TRANSLOCATION PROPOSAL

Reintroduction of the Boodie (*Bettongia lesueur*) to Dryandra Woodland from the *Return to Dryandra* Field Breeding Facility. June 2003

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SUMMARY

The aim of this project is to improve the conservation status of the boodie (*Bettongia lesueur*) by reintroducing it into Dryandra Woodland, Western Australia, a former part of its original mainland distribution, from the *Return to Dryandra* Field Breeding Facility.

The boodie was once widespread across much of Australia and had one of the largest geographic ranges of any Australian mammal. It is now extinct on the mainland but it currently occurs on Dorre, Bernier, Barrow and Boodie Islands off the Western Australian coast. The boodie is classified as "Vulnerable" under the IUCN (1994) criteria and "Fauna that is likely to become extinct or is rare" under the *Western Australian Wildlife Conservation Act 1950.*

This translocation of Boodies to Dryandra Woodland is one of the recovery actions identified in the interim recovery plan for the boodie (Friend and Orell 1997) and it is rated with a high priority. Boodies have been reintroduced previously to Heirisson Prong in Shark Bay, Gibson Desert Nature Reserve and Boodie Island in Western Australia, and Yookamurra Sanctuary and Roxby Downs in South Australia with varying levels of success.

The boodies for this reintroduction will be obtained from the Return to Dryandra field breeding facility. This enclosure was set up as part of the Return to Dryandra project which aims to captive-breed five species of threatened marsupials for reintroduction into Dryandra Woodland or translocation to other sites. The other species involved are the bilby *(Macrotis lagotis,)* the banded hare-wallaby *(Lagostrophus fasciatus)*, the mala *(Lagorchestes hirsutus)* and the western barred bandicoot *(Perameles bougainville)*. The breeding facility was established in 1998. Originally 20 boodies were released into the enclosure; there are currently 52 boodies in the facility.

Boodies appear to be extremely vulnerable to predation by foxes and cats and this may have been a significant factor in their decline (Finlayson 1958, Christensen and Burrows 1994, Short and Turner 2000). The main block of Dryandra Woodland is 12365 ha and has been baited regularly with "1080" dried meat baits since 1989. This control program was increased in 1997 to cover all of the Woodland and its satellite blocks, a total area of 23 860 ha. Fauna recovery has been dramatic to extent that the woylie (*Bettongia penicillata*), previously surviving only at Dryandra and two other sites, has been removed

from the national threatened species list. The recovering woylie population at Dryandra has been used to source hundreds of animals for translocations to the northern jarrah forest, Peron Peninsula and other areas. The tammar (*Macropus eugenii*), also surviving at Dryandra, was also removed from the list of "fauna that is likely to become extinct or is rare" (Wildlife Conservation Act 1950, Western Australia).

The boodie reintroduction will involve an initial release of twenty animals to determine survivorship and the best release methodology. Fifteen of these animals will be monitored intensively by DCLM Science Division and Narrogin District personnel. Depending on results, there may be an additional release of up to twenty animals in the following autumn and a further 20 in the following spring (2004).

PROPONENTS

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Dr N. Marlow, Senior Research Scientist, Department of Conservation and Land Management.

Dr J.A. Friend (advisory role only), Principal Research Scientist, Department of Conservation and Land Management.

TAXONOMY

There are currently three described and one undescribed subspecies of the boodie:

- *Bettongia l. lesueur*, Bernier and Dorre Island
- *Bettongia lesueur* unnamed subsp, Barrow and Boodie Is.
- *Bettongia l. graii*, south-western Australia (extinct)
- *Bettongia l. harveyi*, Eyre Peninsula, South Australia (extinct)

There are some questions as to the validity of these described subspecies (Finlayson 1958, Burbidge 1995, Friend and Orell 1997). However, there is evidence to indicate that two distinct forms of *B. lesueur* exist amongst extant populations. It appears that the Bernier and Dorre Island populations may belong to the same subspecies that was once found on the mainland, and that the Barrow and Boodie Island populations comprise another subspecies, being distinguished by cranial characteristics (Friend and Orell 1997).

BACKGROUND

The boodie is the only macropod that regularly constructs and inhabits warrens (Short and Turner 1993, Burbidge 1995). It is a gregarious animal with several males and females occupying one burrow, suggesting that this is a polygynous species (Sander *et al.* 1997). Work by Short and Turner (1993) on Bernier and Dorre Islands indicates that boodies breed predominantly during the wetter months and that females reach sexual maturity at approximately 7-8 months of age. Females have an oestrus cycle of 23 days and a gestation period of 21 days, with young remaining in the pouch for 115 days (Burbidge 1995). Trapping results at the *Return to Dryandra* Field Breeding Facility indicate that in a captive situation boodies are capable of breeding all year round (N.D. Thomas unpub. obs.).

Individual boodies have been recorded at over 4 years of age on Dorre Island (J.A. Friend and N.D. Thomas unpub. obs.) and over six years of age in captivity (N.D. Thomas unpub. obs.). Boodies are nocturnal and gregarious, emerging from their burrows after sunset to feed. On the mainland boodies dig for tubers, bulbs, seeds, nuts and the green parts of plants, while on Barrow Island their diet includes native figs, seeds, roots, termites and fungi (Burbidge 1995). Robley *et al.* (2001) found that reintroduced populations of boodies on Heirisson Prong have a broad diet that is seasonally variable, feeding on fungi, fruits, seeds, forbs, arthropods, stems, shrubs and carrion.

The boodie has a body weight *circa* 1500g and so falls within the "Critical Weight Range" which is the size category that includes most other native Australian mammals that have exhibited a marked decline in distribution over the past 200 years (Burbidge and McKenzie 1989). The boodie occurred widely throughout mainland Australia at the time of European settlement and inhabited the arid and semi-arid regions of Australia. It had one of the largest geographic ranges of any Australian mammals but by the 1960's had disappeared from its former range and is now extinct throughout mainland Australia and on Dirk Hartog Island (Short and Turner 1993, Burbidge 1995).

The boodie is now confined to three islands: Bernier and Dorre Islands in Shark Bay and Barrow Island off the Pilbara coast (Short and Turner 1993). In 1993 boodies from Barrow Island were successfully reintroduced onto Boodie Island after the population there was extinguished during a rat eradication campaign in 1985 (Morris 2002).

Boodies have been reintroduced into fenced areas at Heirisson Prong in Shark Bay (Short *et al.* 1994), and at two sites in South Australia; Yookamurra Sanctuary, near Sedan, and the Arid Recovery Project near Roxby Downs. In 1992 Christensen and Burrows (1994) attempted to re-establish the boodie in the Gibson Desert Nature Reserve. These reintroductions have met with varying success. All reintroduced boodies in the Gibson Desert were lost, predominantly due to cat predation (Christensen and Burrows 1994). The initial reintroduction of boodies to Heirisson Prong proved to be extremely successful in the absence of foxes and feral cats (Short *et al* 1994) and despite some predation events, attributed to foxes and feral cats, the population of boodies on the Prong

exceeded 300 by 1999 (Short and Turner 2000). However, a recent breach of the fence has shown that boodies are highly susceptible to exotic predators and the population there has now been decimated by feral cats and as few as two foxes (Jeff Short pers. comm.). The feral cat has been implicated in the boodie's extinction on Dirk Hartog Island (Burbidge 1995). Boodies have failed to establish within the main fenced area of Yookamurra Sanctuary and are now confined to breeding pens; the cause of this failure is not known.

CONSERVATION STATUS

In the 1996 Action Plan for Marsupials and Monotremes (Maxwell *et al* 1996) *B. l. lesueur* (Shark Bay islands) and *B. lesueur* unnamed subsp. (Barrow Island and Boodie Island) are listed as Vulnerable and *B. l. graii* (mainland) is listed as Extinct.

The boodie is listed as **'Vulnerable'** by:

- the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
- the Action Plan for Australasian Marsupials and Monotremes (Maxwell *et al.* 1996)
- the IUCN 2002 Red List of Threatened Species.
- the Western Australian Threatened Species Scientific Committee.

In Western Australia it is declared by the Minister to be **'Fauna that is likely to become extinct or is rare'** under the *Western Australian Wildlife Conservation Act 1950.*

RELEVANT THREATENING PROCESSES

Reports by early naturalists in various parts of Australia noted that the boodie was common and, in many parts, the most abundant mammal. The disappearance of the boodie coincided with the establishment of the fox (Finlayson 1958, Burbidge 1995) and recent work has indicated that it is highly susceptible to fox and feral cat predation (Christensen and Burrows 1994, Short and Turner 2000). The rabbit has also been implicated in the decline of the boodie through burrow and resource competition (Newsome 1971). Habitat modification from land clearing and fire has also been highlighted as a contributing factor in the decline of the boodie (Burbidge and McKenzie 1989).

However, the main threatening process operating within the mainland range of the boodie is predation by foxes and feral cats.

THE TRANSLOCATION

Justification

In order to improve the conservation status of the boodies, it is necessary to increase the number of their populations. Translocation is the sole means by which this can be achieved at present. Dryandra Woodland has been earmarked as a 'fauna reconstruction site'; the release of the boodie into the Woodland would increase the conservation value and contribute to the restoration of a functional ecosystem. The presence of boodies would also increase the eco-tourism aspect of the Woodland.

The translocation of boodies into Dryandra Woodland is a high priority action item identified in the interim recovery plan (Friend and Orell 1997).

SOURCE SITE

Boodies for translocation will be taken from the *Return to Dryandra* Field Breeding Facility (32° 45.506'S, 116° 55.787'E). In April 1998, one of the two 10-hectare enclosures was stocked with 20 boodies (7 males, 13 females) that had been captured at White Beach on Dorre Island, 60km west of Carnarvon, WA. Eight boodies were removed from the enclosure in March 2000 for translocation to Yookamurra Sanctuary in South Australia, and 12 boodies were removed in December 2001 and two in March 2002 and sent to Adelaide for use in cross-fostering trials with potoroos. Removed animals are rapidly replaced through breeding and currently there are 52 individuals in the enclosure (Figure 1). All boodies previously removed have been young bred in the enclosure, rather than founders. Sufficient animals will be retained in the breeding colony for continued breeding purposes.

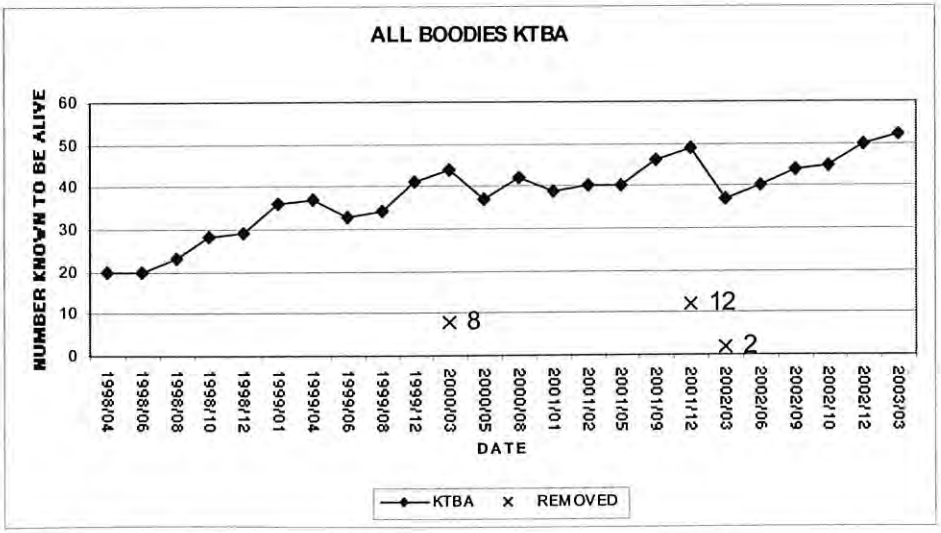

Fig. 1: Boodie numbers known to be alive within the breeding enclosure

DESTINATION SITE

a. Land status at translocation site

Dryandra Woodland is located approximately 20 kilometres north-west of Narrogin on the western edge of the Western Australian wheatbelt. It comprises a conglomerate of disjunct blocks of State Forest (vested in the Lands and Forests Commission for the purpose of multiple use). The larger western portion of eight blocks constitutes Lol Gray State Forest (51) and a smaller eastern portion constitutes Montague State Forest (53), which includes C class water supply reserve 15925 (vested in the Minister for Water Resources). Highbury State Forest (52) comprises seven discrete blocks about 20km south-east of Lol Gray and Montague State Forests and, although part of the Dryandra Woodland, is not included for discussion in this proposal.

Dryandra Woodland is managed by DCLM (Narrogin District) for the purposes of fauna and flora conservation, passive recreation and tourism. Commercial timber production is restricted to plantation areas of Brown Mallet (*Eucalyptus astringens*) which cover about 30% of Dryandra Woodland (DCLM 1995a).

The total area of Dryandra Woodland (Lol Gray and Montague State Forest) is 23860 ha. The largest block, comprising Skelton, Dryandra and Lol Gray Forest Blocks, covers 12365 ha. Most of the forest block is proposed National Park (DCLM 1995a) and it is here that the planned release of boodies is proposed to occur.

b. Habitat at the destination site

A broad range of vegetation communities and landforms occurs in Dryandra Woodland. Twelve vegetation communities, closely linked to landform and soil type, have been identified within Dryandra (Coates 1993, DCLM 1995a). The landforms can be grouped into the Norrine unit (lateritic uplands with gravely soils, of limited extent), the Noombling unit (valley slopes, with sandy loam soils, occupying most of Dryandra) and the Biberkine unit (valley floors with sandy soils). Two of the vegetation communities, Wandoo Woodland and Powderbark Wandoo Woodland, together occupy nearly 50% of the total area of Dryandra (DCLM 1995a). An additional six vegetation communities, of limited extent, are associated with the valley slopes (Coates 1993, DCLM 1995a). Two vegetation communities associated with Biberkine landforms (valley floors), York Gum Woodland and Low Jam Forest, are uncommon and cover small areas. The remaining two vegetation communities, Lateritic Plateau Woodland and *Dryandra/Petrophile* Shrubland, occur on Norrine landforms (lateritic uplands) and cover only small areas (McArthur *et al.* 1977, Coates 1993, DCLM 1995a).

Dryandra Woodland is within the former range of the boodie and the range of habitats available includes those considered suitable for this species. This Woodland has been identified as a possible translocation site for boodies in the 1996 Action Plan for Australian Marsupials and Monotremes (Maxwell *et al.* 1996) and as a DCLM Fauna Reconstruction Site (Burbidge *et al.* 1995). Within the Woodland there is evidence of old

boodie warrens on the valley slopes, many of which have been reactivated by translocated bilbies (N.D. Thomas pers. obs.). An oral history record (by Mr J Harris – 1989) also indicates that boodies were in and around Dryandra but had disappeared by 1925. Mr Harris refers to "large boodie rat warrens on Greens Block" which is on the Yornaning Rd adjacent to the Dryandra satellite blocks of Harris and Bald Rock; this area is 11 kilometres east north east of the soft release enclosure. The size of the main block of Dryandra (12365 ha) is quite adequate for a boodie reintroduction. A self-sustaining population of boodies has become established within the fenced area on Heirisson Prong, which has an area of just 1200 ha.

Dryandra Woodland has experienced a lower loss of vertebrate fauna than has occurred in other areas in the south-west of WA. This may be attributable in part to its relatively recent disconnection from the eastern jarrah forest and the abundance of various species of *Gastrolobium* or poison bush (plants that naturally contain fluoroacetate or "1080"). The advent of fox control in Dryandra has prevented further loss of mammals and ground-nesting birds as well as enabling the recovery of these species (DCLM 1995a).

Burbidge *et al.* (1995) identified a network of DCLM controlled reserves throughout the south-west of Western Australia, as Fauna Reconstruction and Species Recovery Sites that will ensure the conservation of the currently existing threatened mammal fauna and where possible the reconstruction of the original mammal fauna. Dryandra Woodland has been indicated as one of these 'fauna reconstruction sites' and that seven species, including the boodie, have the potential to be reintroduced back into the Woodland.

The size of Dryandra, its diversity of habitats, associated soils and landforms, the diversity of fauna already present and the effectiveness of the ongoing fox control make it an ideal 'fauna reconstruction site', hence the establishment of the *Return to Dryandra* project. Fauna reconstruction is a key concept of the *Western Shield* program that will allow maximum conservation benefit for management effort (particularly predator control) expended. Bilbies (*Macrotis lagotis*) have already been reintroduced to Dryandra; other species that may follow include the Marl (*Perameles bougainville*), Mala (*Lagorchestes hirsutus*), and Banded Hare-wallaby (*Lagostrophus fasciatus*).

TRANSLOCATION TYPE

The IUCN/SSC Guidelines For Re-introductions (1995) state that "The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild" and "it should be re-introduced within the species' former natural habitat and range".

In policy statement #29, Translocation of Threatened flora and fauna (DCLM 1995b), a reintroduction is defined to be 'the movement of an organism into part of its native range

from which it has disappeared or become extirpated in historic times as a result of human activities or natural catastrophe'.

Based on the above criterion, numerous publications and previously approved Translocation Proposals, which have all been classed as reintroductions, this translocation is deemed a reintroduction.

CONTROL OF THREATENING PROCESSES THAT CAUSED THE LOCAL EXTINCTION AT THE DESTINATION SITE

Predation by foxes and feral cats

Fox control, using fresh kangaroo meat baits impregnated with "1080", was first implemented in part of Dryandra in 1982 to investigate the response of numbats (*Myrmecobius fasciatus*) to the removal of foxes. There was a significant response to this experimental baiting program with increased sightings of numbats within two years and a dramatic increase in woylies (Friend 1990, 1996) as well as other species. These findings as well as other research into fox control resulted in the establishment in 1989 of a baiting program across the two largest blocks, extended in 1997 across all the satellite blocks under *Western Shield.*

The current baiting program involves the distribution of "1080" dried meat baits at monthly intervals over most of Dryandra Woodland. A total of 3200 baits are distributed at 100m intervals along tracks within and on boundary tracks of the Woodland.

Feral cats have been observed in Dryandra and some mortality of numbats and bilbies (Friend 2000) has been attributed to this predator. In all cases of bilby mortality attributed to cats, the bilbies had established themselves in rabbit burrows in farmland or on the edge of the Woodland (Friend 2000). Surveys for cats using cat-specific attractants suggest that cats are present within the Woodland but at very low numbers and are not anticipated to have a significant predatory impact upon the boodies. One of the objectives of this Translocation Proposal is to determine whether boodies will be able to become established in the presence of feral cats at their current density. Currently there is no effective method of controlling feral cats in an environment such as Dryandra Woodland. Intensive monitoring is planned to identify the causes of mortality, if possible. If cat predation is observed on the 15 collared boodies and is deemed to be unsustainable (> 50%), the surviving boodies will be recaptured and returned to the *Return to Dryandra* Field Breeding Facility. The release would then be deemed a failure and an alternative release site would need to be selected (if a site could be found where there are fewer cats) or future releases would be delayed until an operational cat bait had been registered.

Competition with rabbits

Newsome (1971) identifies competition with rabbits as a contributing factor to the decline of the boodie on mainland Australia. He states that Finlayson (1958) reported that "bettongs abandoned their warrens to live in holes in the creeks in areas inhabited by rabbits". However, Finlayson (1958) does not attribute this behaviour of abandoning their burrows to any one cause. Instead he states that rabbits and boodies persisted together for 60 years and rabbits have undoubtedly had an adverse effect on the ecology of the boodie but that boodies would have persisted if it were not for the arrival of the fox.

Recent work by Robley *et al.* (2001) has shown that despite high densities of rabbits and low and declining pasture cover on Heirisson Prong, Shark Bay, boodie reproduction, recruitment and rate of increase did not vary, nor did the survival of adult boodies. Also, Burbidge and McKenzie (1989) noted that rabbits never successfully colonised the sand-spinifex habitats that dominated the Desert District where boodies were once common and therefore competition with rabbits for burrows could not have resulted in the decline of boodies in those areas,

While rabbits may pose a greater threat to CWR fauna through habitat modification, degradation and erosion than from direct competition for burrows (Morton 1990, Robley *et al* 2001), within Dryandra Woodland, rabbits tend to be restricted to the edges of the reserve (N.D. Thomas pers. obs.) and as a result are not considered to be a threat to boodies.

Land Clearing

Land clearing for agriculture has been one of the major factors contributing to the decline of many CWR mammals throughout the south-west corner of Western Australia, particularly in the Wheatbelt District (Burbidge and McKenzie 1989). The secure conservation tenure of Dryandra Woodland and its size will protect the habitat of the reintroduced population of boodies.

Fire

Frequent large fires have also been implicated in the decline of CWR mammals (Burbidge and McKenzie 1989). Between 1938 and 1985 there have been nine wildfires within the Dryandra Woodland, the largest burnt area was only 260ha and the average area burnt was 40ha. These and other records suggest that Dryandra Woodland is at a lower fire risk than for the forest in higher rainfall areas of the south-west, despite Dryandra experiencing more severe fire weather conditions than the main Jarrah forest belt (DCLM 1995a).

The primary reasons for the absence of large and devastating wildfires in the Woodland are:

- the lower levels, lower accumulation rate and discontinuous distribution of fuels
- lower spotting distance due to the lack of fibrous-bark trees
- mosaic vegetation pattern
- efficient fire detection and suppression system
- reduced range of fire causes

Since 1985 there has been an active program of fire suppression involving a system of 50 –100m internal buffers, based upon existing roads. This, as well as a very effective fire detection system, is the primary method of wildfire protection within the Dryandra Woodland (DCLM 1995a). The risk of an uncontrolled wildfire devastating the reintroduction sites is considered low and the current detection and suppression system would greatly reduce the impact of any wildfire on the reintroduced population.

THE FOUNDER GROUP

The initial group of 20 boodies to be released will comprise 14 female and six males. These boodies will be released in spring 2003. Fifteen of the 20 boodies will be fitted with mortality collars with a battery life of six months. Short and Turner (2000) found that boodies tend to remain in the release area if there is a bias of females to males in the release group. In their study, boodies typically dispersed less than 2km from their release location in the three months following release. Subject to finding of this initial release, up to twenty additional boodies will be released in the following autumn and a further 20 in the following spring (2004). In total up to 60 individuals will be released, depending upon the availability of animals. All released boodies will have been bred in the *Return to Dryandra* Field Breeding Facility

TRANSLOCATION PROTOCOL

One of the main aims of the *Return to Dryandra* program is to establish optimal release methodologies. The release of boodies into Dryandra Woodland will assess the difference between 'hard' and 'soft' release strategies in terms of survivorship, breeding and dispersal. The first releases are scheduled for spring 2003.

A one-hectare enclosure has been built in suitable woodland habitat within the main block of Dryandra. This 'soft release' enclosure (32° 45.306'S, 116° 56.997'E) has been successfully used to release bilbies. The enclosure has two artificial burrows and a number of burrows constructed by bilbies. The bilbies are no longer using the enclosure and have dispersed from the area. Six boodies (two males and four females) will be released into the enclosure and held for four weeks in order to acclimatise to the area, after which time the gates will be opened and the animals will be free to leave. Food and water will be maintained in the enclosure. These boodies will be monitored twice a week while in the enclosure.

There will be a comparison of two "hard releases". One group of seven boodies (two male and five females) will be released into artificial burrows that are not within an enclosure but are within approximately 10m of old boodie warrens (32° 45.681'S, 116° 57.007'E). A second group of seven boodies (two male and four females) will be released into artificial burrows (32° 46.203'S, 116° 55.628'E) with no enclosure and not in close proximity to old warrens. Food and water will be provided at these sites. These artificial burrows are in the same or similar woodland habitat as the release enclosure. These releases will be timed to coincide with the gates on the 'soft' release enclosure being opened.

Risk assessment

In the first release of twenty boodies, 15 (five males and 10 females) will be fitted with mortality collars to monitor survivorship and movement. These collared boodies will be used to assess the risk of predation of the boodies by feral cats that may be in the area and to determine the best release method. The most appropriate release method will be determined during this initial release.

Further releases

If survival rates are sufficiently high and criteria one and two of Criteria for Success (see below) are met after the first release, additional releases of up to 20 individuals in each of autumn and spring 2004 will be undertaken, an overall total of up to 60 individuals over the three release. If recruitment within the *RTD* Field Breeding Facility is not sufficiently high to allow these additional releases they will be delayed until numbers are sufficiently high enough. The release method used will be dependent on the most effective release strategy determined by the first release.

Post-release monitoring

All boodies are routinely implanted with Trovan® microchips for individual identification. Fifteen of the 20 boodies to be released initially (spring 2003) will be fitted with radio-collars incorporating a mortality sensor to allow monitoring of movement and survivorship. During the day, collared boodies will be located and their burrows mapped using a GPS; habitat and burrow location will also be recorded. Boodies that have dispersed from the release area will be located from a light aircraft that has been fitted with radio-tracking equipment; the boodies will then subsequently be checked on the ground. Where appropriate boodies will be trapped and returned to the release area. Boodies are highly trappable and will readily go into the standard wire mesh cage traps (20cm x 20cm x 56cm) baited with peanut paste, rolled oats and sardines.

Boodies will be monitored on a daily basis for the first four weeks, then twice a week for four weeks, then once a week for eight weeks, then fortnightly for the duration that the animal is fitted with a transmitter. Cage-trapping will be undertaken four weeks after

release and will be concentrated around areas where collared boodies have established themselves. The condition, health, collar tightness and reproductive status of captured animals will be noted. If any individuals have lost significant condition they will be returned to the breeding facility or placed in the care of a local wildlife carer. If any boodies dies during the period of monitoring by radio-tracking, the cause of death is to be established and the implications for the other boodies considered. It may be necessary to recapture the other boodies if fox and cat predation occurs.

Subject to the results from radio-tracking of the collared boodies, trapping grids will be set up in areas where boodies establish successfully. Trapping will be carried out at three-monthly intervals for two years from the cessation of regular radio-tracking. Long-term monitoring of boodies will occur as part of the biennial Western Shield fauna monitoring carried out by DCLM Narrogin District staff within the pre-existing monitoring grids.

Genetics

All released boodies are descendants of the 20 individuals that were originally released into the breeding enclosure and which were obtained from Dorre Island, Shark Bay. These individuals are all from one subspecies and so no issues of hybridisation arise at this time.

It is proposed that microsatellite and mitochondrial DNA analysis will be undertaken to determine genetic variability and relatedness within this sample of boodies. This work is to be funded jointly by Science Division and Edith Cowan University. It will be possible to compare this variability with samples collected from island populations of boodies. Ear tissue has been collected from all individuals. Samples will be taken from any new animals caught during monitoring.

Competition with Woylies

Interactions between woylies and boodies at the individual and population level are unknown as all mainland boodie populations had become extinct before accurate records or observations could be made. However, Finlayson (1958) reported that where boodies and woylies coexisted, the woylie was the more common species. Boodies eat a certain quantity of hypogeal fungi in winter but none in summer (Robley *et al.* 2001), while the fungal intake of woylies peaks in summer and autumn (Christensen 1995). As well as this temporal dietary separation, it is likely that when sympatric, these species are spatially separated if boodie activity is focussed around warrens. It is not anticipated that the reintroduction of boodies will detrimentally affect the woylie population. This release of boodies in Dryandra Woodland will provide a valuable opportunity to closely monitor such interactions.

CRITERIA FOR SUCCESS

The reintroduction will be determined to be a success if the following criteria (Short and Turner 2000, Richards and Short 2003, de Tores *et al.* in prep) are met:

1. boodies build and establish regular use of warrens;
2. > 50% survival of translocated boodies after six months;
3. Reproduction in the wild within one year of the initial release;
4. Wild-born boodies reproducing in the wild within one year of their recruitment into the translocated population;
5. Population persistence and increase over the subsequent two years after successful reproduction in the wild, with no requirement for additional translocation after the final release; other than to augment genetic diversity.

FUNDING AND RESPONSIBILITIES

Dept Conservation and Land Management:

Science Division: Salary of project staff and contribution to genetic work.
Narrogin District: Ongoing baiting costs, reserve management, annual *Western Shield* monitoring (track trapping), District staff.
Western Shield: Cost of radio-collars, vehicle running for the translocation, aircraft cost and the monitoring of the radio-collared animals.

Volunteer assistance: Volunteer help recruited as required and coordinated by Science Division.

AEC APPROVAL

Pending. Application has been submitted (29th July), no releases will be undertaken until approval for this project has been granted by the Department of Conservation and Land Management's AEC. The application for ethic committee approval is being considered 'out of session' so that if approved the translocation of boodies can commence in mid-August.

ATTACHMENTS

Interim Recovery Plan

REFERENCES

Burbidge, A.A. (1995). Burrowing Bettong, *Bettongia lesueur.* In: Strahan, R (Ed), *The Mammals of Australia.* Reed Books, Chatswood, NSW. Pp 289-291.

Burbidge, A.A. and McKenzie, N.L. (1989). Patterns in the modern decline of Western Australia's vertebrate fauna: cause and conservation implications. *Biological Conservation* **50**: 143-198.

Burbidge, A.A., Start, A.N., Morris, K.D. and Armstrong, R. (1995). *"Western Shield" – Bringing back our wildlife.* Unpublished Report. Department of Conservation and Land Management, Perth.

Department of Conservation and Land Management (1995a). *Dryandra Woodland Management Plan, 1995 – 2005, Management Plan No. 30.* Department of Conservation and Land Management, Perth.

Department of Conservation and Land Management (1995b). *Policy Statement No. 29 – Translocation of Threatened Flora and Fauna.* Internal Policy Statement. Department of Conservation and Land Management, Perth.

de Tores, P.J., Rosier, S.M. and Paine, D. (In prep). Conservation of the western ringtail possum, *Pseudocheirus occidentalis*: (i) Translocation of rehabilitated possums.

Christensen, P. (1995). Brush-tailed Bettong, *Bettongia penicillata.* In: Strahan, R (Ed), *The Mammals of Australia.* Reed Books, Chatswood, NSW. Pp 292-293.

Christensen, P. and Burrows, N. (1994). Project Desert Dreaming: experimental reintroduction of mammals to the Gibson Desert, Western Australia. In: Serena M. (Ed), *Reintroduction Biology of Australia and New Zealand Fauna.* Surrey Beatty and Sons, Chipping Norton, NSW. Pp 183-188.

Coates, A. (1993). Vegetation Survey of Dryandra Forest. Unpublished Report. Department of Conservation and Land Management, Perth.

Finlayson, H.H. (1958). On Central Australian mammals (with notice of related species from adjacent tracts). Part III – the Potoroinae. *Records of South Australian Museum.* **13:** 235-302.

Friend, J.A. (1990). The numbat *Myrmecobius fasciatus* (Myrmecobiidae): history of decline and potential for recovery. *Proceedings of the Ecological Society of Australia* 1990, **16**: 369-377.

Friend, J.A. (1996). Protecting endangered fauna from introduced predators. *Unwanted Aliens? – Australia's Introduced Animals.* Ed Diekman, B. Nature Conservation Council of NSW, Sydney. Pp 127-142

Friend, J.A. (2000). Reintroduction of the Bilby to Dryandra: Progress Report – 28 August 2000. Department of Conservation and Land Management, Perth.

Friend, J.A. and Orell, P. (1997). DRAFT: Boodie (*Bettongia lesueur*) Interim Recovery Plan 1997 – 1999. Department of Conservation and Land Management, Perth.

IUCN (1995). IUCN/SSC Guidelines for Re-Introductions. Prepared by the SSC Re-introduction Specialist Group, Gland Switzerland, May 1995. http//www.iucn.org/themes/ssc/pubs/policy/reinte~1.htm

McArthur, W.M., Churchward, H.M. and Hick, P.T. (1977). Landforms and soils of the Murray River catchment area of Western Australia. Land Resource Management Series No 3 Pp 1 – 23. Division of Land Resources Management, CSIRO, Perth.

Maxwell, S., Burbidge, A.A. and Morris, K., eds (1996). The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Endangered Species Program, Project No. 500. Environment Australia, Canberra.

Morris, K.D. (2002). The eradication of the black rat (*Rattus rattus*) on Barrow and adjacent islands off the north-west coast of Western Australia. Turning the Tide: The Eradication of Invasive Species. Ed Veitch, C.R. and Clout, M.N. Occasional Paper of the IUCN Species Survival Commission No. 27. Pp 219-225

Morton, S.R. (1990). The impact of European settlement on the vertebrate animals of arid Australia: a conceptual model. *Proceedings of the Ecological Society of Australia.* **16:** 201-213.

Newsome, A.E. (1971). Competition between wildlife and domestic livestock. *Australian Veterinary Journal.* **47:** 577-586.

Richards, J.D. and Short, J. (2003). Reintroduction and establishment of the western barred bandicoot *Perameles bougainville* (Marsupialia: Peramelidae) at Shark Bay, Western Australia. *Biological Conservation.* **109:** 181-195

Robley, A.J., Short, J. and Bradley, S. (2001). Dietary overlap between the burrowing bettong (*Bettongia lesueur*) and the European rabbit (*Oryctolagus cuniculus*) in semi-arid coastal Western Australia. *Wildlife Research.* **28:** 341-349.

Sander, U., Short, J. and Turner, B. (1997). Social organisation and warren use of the burrowing bettong *Bettongia lesueur* (Macropodoidea: Potoroidae). *Wildlife Research.* **24:** 143-157.

Short, J. and Turner, B. (1993). The distribution and abundance of the burrowing bettong (Marsupialia: Macropodoidea). *Wildlife Research.* **20:** 525-534.

Short, J. and Turner, B. (2000). Reintroduction of the burrowing bettong *Bettongia lesueur* (Marsupialia: Potoroidae) to mainland Australia. *Biological Conservation* **96:** 185 – 196.

Short, J., Turner, B., Parker, S. and Twiss, J. (1994). Reintroduction of endangered mammals to mainland Shark Bay: a progress report. In: Serena M. (Ed), *Reintroduction Biology of Australia and New Zealand Fauna.* Surrey Beatty and Sons, Chipping Norton, NSW. Pp 183-188.

Proponent's signature

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Date

....
Date

Endorsement

1) This project has my endorsement; Narrogin Region/District resources committed here are available for this purpose.

....
Regional Manager, Narrogin Region Date

....
District Manager, Narrogin Region Date

2) This project has my endorsement; Biodiversity Conservation Group resources committed here are available for this purpose.

....
Group Manager, Biodiversity Conservation Group Date
Department of Conservation and Land Management, Science Division

Approved by:

....
Director, Nature Conservation Date

Taxon	Boodie (*Bettongia lesueur*)
Status	Declared by the Minister to be **"Fauna that is likely to become extinct or is rare"** *Western Australian Wildlife Conservation Act 1950.* Ranked as **Vulnerable** by the WA Threatened Species Scientific Committee Listed as **"Vulnerable"**: Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*; Action Plan for Australasian Marsupials and Monotremes (Maxwell *et al.* 1996); 2002 IUCN Red List
Translocation Type	Reintroduction
Source Animals	Bred in 10-hectare enclosure, *Return to Dryandra* Field Breeding Facility. Original stock from Dorre Island, Shark Bay.
Planning	In accordance with Interim Recovery Plan for the Boodie.
Number of Animals	Up to 60: 20 individuals to be released in each of spring 2003, autumn 2004 and spring 2004, depending upon availability of animals and the success of the first release in spring 2003.
Age of Animals	The species breeds at six months after permanent pouch exit.
Proposed Date	September 2003.
Proponent	Mr N.D. Thomas, Senior Technical Officer, Department of Conservation and Land Management. Dr N. Marlow, Senior Research Scientist, Department of Conservation and Land Management.
Funding	Department of Conservation and Land Management
AEC Approval	Pending