a single specimen collected by Ride and Tyndale-Biscoe (1962) contained plant material and an insect fragment. They have also been observed eating spiders (Morris, personal observation). Like many native rodent species they appear to be vegetarian / omnivores.

1.5 Reproduction

Most information on the reproduction of the Djoongari has been obtained from observations of captive animals. Watts and Spencer (1978) reported an animal taken from Bernier Island mated and produced two litters, one of four and one of three, in captivity. The oestrus cycle appears to be less than 14 days and the gestation period is about 28 days. The young are born hairless and with ears folded down. At 11 days of age they are well furred and the ears are free but their eyes are still closed. The eyes open after 15 days and by 30 days of age the juveniles are weaned. They are attached to their mother's teats for the first 16 days from birth. The upper and lower incisors erupt by day three. By 100 days of age the mice have reached full adult size. The male was observed to share the nesting box with the female and young when the young were four weeks old. He also behaved protectively towards the young when the female was absent. More recently, successful breeding in captivity has been difficult, with Djoongari mothers being easily disturbed and cannibalising young. Size of the holding pen is probably also important.

On Bernier Island, Djoongari can breed at any time between May and November, with sub-adults (< 30 g body weight) entering the population between November and March (Morris and Speldewinde 1992). Litter sizes up to five have been observed and more use is made of burrow systems during the breeding season. Animals on Bernier Island live for at least two years. In captivity, births have occurred from November to February, and it is possible that breeding can occur throughout the year.

1.6 Conservation status and limiting factors

Until 1993, the Djoongari occurred only on Bernier Island (4 200 ha) and at this time was one of Australia's most geographically restricted mammals. It is listed as a species that is rare, or likely to become extinct under the Western Australian *Wildlife Conservation Act 1950* and is currently listed as Endangered under the Commonwealth *Endangered Species Protection Act 1992* and in the Rodent Action Plan (Lee 1995). In 1993 Djoongari were translocated to Doole Island and this population appears to have established. In 1994 it was translocated to Heirrison Prong, but this population has not established.

Orell and Morris (1992) in the first edition of the Djoongari Recovery Plan had stated the recovery plan objective as downlisting the Djoongari from Endangered to Vulnerable (ANZECC 1991). Since the original recovery plan IUCN Red List Categories have been prepared. Using IUCN (1994) criteria, the Djoongari qualifies as Critically Endangered: it occupies an area of occurrence of less than 100 km^2, is known from a single location (the Doole Island population is not considered here as it has not been established for five years), and has extreme fluctuations in the number of mature individuals. IUCN define extreme fluctuations as typically variations greater than one order of magnitude. Numbers of Djoongari fluctuate greatly and population estimates vary widely and are considered unreliable. IUCN suggests that where wide variation in estimates is found it is legitimate to apply the precautionary principle and use the estimate that leads to listing in the category of highest risk. With the establishment of the Doole Island population after five years the species could be downlisted to Endangered. The area of occupancy of the species will be less than 500 km^2, exists at no more than five locations and extreme fluctuations in the number of mature individuals. To be downlisted to Vulnerable under IUCN criteria five populations of Djoongari will have to exist in the wild. Under this recovery plan only a maximum of four wild populations will exist by 2001, although guidelines for future introductions of Djoongari will have been established. By 2001 techniques for the reintroduction and management of Djoongari will have been developed through the recovery plan. Future work can then be aimed at down listing the species to Conservation Dependent (IUCN 1994).

The reasons for the decline of the Djoongari are not known. It has been suggested that cats became established on the mainland prior to European settlement, from 17th century shipwrecks on the west coast (Burbidge *et al.* 1988). These may have been responsible for the decline and extinction of many species, particularly rodents, on the mainland. Burbidge and Fuller (1979) report that the Aborigines in the Warburton area attribute the disappearance of native animals in this area to the cat, however the Aborigines of the central deserts regard the cat as always having been present (Burbidge *et al.* 1988) and value it as a food item.

The advent of the pastoral industry is closely associated with the date of last collection of specimens of *P. fieldi* both in central Australia and Shark Bay. A decrease in environmental productivity and loss of nutrients caused by grazing and trampling by domestic stock has been suggested as a mechanism for the extinction of Australian fauna (Burbidge and McKenzie 1989) and this mechanism

may have been involved in the extinction of *P. fieldi* on the mainland. Morton (1990) suggests that the rabbit has been a major factor in mammal extinctions in the arid zone. Both native and exotic mammals in the arid zone depend on pockets of relatively fertile and productive habitat (for example, around water holes, salt lakes or drainage lines) to survive droughts. Competition and habitat degradation caused by increases in rabbit numbers are exacerbated by successive droughts which eventually leads to the destruction of drought refuges and inevitably to extinctions. Altered fire regimes and predation by foxes and feral cats are cited as secondary factors.

The construction of deep, complex burrow systems may be an important factor in the survival of native rodents and this attribute is shared by all extant species on the Shark Bay mainland (*Pseudomys albocinereus, Pseudomys hermannsbergensis, Rattus tunneyi* and *Notomys alexis*). It appears that the Djoongari does not construct substantial burrow systems but rather builds tunnels and runways amongst vegetation (Robinson 1983; Watts and Aslin 1981) and shallow burrows during the breeding season (Morris and Speldewinde, 1992). On the mainland, this behaviour would have made it particularly vulnerable to cat and fox predation and the physical effects of stock and rabbit grazing and trampling.

1.7 Existing Conservation Measures

Currently, the primary Djoongari population is protected from the above threats on Bernier Island as this is part of the Bernier and Dorre Islands Nature Reserve (Class A Reserve No 24869). Feral goats were eradicated in 1984 and the island is free of exotic predators. Public access to Bernier Island is limited to day visits. Doole Island is also a nature reserve and in a relatively remote location.

Due to its restricted occurrence, however, the species is highly vulnerable to extinction and protection of a single population on Bernier Island is not considered sufficient to ensure long term survival. Under this recovery plan, the Djoongari has recently been translocated to another exotic predator-free island nature reserve, Doole Island in Exmouth Gulf (June 1993), and to Heirisson Prong, Shark Bay (November 1994) where intensive predator control is underway (Figure 2). Only the population on Doole Island is believed to have established.

1.8 Strategy for Recovery

This recovery plan will guide the recovery of the Djoongari for 10 years from 1992 - 2001 inclusive. Four primary strategies will be pursued during this term and these are presented below in chronological order. Once commenced, the implementation of these strategies will be run concurrently.

Strategy 1 **Initiate research into population size, distribution and biology of *P. fieldi* on Bernier Island, 1992 -1993.**

This is an important first step as it will provide sound knowledge of the biology and requirements of the Djoongari and will determine whether the population is large enough to support a translocation program. It will also assist in determining the key requirements for successful translocations. The Bernier Island population will also be monitored twice annually for the duration of the recovery plan.

Strategy 2 **Undertake translocation to Doole Island and monitor population, 1993 - 2001.**
This will establish a second population and provide added security for the species, without the expense of exotic predator control. Captive breeding may be required to support this and other translocations.

Strategy 3 **Undertake translocation to Heirisson Prong (Shark Bay mainland) and monitor population, 1995 - 2001.**
This will establish a mainland population for the first time in 140 years, and provide information for subsequent translocations to mainland sites. Intensive feral animal control is already underway at this site.

Strategy 4 **Undertake translocation to Peron Peninsula (Shark Bay mainland) and monitor population, 1997 - 2001.**
This will initially involve a program to control rabbits, goats, foxes and cats at acceptably low levels (1995-1997) followed by a translocation and monitoring program (1997-1999). The translocation will only occur after successful control of exotic predators and competitors has been achieved and is part of a program to re-establish the former fauna of these areas.

A Recovery Team was appointed in 1992 to coordinate the implementation of this recovery plan. As of April 1996 it comprised representatives from the Department of Conservation and Land Management (CALM) Science and Information Division, WA Threatened Species and Communities Unit (WATSCU) and Mid West Region, CSIRO Division of Wildlife and Ecology, Useless Loop Community Biosphere Project Group, Inc., Environment Australia and World Wide Fund for Nature. Perth Zoo was included as a member of the recovery team in 1996.

2 RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Recovery Plan is to achieve down listing of the conservation status of the Djoongari from Critically Endangered to Endangered (IUCN 1994) within 10 years by successfully:

(i) maintaining the current (1992) population distribution and abundance on Bernier Island, taking into consideration annual fluctuations in population parameters.
(ii) establishing a second island population, and
(iii) re-establishing the species in at least two other sites within its previous distribution on the Shark Bay mainland.
(iv) establishing a captive breeding colony at Perth Zoo.

2.2 Criteria for success

Achievement of the above objective will be assessed on the following criteria:

(1) That there is no decrease in the abundance and distribution of Djoongari on Bernier Island over the recovery period. This will take into account the expected population fluctuations.

(2) A self-sustaining population will be established on Doole Island by 1998 with demonstration of population growth.

(3) Two self-sustaining populations established on the Shark Bay mainland by 1999 with some demonstration of population growth at each.

Population abundance will be assessed using a standardised monitoring program that will be developed in the first four years of the recovery plan.

3 RECOVERY ACTIONS

Recovery actions for the Djoongari are presented below. Costings for 1992 to 1996 were calculated at 1991 prices. Costings for 1997 to 2001 were calculated at 1996 prices. A contract zoologist will be employed to undertake the prescribed actions as indicated. The salary for this person has been included as a whole to certain actions throughout the period of the recovery plan. This is for convenience, rather than indicating that 100 % of the persons time is taken with that particular action. Unless otherwise stated, CALM contributions include supervision of the contract zoologist (10% of a Research Scientist's time) and payment of the vehicle standing fees ($2 500/year). Perth Zoo contributions include keeper time. Some of the recovery actions have already been carried out, details of these actions are found in Speldewinde (1996).

3.1 Action 1 - Research and monitoring on Bernier Island

3.1.1 Research into population size, distribution and biology of the Djoongari on Bernier Island:

Before translocations can be undertaken, information is required on population size and distribution on Bernier Island, nesting habits and requirements, diet, genetic variation and reproduction. As well as aiding the appropriate management of Bernier Island Nature Reserve, this information will enable the Recovery Team to determine whether the population on the island can support a translocation program or whether captive breeding will be required. It will enable better habitat assessments for translocation sites based on dietary and nesting requirements and preferred habitat on Bernier Island. Knowledge of the genetic variation and relatedness of *P. fieldi* from various locations on the island will be important when trapping mice for translocations. Knowledge of reproductive biology will be important for the translocation program as it will help to determine the most appropriate timing for translocations and aid in the subsequent monitoring.

This research will be undertaken in 1992 by a contract zoologist with the assistance of volunteers and will require four trips to Bernier Island, each of three weeks duration. The research will involve systematic trapping using Elliott traps, radio-tracking individuals to find nest sites or burrows, scat analysis to determine diet, and taking blood samples from mice at four separate locations on the island for DNA fingerprinting to determine genetic relatedness.

CALM's contribution will include $2 000 for camping equipment plus supervision and vehicle standing fees. ESP or other funds are required for the contract zoologists' salary, equipment and support including a portable HF radio, radio telemetry equipment, DNA fingerprinting, 200 Elliott traps, travel expenses, boat hire, field allowance and consumables.

	1992
CALM contribution	$ 9 500
ESP funds required	**$ 62 100**
Total cost	$ 71 600

3.1.2 Monitoring the Bernier Island population:

Monitoring of the Djoongari population on Bernier Island will be undertaken twice annually through grid trapping, following the completion of the above research. This will provide information on the well-being of the population and on long-term population dynamics. This will be undertaken by a contract zoologist and volunteers and will require four weeks (two trips) per year on Bernier Island for trapping and survey work. Standardised monitoring protocols will be developed so they can be used consistently for assessing all Djoongari populations both during and after this recovery plan has been completed.

ESP funds are required for the cost of annual monitoring, primarily travel and boat charter costs. Costs for using the Fisheries patrol vessel for transport to Bernier Island increased significantly in 1995 as the Fisheries Department moved towards full cost recovery on its services. Salary for the contract zoologist is included under other recovery actions.

	1993-6	1997-2001
CALM contribution	0	$ 1 500
ESP funds required	**$ 2 200**	**$ 9 000**
Total cost	$ 2 200	$ 10 500

3.2 Action 2 - Translocation to Doole Island

3.2.1 Undertake translocation:

Translocation to Doole Island in Exmouth Gulf will provide much needed security for the Djoongari. This translocation can be undertaken without the risks and expense of vermin control. Initially 40-50 mice will be trapped and removed from Bernier Island. Initial monitoring post-release, by radiotracking, trapping and track counts, is required every six weeks for the first six months, and every three months for the next 12 months. A translocation of another threatened rodent, the Greater Stick-nest Rat (*Leporillus conditor*) to Salutation Island in Shark Bay has proven successful (Morris and Copley 1992). Results from the initial monitoring will be used to determine whether restocking is required at a later date. The timing of translocation and the numbers of mice taken from Bernier Island will be determined by assessing monitoring data and taking into account numbers available at certain times of the year.

ESP funds are required for the contract zoologist's salary for two years, travel expenses including boat charter, radio telemetry equipment, DNA fingerprinting and consumables.

	1993	1994
CALM contribution	$ 7 900	$ 8 100
ESP funds required	**$49 500**	**$29 100**
Total cost	$57 400	$37 200

3.2.2 Monitoring of translocated population on Doole Island:

After the initial 18 month monitoring period, the Doole Island population will need to be monitored once each year for the duration of the recovery plan to determine the success of the translocation. This will be undertaken by a contract zoologist with volunteer assistance and will require two weeks (two trips) of trapping per year on the island. An assessment of the genetic variation of the population through DNA fingerprinting will be required in 1999. ESP funds are required for field allowance, travel costs and consumables. Funds for DNA fingerprinting are required in 1999.

	1993-96	1997-98	1999	2000-01
CALM contribution	0	2 500	2 500	1 500
ESP funds required	**$ 2 000/yr**	**$ 4 000/yr**	**$ 5 000**	**$ 4 000/yr**
Total cost	$ 2 000/yr	$ 6 500/yr	$ 6 500	$ 6 500/yr

3.3 Action 3 - Translocation to Heirisson Prong

3.3.1 Undertake translocation:

A translocation of Djoongari to Heirisson Prong (Figure 2) was initially planned for 1993 (Orell and Morris, 1991) but was delayed until 1994 due to problems with feral predator control. This translocation will be undertaken to establish a mainland population of Djoongari in an area that is already being intensively managed for threatened fauna translocations by CSIRO Division of Wildlife and Ecology, the Useless Loop Community and Shark Bay Salt Joint Venture (SBSJV) (Short *et al*, 1994). The coastal habitat is similar to that found on Bernier Island and rabbit and introduced predator control is currently being implemented as part of the CSIRO project. CSIRO have or are proposing to reintroduce other threatened species such as Boodie, Western Barred Bandicoot and Greater Stick-nest Rat to this site.

The Djoongari translocation was undertaken in November 1994 and involved trapping 36 *P. fieldi* on Bernier Island, transporting the mice to the translocation site, releasing them at a selected site near the northern tip of Heirisson Prong and then monitoring using radio telemetry and standardised trapping techniques. Twenty mice were fitted with radio-collars. This translocation does not appear to have been successful. Although the mice were initially constrained within a temporary enclosure, aggressive behaviour because of high densities of mice resulted in some mortality, and rapid dispersal from the release site made monitoring difficult. Restocking will be required, however this will not be undertaken until translocation protocols have been refined and a captive breeding colony has been established. It is likely that this will be after a reintroduction to Peron Peninsula. Once Djoongari have established on Heirisson Prong the opportunity will be available to examine the comparative ecology of the Djoongari, the two *Pseudomys* species and *Rattus tunneyi* which also exist on the peninsula.

An electric fence has been erected by the Useless Loop Community and CSIRO, 10 km south of Cape Heirisson on Heirisson Prong. This, combined with regular baiting with dried meat baits containing 1080, by CSIRO and Agriculture Western Australia will control foxes at the translocation site. Cat control through trapping, shooting and baiting is also being implemented by CSIRO. Monitoring for signs of feral predators is carried out north of the fence.

ESP funds are required for the contract zoologist's salary, travel expenses including boat charter, radio telemetry equipment, enclosure materials and consumables.

	1994	1995	1996
CALM contribution	$ 8 100	$ 7 500	$ 7 700
CSIRO / SBSJV contribution	$ 40 000	$ 40 000	$ 40 000
ESP funds required	**$16 200**	**$49 800**	**$46 700**
Total cost of translocation.	$64 300	$97 300	$94 400

3.3.2 Monitoring of translocated population on Heirisson Prong:

Providing the translocation proceeds in 1994, the establishment of the new population on Heirisson Prong will need to be monitored at least four times in 1995 and then twice each year thereafter. Monitoring will be undertaken by the contract zoologist with volunteer assistance and will require one week of trapping per monitoring session. An assessment of genetic variation and changes in the new population through DNA fingerprinting will be required in 1999. ESP funds are required for field allowance, vehicle operating costs, consumables, and, in 1999, DNA fingerprinting.

	1997	1998	1999	2000 - 01
CALM contribution	$ 1 000	$ 1 000	$ 1 000	$ 1 000
CSIRO / SBSJV contribution	$ 40 000	nil	nil	nil
ESP funds required	**$ 5 000**	**$ 4 000**	**$ 5 500**	**$ 4 000/yr**
Total cost	$ 46 000	$ 5 000	$ 6 500	$ 5 000/yr

3.4 Action 4 - Control of introduced predators and competitors Peron Peninsula

Prior to a translocation to Peron Peninsula (Figure 2), it will be necessary to control the introduced predators and competitors at this site. CALM acquired Peron Station in 1989 and the northern portion is now Francois Peron National Park (FPNP). CALM has commenced a program to remove all sheep and goats and to control foxes, cats and rabbits in the park. A vermin proof fence has been constructed across the narrow neck of Peron Peninsula (Taillefer Isthmus) to further assist in the control of introduced species.

Once all the sheep and goats have been removed from the FPNP and the rabbits, foxes and cats are being controlled at minimal levels, CALM will begin reconstructing the fauna of Peron Peninsula by translocating several species of threatened mammal species to the area (Project Eden). The Djoongari will be one of the first species to be translocated and will be reintroduced to Peron Peninsula area in 1997, providing feral animal control has been successful ESP funds are required to complement the feral animal control program already underway, monitoring of other small mammal species, and for monitoring to ensure that the release site is free of introduced fauna species.

	1995	1996	1997- 2001
CALM contribution	$150 000	$150 000	$50 000/year
ESP funds required	**$ 40 000**	**$ 40 000**	**$ 4 000/year**
Total cost	$190 000	$190 000	$54 000/year

3.5 Action 5 - Captive breeding

In the initial Djoongari recovery plan (Orell and Morris 1991), it was proposed that a captive breeding program should be established to sustain translocations. When a population estimate of 6 000 - 8 000 was derived for Bernier Island (Morris and Speldewinde 1992) the recovery team suggested that the natural population was sufficiently abundant to sustain translocations to Doole Island and Heirisson Prong. This estimate needs to be reassessed on the basis of mature animals only. Due to fluctuations in Djoongari numbers it has often been difficult to capture sufficient numbers on Bernier Island for translocation and as it is likely that Doole Island and Heirisson Prong will require restocking, it is appropriate that a captive breeding colony be established. Captive breeding of Djoongari will be undertaken as part of a larger program involving the captive breeding of several species of threatened mammals on the Peron Peninsula as part of CALM's Project Eden. Perth Zoo will be involved in the captive breeding of Djoongari and will be represented on the recovery team. ESP funding would be required initially for purchase of terrariums and then ongoing maintenance and food.

	1997 - 2001
CALM/Perth Zoo contribution	$ 2 000
ESP funds required	**$ 1 500**
Total cost	$ 3 500

3.6 Action 6 - Reintroduction to Peron Peninsula

3.6.1 Undertake re-introduction:

Reintroduction of the Djoongari to Peron Peninsula will be undertaken in 1997 by a contract zoologist with the assistance of volunteers following the reduction and control of foxes, feral cats, rabbits and goats. Initially 20 captive bred Djoongari, all radiocollared, will be transported to Peron Peninsula for release at Guichenault Point, near Herald Bight or Cape Rose, near Monkey Mia. Ten will be released unconstrained and ten (five pairs) will be released into 8 m^2 enclosures, one pair per enclosure. Intensive monitoring through radiotracking and trapping will be undertaken for two - three months. If this indicates that the founders have survived and established, a further 30 captive bred Djoongari will be released at the site and monitored over the next 12 months. ESP funds are required for the contract zoologist's salary, travel expenses and vehicle operating costs, radio telemetry equipment and consumables.

	1997	1998
CALM contribution	$ 10 500	$ 10 500
ESP funds required	**$ 53 500**	**$ 50 400**
Total cost	$ 64 000	$ 60 900

3.6.2 Monitoring re-introduced population:

Monitoring of the established population at Peron Peninsula will be undertaken twice a year for the duration of the recovery plan. This will probably be undertaken in conjunction with the translocation programs for other threatened species on Peron Peninsula. ESP funds are required for the contract zoologists salary plus operating costs, primarily travel costs.

	1999-01
CALM contribution	$ 10 500/yr
ESP funds required	**$ 51 200/yr**
Total cost	$ 61 700/yr

4 IMPLEMENTATION SCHEDULE (1992-6 costs in 1991 $ 000 s / year; 1997-01 costs in 1996 $ 000 s / year)

Task	Description	Priority	Feasibility	Responsibility	Funds from	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
1	**Research & monitoring Bernier Is.**															
1.1	Undertake research	1	100%	CALM	a b c	9.5 62.1 71.6	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	9.5 62.1 71.6
1.2	Monitor	1	100%	CALM	a b c	NIL	0 2.2 2.2	0 2.2 2.2	0 2.2 2.2	0 2.2 2.2	1.5 9.0 10.5	1.5 9.0 10.5	1.5 9.0 10.5	1.5 9.0 10.5	1.5 9.0 10.5	7.5 53.8 61.3
2	**Translocate to Doole Is.**															
2.1	Undertake translocation	1	95%	CALM	a b c	NIL	7.9 51.5 57.4	8.1 31.3 37.2	NIL	NIL	NIL	NIL	NIL	NIL	NIL	16.0 82.8 94.6
2.2	Monitor translocated population	1	95%	CALM	a b c	NIL	NIL	NIL	0 2.0 2.0	0 2.0 2.0	2.5 4.0 6.5	2.5 4.0 6.5	1.5 5.0 6.5	2.5 4.0 6.5	2.5 4.0 6.5	11.5 25.0 36.5
3	**Translocate to Heirisson Prong**															
3.1	Undertake translocation	2	95%	CALM	a b c	NIL	NIL	48.1 16.2 64.3	47.5 49.8 97.3	47.7 46.7 94.4	NIL	NIL	NIL	NIL	NIL	143.3 112.7 256.0
3.2	Monitor translocated population	2	95%	CALM	a b c	NIL	NIL	NIL	NIL	NIL	41.0 5.0 46.0	1.0 4.0 5.0	1.0 5.5 6.5	1.0 4.0 5.0	1.0 4.0 5.0	45.0 22.5 67.5
4	**Exotic predator and competitors control**	2	75%	CALM	a b c	NIL	NIL	NIL	150.0 40.0 190.0	150.0 40.0 190.0	50.0 4.0 54.0	50.0 4.0 54.0	50.0 4.0 54.0	50.0 4.0 54.0	50.0 4.0 54.0	550.0 100.0 650.0
5	**Captive breeding**	2	75%	CALM	a b c	NIL	NIL	NIL	NIL	NIL	2.0 1.5 3.5	2.0 1.5 3.5	2.0 1.5 3.5	2.0 1.5 3.5	2.0 1.5 3.5	10.0 7.5 17.5
6	**Reintroduce to Peron Peninsula**															

6.1	Undertake reintroduction	2	75%	CALM	a b c	NIL	NIL	NIL	NIL	NIL	10.5 53.5 64.0	10.5 50.4 60.9	NIL	NIL	NIL	21.0 103.9 124.9
6.2	Monitor reintroduction	2	75%	CALM	a b c	NIL	NIL	NIL	NIL	NIL	NIL	NIL	10.5 51.2 61.7	10.5 51.2 61.7	10.5 51.2 61.7	31.5 153.6 185.1
	TOTAL				**a** **b** **c**	**9.5** **62.1** **71.6**	**7.9** **53.7** **59.6**	**56.2** **49.5** **103.7**	**197.5** **94.0** **291.5**	**197.7** **90.9** **288.6**	**107.5** **77.0** **184.5**	**67.5** **72.9** **140.4**	**66.0** **76.2** **142.7**	**67.5** **73.7** **141.2**	**67.5** **73.2** **141.2**	**841.3** **723.7** **1565.0**

a = CALM / other agency contributions
b = ESP funding required
c = total funding required

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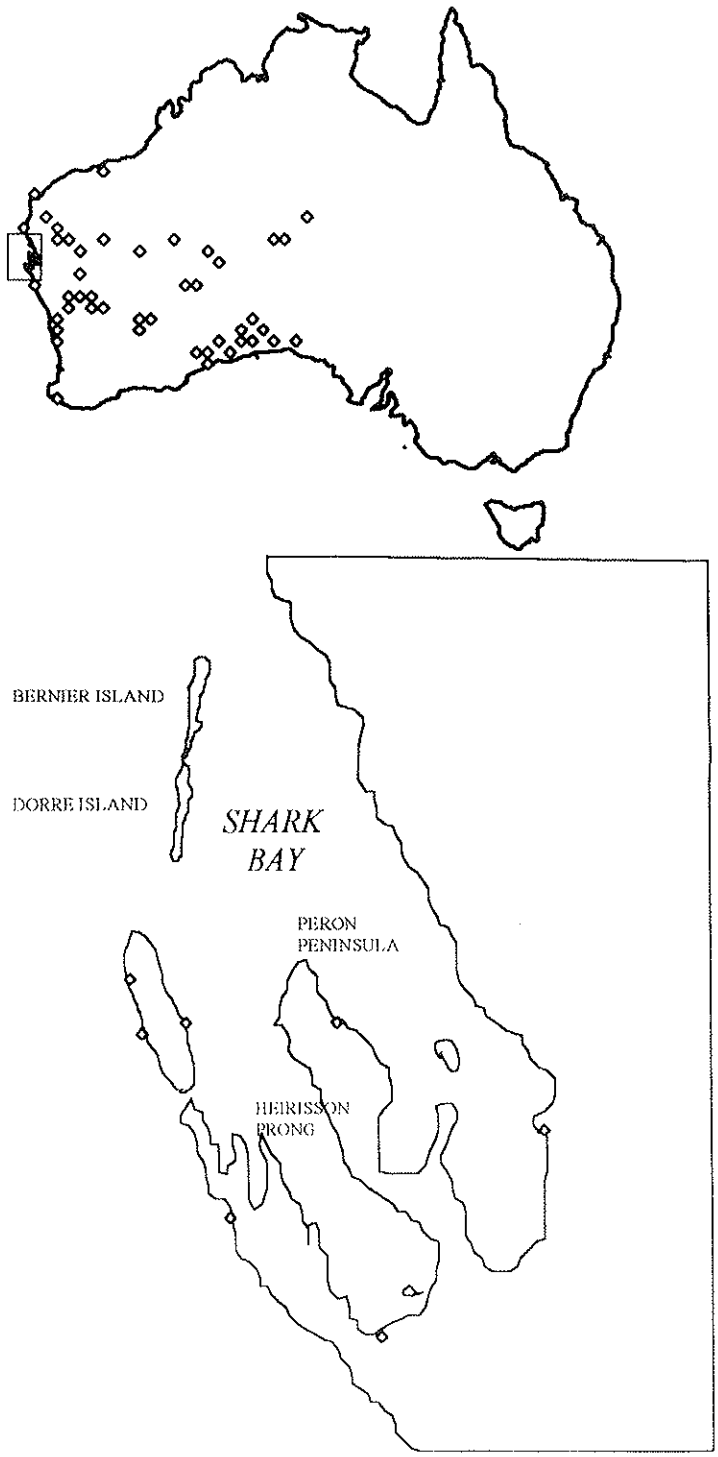

Figure 1:Past distribution of *Pseudomys fieldi* based on subfossil remains from cave surface deposits. Present distribution is limited to Bernier Island. Data from A. Baynes.

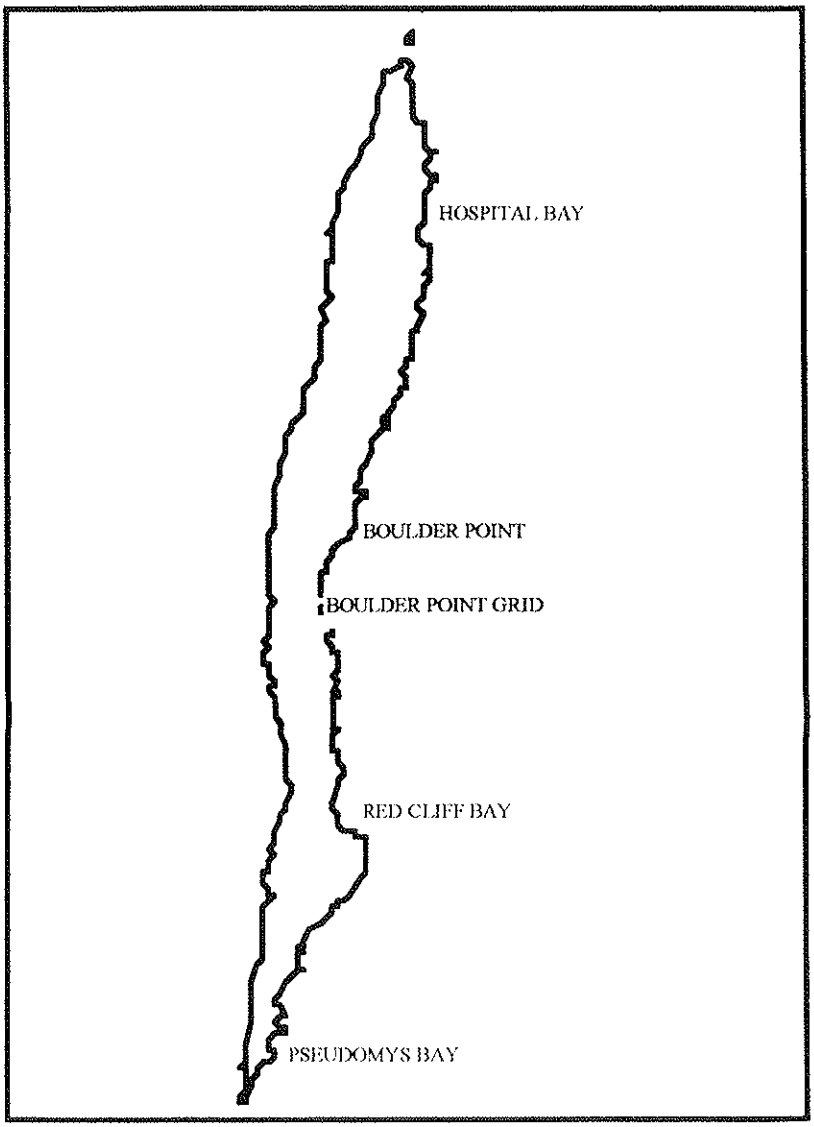

Figure 2: Map of Bernier Island showing monitoring sites at Red Cliff, Pseudomys Bay and Boulder Point

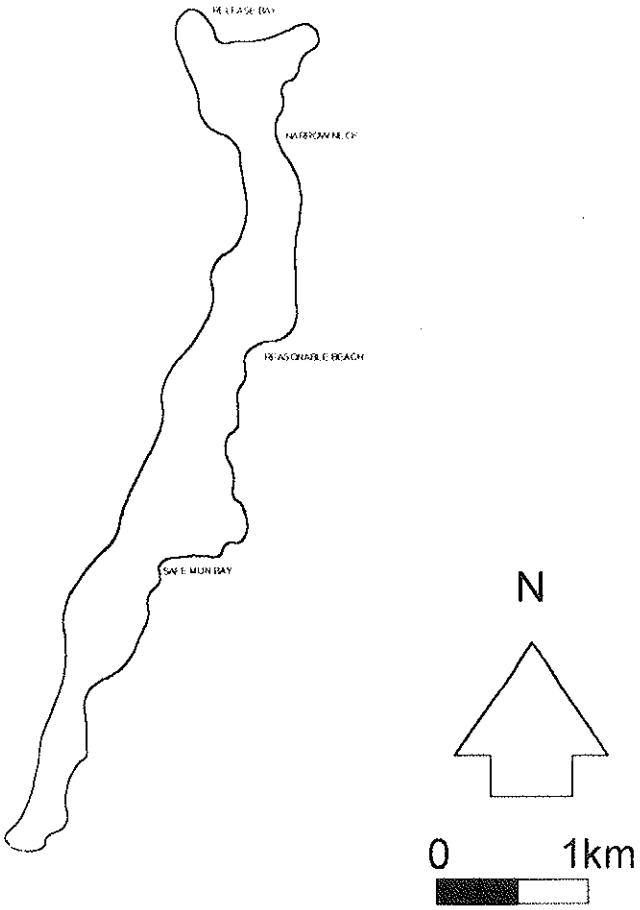

Figure 3: Map of Doole Island showing release site at Release Bay, and monitoring sites at Release Bay, Reasonable Beach and Safe Mun Bay.