NUMBAT RECOVERY TEAM

ANNUAL REPORT

1996

by Tony Friend

for

The Numbat Recovery Team

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SUMMARY

The Numbat Recovery Program aims to maintain the three numbat populations judged to be self-sustaining in 1994 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 indices for these three areas in 1996 indicated decreases in numbers at all sites. Intensive monitoring of radio-collared animals at Dryandra did not reveal unusually high mortality rates, although cat predation was relatively more important than in other years. The growth rate of young at Dryandra, as well as at the three other sites where young were captured, was much lower than usual, however. The climate in the south-west of Western Australia was unusual in 1996 in that the winter rains did not start until July and cool wet weather persisted throughout spring and into December. Termite availability in spring is likely to be lower under these conditions and this would result in food shortages for lactating females and hence low growth rates in their young. Low food availability may also explain the lower numbers recorded in the three existing populations. Population monitoring regimes will be continued in 1997.

Monitoring of radio-collared animals at reintroduction sites at Tutanning, Batalling, Dragon Rocks, Yookamurra and Karakamia continued in 1995. During the last 2-3 years, this project has been plagued by unreliability of radio-collars used. Use of a new more reliable type of radio-collar in 1995 and 1996 has greatly improved our ability to monitor the early stages of translocations. In 1996, there has been a consolidation of reintroduced populations, as numbat sightings become more common in several of the translocation sites, particularly Batalling and Yookamurra. At Tutanning, monitoring has moved to the second phase, with the first annual driven survey carried out in 1996.

During 1996, a new translocation site was established according to the Numbat Recovery Plan at Dale Conservation Park in the northern jarrah forest, approximately 50 km from Perth. Baiting is carried out over this area of the forest at either two or four times a year. A release site was selected and twenty numbats captured at Dryandra were released there on 5 and 6 December 1996. The second translocation to Dragon Rocks Nature Reserve was carried out when 17 numbats from Dryandra were released there on 10 and 11 December 1996.

No breeding was recorded in the captive colony at Perth Zoo during 1996. A new captive breeding research program has commenced there in an effort to solve problems that prevent breeding in some years.

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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 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 fourth annual report of the Numbat Recovery Team and it summarises the progress on actions scheduled in the Recovery Plan for 1996.

MEMBERSHIP

The membership of the Numbat Recovery Team at the commencement of 1996 was as follows:

Tony Friend (Chair)	CALM Division of Science and Information
Rob Brazell	CALM Mornington District, Central Forest Region
Paul Brown	CALM Swan 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
Colin Hyde	Perth Zoo
David Mitchell	CALM Wheatbelt Region
Ray Nias	World Wide Fund for Nature Australia
Sally Stephens	Environment Australia, Biodiversity Unit

During 1996, Paul Brown was transferred from Swan Region. David Mitchell took over his former position and was appointed as Swan Region's representative on the Recovery Team. The Wheatbelt Regional Manager informed the Chair that David's replacement would represent the Wheatbelt Region on the Recovery Team, but at the end of 1996 no appointment had been made. In March 1996 Mark Bradley was appointed Director of Conservation at Perth Zoo and replaced Colin Hyde as the Zoo's representative on the Recovery Team

At its June meeting, the Recovery Team decided to invite CALM's Wildlife Branch to nominate a representative. Gordon Wyre attended the Recovery Team meeting in November 1996, but

foreshadowed the attendance of Peter Orell in future. 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 1996. Meeting 7 was held at Perth Zoo's Education Centre on 25 June 1996. Meeting 8 was held at the Western Australian Wildlife Research Centre, Woodvale, on 19 November 1996.

RECOVERY PLAN STATUS AND FUNDING

The Numbat Recovery Plan was completed and submitted to ANCA 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. ANCA provided $76 928 for work in 1996 (including $21 428 from the Feral Pests Program).

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). During 1996 the baiting regime was changed from four-weekly (13 times per year) to monthly (12 times per year) to facilitate co-ordination with three-monthly baiting operations in place elsewhere. 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.

During 1996 the baiting frequency at Perup-Kingston was increased from twice to 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 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 1996, 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

Ten numbats were sighted during the April 1996 survey of the Dryandra main block, giving a sighting rate of 2.3 sightings/100 km. During the November-December 1996 survey, 13 numbats were sighted, at a rate of 3.4 sightings/100 km. Figure 2 shows the numbat sighting rates in November-December surveys in the main block since 1985. These sighting rates indicate that sighting rates have oscillated since the decline of 1993 and that the 1996 value is the lowest recorded since 1988, at the beginning of the steep increase in response to the extended baiting program at Dryandra. There is an indication that population numbers in the main block are continuing to decline following the 1993 crash, although there are no significant differences between consecutive years after 1992-1993.

The sighting rate at Montague block in December 1996 was 7.9 sightings/100 km, a significant decrease from the figure of 13.4/100 km recorded in 1995. As shown in Figure 2, the Montague sighting rate rose 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 1996, there were 6 radio-collared numbats in Dryandra. Thirty adults and 22 young were fitted with radio-collars during the year. Of these, 13 adults and 9 young were collared during the April survey and during other work, particularly in August-September. Seventeen adults and 13 young were collared shortly prior to translocation during the November-December survey and translocation period.

Results

Seven collared animals were found dead during the year. Causes of death comprised predation by cats (4), a python (1) and a raptor (1) and one caught by the collar in a log. Seven suffered signal loss and the collar was removed from one. The incidence of cat predation is higher this year (three out of five, compared with a possible one out of five deaths in 1995). Thirty-seven animals were translocated from Dryandra to reintroduction sites between 5 and 11 December 1996. At the end of 1996, four animals remained alive and transmitting in Dryandra.

Feral cats have emerged as a small but significant source of predation on numbats at Dryandra. It is essential to maintain the program to monitor sources of mortality at Dryandra as well as other sites in case the incidence of predation by cats increases. This is of particular relevance now because of the decrease in rabbit numbers following the arrival of RCD in the Dryandra area and the possibility of prey-switching by cats to include more native mammals in their diet.

Capture and measurement of young at Dryandra in 1996 showed that the growth of young was much slower this year than in previous years. This tendency was also observed at reintroduction sites. This may have been due to low temperatures in spring in 1996 and consequent low termite activity affecting food availability for females. By December, however, weights were similar to other years and it is unlikely that this will cause lower recruitment than usual. It is possible that low termite availability due to the climate may explain the depressed population numbers as well.

Perup

Driven surveys were carried out at Perup-Kingston in February and October 1996. 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) and 1.34/100 km (1994). In February 1996, only one numbat was seen on the survey, a rate of 0.30/100 km. Another survey was carried out in October in order to catch females so that their young could be captured for translocation. Due to rain and subsequent road closures, this survey was restricted to roads with all-weather access. The sighting rate was 1.1/100 km, an increase on February's rate that reflects the presence of young in the population. Given the low sighting rate recorded in February, compared with February 1994, it appears that the Perup/Kingston population has declined significantly. CALM Manjimup staff also reported that there were fewer numbat sightings in 1996 than in previous years.

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 1996, diggings searches were carried out at 44 paired monitoring sites in numbat habitat in the east block, and an intensive diggings search (searches at 200 m intervals along most firebreaks, a total of 269 monitoring sites)

was carried out 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 that in the east block fewer monitoring sites were occupied in 1996 than in 1995 (Figure 3). In the west block there was little difference in the distribution of diggings between 1995 and 1996. Driven surveys bore out these findings, with a decrease in sighting rate in the east block from 2.17/100 km in 1995 to 1.29/100 km in 1996, and a smaller decrease in the west block from 3.08/100 km in 1995 to 2.56/100 km in 1996.

Figure 2 shows the changes in sighting rates at Boyagin since 1992. These data indicate that the east block population has peaked after reaching carrying capacity (Friend 1996b) and is still falling. In the west block it appears that the population has stopped growing and may fall further next year.

Discussion

Numbat numbers appear to have dropped in all three existing populations in 1996. The mortality rate at Dryandra is not significantly higher than in previous years, but the growth rate of young in 1996 has been found to be low at Dryandra as well as at all other sites where young were caught (Dragon Rocks, Batalling and Karakamia: see Action 3.4). Unusual climatic conditions in 1996 may be responsible for these low growth rates and it is possible that the overall population size in November was affected by poor food supplies in spring.

Action 1.3. Effectiveness of silviculture guidelines

During 1995, two numbats resident in logging coupes in the Kingston area near Perup were fitted with radio-collars and tracked through the logging operation. Both survived the logging period without moving home range, but their signals were both lost before further monitoring could be carried out (Friend 1996b). No more numbats were captured in the logging area before the cessation of logging.

No further work was carried out on this action in 1996. If another opportunity arises, where logging is to be carried out in an area in which numbats are resident, high priority should be given to monitoring the effects of logging on the resident numbats.

Action 2. Genetic survey of existing populations

Until now, all numbats for translocation have been taken from, 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. One hundred and forty samples from Dryandra, 15 from Perup and 7 from Boyagin have been sent to Brisbane for this project. Due to unforeseen delays, no results are yet available, but it is anticipated that the Dryandra/Perup comparison will be completed by mid-

1997 at the latest, in good time for a decision on sources of animals for the November 1997 translocations.

Action 3. Translocation

A program of translocations is set out in the Numbat Recovery Plan (Friend 1994). About 20 numbats are to be released 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 (Figure 1), was implemented. Another new translocation site, in the northern jarrah forest, was required for a release in late 1996, while the second annual release at Dragon Rocks was also programmed for late 1996.

Action 3.1. Selection of reintroduction sites

The Numbat Recovery Plan specifies a new reintroduction site in the northern jarrah forest for 1996-98. Fox control in the northern jarrah forest is carried out under the "Operation Foxglove" program, funded by Alcoa and CALM. Selection of a site was carried out with assistance from CALM Mundaring District staff. The criteria for site selection were that the release site should be:

1) an upland jarrah site (consistent with habitat usage recorded in the northern jarrah forest and Perup/Kingston, which is predominantly jarrah)
2) a conservation area
3) under fox control

A number of sites were examined over four months and the area finally selected was on the western boundary of the Dale Conservation Park (Figure 1). Release points were located along Dale Road, which forms the boundary between areas baited twice and four times annually under Operation Foxglove.

A Translocation Proposal prepared according to CALM Policy Statement No. 29 (Translocation of Threatened Flora and Fauna) was submitted and approved. The selected site was used for the release of animals translocated from Dryandra in December 1996.

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

During 1996, the frequency of aerial baiting at Karroun Hill was increased from twice to four times a year, but the intensity has decreased from 7.5 to 5 baits/km^2, in order to meet the CALM standard for baiting large reserves. An area of 40 000 ha with the release site at its centre is now baited in January, April, July and October. During earlier work at Karroun Hill, cat predation became one of the more significant causes of numbat mortality at Karroun Hill. In order to monitor the presence and abundance of cats, cyanide transects were operated for two nights (April 9 and 10, 1996) over 15 km of tracks near the release site, using the most recent methods recommended by

cat control researchers (D. Algar, pers. comm.). Bait stations were established at 200 m intervals along the track and each was marked by a metal stake (chaining arrow) with tinsel tied to the top as a visual lure. Baits used were mulies (large sardines) each with a cyanide capsule (Algar and Kinnear 1992) inserted into the body cavity. At each bait station, one bait was laid and fixed to the ground with a roofing nail to prevent it from being removed intact. The transects were checked at dawn each morning and the baits collected; new baits were put down at dusk.

No cats or foxes were found dead at bait stations. One set of cat tracks and one set of fox tracks crossed the track between stations, but most disturbance of capsules was by birds (ravens in particular). It appears that cat and fox numbers at Karroun Hill are still low, as at October 1995 (Friend 1996b).

Dragon Rocks

During 1996, 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 and initial translocation to a northern jarrah forest site

Dragon Rocks

The Numbat Recovery Program identifies Dragon Rocks Nature Reserve as a translocation site during 1995-1997. In December 1995, 20 numbats were translocated from Dryandra to a release site within Dragon Rocks NR (Friend 1996b). The 1996 translocation group comprised 17 animals captured from the wild at Dryandra, including 5 juvenile and 3 adult males, and 1 juvenile and 8 adult females. Ten were released at Dragon Rocks on 10 December and seven on 11 December 1996. Three release sites were used, comprising the 1995 release site and two other valleys containing stands of salmon gum (*Eucalyptus salmonophloia*) where numbats from the 1995 release had established home ranges.

Dale Conservation Park (northern jarrah forest)

In November, suitable release logs were selected at four release sites in upland jarrah forest in Dale Conservation Park, over a distance of 1.5 kilometres along Dale Road. The release group comprised 20 numbats taken from the wild at Dryandra and included 5 juvenile and 4 adult males, and 5 juvenile and 6 adult females. Twelve numbats were released on 5 December and the remaining 8 on 6 December 1996.

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 have been carried out at Karroun Hill during 1995 and 1996. The first diggings search will be 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
Dale CP	1996

Karroun Hill

No animals remain radio-collared at Karroun Hill NR. During the field trip in April 1996 to run cyanide transects to survey for cat presence, searches for numbat diggings were also carried out, and together with searches in October 1995, have 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 clear that a residual population exists at Karroun Hill Nature Reserve. Due to the large size of the reserve (300 000 ha) 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. A review of the role of Karroun Hill in the numbat recovery program will be carried out during 1997, as it is listed as the next release site, for releases in 1997-99.

Batalling

The major releases of numbats at Batalling, involving 15-20 animals each year, were carried out in 1992, 1993 and 1994. Due to a high transmitter failure rate during the latter two years, it was difficult to assess the success of the reintroduction, however. Transmitters were obtained from another supplier in 1995 and another 9 animals were released there in November/December 1995. This allowed continued monitoring of numbats at Batalling and the capture and collaring of four young raised by one of the translocated females. Two numbats were not located from the air after release, and may have moved out of the search area. The signal of another was lost, after she had been located on the ground alive, and one numbat appears to have removed its own collar, which was still transmitting. Four young were collared in October, so there is now a group of seven animals to allow radio-monitoring to continue (Table 2). As at Dryandra, these young were small for their age.

The first unassisted sightings of numbats at Batalling were made in November 1996. This may indicate that the population is building up in the area. Together with the low mortality rate demonstrated by radio-monitoring, the impression is given that the Batalling population is becoming established. Diggings searches to be carried out in January 1997 will shed further light on the state of the population.

Tutanning

Tutanning Nature Reserve is only 2089 ha in area and may be close to the minimum size able to support a viable numbat population. With the exception of 1991, each year's release groups have been small in size as the reintroduction there has always been of lower priority than those to larger reserves. Numbers released each year are as follows: 1987, 3; 1990, 2; 1991, 14; 1992, 7; 1994, 1; 1995, 6; 1996, 2. Before 1996, monitoring had solely involved checking on collared individuals, although 12 of the 35 animals were released without radio-collars.

A number of incidental sightings have been recorded since 1994, however, signifying that the density of numbats has risen to a significant level. In March 1996, the first driven survey at Tutanning was carried out. Six circuits of a set route of 37.1 km were driven over a week. Only two numbats were sighted, giving a sighting rate of 0.9/100 km. This sighting rate is low in comparison with some other areas, but that is to be expected, as the visibility is much lower than, for instance, Dryandra. It indicates that a residual numbat population exists at Tutanning, after years of translocation of low numbers of animals. This survey has established a baseline for subsequent annual driven surveys.

Dragon Rocks

Twenty numbats were translocated from Dryandra to Dragon Rocks NR in December 1995 in the first of three planned releases. Currently eight of these animals are alive and transmitting. Seven are known dead, four signals have been lost (including one that was not picked up from the air after release). Two animals removed their own collars, but one was fortuitously sighted by Neil Thomas and recaptured. The causes of the seven known deaths have been attributed to the following causes: one, predation by a raptor; one, no obvious cause of death (possibly starvation); five, probable predation by cats.

Four litters of young bred at Dragon Rocks were recorded during the year. A total of 15 attached young (three litters of four and one litter of three) were recorded and 12 were collared in October/November 1996. Seventeen more animals were translocated from Dryandra in December 1996.

The relatively low mortality rate experienced at Dragon Rocks in the first year gives cause for optimism. Including the young captured, the radio-collared population in early December 1996, at 19, is almost as large as the original release group. The use of reliable radio-collars has greatly enhanced our ability to monitor the progress of this reintroduction. The prominent role of cats in the mortality of Dragon Rocks numbats is of concern, however. It may be necessary to deploy cat control methods as soon as they become available.

Yookamurra

Fifteen radio-collared numbats were released at Earth Sanctuaries' 1113 ha fenced property, Yookamurra, in South Australia, in October and November 1993. The progress of the population has been monitored by Yookamurra staff with advice and assistance from CALM SID staff.. Only one young was collared in October 1994, despite 16 attached young being recorded during the year. Four young were collared in October 1995, but all slipped their collars before the end of the year. At the beginning of 1996, only two numbats were collared, a female (Gizmo), from the 1993 release and a locally-born male, Judas II, captured fortuitously on 30 December 1995. In March, Gizmo's signal was lost, but one of the previously-collared 1993 release males, Matski, was seen and recaptured on 10 May 1996. Two new males were also seen, captured and collared during the year; Al (22 March 1996) and Elvis (17 October 1996)..

During spring 1995, several unassisted sightings were made at Yookamurra. This indicated that the Yookamurra reintroduction had reached the second monitoring phase, when diggings searches and driven surveys are warranted. To this end, Tony Friend visited Yookamurra in August 1996 to carry out a diggings survey to assess the spread of numbats in the sanctuary. At this stage, only two males were collared, but diggings were found in a number of areas of the sanctuary outside the home ranges of both animals'. During 1996, sightings of uncollared numbats in the sanctuary increased, and 15 had been recorded by mid-July. Twenty sightings were made in the last two weeks of October 1996, at the time when the young are normally starting to move around.

These observations indicate that the Yookamurra population is also now well established. Early problems with feral predator incursion seem to have been solved, with routine baiting now part of the management of the sanctuary.

Karakamia

In December 1994 this 180 ha fenced sanctuary was the site of the release of a male and two female numbats from Dryandra. The transmitter on the female Yoko failed soon after release, but she was seen several times afterwards and a young female Kiri, that was not progeny of the other female Samantha, was captured on 20 December 1995. Three young of Samantha (one female, Sarsby and two males, Tom and Bill) were collared on 18 October 1995. The young female was found dead on 24 October 1995. At the beginning of 1996 the adult male, Buzz, Samantha, Kiri, Tom and Bill were being radio-tracked. After the breeding period, Samantha had four young attached and Kiri three. Buzz was found dead on 29 March 1996, all indications being that he was taken by a bird of prey.

At this stage discussions between Karakamia management and CALM resolved that in order to reduce inbreeding, the two young males would be removed and a new male introduced from Dryandra. On 19 April 1996 a juvenile male from Dryandra, Chaplin, was released at Karakamia. His signal was lost almost immediately, so to ensure that at least one male remained it was decided to remove only one of the young males. Tom was captured and released at Tutanning on 30 April 1996. Bill's signal was later lost but he was recaptured on 8 July 1996 and recollared. On 3 October 1996 he was recaptured and found to have a large abscess under the radio-collar, so the collar was removed.

Attempts to capture young for collaring were foiled by the small size of young at the time when they are usually over 350 g and quite large enough to collar. The tendency of females at Karakamia to make nursery dens in old rabbit warrens, rather than digging their own simple burrows, also caused great difficulty. Samantha's young escaped when she was dug up on 24 October 1996, and when Kiri was dug up with two young on 24 October 1996, she was found to have a broken leg, which may or may not have happened in the struggle to unearth her. The young weighed only 140 g and 145 g, and were released uncollared. Kiri's undamaged collar was found six days later with a small tuft of fur: it is impossible to say whether she removed her own collar or if she was taken by a bird of prey.

In future, attempts to dig up and collar young at Karakamia will only be made if the female is easily accessible.

At the end of 1996, only Samantha remains collared. The results of radio-monitoring in 1995 and 1996 show that numbats survive and breed well at Karakamia. It is possible that this year's attempts to catch young may have resulted in a setback for the colony, but the ability of Karakamia to support a managed numbat population has been proven. If staff time can be allocated at the

current level to maintaining radio-collars on animals, Karakamia may be able to supply numbats to the reintroduction program.

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.

Fresh faecal samples are sent for screening for other parasites. A health monitoring protocol for the translocated numbats is being implemented in 1997.

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.

The captive colony at Perth Zoo currently consists of 17 individuals (seven adult males and 10 adult females). No breeding occurred in the colony during the January 1996 breeding season. An adult male (studbook no. 40, tattoo 40 right thigh) died on 25 October 1996 of haemoglobinuric nephrosis. He was born in January 1991 at Dryandra and was taken from the wild on 28 November 1991, remaining in captivity for almost 5 years and siring two litters. One juvenile male (implant no. 00-011E-A95B) was taken from the wild at Dryandra on 19 April 1996 and incorporated into the breeding colony.

A new breeding research program commenced on 7 October 1996 and currently six pairs utilise the 24 cage units, with females having a double cage and males having a single cage. There is a one metre high visual barrier surrounding all enclosures. The animals will remain separated until there is evidence of pro-oestrus by monitoring epithelial cell development in the urine of females and if males are producing spermatozoa.

There are two female and one male control animals which will be monitored but not paired. The two older females (8 years old) currently reside on display and will not be included in the breeding program. Fortnightly trapping will continue until May 1997. During this period urine and faeces samples will be collected, testes and sternum glands measured and accessory sex glands monitored. A steady and reliable supply of termites is anticipated. Nutritional analysis of termites is under consideration. Storage of larger quantities of termites may create a problem in the future so investigation into the possibilities is worthwhile.

Action 6. Public awareness, education

Talks on the Numbat Recovery Program were presented at a number of forums during 1996: the Perth Zoo Docents Association on 13 March 1996, the WA Naturalists Club on 12 April 1996, Coolbinia Primary School Year 7 on 9 May 1996, Belmont Primary School Years 5 & 6 on 16

May 1996, Quintilian Primary School Year 2 on 28 June 1996, Friends of the Perup on 7 & 8 December 1996.

ACKNOWLEDGMENTS

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REFERENCES

Algar, D., and Kinnear, J.E. (1992). Cyanide baiting to sample fox populations and measure changes in relative abundance. Pp. 135-8 **in** P. O'Brien and G. Berry (eds) "Wildlife Rabies Contingency Planning in Australia". (Bureau of Rural Resources Proceedings No. 11). Australian Government Printing Service: Canberra.

CALM (1994). Fox control manual. Department of Conservation and Land Management, Perth.

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. (1994). Recovery Plan for the Numbat, 1995-2004. Report to the Australian Nature Conservation Agency under Project 351, Endangered Species Program. Department of Conservation and Land Management, Perth.

Friend, J.A. (1995). Numbat Recovery Team: Annual Report for 1994. Report to ANCA Endangered Species Program, Department of Conservation and Land Management, Perth.

Friend, J.A. (1996a). Protecting endangered fauna from introduced predators. Pp. 127-42 **in** B. Diekman (ed) "Unwanted Aliens? - Australia's Introduced Animals". Nature Conservation Council of NSW, Sydney.

Friend, J.A. (1996b). Numbat Recovery Team: Annual Report for 1995. Report to ANCA Endangered Species Program, Department of Conservation and Land Management, Perth.

Kinnear, J. (1990). Trappings of success. *Landscope* **5** : 35-40.

Kinnear, J.E., Onus, M.L. and Bromilow, R.N. (1988). Fox control and rock-wallaby population dynamics. *Australian Wildlife Research* **15** : 435-50.

TABLE 1. Results of monitoring radio-collared numbats at Dryandra over the period 1 January-31 December 1996.

Origin	Collared	Known dead	Signal lost	Trans-located	Alive and transmit-ting
DRYANDRA					
Collared at 1 January 1996	6	1	2		3
Young collared during 1996	22	4	2	16	0
Adults collared during 1996	30	2	4 (1 removed)	23	1
Total	**58**	**7**	**8**	**39**	**4**
PERUP					
Adults collared during 1996	2		1		1
Total	**2**	**0**	**1**	**0**	**1**

TABLE 2. Results of monitoring radio-collared numbats at reintroduction sites over the period December 1995-December 1996.

Site and origin	Collared	Known dead	Signal or collar lost	Trans-located	Alive and transmit-ting
BATALLING					
Adults resident 1/12/95					0
Young bred on site 1995					0
Translocated from Dryandra 12/95	9	2	4 (1 broke collar)		3
Young bred on site 1996	4				4
Total	**13**	**2**	**4**		**7**
TUTANNING					
Adults resident 1/12/95	1	1			0
Translocated from Karakamia	1	1			0
Translocated from Perth Zoo	1	1			0
Total	**3**	**3**	**0**		**0**
YOOKAMURRA					
Adults resident 1/12/95	3		2		1
Young bred on site 1995	1				1
Young bred on site 1996					
Total	**4**	**0**	**2**	**0**	**2**
KARAKAMIA				(Tutanning)	
Translocated from Dryandra	2		1		1
Young bred on site 1995	3	2	1	1	0
Young bred on site 1996	0				0
Total	**6**	**0**	**2**	**1**	**3**
DRAGON ROCKS					
Translocated from Dryandra Dec. 1995	20	7	5 (1 slipped collar)		8
Young bred on site 1996	12	1			11
Translocated from Dryandra Dec. 1996	17				17
Total	**49**	**8**	**5**		**36**
DALE CP					
Translocated from Dryandra Dec. 1996	20				20
Total	**20**	**0**	**0**		**20**

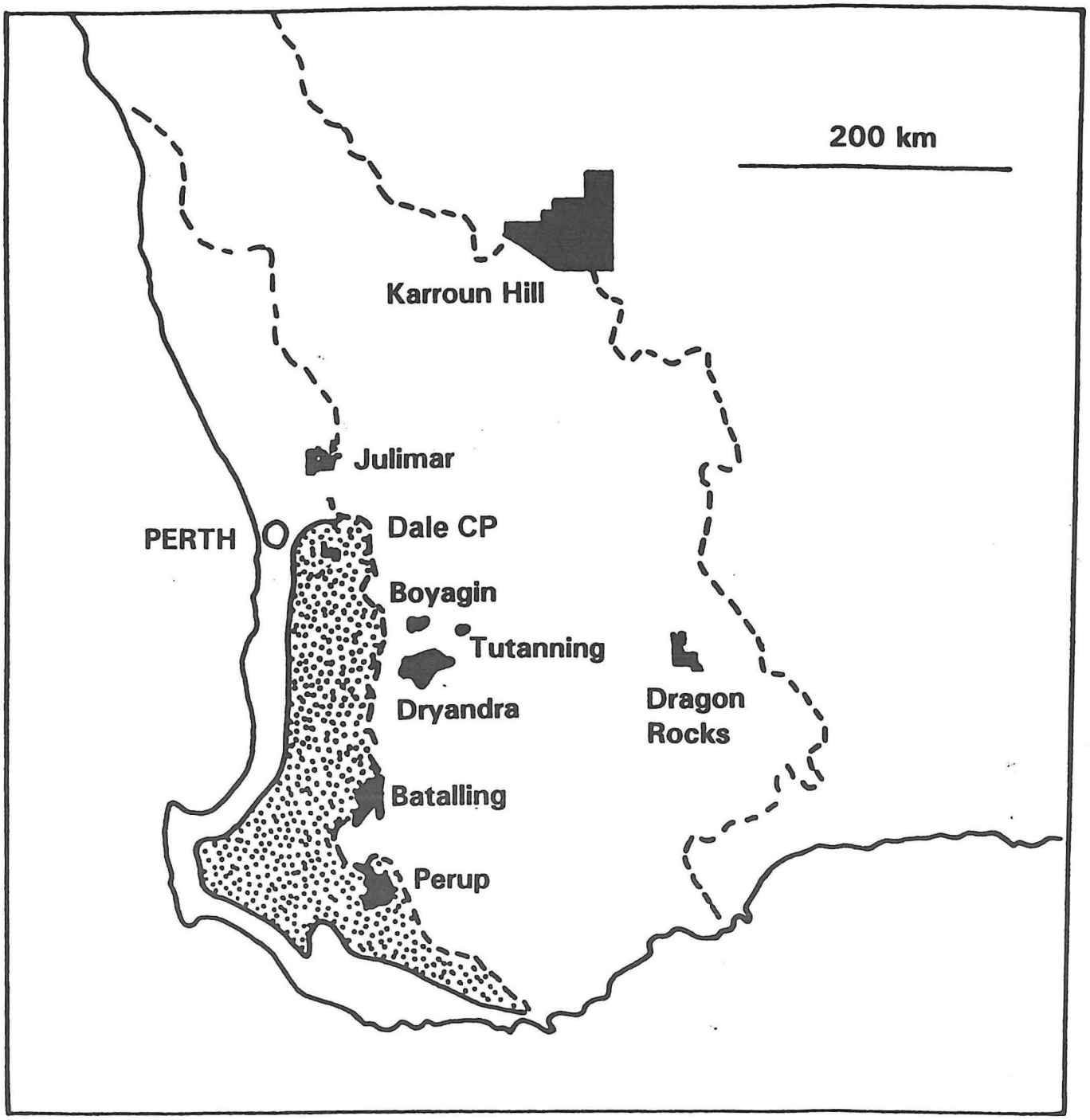


Figure 1. Locations of surviving Numbat populations and proposed re-introduction sites (shown in black). The dashed lines enclose the most heavily cleared agricultural area (termed "the wheatbelt"); the stippled area is the portion of the main forest block dominated by jarrah or wandoo.

Figure 2. Numbat sighting rates during driven surveys at Dryandra Woodland (main block and Montague block) and at Boyagin Nature Reserve (east and west blocks). Note that these graphs only demonstrate trends within each site: because of variation in visibility between sites, it is not possible to compare sighting rates at different locations. Thus the denser vegetation at Boyagin results in lower sighting rates than at Dryandra.

Numbat Sighting Rate

at Dryandra and Boyagin

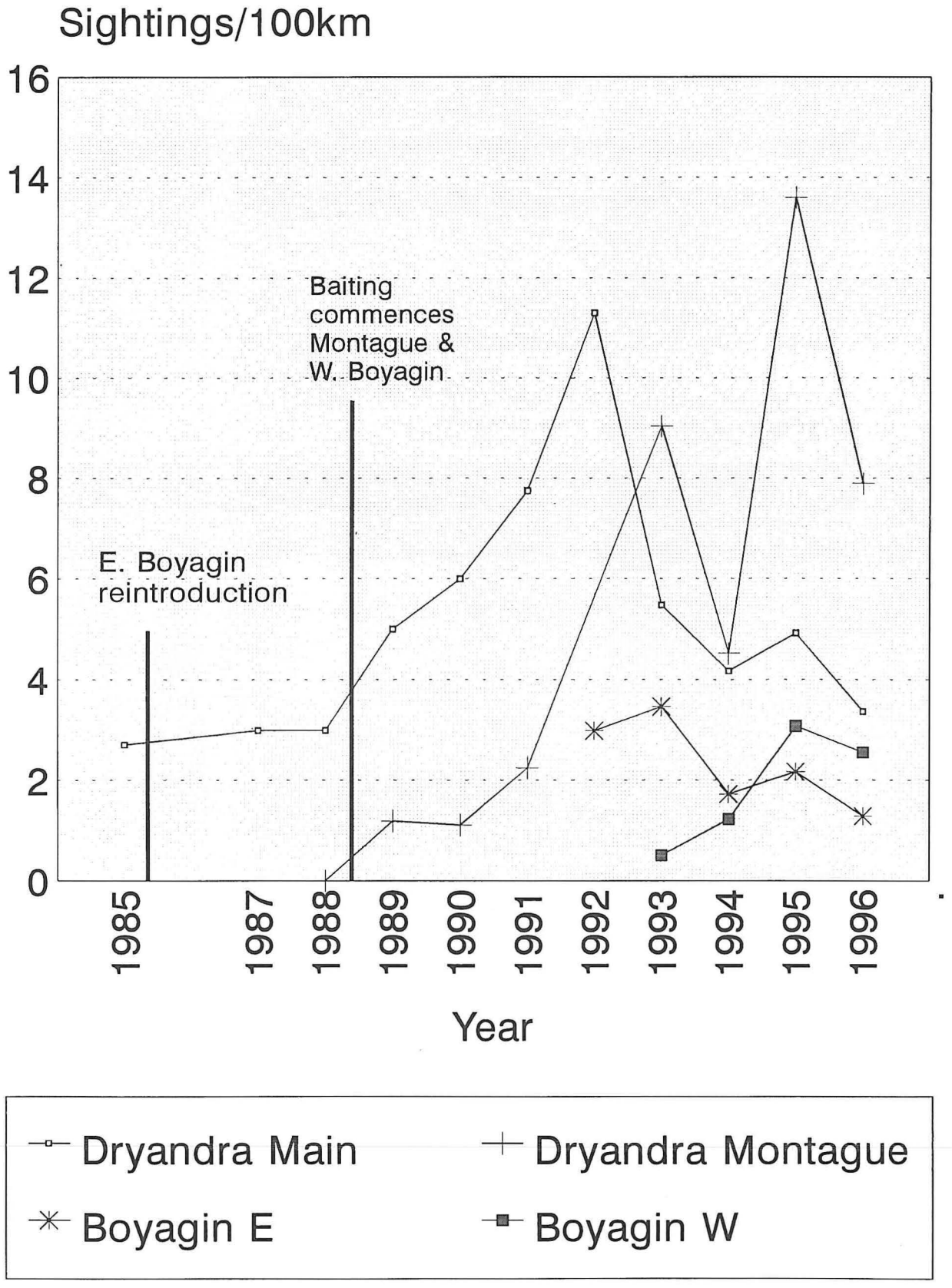
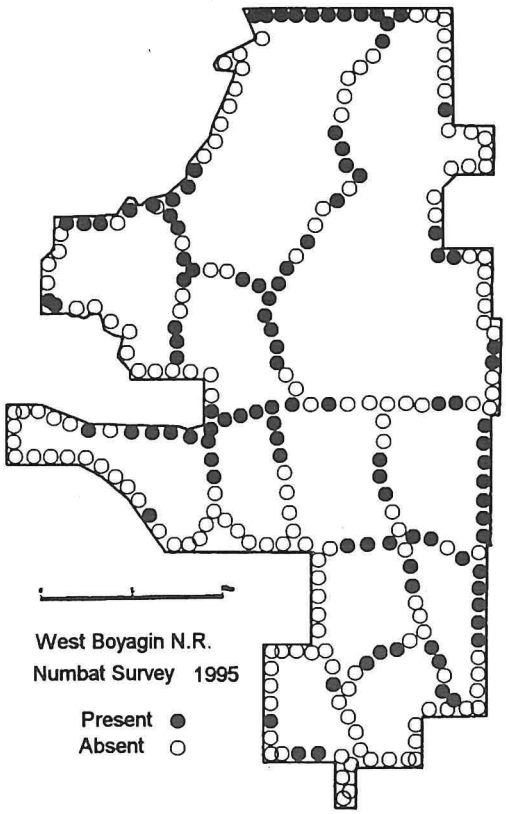
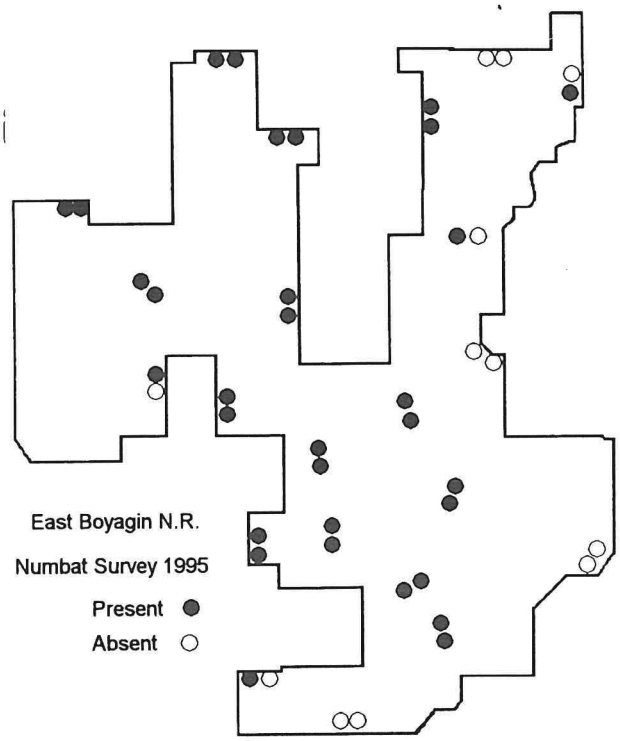


Figure 3. Results of diggings surveys in east and west blocks of Boyagin Nature Reserve in October 1995 and October 1996.


West Boyagin N.R.
Numbat Survey 1995
Present
Absent


East Boyagin N.R.
Numbat Survey 1995
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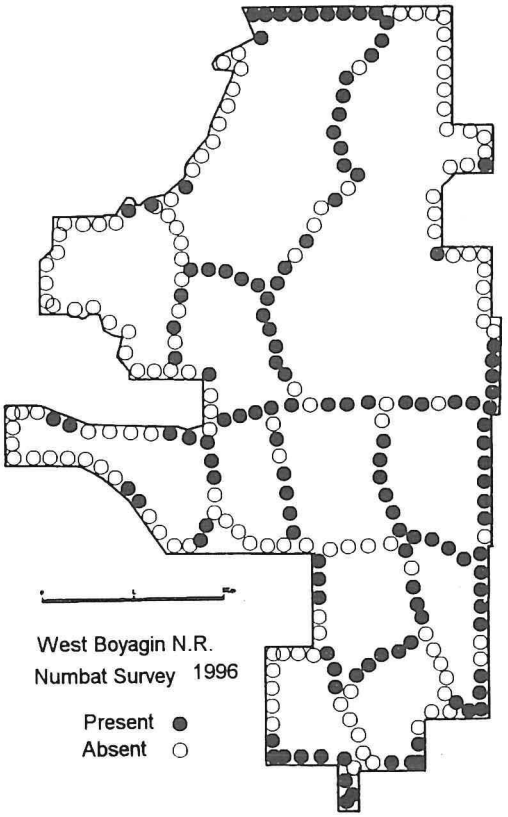
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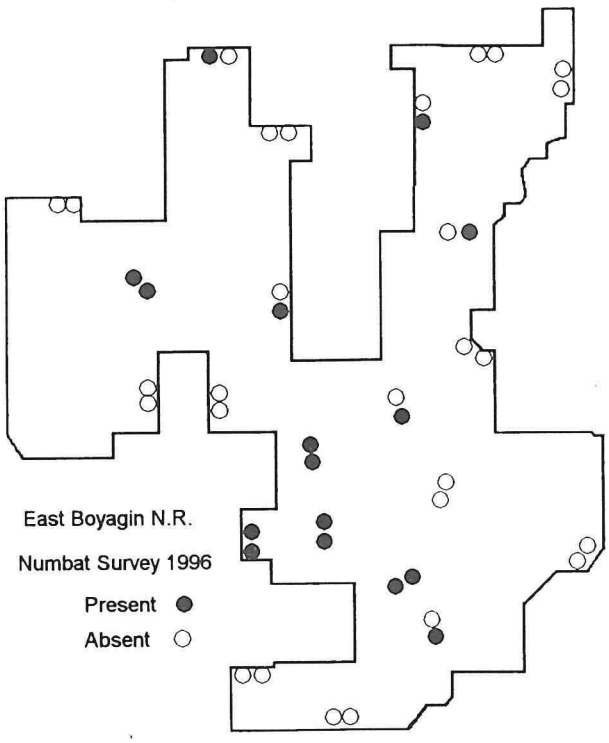
East Boyagin N.R.
Numbat Survey 1996
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