NUMBAT RECOVERY TEAM

ANNUAL REPORT

1997

by Tony Friend

for

The Numbat Recovery Team

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ıment is vested jointly in the Director, National Parks and Conservation Agency, and the Executive Director, Western nt of Conservation and Land Management.

SUMMARY

The Numbat Recovery Program (Friend 1994) aims to maintain the three numbat populations judged in 1994 to be self-sustaining and to increase the number of self-sustaining populations to at least nine, by reintroduction to former habitat. The three existing populations are at Dryandra Woodland, Perup Nature Reserve/Kingston State forest and Boyagin Nature Reserve, and these are monitored annually. Population numbers at Boyagin and Perup Kingston remained unchanged from 1996 levels, but numbers at Dryandra have continued to decline. Intensive monitoring of radio-collared animals at Dryandra did not reveal unusual sources of mortality, however. This is a major cause for concern, as the Dryandra population has been the chief source of animals for translocation. Consequently two of the three translocations planned for 1997 were not carried out.

Monitoring of radio-collared animals at reintroduction sites at Tutanning, Batalling, Dragon Rocks, the northern jarrah forest, Yookamurra and Karakamia continued in 1997. High rates of survival and reproduction at Dragon Rocks indicate successful population establishment there. The results of a driven survey at Tutanning, indicated an increase in the population in this small area. At Batalling, a diggings survey showed that the reintroduced population there is still quite small, but that the most favoured habitat is wandoo woodland near the eastern margin of the forest.

The most recent new translocation, to Dale Conservation Park in the northern jarrah forest, met with limited success as the animals dispersed widely from the release site and most were not located, although survival amongst the few animals was high. A new release site, in an area dominated by wandoo rather than jarrah, was used in 1997 for the second release.

Eight young were produced in the captive colony at Perth Zoo during 1997. A new captive breeding research program has commenced there in an effort to solve problems that prevent breeding in some years.

A review of the progress of the implementation of the Numbat Recovery Plan was carried out in October 1997 as required and submitted to Environment Australia for assessment (Friend 1997c).

CONTENTS

INTRODUCTION

The Numbat (*Myrmecobius fasciatus*) is one of Australia's more threatened mammals. Since European settlement, its distribution has shrunk to less than 1% of its former extent and numbers had fallen well below 500 by the late 1970s. Intensive research aimed at the conservation of the species commenced in 1980, and even since then a number of small populations have become extinct. Total population numbers are still below 1500, and a very substantial increase in population numbers is required before the Numbat can be regarded as secure.

Only two original populations have survived, at Dryandra Woodland and Perup Nature Reserve in the south-west of Western Australia. Fox control by regular distribution of 1080 meat baits has caused substantial increases in those two populations. A reintroduced population, at Boyagin Nature Reserve 40 km north of Dryandra, is now self-sustaining. Establishment of further Numbat populations is under way through translocation, predominantly from Dryandra, to areas of former occurrence in Western Australia and one site in South Australia (Friend 1994).

The Numbat Recovery Team was established in 1993. The Recovery Plan for the Numbat was completed in 1994 and submitted to the Australian Nature Conservation Agency, ANCA, (now Environment Australia, EA) for funding. The Plan presents objectives and criteria for recovery of the species and specifies a number of actions to achieve recovery, extending the research and conservation program that has been in progress since the early 1980s (Friend 1994). Commencing in January 1995, the Western Australian Department of Conservation and Land Management received funding through ANCA's Endangered Species Program to implement the Recovery Plan for the Numbat. This is the fifth annual report of the Numbat Recovery Team and it summarises the progress on actions scheduled in the Recovery Plan for 1997.

MEMBERSHIP

The membership of the Numbat Recovery Team at the beginning of 1997 was as follows:

Tony Friend (Chair)	CALM Division of Science and Information
Mark Bradley	Perth Zoo
Rob Brazell	CALM Mornington District, Central Forest Region
Andrew Burbidge	CALM WA Threatened Species and Communities Unit
Peter Copley	SA Department of Environment and Natural Resources
Bob Hagan	CALM Southern Forest Region
Stephanie Maxwell	Environment Australia, Biodiversity Group, Threatened Species and Communities Section
David Mitchell	CALM Swan Region
Denise True	World Wide Fund for Nature Australia
(Vacant)	CALM Wheatbelt Region

During 1997, Brett Beecham was appointed as CALM's Regional Ecologist, Wheatbelt Region, and joined the Team to represent the Wheatbelt Region. Peter Orell was appointed to represent CALM's Wildlife Branch, at the invitation of the Team (June 1996 meeting). Stephanie Maxwell had replaced Sally Stephens on the Team, while Sally was on secondment. Anne Duncan became Project Officer during 1997 but the responsibility passed back to Sally Stephens later in the year. Neil Thomas and Mike Scanlon (CALM, SID) attend all meetings of the Numbat Recovery Team.

MEETINGS

The Recovery Team met in Western Australia twice during 1997. Meeting 9 was held at the WA Wildlife Research Centre, Woodvale, on 5 June 1997. A two-day meeting was held on 29-31 September at Dryandra to carry out a three-year review of the progress of the recovery plan and provide a report to Environment Australia. The usual November meeting was cancelled.

RECOVERY PLAN STATUS AND FUNDING

The Numbat Recovery Plan was completed and submitted to ANCA (now EA) in May 1994 as an application for funding under the Endangered Species Program in 1994/95. The Recovery Plan establishes a series of actions to be carried out over the 10 years from 1995-2004. This application was successful, and the funding requested was granted in full. EA provided $102 200 for work in 1997. This amount was based on the estimates provided in the Recovery Plan, in 1995 dollars and at 1995 costing levels as required in the guidelines. No adjustment has been made by EA for cost increases in funding the actions in subsequent years.

PROGRESS ON RECOVERY PLAN ACTIONS

Action 1. Management of existing populations and habitat

The Recovery Plan refers to three "existing populations" of numbats, comprising those at Dryandra and Perup-Kingston, which are the only surviving original populations, and at Boyagin, where numbats were reintroduced in 1985-1987 resulting in the establishment of a self-sustaining population.

Action 1.1. Exotic predator control

Fox control by baiting with 1080 dried meat baits is now part of CALM's routine management procedure at Dryandra Woodland, Boyagin Nature Reserve and Perup Nature Reserve-Kingston State forest. Baiting is carried out monthly in the main block of Dryandra (13 000 ha) and at Boyagin (5 000 ha). A monthly baiting regime has been shown to cause increases in medium-sized mammal populations in these and other WA wheatbelt reserves (Kinnear *et al.* 1988, Kinnear 1990, Friend 1990, 1994, 1996a, J.E. Kinnear unpublished data). In addition, an experimental fox control program, with baiting every two months, has been carried out since January 1989 in Montague block at Dryandra, an area of 5000 ha separated from the main block at the closest point by 100 m of farmland. The numbat population in Montague block is monitored by an annual driven survey and diggings searches, to measure the effectiveness of this baiting regime.

Baiting is carried out at Perup-Kingston four times per year, over an area of approximately 60 000 ha. All baiting programs covering existing numbat populations are funded by CALM.

Action 1.2. Monitoring of existing populations

Dryandra

Monitoring of the numbat population at Dryandra comprises driven surveys in November and April and regular checks on radio-collared animals throughout the year.

Driven surveys

Since 1985, the population at Dryandra has been monitored by means of an annual driven survey carried out in November-December. An additional annual survey, conducted in April, was introduced in 1994 because of the need to keep a closer watch on the Dryandra population, given the dramatic decline in numbers in 1993 (Friend 1995). The procedure in use is to drive a vehicle equipped with a roof hatch, with three observers (hatch, left observer and driver), along a set route of about 65 km during those times of day when numbats are active, six times over a period of two weeks, recording numbat sightings. The mean number of sightings per 100 km of track on the driven survey provides an index of population size for comparison between years. Line transect methodology can also be applied to the data collected in order to obtain an estimate of the population density along the survey route. During 1997, driven surveys were carried out at Dryandra in April and November-December.

In addition, a driven survey in Montague block has been carried out in November-December each year since 1988 to assess the effectiveness of the less intensive baiting regime there. Here, a set route of about 30 km is driven during those times of day when numbats are active, three times within two weeks, recording numbat sightings.

Results

Eleven numbats were sighted during the April 1997 survey of the Dryandra main block, giving a sighting rate of 2.85 sightings/100 km. During the November-December 1997 survey, when the highest sighting rates of the year are generally recorded, only 5 numbats were sighted, at a rate of 1.29 sightings/100 km. This value is the lowest recorded for the November/December survey since 1988, at the beginning of the steep increase in response to the extended baiting program at Dryandra. Since the crash of 1993, sighting rates have continued to decline even further, although there are no significant differences between consecutive years after 1992-1993.

The sighting rate at Montague block in December 1997 was 2.25 sightings/100 km. The sharp decrease between 1995 and 1996 has continued (1995: 13.4/100 km; 1996: 7.9 sightings/100 km). The Montague sighting rate had risen steadily until 1995 (with the exception of 1994), mirroring the rise at Dryandra but with a lag of about three years.

Monitoring of radio-collared animals at Dryandra

In order to determine the principal causes of mortality in the Dryandra population, a group of radio-collared animals is maintained and monitored throughout the year. Each month every animal is located and either its movement monitored or it is sighted (usually in a log) to ascertain whether or not it is alive. If the animal is dead, examination of the radio-collar and remains (if present) can indicate the cause of death. All females are examined during the period when young are carried (February-July) to record the incidence of young.

At the commencement of 1997, there was only one radio-collared numbat in Dryandra. Nineteen adults and 10 young were fitted with radio-collars during the year. A male and a female with four attached young were transferred to Perth Zoo in April 1997. Fifteen animals were translocated from Dryandra to Hills Forest between 27 November and 4 December 1997. At the end of 1997, nine animals remained alive and transmitting in Dryandra.

Results

Five collared animals were found dead during the year. Three deaths were due to raptor predation, one numbat was taken by a python and one was found dead with no obvious cause.. One collared numbat suffered signal loss.

Perup

Driven surveys were carried out at Perup-Kingston in February and September 1997. February has been favoured as the month for the annual survey at Perup because it avoids both wet weather (and hence road closures) and the heavily committed November-December field period, while still following reasonably closely the spring recruitment of young. Previous surveys in February have resulted in sighting rates of 0.95/100 km (1993) 1.34/100 km (1994) and 0.30/100 km (1996). In February 1997 a driven survey was carried out with the assistance of Brian Whittred from CALM Manjimup District, who proved very helpful. Five sightings were made, giving a sighting rate of 1.45 sightings/100 km, indicating a recovery from the apparent decline in 1996. Another survey was carried out in September 1997 in order to catch females so that their young could be captured for translocation. The sighting rate was 0.58/100 km, lower than February 1997 as might be expected because the next cohort of young would not have been out of the burrows yet. Unfortunately only a male numbat was captured during this survey. During the year, one radio-collared animal was found dead, probably due to raptor predation.

Boyagin

Since the reintroduction of numbats to Boyagin Nature Reserve in 1985-87, monitoring of the resulting population involved radio-tracking for the first 4 years, then diggings searches since 1989 to reveal the extent of colonisation of the reserve, and driven surveys since 1992. Diggings searches and driven surveys are now conducted each year in both the east and west blocks of the reserve (most numbats were released into the east block). In November 1997, diggings searches were carried out at 44 paired monitoring sites in numbat habitat in the east block, and at 39 paired monitoring sites in the west block. The driven survey consisted of a circuit in each block driven six times (a total of 230 km in the east block and 195 km in the west block).

Results

The diggings searches showed a slight recovery in the distribution of diggings in the east block since the 1996 survey. In the west block there was little difference in the distribution of diggings between 1996 and 1997. Driven surveys bore out these findings, with last year's sighting rate being maintained in the east block (1.28/100 km in 1997, compared with 1.29/100 km in 1996 and 2.17/100 km in 1995). In the west block, there was a slight recovery in the sighting rate from last year (3.05/100 km in 1997 compared with 2.56/100 km in 1996 and 3.08/100 km in 1995).

Discussion

Numbat numbers appear to have dropped significantly in Dryandra, while being stable at Boyagin and Perup populations in 1997. There are no other data which might explain the steep decline in

numbers at Dryandra. No unusual pattern of mortality has been exposed by monitoring radio-collared animals. The unusual event of 1996 was the small size of young in mid-October when they were captured as usual for collaring. However, this phenomenon was also noted at all other locations where young were captured for this purpose (Dragon Rocks, Batalling and Karakamia). The new decline at Dryandra is a matter for concern, as this population has been the backbone of the translocation program. Accordingly, the number of animals to be removed from Dryandra for the translocation program in November-December 1997 was reduced by dropping the proposed new translocation to the Stirling Range NP (see Action 3, Translocations).

Action 1.3.3: Research on numbat home range size

During 1997, the home ranges of six numbats at Dryandra (3 males and 3 females) were determined by radio-tracking over two weeks in June. In September, five of these animals were radio-tracked for two weeks (one of the females was missing). In December, tracking was carried out on four of the original animals and two juvenile males of the new cohort. At Perup, only two numbats (one male, one female) were captured. Home ranges were also determined in June and in September, although the transmitter on the male tracked in the first session failed, so another male was captured and tracked for the second session.

Action 2. Genetic survey of existing populations

Until now, all numbats for translocation have been taken, or bred from animals taken from Dryandra. Perup/Kingston represents a significant source of animals for the translocation program, if there are not likely to be detrimental effects from mixing stocks (e.g. outbreeding depression). A project commenced in July 1996 to compare Dryandra and Perup/Kingston populations by analysis of mitochondrial DNA using small ear-tissue samples collected by CALM personnel. A post-doctoral fellow at the University of Queensland, Luca Fumagalli, is working on this project and will carry out other work in conjunction with CALM to determine the mating systems of numbats in the wild. The post-doctoral stipend is provided by the Swiss government, with costs of consumables being provided by CALM. Over 90 samples from Dryandra, 12 from Perup and 6 from Boyagin have been sent to Brisbane for this project.

Luca has reported that he has had great difficulty in extracting "good" DNA from the numbat ear tissue. No results are yet available, but it is anticipated that the Dryandra/Perup comparison will be completed by early in 1998.

Action 3. Translocation

A program of translocations is set out in the Numbat Recovery Plan (Friend 1994). About 20 numbats are to be released at each site each year for three years, after which a review is carried to out determine if a new population has been established, or if not, whether the release of more animals will enhance the chance of establishment. In 1995 a new translocation project, taking animals from Dryandra for release at Dragon Rocks near Hyden, was implemented. Another new translocation, to a site at Dale Conservation Park (northern jarrah forest), was commenced in late 1996. The translocation program in the Recovery Plan called for a new series of releases at Karroun Hill NR to commence in 1997, while the third annual release at Dragon Rocks and the second at Dale CP were also programmed for late 1997.

In Recovery Team Meeting 9 on 5 June 1997, the Team decided to postpone the proposed release at Karroun Hill while an investigation of numbat habitat at KHNR using remote imagery was being carried out. In the meantime, the Team agreed on the substitution of the Stirling Range NP as a new translocation site, based on similarities in habitat with Dragon Rocks, where a very successful translocation has been carried out. The Stirling Range NP is being baited for foxes four times a year under CALM's Western Shield program. It was also agreed, given the high survival of the Dragon Rocks numbats, and given the continued low population numbers at Dryandra, that the third release at Dragon Rocks should be cancelled. Thus the 1997 translocation program agreed to in June 1997 proposed the release of 20 numbats in the northern jarrah forest and 20 at Stirling Range NP.

When the November 1997 driven survey showed that the Dryandra numbat population numbers had fallen yet again, however, recovery team members were contacted individually for their comments on a proposal to postpone the 1997 release at Stirling Range NP. This was proposed in order to reduce the impact of removal of animals on the Dryandra population. Only 6 animals were available from the Perth Zoo population (two captive bred young and four captive-reared young) and alternative source sites (Perup, Boyagin, Karakamia) could not provide more than a few extra animals. It was still proposed to release 20 animals at a site in the northern jarrah forest, mainly from Dryandra but supplemented as far as possible with animals from Boyagin.

Addressing the possibility that the pattern of removal of animals from along the survey route in previous years might have caused an artificially low density of animals along the survey route and hence to the low survey sighting rate, it was proposed that only juvenile animals would be removed from the survey route, and adults and juveniles taken from other areas in Dryandra and Boyagin NR.

These proposals were supported by all members of the Recovery team who responded. Environment Australia was notified of the Team's decision to reduce the number of translocations to be carried out in 1997 in a Progress Report submitted in July 1997.

Action 3.1. Selection of reintroduction sites

As the new translocation site proposed for 1997 in the Recovery Plan was Karroun Hill, a well known area, no funds were requested for selection of reintroduction sites. After the decision to release animals at Stirling Range NP in 1997, it was necessary to select release sites in the Park. Funds for this action were provided through savings resulting from the postponement of proposed translocations to Karroun Hill and Dragon Rocks.

Consultation with CALM South Coast Region and Albany District staff had identified the western end of the Stirling Range NP as the most suitable area for a release, as it holds the most extensive areas of wandoo woodland and is the longest unburnt part of the Park. A field examination of the site by CALM Science and Information Division, South Coast and Albany staff resulted in the selection of a particular stretch of the Chester Pass Road as the appropriate release area.

A Translocation Proposal prepared according to CALM Policy Statement No. 29 (Translocation of Threatened Flora and Fauna) was submitted. It was sent out and refereed but could not be completed and approved due to the decision of the Recovery Team to postpone the Stirling Range NP translocation.

Action 3.2. Exotic predator control

Batalling and Tutanning

Routine baiting was carried out at Batalling (aerial baiting four times per year) and at Tutanning (monthly vehicle-based baiting).

Karroun Hill

Fox control by aerial baiting with 1080 was carried out in January, April, July and October 1997 over an area of 40 000 ha with the former release site at its centre. This comprises approximately 13% of the area of the nature reserve, extends at least 10 km in all directions from the release site and covers all habitat where numbats are known to be surviving.

Dragon Rocks

During 1997, Dragon Rocks NR was baited eight times, comprising four three-monthly combined ground and aerial operations alternating with four ground baiting operations. A combined ground and aerial baiting operation involves the distribution of dried meat baits containing 4.5 mg of 1080 at 100 m intervals along the reserve perimeter and from the air along lines 1 km apart. at a rate of 5 baits/km^2 (CALM 1994). Baiting from the ground involves distributing baits from a vehicle at 100 m intervals along the perimeter and most internal tracks.

Action 3.3. Translocation to Dragon Rocks NR, to a northern jarrah forest site and to Karroun Hill NR

Following the decisions of the Numbat Recovery Team described earlier, the translocation program for 1997 was altered to comprise only a translocation to the northern jarrah forest site. Some funds originally allocated for this action were used to carry out an action which cost more than originally predicted (flying to locate numbats in the northern jarrah forest) and the unscheduled search for a release site at Stirling Range NP.

Northern jarrah forest site

The results of monitoring the dispersal of numbats released in upland jarrah forest at the eastern end of Dale Road in Dale Conservation Park is described under Action 3.4 Monitoring of reintroduced populations. In summary, no animals remained near the release site, all moving further than 5 km away before establishing home ranges. At Recovery Team Meeting 9 in June 1997, the team decided that a new release site in the northern jarrah forest would be identified, centred on wandoo woodland valleys, as these seemed to be favoured by the animals that had been found.

In November, suitable release logs were selected along Topher Road, extending approximately 3 km along the road where it follows a wandoo valley. This site is about 10 km east of the 1996 release site and is the twice-yearly baited treatment area. under Operation Foxglove. The release group comprised 23 numbats, of which 15 were taken from the wild at Dryandra, two were taken from the wild at Boyagin and six were from Perth Zoo (two captive-bred and four captive-reared) and included 9 juvenile and 4 adult males, and 5 juvenile and 5 adult females. Thirteen numbats

were released on 27 November, three on 2 December, one on 4 December and six on 10 December 1997.

Action 3.4. Monitoring of reintroduced populations

The first phase of monitoring numbat translocations consists of regular checking of radio-collared animals, and the maintenance of functioning radio-collars on these animals (Friend 1994). In a reintroduction involving annual releases for three years, this method is appropriate for the first 3-4 years, or until few radio-collared animals remain. After that, diggings searches and driven surveys must be used. An annual driving survey was introduced at Tutanning in 1996, and several diggings searches were carried out at Karroun Hill during 1995 and 1996. The first diggings search was carried out at Batalling early in 1997. Regular diggings searches and driven surveys have been carried out to monitor the reintroduced population at Boyagin, but these results are reported under Action 1.2.

The history of releases at numbat reintroduction sites is as follows:

RELEASE SITE	RELEASE YEARS
Boyagin	1985-87
Karroun Hill	1986-93
Tutanning	1987, 1990-92, 1995
Batalling	1992-95
Yookamurra (SA)	1993
Karakamia	1994
Dragon Rocks	1995-96
N. jarrah forest	1996-97

Karroun Hill

No animals remain radio-collared at Karroun Hill. Although no diggings surveys were carried out at Karroun Hill in 1997, searches in October 1995 and April 1996 located signs of numbat presence in most of the preferred sites searched (areas that consistently had radio-collared animals in previous years). As no numbats have been released at Karroun Hill since 1993 and the last major release was in 1991, it is likely that a residual population exists at Karroun Hill Nature Reserve. Due to the large size of the reserve and poor vehicle access, monitoring with current methods (diggings searches and driven surveys) will be extremely labour-intensive. Karroun Hill has an extremely important place in the Numbat Recovery Program because it is apparently capable of supporting a large number of animals, simply through its very large size.

In 1997, a study has been commenced using remote imaging analysis techniques (ER Mapper) to identify vegetation types that have supported numbats and to map their distribution in Karroun Hill Nature Reserve. The results of this study will be used in 1998 to select areas within the reserve for survey to determine the extent of the residual population.

Batalling

The last release at Batalling was in December 1995, when nine animals were released there. At the beginning of December 1996, two of these animals were alive and transmitting, as they were still at the end of 1997. In addition, a litter of four young were collared in October 1996 but two of the signals were lost during the year. Four animals remained alive and transmitting at the end of 1997.

The diggings survey planned for Batalling was carried out in January 1997. Numbat diggings were not found to be widespread in the area. The search concentrated on the roads within five kilometres of the two release sites (on Varis and Steed Roads) and generally speaking, few diggings were found except where radio-collared numbats were known to be. However, many diggings were found in a wandoo area to the north-east of the Batalling Block. This, together with the results of the Hills Forest release, indicates firstly that long-range dispersal of animals after release is to be expected in the forest (i.e. lack of success in finding many animals after release is due to dispersal out of the search area, not simply transmitter failure), and secondly that wandoo on the eastern side of the main forest block may be the most promising areas in the northern and central forest for reintroductions.

Tutanning

The second annual driven survey at Tutanning was carried out in March 1997. Four sightings were made at rate of 1.8 sightings/100 km, as compared with 0.9 sightings/100 km in March 1996. Increased predation by cats and raptors anticipated following the arrival of the Rabbit Calicivirus Disease (Friend 1997b) does not appear to have been a factor affecting numbat numbers. In fact rabbit numbers have increased after an initial decrease, and numbat numbers have increased over the year during which RCD arrived. This is despite the observation that the only collared numbat in Tutanning at the beginning of the year was taken by a wedge-tailed eagle.

Dragon Rocks

Twenty numbats were translocated from Dryandra to Dragon Rocks NR in December 1995 in the first of three planned releases. At the beginning of December 1996, 10 of these were still alive and transmitting. Twelve young were collared in October-November 1996. Seventeen more animals were translocated from Dryandra in December 1996, in the second planned release. By the end of November 1997, 18 animals from these three sources were known to be still alive. In October - November 1997, 17 young were radio-collared, giving a total of 35 animals alive and transmitting. Causes of death recorded amongst radio-collared numbats in 1997 were predation by cats (4), fox (1), raptor (1) and one found dead with no obvious cause.

The survival rate of released animals and young bred on site has been higher than in any previous reintroduction. In addition, numbats are inhabiting most woodland types; mallee types as well as salmon gum and mallet woodland. Potential habitat probably covers about half of the reserve. The original estimate of 650 animals for the carrying capacity of Dragon Rocks (Friend 1996c), although based on the density of animals at Dryandra, now appears quite achievable.

Northern jarrah forest

In December 1996, 20 numbats taken from the wild at Dryandra were released at four release sites over a distance of 1.5 kilometres along Dale Road, in upland jarrah forest within Dale Conservation Park, an area baited four times a year. Aerial searches for the radio-collared animals were carried out in March and April over a large section of the northern jarrah forest, covering most of the area bounded in the north by the Great Eastern and Great Southern Highways, west to the Darling Scarp, east to the edge of farmland and south to the Jarrahdale area. This required a much larger amount of flying than was originally planned. Funds for this action were provided through savings resulting from the postponement of proposed translocations to Karroun Hill and Dragon Rocks. Only six numbats were found, scattered over the area, the most distant being a female found in forest adjacent to the Brookton Highway as it leaves the eastern extremity of the forest and a male found one kilometre south-west of Mundaring Weir. No animals remained near the release site.

Amongst the animals that were located, however, there was a very high initial survival rate. By the end of May, five of the six numbats were still alive (one had been taken by a raptor). None was close to any other radio-collared numbat and neither of the two surviving females produced young in 1997. Two males had established home ranges in good quality wandoo habitat east of the release site (baited twice a year), whereas the two females were in poorer jarrah sites. The females were moved in June, each being placed near one of the males. Both females established home ranges near the point of re-release.

The lesson learned during 1997 was that wandoo valleys in the eastern forest would probably provide more promising release sites than upland jarrah in the central forest. Consequently, the release sites for 1997 were selected in a wandoo valley along Topher Road about 10 km east of the 1996 release site.

Karakamia

At the beginning of 1997, the only collared numbat at Karakamia was a female called Samantha, one of the original three to be introduced there in December 1994. She was found dead in April 1997, under circumstances which indicated that she was taken by a raptor. This is not certain as the collar was unmarked. Another possibility is that she was taken by the chuditch which turned up recently inside the fence, although this is less likely as chuditch seem to chew at the collars of radio-collared prey.

Sightings of numbats and their sign within Karakamia indicate that animals are still present, but it will be a matter of time before one or more are captured and radio-collared. The sanctuary could be a source of animals for translocation, but one problem has been that the females tend to nurse their young in old rabbit warrens, making it very difficult to capture them for collaring as they escape along the tunnels during excavation.

Action 4. Disease survey and health monitoring of all populations

After the finalisation of the Recovery Plan in 1994, some further investigations were made at Dryandra into field anaesthesia of numbats for blood sampling (Haigh 1994). It was concluded that blood sampling in the field was too traumatic under ideal conditions, let alone prior to translocation.

During 1997, faecal samples were collected from numbats in all populations where animals were handled. These have been stored in formalin for future parasitological examination, with particular emphasis on detection of eggs belonging to the acanthocephalan species found to have killed a number of numbats in or from the Dryandra population. However the proposed thorough faecal screening necessary was not possible because it was too time consuming for Murdoch Parasitology laboratory to perform. It has not yet been possible to divert SID personnel from field duties for sufficient time to carry out this work.

Since November 1994, all animals translocated from Dryandra either to Perth Zoo or to reintroduction sites have been wormed by injection with Ivomectin.

Action 5. Captive breeding

In the event that wild populations cannot provide sufficient animals for the translocation program (1995-2001), a healthy and genetically viable captive breeding program will be of great value to

recovery in the wild. The captive breeding colony at Perth Zoo also has the potential to make a great contribution to the Numbat recovery effort by forming a valuable resource for raising public awareness of the plight of the Numbat and the work involved in its recovery.

In the 1997 breeding season the Zoo undertook to develop a more reliable breeding protocol than in previous years. The results of the urine monitoring done indicated that numbats are seasonally polyoestrous and also that the development of the auxiliary sex gland of the male was significant in the fertility of the male. Some females had several oestrus cycles, up to four in one case. Oestrus cycles were determined by behavioural signals and by the appearance of epithelial cells in urine collected at two-weekly intervals. Older males produced sperm in the urine early in the breeding season but younger ones didn't produce sperm until later in the season. Oestrus is independent of the presence of the male.

Eight young were produced, a great improvement over the last two years, during which two and zero young were produced. However, the number of young per litter is small amongst this year's crop. Most of this year's captive-bred litters comprise only one young, which is very different from the wild situation, where about 85% of litters comprise four young. The reasons behind this require further research. In 1998 the Zoo will be looking at the effect of diet on breeding. Provision of termites is again a problem over winter. The Zoo are negotiating a contract with Termi-Mesh to provide termites for the numbats.

The reasons behind the zoo's success this year appeared to be closer monitoring including urine analysis compared with the last few years, reducing the amount of swapping of males between females, as they take a while to settle into a new enclosure, increased accountability by the numbat keeper, the adoption of a plan from before the breeding season and a team approach.

One of the captive females (studbook number 93), approximately 4 years old, died on 3 June 1997 due to sand impaction in the gut. She had habitually eaten sand and was even put on leaf litter for six weeks and she would dig around looking for any sand she could eat. This appears to be a behavioural problem that occurs in a few individuals.

Two old captive-bred females (studbook nos. 24 and 25) were transferred in March from Perth Zoo to the Alice Springs Desert Park for display. Termite supply is *Mastotermes darwinensis* being brought down in damp cardboard from Darwin, where they are collected easily. The numbats are being well displayed and are a major attraction at the Desert Park.

Action 6. Public awareness, education

Talks on the Numbat Recovery Program were presented at a number of forums during 1997: two field excursions for members of the public were run on April 14 and 21 as part of CALM's Go Bush! Program at Hills Forest, Mundaring; a field excursion at the Dryandra Woodland Ecology Course, 9-11 May 1997; Busselton Naturalists Club on 11 June 1997; Greenwood Senior High School, 5 November 1997 and Friends of Perup, 30-31 December 1997.

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Table 1 : Result of monitoring radio-collared numbats at Dryandra and Perup over the period 1 January - 31 December 1997.

Origin	Collared	Known Dead	Signal Lost	Trans-located	Alive and Transmitting
Dryandra					
Collared at 01/01/97	3	2 (1P,1D)	0	0	1
Young collared 1997	10	1 (1R)	0	5	4
Adults collared 1997	19	2 (2R)	1	12 (2 zoo)	4
Total	32	5	1	17	9
Perup					
Collared at 01/01/97	2	0	1	0	1
Young collared 1997	0	0	0	0	0
Adults collared 1997	2	1 (1R)	0	0	1
Total	4	1	1	0	2

Table 2 : Result of monitoring radio-collared numbats at reintroduction sites over the period December 1996 - December 1997.

Origin	Collared	Known Dead	Signal Lost	Trans-located	Alive and Transmitting
Batalling					
Adults resident 1/12/96	2	0	0	0	2
Young bred on site 96	4	0	2	0	2
Total	6	0	2	0	4
Tutanning					
Adults resident 1/12/96	1	1 (1R)	0	0	0
Dragon Rocks					
Adults resident 1/12/96	10	1 (1C)	4	0	5
Young bred on site 96	12	2 (1C,1U)	5	0	5
Trans from Dry 96	17	5(1U,1F,1R,2C)	4	0	8
Young bred on site 97	17	0	0	0	17
Total	56	8	13	0	35
Hills Forest					
Trans from Dry 96	20	1 (1R)	14	0	5
Young bred on site 97	0	0	0	0	0
Translocated from:					
Dryandra 97	15	0	0	0	15
W. Boyagin 97	2	0	0	0	2
Perth Zoo 97	6	0	0	0	6
Total	43	1	14	0	28
Karakamia					
Adults resident 1/12/96	1	1 (1R)	0	0	0

U: Unknown Predator, G: Chuditch, R: Raptor, D: Dead Unknown Cause, C: Feral Cat, F: Fox, P: Carpet Python