NUMBAT RECOVERY TEAM

ANNUAL REPORT

1999

by Tony Friend

for

The Numbat Recovery Team

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SUMMARY

The conservation status of the Numbat has improved significantly since the commencement of intensive research on the species in 1980. At that stage, there were probably only 200-400 individuals in existence, in three populations. Since the discovery that fox control using meat baits containing 1080 caused numbat numbers to increase, recovery of existing populations and re-introductions have increased estimated numbers towards 2000. There are now 12 populations in 3 States.

Significant events in Western Australia during 1999 include:

- Recovery of the Dryandra population from the 1993 post-peak slump
- Persistence of all 6 populations monitored intensively during 1999
- Sightings recorded at 2 other populations
- Seven young radio-collared at Hills Forest
- Second release at the Stirling Range NP
- Assessment of new methods to transfer numbats from captivity into the wild
- Re-stocking release at Karakamia Sanctuary

In other States:

- Growth of the Yookamurra Sanctuary (SA) population to the point where it can be harvested
- Re-introduction to Scotia Sanctuary (NSW)

The successes of the program are attributable to close cooperation between stakeholder organisations, including CALM, Perth Zoo, Earth Sanctuaries Limited, SADEH, NSW NPWS and Karakamia Sanctuary, as well as the dedicated work of many individuals.

CONTENTS

INTRODUCTION

The numbat is one of Australia's rarest mammals. After an apparently rapid decline within its two stronghold areas in the late 1970s, conservation action commenced in 1980 with broadscale survey and research to determine the principal causes of decline. This work showed that by 1985 only two populations persisted, at Dryandra Woodland andPerup Nature Reserve in the south-west of WA, and that fox control was the single most effective technique to reverse the decline (Friend 1990). An experimental re-introduction that commenced in 1985 resulted in the establishment of a self-sustaining population atBoyagin Nature Reserve 40 km north of Dryandra (Friend and Thomas 1994).

More recently, a program of translocations has been implemented and by the end of 1998, nine new populations of numbats existed. Accurate population estimates are not yet available, but it is unlikely that total numbers yet exceed 2000. The Numbat Recovery Team was formed in 1993. This report summarises the recovery actions coordinated by the Team during 1990.

MEMBERSHIP

The membership of the Numbat Recovery Team at the beginning of 1999 was as follows:

Tony Friend (Chair)	CALMScience
Brett Beecham	CALM Wheatbelt Region
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
Alan Danks	CALM South Coast Region
Bob Hagan	CALM Southern Forest Region
Sandra McKenzie	WWFA/National Threatened Species Network
David Mitchell	CALM Swan Region
Peter Orell	CALM Wildlife Branch
Helen Robertson	Perth Zoo
Sally Stephens	Environment Australia, Biodiversity Group, Threatened Species and Communities Section

Early in 1999, Dr Terry Fletcher was appointed Director of Research at Perth Zoo and took over as the Zoo's representative on the Team. During the year, CALM was notified of a decision of the Threatened Species and Communities Section of Environment Australia that section staff would no longer be attending recovery team meetings on a regular basis. In addition, responsibilities were changed such that one staff member would be the contact person for all WA recovery programs. Early in the year, this person was Susanne Ward, but she was later replaced by Sarah May. NeilThomas (CALMScience) attends all meetings of the Numbat Recovery Team.

MEETINGS

The Recovery Team met in Western Australia twice during 1999. Meeting 12 was held at the WA Wildlife Research Centre, Woodvale on 24 June. Meeting 13 was held on 3 December, also at the WA Wildlife Research Centre, Woodvale.

RECOVERY PLAN STATUS AND FUNDING

The Numbat Recovery Plan (Friend 1994) 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 EA funded the program from 1995 until 1997, when a three-year review was carried out (Friend 1997). Although progress on the recovery plan was judged to be satisfactory, funding was not renewed in 1998. Since then, operational costs for the fieldwork component of the numbat recovery program in Western Australia have been provided by CALM through the Western Shield program. This includes specifically the translocation program and a reducedpopulation monitoring program. Perth Zoo has continued to fund the captive breeding component of the plan, with financial support from the Marsupial Reproduction CRC. Earth Sanctuaries Limited has funded the re-introductions to Yookamurra Sanctuary in South Australia and to Scotia Sanctuary in New South Wales, and the monitoring of those re-introduced numbat populations.

One consequence of the reduction in funding for the recovery program due to the cessation of funding from Environment Australia and a reduction in support fromCALMScience was that some actions listed in the Recovery Plan for 1999 have not been implemented. A summary of these is shown in the Appendix.

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 re-introduced in 1985-1987, resulting in the establishment of a self-sustaining population by the time of writing of the plan.

Action 1.1. Exotic predator control

Fox control by baiting with 1080 dried meat baits is now part ofCALM's routine management procedure at Dryandra Woodland, Boyagin Nature Reserve and Perup Nature Reserve-Kingston State forest (the sites of the existing populations) under the Western Shield program. Since January 1989, baiting has been 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, 1996, 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 3051 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.

During 1998, monthly baiting was extended to the remaining satellite blocks of Dryandra Woodland, increasing the total area baited there to 23787 ha.

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 numbat 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 instituted 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 analysis can also be applied to the data collected in order to obtain an estimate of the population density along the survey route. The November survey coincides with the highest expected sighting rates, as the year's cohort of young are becoming independent. By April, that cohort of young has shrunk considerably, through predation and failure to find suitable vacant habitat, so sighting levels are relatively lower and it is hard to compare November rates with April rates.

During 1999, 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 lessintensive baiting regime there. Here, a set route of about 30km is driven during those times of day when numbats are active, three times within two weeks, recording numbat sightings.

Results

In recent years the sighting rates at Dryandra have been fairly low and have indicated a poor recovery after the population crash of 1993. In November 1998, the highest sighting rate for several years was recorded (4.15/100km) suggesting that population size was increasing towards the estimated fully-stocked levels (corresponding to a sighting rate of about 5/100km). Surprisingly, the numbat sighting rate during the April 1999 survey at Dryandra gave the lowest value yet, at 0.55 sightings/100km (cf. 2.20/100km in April 1998). However the sighting rate in November 1999 (3.11/100km), while lower than in November 1998, indicated that a sustained decline had not occurred (see Figure).

The sighting rate at Montague block in December 1999 was 3.38 sightings/100 km. This figure declined after reaching a peak of 13.6 in 1995, falling to 7.9 in 1996, 2.25 in 1997 and 1.13 in 1998. This year's results suggest that the decline, which mirrored that in the main block of Dryandra but with a lag of three years, has halted (see Figure).

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.

Results

The results of monitoring radio-collared numbats in Dryandra during 1999 are shown in Table 1. At the beginning of 1999, there were 4 radio-collared numbats in Dryandra. During the year, two of these were taken by raptors and the signals of two were lost without explanation (presumably due either to predation or to transmitter failure). During 1999, seven numbats were radio-collared prior to the November driven survey. One was transferred to Perth Zoo in May 1999 (see Action 5 Captive Breeding). All of the other six were still alive and transmitting at the end of 1999.

Discussion

The condition of the Dryandra numbat population has been a cause for concern since the numbers crashed in 1993 following a peak in 1992. At that time, intensified monitoring showed no unusual source of mortality in operation and this led to the conclusion that the drop in numbers was due to the population outstripping some resource (probably food). Between 1993 and 1997, however, numbers continued to decline (see Figure), implying that if termite supply was indeed the cause of decline, some long-term damage may have been done to the resource.

The decline seems now to have stopped and numbers have stabilised. Only small numbers of animals have been removed from Dryandra in the last two years, and this may have helped. A review of numbat population numbers using population modelling techniques will be carried out in 2000, in order to derive a more accurate estimate of numbers.

Perup

No monitoring was carried out at Perup in 1999. The community group Friends of Perup conducts an annual numbat driven survey in November or December based on the routes established to monitor numbat numbers at Perup and Kingston under the Numbat Recovery Program. In November 1999 rainy conditions prevented access to thePerup due to dieback restrictions in wet soil conditions. The survey was postponed to March 2000.

Boyagin

Since the re-introduction 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 commencing in 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 1999, 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 235km in the east block and 195 km in the west block).

Results

Diggings survey

The diggings survey revealed a lower occurrence of numbat sign than in previous years. Diggings or scats were recorded at 19 of the 44 monitoring sites in the east block and at 25 of the 54 sites in the west block. The distribution of this sign does confirm however that numbats are widespread in both blocks even though no sightings were made in the west block.

Driven survey

In the west block of Boyagin, the sighting rate was down on 1998; in fact no sightings were made (0/100km, compared with 1.53/100km in November 1998). The sighting rate in the west block has declined since peaking in 1995, when the sighting rate was 3.08/100km (see Figure).

A slight increase was recorded in the east block (0.43/100km, compared with no sightings in November 1998. The population level still appears to be low relative to previous years (see Figure).

Discussion

Numbat numbers in the east block of Boyagin rose sharply after the re-introduction in 1985-87. As there was no major numbat release in the west block, it was colonised more slowly by animals that made their way across from the east block. The rates of increase in the distribution of diggings and in the sighting rates were lower in the west block, although at their peak those rates approached the highest sighting rates recorded in the eastern block.

The current low numbers seem to be due to the correction that has followed the rapid population rises in recovering numbat populations at both the Dryandra main block and at Montague. This pattern seems to be one that should be anticipated in future re-introductions. It might be important to anticipate the peak and utilise it for the provision of a pulse of animals for translocation.

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 Centre for Conservation Biology at the University of Queensland, Luca Fumagalli, worked on this project. Over 90 samples from Dryandra, 12 from Perup and 6 from Boyagin were sent to Luca for this project.

The results were submitted as a paper in Molecular Ecology and published during the year (Fumagalli *et al.* 1999). The findings indicated that the Dryandra population has been less affected by bottlenecks than has the Perup population, but that both were quite recently connected. The conclusion is that the Dryandra population is definitely the better one to use as a source for translocation, but that some mixing of stocks for translocation should not cause problems. In fact, if done correctly, it should increase the genetic variation within the

translocated populations. The authors also pointed out the possible benefits of transfers of animals between Dryandra and Perup. This option should be approached carefully, however, due to the possibility of disease transmission and other concerns.

Action 3. Translocations.

A program of translocations is set out in the Numbat Recovery Plan (Friend 1994). About 20 numbats are to be released at each translocation 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. 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 translocation has been very successful. The Stirling Range NP is being baited for foxes four times a year under CALM's Western Shield program. The 1997 translocation program agreed to by the Team comprised 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. Insufficient animals were available from the breeding colony at Perth Zoo and alternative source sites (Perup, Boyagin, Karakamia) could not provide more than a few extra animals. A release of 20 animals at a site in the northern jarrah forest was carried out, mainly from Dryandra but supplemented as far as possible with animals from Boyagin.

In April 1998, the sighting rate at Dryandra was still low, but by November it had risen to 4.15/100km and the population was looking quite healthy again. As the routine program of three annual releases had been completed at Hills Forest, no more animals were required for translocation there, so some animals from Dryandra would be available for the Stirling Range NP. Consequently the first release at the Stirling Range NP was planned for December 1998.

In two releases during December 1998, four animals from Perth Zoo (two adult males and two adult females) and 10 from Dryandra (five adult males, four adult and one juvenile female) were released at two sites in the western end of the Stirling Range NP. This area was chosen because of the long unburnt nature of the vegetation in this part of the park.

Action 3.1. Selection of re-introduction sites

Stirling Range NP

The results of monitoring the Stirlings translocation during 1999 indicated that the sites used for the 1998 releases (Red Gum Pass Road south of Stirling Range Drive, and Red Gum Springs) were less than ideal. The four Zoo animals released at the first of these sites had all

been taken by birds of prey in this area, before they had moved very far and possibly soon after release. Three of the four numbats that were known to have survived the first five months had dispersed long distances from the release site, and had settled in denser habitat. The fourth had also moved into thick vegetation, close to the release site. The two numbats released at Red Gum Springs were not located again.

A survey was required in order to select a release site for the second year's translocation, scheduled for December 1999. The choice of site was constrained by the need for dense, and therefore unburnt vegetation, whilst remaining in the general vicinity of the first release site. A survey was carried out during three visits to theStirlings by visual inspection and by liaison with the Ranger-in-charge, Luke Coney. Several potential sites were identified. The most favoured site was on Middle Spring Trackin jarrah woodland with a dense shrub layer. This site had the disadvantage of being inaccessible by vehicle during wet soil conditions, due to *Phytophthora* hygiene requirements. A second site was selected in case of wet weather at the release date. This site comprised two locations along Red Gum Pass Road near the intersection with Madyerup Track.

Scotia Sanctuary

During 1998 CALM was approached by Earth Sanctuaries Limited (ESL) for advice and assistance in implementing a translocation of numbats fromYookamurra Sanctuary in South Australia to Scotia Sanctuary in New South Wales. The New South Wales National Parks and Wildlife Service asked me to carry out a site inspection and survey of habitat type and provide a report before they would agree to the move. Earth Sanctuaries relayed this request and asked that I organise a survey of termite availability in various habitat types in order to satisfy the NPWS requirements. I visited Yookamurra and Scotia in July 1999 and carried out termite surveys with the help of ESL staff. A report on this survey was submitted to ESL and NPWS. One recommendation was that an assessment of the raptor numbers atScotia be carried out, as predation by birds seemed to be the main threat to successful establishment.

Release sites were selected in Stage 1 (4000 ha fenced and with rabbits, foxes, cats and goats removed) that satisfied criteria relating to termite abundance, shrub cover and log abundance. Suitable release logs were selected within these sites.

Action 3.2. Exotic predator control

Karroun Hill

Aerial baiting with 1080 meat baits is carried out under the Western Shield program at three monthly intervals over 40 000 ha within Karroun Hill NR. This is a 20km x 20km square area surrounding the numbat core area close to Karroun Hill itself. During 1999, aerial baiting was carried out on 15 March, 1 May, 19 October and 14 December).

Tutanning

Baiting with 1080 meat baits is carried out monthly around the perimeter and on selected tracks within the nature reserve.

Batalling

This area is baited by air at three monthly intervals under the Western Shield program. During 1999 Batalling was baited on 12 March, 3 June, 13 October and 21 December.

Dragon Rocks

This nature reserve is baited four times a year from the air (in 1999, on 12 March, 31 June, 19 October and 21 December). Ground baiting around the perimeter and on selected internal tracks is also carried out four times a year during the intervals between aerial baiting.

Hills Forest

The area east of Mundaring in which numbat releases have been implemented is part of the Western Shield northern jarrah forest baiting program. Under the Operation Foxglove research program, part of the area is baited twice each year (in 1999, on 4 March and 4, 18 & 20 October) and part is baited four times each year (in 1999, on 4 March, 31 May, 18 October and 13 December).

Stirling Range

The Western Shield aerial baiting program is carried out in the Stirling Range NP four times each year (in 1999, on 15 April, 8, 9 & 10 June, 23-24 September and 19 & 26 November). Perimeter baiting is carried out to coincide with the aerial baiting, although in some areas the baiting route is 1 km inside the Park, on the first firebreak that is more than 20m from farmland.

Yookamurra and Scotia Sanctuaries

Control of introduced predators on these sanctuaries is carried out by exclusion with an electrified fence and eradication of the individuals inside. Removal of the last of any species is a problem. Dogs are used to locate the last few feral animals so thathunters, or the dogs themselves can dispatch them. Any feral animals that manage to get in are hunted down or removed by baiting.

Action 3.3. Translocation program

Hills Forest

Numbats were released in an area onTopher Road east of Mount Dale in 1997 and 1998, after the numbats released in 1996 all dispersed away from the first release site just west of Mount Dale. Following the procedure established in the Recovery Plan, three annual releases of 15-20 numbats are carried out before an assessment of whether the translocation is likely to be successful. This year (1999) no animals have been released, according to this strategy, but young collared in 1998 and surviving adults have been monitored.

Stirling Range NP

The second of three annual releases of numbats in the Stirling Range National Park was scheduled for late 1999. Eight animals were available fromYookamurra Sanctuary and seven from Perth Zoo. The Yookamurra animals, comprising one adult and one juvenile male, and one adult and five juvenile females, were captured on the afternoon of 7 December and held overnight at Yookamurra. Next morning they were driven from Yookamurra to Adelaide,

flown by commercial jet to Perth airport, driven to Jandakot airport and flown by light aircraft to Cranbrook, 30km from the release site, then driven to the Middle Spring Road release site by 3 p.m. on 8 December. Six of the numbats were released into hollow logs at that release site, and two females were released into hollow logs in the home range of the only radio-collared numbat (a male) remaining from the previous release.

The seven Perth Zoo animals included three litter-mates (one male, two females) bred in captivity in the 1999 breeding season and an adult female and three (two males, one female) of her litter of four that were brought in with her from Dryandra in April 1999. They were released on the afternoon of 13 December. Recent rain prevented access on Middle Spring Track and necessitated the use of the second release site, on Red Gum Pass Road.

The release and subsequent movements of the Zoo animals were monitored as a short-term research project by a Murdoch student, Lisa Mantellato. Her project was supported by the Marsupial CRC and CALM and involved a comparison of the behaviour and movements of numbats released into logs on site compared with those released in their nest boxes from the zoo. Lisa's fieldwork continued into January 2000, but by the end of 1999, significant results included the immediate dispersal of all three young females, whereas the adult female and all three young males were still not far from the release site. No effect of releasing the numbats in nest boxes was apparent.

Karakamia

This small area of 180 ha enclosed by a fence has the potential to hold only a small number of numbats. Its population will have to be actively managed if inbreeding is to be avoided. Numbats were released into the sanctuary in December 1994, and were monitored byradio-tracking for over a year. While at least one numbat has been sighted over the last year, no animals were still fitted with functioning collars. In response to a request to CALM from Karakamia's management, two numbats (an adult male and a juvenile female) were captured at Dryandra and released at the sanctuary on 15 December 1999.

Scotia

By November 1999 all approvals were in place for a transfer of 20 numbats fromESL's Yookamurra Sanctuary in SA to Scotia Sanctuary in NSW. Early on 23 November, 10 numbats were captured at Yookamurra, weighed, measured, implanted with transponders (if not already implanted), and had new collars fitted. Leaving in the late morning, they were driven to Scotia, a drive of about four hours. On the morning of 24 November, two males were released into logs in front of television cameras and a crowd of about 60 people. The remaining animals were released immediately afterwards into existing hollow logs at intervals along the tracks in the designated release sites.

Two weeks later, 10 more numbats were translocated from Yookamurra to Scotia.

Action 3.4. Monitoring of re-introduced populations

Tutanning

A driven survey was carried out atTutanning NR in March 1999. Sighting rates were down on the previous survey in 1997 (0.9 sightings/100km in 1999 versus 1.8 sightings/100km in 1997).

Batalling

No monitoring of the Batalling population was carried out in 1999, apart from the occasional sighting by visitors, confirming the persistence of numbats there. A diggings survey is proposed for early in 2000.

Hills Forest

The third release under the translocation to Hills Forest was carried out in December 1998. Ten numbats from Dryandra and nine from Perth Zoo were released into logs alongTopher Road in the release area used first in 1997. Topher Road runs along a wandoo valley at this point and three of the numbats released in 1997 were still living in or near this area. In addition, one of the progeny of the 1998 release had been collared in this area in October 1998. The Dryandra animals were released into logs that had been used for releases in 1997. The Perth Zoo animals were released into the same logs a week later.

By the end of 1999, six of the 10 animals from Dryandra had been taken by raptors. Two of the Dryandra animals were alive with functioning radio-transmitters and two were never located after release. The picture with the Perth Zoo animals is rather different. Seven of the nine released were never relocated; one was taken by a raptor and one was still alive at the end of 1999. It is unlikely that so many radio-transmitters failed in the first weeks. The more likely explanation is that the animals dispersed so far from the release site that theaerial search did not reach their new locations. Perhaps numbats from the earlier releases were still resident in the vicinity and ejected the newcomers.

Seven of the progeny born at Hills Forest during 1999 were captured and fitted with radio-collars. They had dispersed by the end of the year but had not yet been relocated from the air.

Karroun Hill

Numbat releases in 1986-93 formed the basis of a population that persisted in 1996. No monitoring trips have been carried out since then due to lack of funds.

Monitoring is carried out by diggings survey. Monitoring personnel walk in to areas in which numbats were recorded during the radio-tracking phase (1986-1993) and search for recent numbat sign (diggings, scats). This technique was used successfully in 1995 and 1996 to demonstrate the persistence of the population at Karroun Hill NR.

Dragon Rocks

No monitoring was carried out at Dragon Rocks during 1999. When Environment Australia withdrew funding for the Recovery Program in 1998, all radio-collars were removed from numbats at Dragon Rocks. Future monitoring will be limited to diggings searches unless sightings become frequent enough to warrant driven surveys. Adiggings survey is planned for 2000.

Stirling Range NP

During 1999, the numbats released in December 1998 were monitored by radio-tracking. These animals included 4 adults (2 males, 2 females) from Perth Zoo and 9 adults (5 males, 4 females) and one juvenile female from Dryandra. Three numbats were not located at all, and one was located from the air but not found on the ground or subsequently by aircraft. By the

end of March, six, including all the zoo animals, had been taken by raptors. The surviving radio-collared animals were all males, and three had dispersed far from the release site, establishing home ranges in dense bushland. The fourth male was still not far from the release site, but also had access to dense bushland.

The 1998 release site was a large area of wandoo woodland fringing Red Gum Pass Road. In terms of the understorey it was relatively open compared with wandoo woodland in numbat habitat at Dryandra. Observations made during the year showed that wedge-tailed eagles are particularly abundant at the Stirling Ranges and appear to be supported by the large population of rabbits. The rabbits are not restricted to the fringes of the park, but are found throughout the woodland areas. In the open woodland areas, numbats are likely to be at high risk of predation when eagles are hunting for rabbits in the late afternoon.

Amongst the six numbats that were taken by raptors, the remains of five were found in wandoo open woodland near the release site. The other was in similar vegetation on the western edge of the park, over 10 km from the release site.

Signals were lost form three of the four surviving males before their collarswere able to be changed. Fresh numbat diggings were found in their home ranges in October so it is likely that they survived to the end of the year. The single male that did not disperse far was still wearing a functioning collar at the end of the 1999.

Karakamia

As mentioned earlier, there were no radio-collared numbats atKarakamia during 1999 until the release of two animals from Dryandra on 15 December. Both were still alive at the end of the year.

Yookamurra

Survey results by Yookamurra staff in November 1998 indicated that over 100 numbats (including newly independent young) existed there. I was asked to provide a monitoring protocol to be used at Yookamurra and to give advice on methods of gaining an absolute estimate of the numbat population there. I proposed mark-recapture and line transect methods and these will be developed with Yookamurra staff.

Scotia

The 20 radio-collared numbats released in November and December 1999 atScotia were monitored daily for the first two months after release. This entailed a team of two going out each day and locating each numbat and finding an approximate position, fixed by GPS, if the animal was moving, or if it was in or moved into a log, by taking a fix of the log. The locations were mapped weekly and maps provided to CALM.

By 31 December 1999 only one of the 20 animals had been found dead, through raptor predation. This is a very high survival rate and attests to the low number of raptors atScotia, by comparison with Yookamurra and WA sites. The result is unexpectedly good, given the very open nature of the Scotia environment.

Action 4. Disease survey and health monitoring of all populations.

Faecal samples have been collected from numbats in all populations where animals are being handled. These are stored in formalin for 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. 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.

At beginning of 1999, the captive population at Perth Zoo comprised 8 males and 2 females. Both females produced litters of four young during the 1998/99 breeding season. Discussions at the November 1998 recovery team meeting had identified the need to bring more females into captivity for genetic reasons as well as to increase the captive breeding output. Due to low sighting rate recorded at Dryandra in April 1999 and consequent concern about the effect of removing adult animals from the population, only one female (with fourpouch young) was brought in, during April 1999. The decision was made that when her young were weaned in November, the female and three of her young would be released as part of the Stirling Range translocation. One female young would be retained in the breeding colony.

On 11 June 1999, one of the two females died suddenly due to a ruptured aortic aneurism. She had lost one of her four young three weeks earlier. At that stage she had been examined by zoo vets for signs of illness that may have led to the loss of the pouch young. The only problem was a lump on the side of the neck that had been apparent since the previous December, when a biopsy had been taken. The biopsy did not indicatean malignancy and there was no surgical intervention. The mother was active and apparently healthy until her death. The remaining three young (all males) were alive and vigorous when the mother's body was found, but attempts to hand -rear them failed. The female was at least 7.5 years old.

The group of animals for release at the Stirling Range (the only WA translocation site in 1999) comprised three of the four young brought in with their mother in May 1999 and the four captive-bred young of the other female. This group totalled three juvenile males and five females (four juvenile, one adult). These animals were released on 13 December 1999.

Two juvenile weaned females were captured in November 1999 at Dryandra and brought into the captive population sufficiently early to be settled in time for the 1999/2000 breeding season.

Predator training

All young were exposed to a bird of prey (a black-breasted buzzard) in an attempt to heighten their "flight" instincts. Responses varied, but there was a clear improvement after a couple of exposures. Sarelle (wild female captured in May 1999) and her litter reacted far better than the young of Chelsea (wild female captured in April 1997) did. AsSarelle only recently came into captivity, her natural "flight" instincts are presumably stronger. Chelsea is much more conditioned to captivity and is slower to react. The young tend to mimic the behaviour of their mother. It has yet to be established whether this training results in better survival after release.

Alice Springs Desert Park

Two old females were transferred in December 1998 from Perth Zoo to the Desert Park as display animals. They were 6 years and 7+ years old respectively at the beginning of 1999. The younger female died on 28 July 1999 after being found cold and lethargic the day before; the cause of death was not established.

- thanks to Cathy Lambert, Perth Zoo, for her contribution to this report.

Action 6. Public awareness and sponsorship program.

Talks on the Numbat Recovery Program were presented at a number of forums during 1999, including the Perth Group of the Nutrition Society of Australia in March, the Valley of the Giants Ecopark at Nornalup in April, the Friends of the Stirling Range NP in July, the WA Wildflower Society Albany Branch meeting in August, the Youth Leadership Environment Conference in August, and at the Kanyana Wildlife Rehabilitation Centre Endangered Species Seminar in August.

ACKNOWLEDGMENTS

Thanks are due to all those involved in the various aspects of the Numbat Recovery Program during 1999. Neil Thomas (CALMScience) has carried out the bulk of the heavy field program in Western Australia. Brian Macmahon and CALM staff based at Pingelly and Narrogin have faithfully maintained baiting regimes at Dryandra, Boyagin and Tutanning. Clare Anthony (CALM Narrogin) assisted with the Dryandra numbat surveys. At Batalling, the Operation Foxglove aerial baiting program has been supplemented by ground baiting supervised by Rob Brazell from CALM Collie. Dennis McDonald of CALM Mundaring provided assistance in monitoring of the radio-collared animals in the northern jarrah forest. Mal Grant and Peter Collins (CALM Albany) assisted with releases in the Stirling Range NP. Lisa Mantellato and Helen Robertson made a great contribution by monitoring the early movements of zoo numbats at the Stirlings. Baiting support at Dragon Rocks has been provided by staff of CALM Katanning District, particularly Ken Wheeler and Des Plumb. Paul Hewitt (Blue Sky Banners) has again provided skilful and reliable flying for radio-tracking. At Perth Zoo, the efforts of Vicky Power, Cathy Lambert and other members of the Native Species Breeding Program deserve particular mention. I would also like to thank Lyn Pope and Tim Vale of Yookamurra, Peter Harris and staff at Scotia and André Schmitz of Karakamia for their efforts in monitoring numbats on those properties and for providing reports on the animals' progress. During 1999 this program received financial and in-kind support from CALM's Western Shield Program, the Marsupial Reproduction CRC through Perth Zoo, and Earth Sanctuaries Limited.

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APPENDIX

Actions listed for implementation in 1999 in the Numbat Recovery Plan.

1
- 1.1 Implemented (see report)
- 1.2 Implemented (see report)
- 1.3
  - 1.3.1 Completed in 1996
  - 1.3.2 Not implemented (dependent on EA funding)
  - 1.3.3 Completed in 1998
- 1.4 No specific recommendations possible yet.

2 Completed in 1998, results published in 1999

3
- 3.1 Implemented (see report)
- 3.2 Implemented (see report)
- 3.3 Implemented (see report)
- 3.4 Partially implemented (see report) - detailed monitoring at Dragon Rocks curtailed due to funding cuts
- 3.5 Not implemented - no genetic management program yet designed.

4 Not implemented (dependent on EA funding)

5 Implemented (see report)

6
- 6.1 Implemented (see report)
- 6.2 Implemented (see report)

Table 1: Results of monitoring radio-collared Numbats at Dryandra over the period 1 January — 31 December 1999.

Origin	Collared	Known Dead	Signal Lost	Collars Removed	Alive and Transmitting
Dryandra					
Collared at 1/1/99	4	2 (1U,1R)	2	0	0
Collared during 1999	7	1 (R)	0	1 (Z)	5
Captured during Nov. 1999 driving survey	13* (+2NC)	0	0	2 (2R)	11
Total	**24**	**3**	**2**	**3**	**16**

* 7 Dug up from burrows

Table 2: Results of monitoring radio-collared Numbats at re-introduction sites over the period 1 January — 31 December 1999.

Origin	Collared	Known Dead	Signal Lost	Trans-located	Alive and Transmitting
Hills Forest					
Adults resident 1/12/99	3	2 (R)	0	0	1
Young bred on site 1998	1	1 (R)	0	0	0
Young bred on site 1999	7	0	0	0	7
Translocated from:					
Dryandra 1998	10	6 (R)	2	0	2
Perth Zoo 1998	9	1 (R)	7	0	1
Total	**30**	**10**	**9**	**0**	**11**
Stirling Range NP					
Translocated from :					
Dryandra 1998	10	2 (R)	7 (3CF)	0	1
Perth Zoo 1998	4	4 (R)	0	0	0
Total	**14**	**6**	**7**	**0**	**1**

U: Unknown Predator, G: Chuditch, R: Raptor, D: Dead Unknown Cause,
C: Feral Cat, F: Fox, P: Carpet Python, Z: Captive Breeding Program
NC: Not Collared, CF: Collar Failed

Numbat Sighting Rate

at Dryandra and Boyagin