ANCA FERAL PESTS PROGRAM
PROJECT 18

ASSESSMENT OF THE EFFECT OF FOX CONTROL ON POPULATIONS OF THE RED-TAILED PHASCOGALE PHASE 3

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SUMMARY

An experiment has been set up to test the hypothesis that fox control causes an increase in numbers of *Phascogale calura* where this species occurs in remnant vegetation in the Western Australian wheatbelt. Population numbers are monitored by trapping between March and June, before all the males of this semelparous species die, in July. *Phascogale calura* populations on nine reserves have been monitored since 1993. Fox control by 1080 baiting has been carried out for over five years on three of these reserves, and commenced on three more in October 1994 and another in December 1994. Two reserves remain unbaited as controls. It is expected that any effect of baiting on *P. calura* populations will be detected through relative changes in the numbers of phascogales captured.

The trapping program established in 1993-94 continued in 1995. Between March and June, three trapping sessions of three nights' duration were conducted on each of two grids on each reserve (288 trapnights per session per reserve). The trapping program resulted in 373 captures (including repeats) and involved the capture of 234 individual red-tailed phascogales. This compared with 599 captures comprising 294 individuals in the identical trapping program carried out in 1994. There is some evidence that the drought of 1994 has reduced *P. calura* population numbers in 1995, and it is likely that increased interference from brushtail possums and woylies also contributed to the drop in the total number of captures. The most dramatic changes in the number of red-tailed phascogales known to be alive on reserves at the second trapping session in 1995 compared with 1994 were decreases recorded on one of the unbaited reserves and on one of the newly-baited reserves. As baiting had only been in progress for three months on one reserve and five months on three others, it is too early to draw any conclusions about the effect of fox-baiting on *P. calura* numbers. However, populations on long-term baited reserves appear to exhibit more stability of numbers.

An extra trapping session was carried out on each reserve in August-September 1995 to monitor the production of young, as in 1994. Trapping commenced almost two weeks later than in 1994. Twenty-eight females were captured, but none was carrying pouch young, although most were lactating. It is likely that breeding occurred earlier in 1995 than in 1994, possibly because of differences in weather between the two years.

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INTRODUCTION

The red-tailed phascogale (*Phascogale calura*) is a small (30-70 g) semi-arboreal carnivorous marsupial now found only in semi-arid woodlands in south-west of Western Australia. The record of the former distribution of this species provided by collections of live specimens indicates a patchy occurrence across much of arid and semi-arid Australia (Kitchener 1982). Recent work on sub-fossil material shows that red-tailed phascogales were widely distributed across that area (e.g. Smith and Medlin 1982; Baynes and Baird 1992; Baynes and Jones 1993), but survey work as well as Aboriginal information show that the species has disappeared from much of that range (Friend and Friend 1992; Burbidge *et al.* 1988). As with many medium-sized Australian mammals, all *P. calura* populations in the arid zone and many in the semi-arid zone had disappeared by the end of the 1950s and many of the local extinctions coincided with the arrival of the red fox (*Vulpes vulpes*) (Finlayson 1961).

Today, conservation of the red-tailed phascogale relies on its persistence in a scatter of isolated, mostly small vegetation remnants in the southern part of the Western Australian wheatbelt (the region known as the "Great Southern"). Most of the known populations occur on nature reserves, over half of which are smaller than 300 ha (Friend and Friend 1992). These reserves are managed by the Department of Conservation and Land Management for nature conservation. In many of them, *P. calura* is the only threatened animal species recorded. The current project, funded under the Feral Pests Program, Australian Nature Conservation Agency, involves an experiment designed to quantify the effect of fox control on the population dynamics of *P. calura*, in order to determine whether baiting programs should be implemented to improve the conservation status of the species. This report gives details of the progress made on the Scope items laid out in the contract for Phase 3 of the project, covering work carried out in 1995. A general outline of the experiment follows.

Measurement of population size in P. calura

Adult *P. calura* are readily trapped in medium-sized Elliott traps, but juveniles are not. Due to the pattern of annual male die-off in this species after mating in July and the death of most females after weaning their first litter in November (Kitchener 1981, Bradley 1987), the most productive trapping period is between February and June, when all animals have attained adult size (and trappability) but prior to the male die-off. The strategy employed in this project is to run three trapping sessions at each site over a three-month period during that time, and to use the number of animals known to be alive (KTBA) at the second trapping session as the population index at each grid site.

Use of KTBA at the second of three trapping sessions is intended to provide a more reliable estimate of population numbers than one or two sessions. The length of a single trapping session is limited as a significant number of *P. calura* individuals go into traps every night they are set (Friend and Scanlon 1995a). The longer the trapping session, the greater is the risk of trap death due to lack of feeding and cold (*P. calura* tend not to eat the bait provided). In this project, therefore, trapping sessions are limited to three nights duration.

Experimental design

This experiment conforms to the BACI design (Before/After/Control/Impact). Regular trapping to assess red-tailed phascogale population numbers is carried out on a total of nine reserves in the Great Southern district of Western Australia. Fox control has been carried out on three of them (Dryandra, Tutanning and Boyagin) for at least five years prior to 1993. These reserves constitute a "baited control", on the assumption that their fauna populations have reached an equilibrium under a baiting regime. Fox control commenced on four of the other reserves (Jaloran, Dongolocking, Pingeculling and East Yornaning) between October and December 1994, and two (West Ashby and Yilliminning) will remain unbaited. Locations of these reserves are shown on Figure 1, and details of their size and baiting history are given in Friend *et al.* (1994).

Two trapping grids (6 x 8 medium Elliotts at 40 m spacing) have been established and permanently marked in suitable habitat on each reserve, and trapping sessions are conducted three times between February and June each year. During 1993 as Phase 1 of this project, the study reserves were selected after survey trapping, and one trapping session was conducted on each reserve. In 1994, as Phase 2 of this project, a full trapping program was conducted in order to establish population levels before the commencement of the new baiting programs. Phase 3 involved the repetition of that trapping program in 1995 to begin to assess the effect of fox control on *P. calura* populations. The trapping program will continue until at least 1997, allowing three post-baiting censuses to follow any changes in the size of *P. calura* populations. Other mammal populations, such as the numbat *Myrmecobius fasciatus* (Friend 1990), the woylie *Bettongia penicillata* and the tammar *Macropus eugenii* (Kinnear 1990) have responded to fox control within this time.

When there are sufficient years' data to allow, trapping data will be analysed by repeated measures ANOVA (Green 1993), which can use changes with time as well as comparison between control and experimental sites to detect any treatment effect on the KTBAs across reserves in each group.

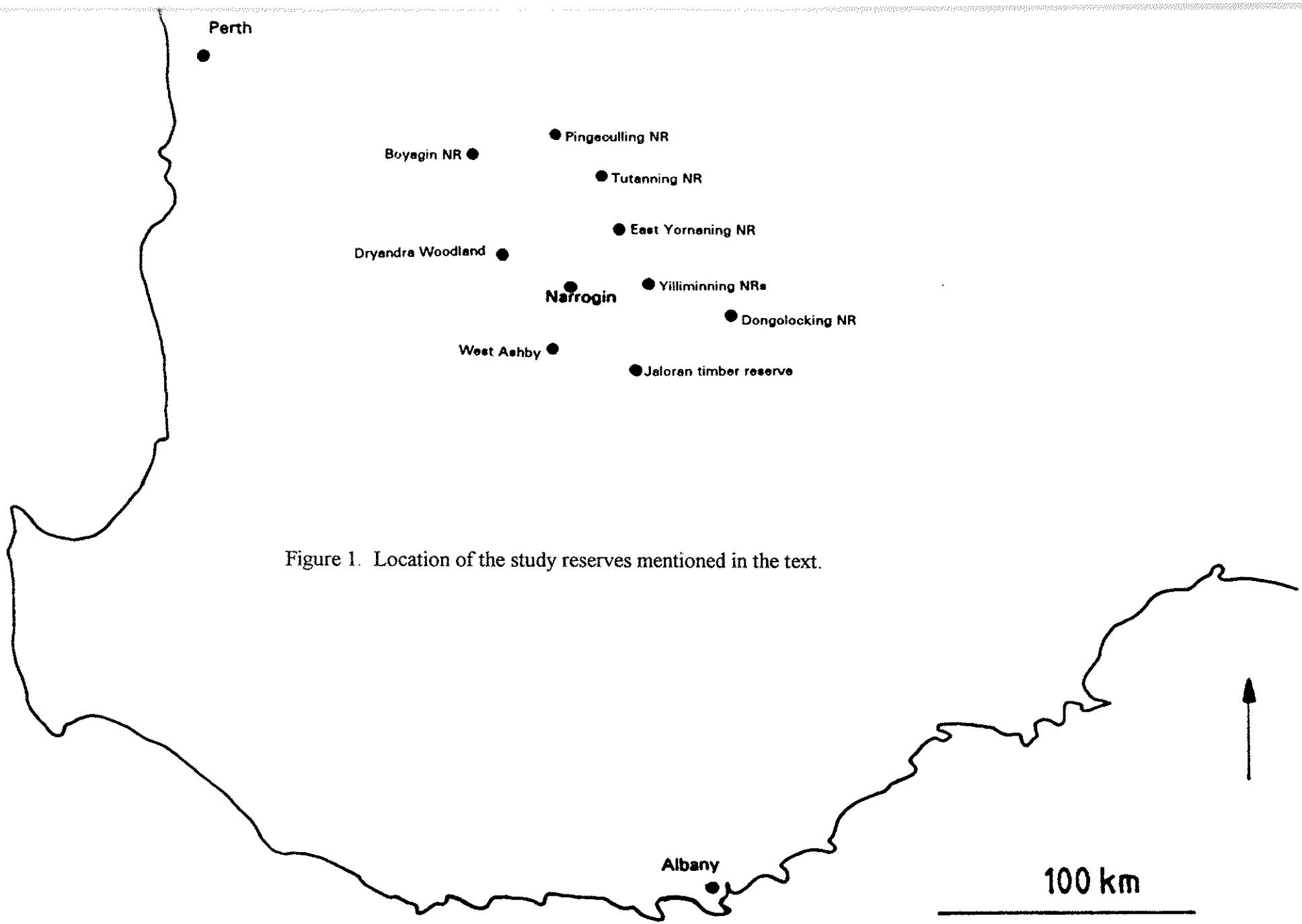

Figure 1. Location of the study reserves mentioned in the text.

TRAPPING PROGRAM IN 1995 (SCOPE ITEM 1)

Scope item 1) ***Following commencement of fox-baiting on three of the previously unbaited reserves, continue to conduct trapping censuses on each of the trapping grids established in the first phase of the project.***

Fox control implementation

The new baiting programs implemented under this project are carried out by CALM district staff and commenced in October 1994. As explained in the final report for Phase 2, baiting was introduced on four, rather than three reserves: Pingeculling, Jaloran, Dongolocking and East Yornaning. Baiting is now being carried out at Pingeculling and East Yornaning by CALM staff based in Pingelly and Narrogin, and at Jaloran and Dongolocking by CALM staff based in Katanning.

Ongoing fox-baiting on Dryandra, Tutanning and Boyagin is carried out by CALM district staff based at Pingelly and Narrogin.

Currrent fox baiting procedures (CALM 1993) involve spreading of dried meat baits from a vehicle or by plane. On small reserves surrounded by cereal and sheep farms, aerial baiting is generally not practicable, so vehicle-based baiting is used.

Baits are made from kangaroo meat cut into 120 g pieces and dried to 40% of their wet weight. After about one day of drying, the baits are injected with a solution of sodium fluoroacetate (1080) such that the dose per bait is 4.5 mg of 1080. One bait contains sufficient 1080 to kill any fox.

Baits are laid along perimeter firebreaks (except near corners, gates and areas used by the public) and some internal firebreaks. Before the commencement of baiting, the neighbours are contacted and warned of impending danger to wandering dogs. Warning signs are erected on baited reserves.

A regime of monthly baiting using meat baits commenced on Pingeculling on 13 October 1994, on Jaloran and Dongolocking on 24 October 1994 and on East Yornaning on 30 December 1994. Table 1 shows the dates on which subsequent baiting has been carried out. On Dongolocking and Jaloran, baits were initially distributed at 200 m intervals, but from 20 February 1995, baiting intensity was increased by reducing the distance between baits to 100 m for consistency with the baiting carried out at Pingeculling and East Yornaning and following guidelines for small reserves set out in CALM (1993).

The effectiveness of the baiting method in reducing fox numbers is monitored through opportunistic observation of fox tracks on sandy firebreaks in the reserves.

Table 1. Dates on which baiting was carried out on newly baited study reserves, up to the middle of January 1996. Dates in italics indicate distribution of baits at 200 m intervals along firebreaks; baiting on other dates was at 100 m intervals.

Jaloran and Dongolocking	Pingeculling	East Yornaning
24 October 1994	13 October 1994	
22 November 1994	16 November 1994	
23 December 1994	12 December 1994	30 December 1994
19 January 1995	20 January 1995	20 January 1995
20 February 1995	16 February 1995	14 February 1995
21 March 1995	21 March 1995	22 March 1995
24 April 1995	11 April 1995	12 April 1995
29 May 1995	17 May 1995	17 May 1995
28 June 1995	9 June 1995	9 June 1995
2 August 1995	4 July 1995	7 July 1995
15 August 1995	14 August 1995	16 August 1995
26 September 1995	13 September 1995	11 September 1995
24 October 1995	16 October 1995	17 October 1995
21 November 1995	15 November 1995	16 November 1995
14 December 1995	14 December 1995	13 December 1995
11 January 1996	7 January 1996	9 January 1996

Trapping censuses

Methods

Methods and trapping grids used were as described earlier. Trapping was conducted on all nine reserves between 21 March and 16 June 1995. Three trapping sessions were completed on all 18 grids between those dates, comprising 864 trapnights on each reserve, or a total of 7776 Elliott trap-nights. Table 2 shows the dates on which each three-night trapping session commenced on each reserve.

Results

Phascogale populations across reserves

A total of 373 captures (including repeats) were made during the March-June 1995 trapping program. This tally involved the capture of 234 individual red-tailed phascogales. This is a lower overall rate of capture than during the 1994 trapping season (599 captures of 294 individuals). Use of numbers known to be alive (KTBA) at the second trapping session has been found to be an robust measure of the red-tailed phascogale population size in this project (Friend and Scanlon 1995a). Table 3 shows

Table 2. Pre-mating period trapping program completed in 1995.

Reserve	First night of trapping session			Treatment
	Session 1	Session 2	Session 3	
Dryandra	19/4/95	16/5/95	7/6/95	Long-baited
Tutanning	11/4/95	23/5/95	14/6/95	Long-baited
Boyagin	19/4/95	23/5/95	14/6/95	Long-baited
Jaloran	21/3/95	3/5/95	31/5/95	Newly baited
Dongolocking	5/4/95	16/5/95	14/6/95	Newly baited
Pingeculling	11/4/95	23/5/95	14/6/95	Newly baited
East Yornaning	29/3/95	9/5/95	7/6/95	Newly baited
West Ashby	21/3/95	3/5/95	31/5/95	Unbaited
Yilliminning	5/4/95	9/5/95	14/6/95	Unbaited

the numbers of red-tailed phascogales known to be alive (KTBA) at the second trapping session on the study reserves in 1994 and in 1995. The data for each reserve (pooled captures for both grids) are also presented in Figure 2.

Note that there are some differences from data presented in the progress report for Phase 3. The data in Table 3 and Figure 2 include some animals caught in previous years and only recaptured during trapping session 3. These animals were inadvertently omitted from the calculations of KTBA in previous analyses.

Table 3. Numbers of red-tailed phascogales known to be alive (KTBA) on each grid at the second of three trapping sessions in 1994 and 1995, and total KTBA on both grids in the nine study reserves.

Treatment	Reserve	Grid 1	Grid 2	Grids 1+2	Grid 1	Grid 2	Grids 1+2
		1994			1995		
Long-baited	Dryandra	1	1	2	1	1	2
Long-baited	Tutanning	11	5	16	7	11	18
Long-baited	Boyagin	6	4	10	9	4	13
Newly baited	Jaloran	11	7	18	1	4	5
Newly baited	Dongolocking	2	8	10	4	7	11
Newly baited	Pingeculling	10	2	12	5	8	13
Newly baited	East Yornaning	29	16	45	19	12	31
Unbaited	West Ashby	6	3	9	2	2	4
Unbaited	Yilliminning	10	9	19	4	0	4

Recaptures between years

On the basis of trapping on each grid over three years, survival of red-tailed phascogales may be determined. Although several males which may have survived the die-off were recorded in 1994 from ear-notches, the lack of captures of large males early in any trapping season makes it more likely that these were misidentified or mismarked animals. Figure 3 shows the number of female phascogales from each

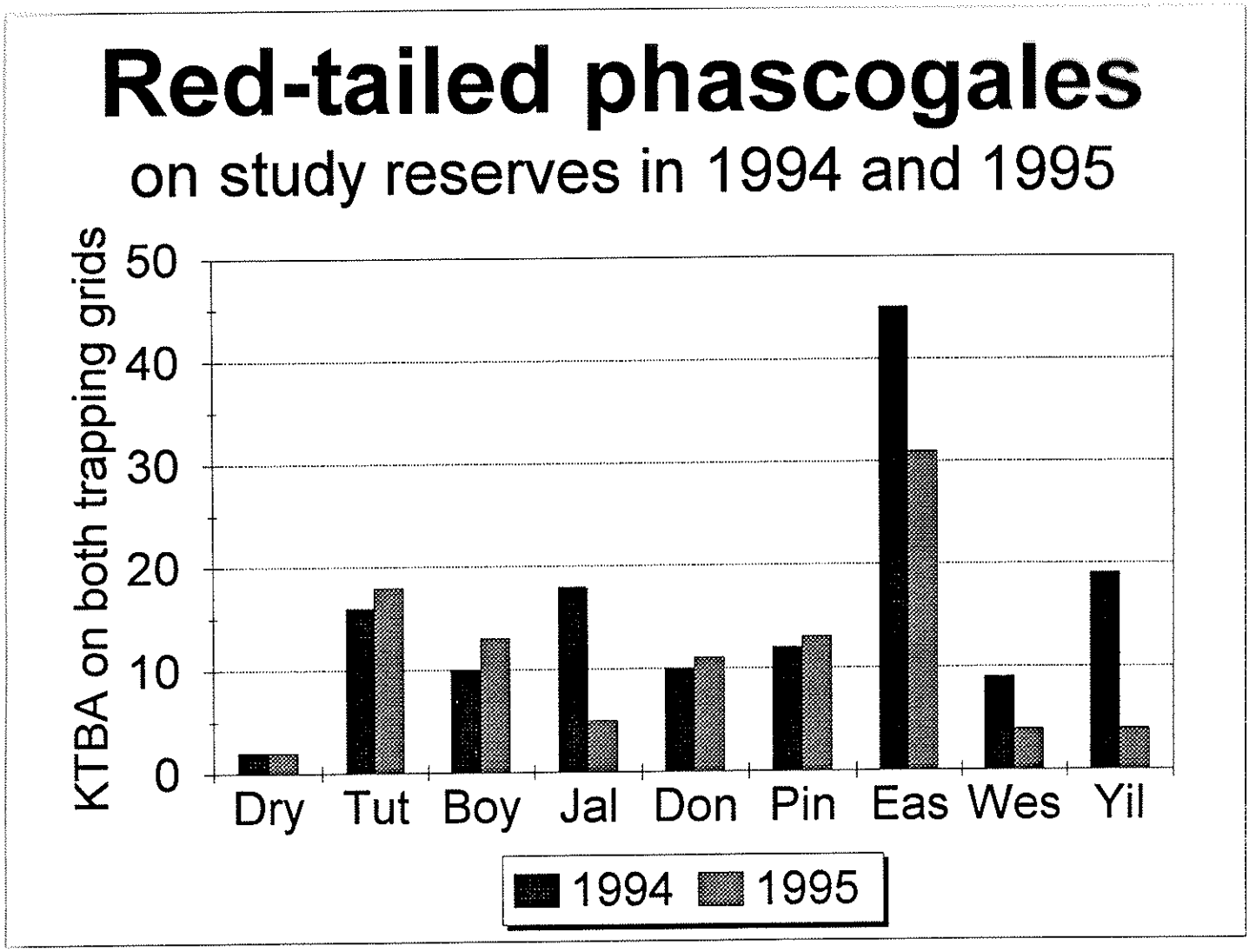

Figure 2. Numbers of red-tailed phascogales known to be alive on two trapping grids on each of nine study reserves in May 1994 and May 1995. Baiting commenced on Jaloran, Dongolocking and Pingeculling in October 1994 and at East Yornaning in December 1994.

Dry - Dryandra Woodland
Tut - Tutanning Nature Reserve
Boy - Boyagin Nature Reserve
Jal - Jaloran Road Timber Reserve
Don - Dongolocking Nature Reserve
Pin - Pingeculling Nature Reserve
Eas - East Yornaning Nature Reserve
Wes - West Ashby block, Highbury Woodland
Yil - Yilliminning Nature Reserve

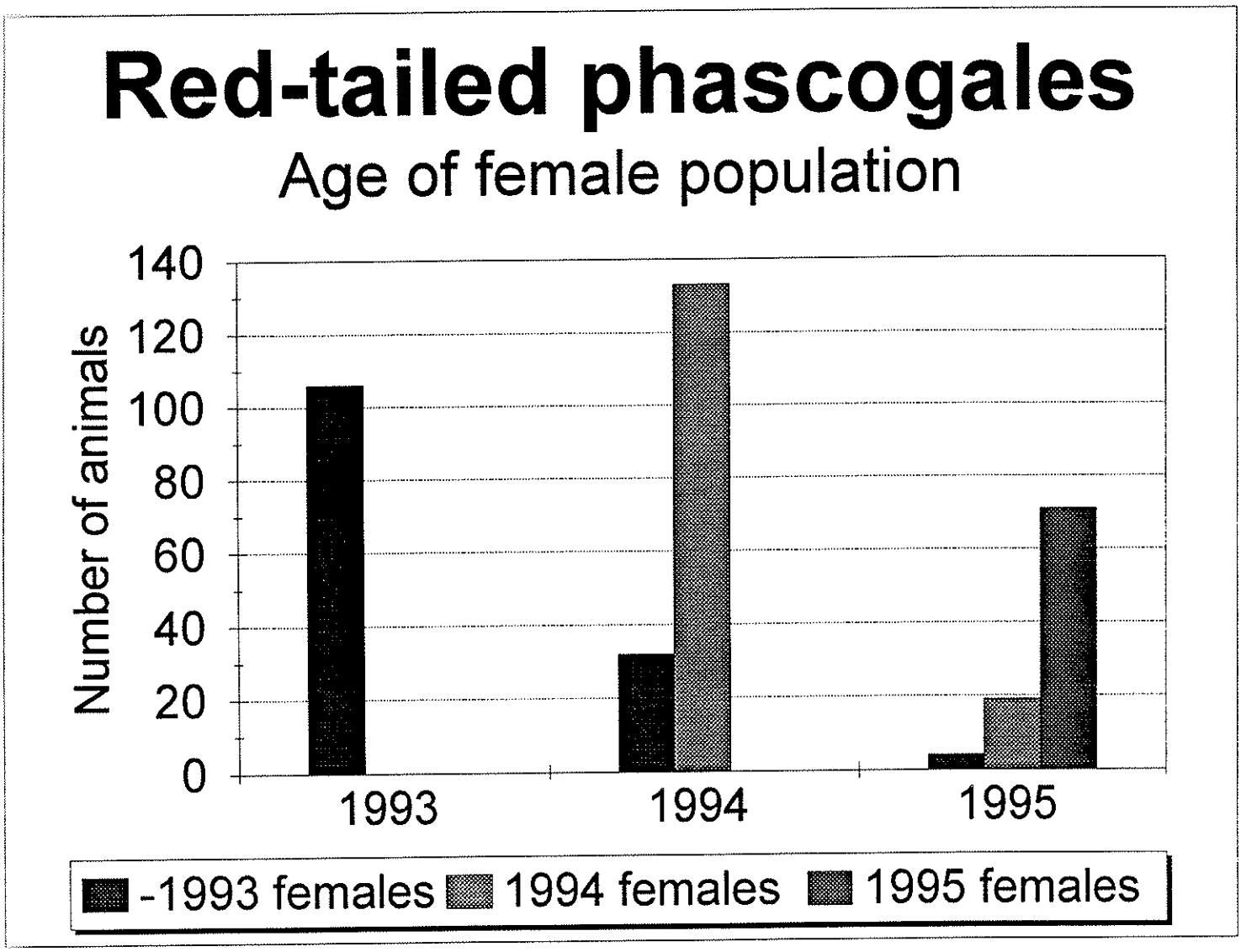

Figure 3. Numbers of female red-tailed phascogales captured during the 1993, 1994 and 1995 trapping seasons, showing the contribution of animals first captured in each year to the female population.

year's cohort trapped each year since 1993, pooled across reserves. This gives an indication of the rate of survival of females from one year to the next. It is assumed that animals caught for the first time in any particular year belong to the cohort of that year. Percentage survival to subsequent years of the animals first captured in each year of the study is shown in Table 4.

Table 4. Percentage survival of females in each year's cohort to each trapping year, and percentage of females captured made up by that cohort.

Trapping year	1994	1995	
First caught	1993	1993	1994
% survival of cohort	30.2%	3.8%	14.3%
% of trapping year's females	19.4%	4.3%	20.2%

Discussion

Phascogale populations across reserves

The mean KTBA pooled for the two grids on each reserve (± S.D.) in 1995 was 11.2 ± 9.16, compared with a mean of 15.6 ± 12.18 in 1994. A one-tailed paired sample t-test reveals that these means are significantly different at the 0.05 level (t_8=1.95, P=0.034), that is, there has been a significant drop in the mean KTBA across reserves between 1994 and 1995.

Examination of rainfall data for several localities in the study area shows that the annual rainfall was very low in 1994 (Figure 4). Total KTBA on all reserves between 1993 and 1995 is correlated with total annual rainfall (mean of stations shown in Figure 3) in the previous year (see Figure 5: r^2=0.96 for these two variables). It is likely that low rainfall in one year would cause a phascogale population response in the following year, as decreases in invertebrate prey and the consequent failure of phascogale recruitment would take at least one breeding season to take effect.

Comparison of KTBAs on individual reserves between years (Figure 2) shows that on five reserves, KTBA has remained the same or increased slightly, while on four reserves it has decreased. Two of these decreases are very marked. On Jaloran, a newly baited reserve, KTBA has decreased from 18 in 1994 to 5 in 1995, mainly due to a drop in numbers on Grid 1 (Table 3). On Yilliminning, an unbaited reserve, KTBA has fallen from 19 in 1994 to 4 in 1995, following crashes on both grids. There was extensive interference with traps by possums at Jaloran (see Scope item 3), but this was not a feature of trapping at Yilliminning. Table 5 shows the total captures on each reserve in 1994 and 1995. These figures underline the magnitude of the decreases in capture rate at Jaloran and Yilliminning.

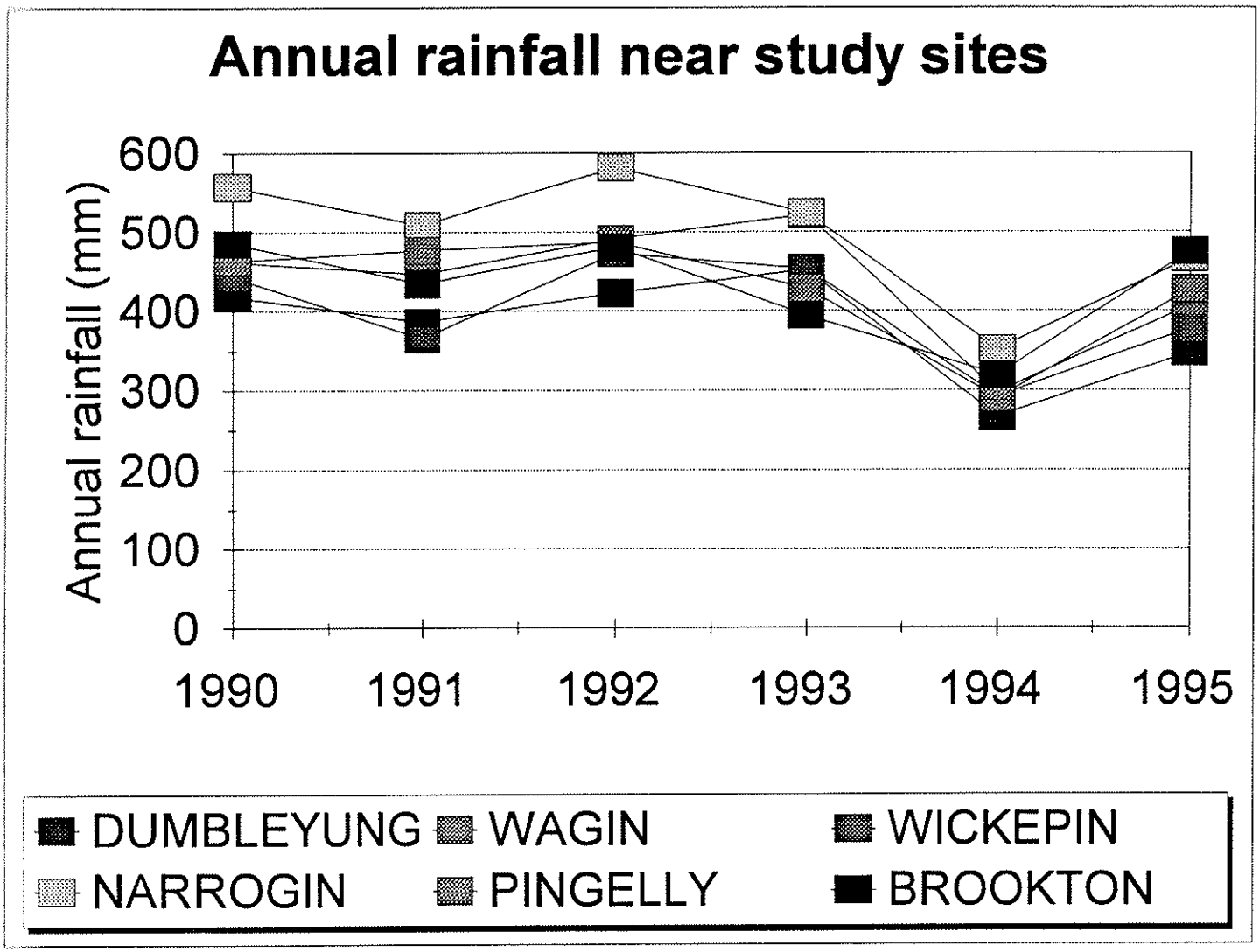

Figure 4. Annual rainfall recorded (1990-1995) at towns near the study reserves.

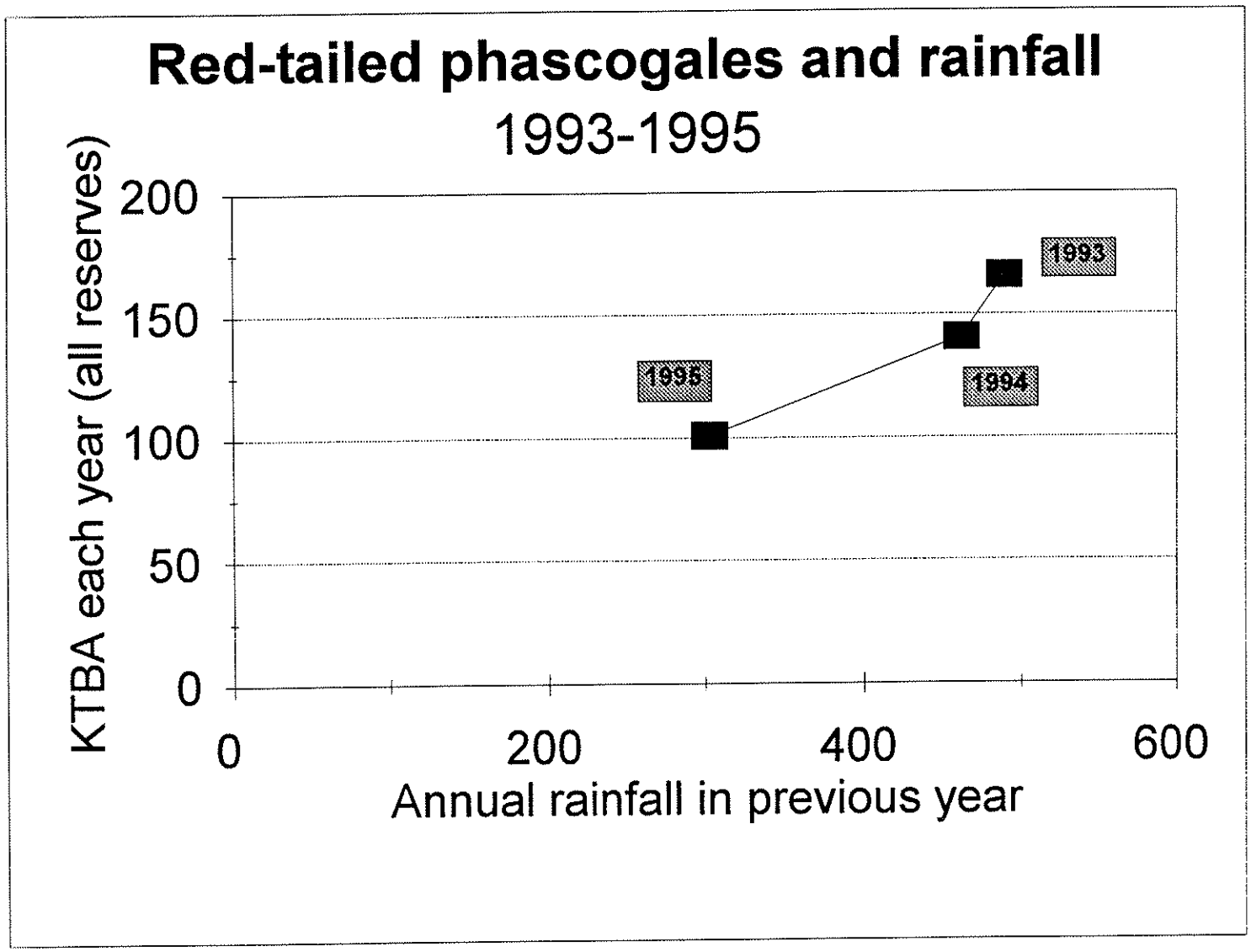

Figure 5. Plot of the number of red-tailed phascogales known to be alive on all study reserves in 1993, 1994 and 1995 against the previous year's annual rainfall (mean for the six towns listed in Figure 4). Phascogale numbers for 1993 include all animals captured during one trapping session on each reserves.

Table 5. Total captures (including repeat captures in the same trapping session) in three trapping sessions between March and June 1995, compared with similar data from 1994.

Treatment	Reserve	Total captures 1994			Total captures 1995		
		Grid 1	Grid 2	Grids 1+2	Grid 1	Grid 2	Grids 1+2
Long-baited	Dryandra	4	1	5	1	1	2
Long-baited	Tutanning	53	20	73	26	25	51
Long-baited	Boyagin	23	16	39	20	22	42
Newly baited	Jaloran	54	19	73	6	13	19
Newly baited	Dongolocking	6	36	42	13	26	39
Newly baited	Pingeculling	51	16	67	12	14	26
Newly baited	East Yornaning	108	64	172	109	60	169
Unbaited	West Ashby	19	17	36	8	5	13
Unbaited	Yilliminning	50	42	92	11	1	12

Effect of fox control

Figure 6 shows the mean KTBA per reserve in each treatment group. In 1993, only one trapping session was conducted, so KTBA for that year is simply the number of individuals captured. In 1994 and 1995, KTBA at the second trapping session is used. The data for 1993 are included in Figure 6 for interest, although they cannot be compared statistically with the 1994 and 1995 results, as they represent a much lesser trapping effort during a period which extended past the male dieoff (Friend *et al.* 1994).

The "Newly baited" group of reserves were unbaited until late 1994, after the trapping period. With respect to the effect of baiting, the most meaningful statistical comparison is between the "before baiting" and "after baiting" KTBAs, using the long-term baited and unbaited reserves as controls. This will be carried out by repeated measures ANOVA when 1996 data are available.

The change in the mean KTBA between 1994 and 1995 was compared between the treatment groups by t-test on the difference between means of 1995 and 1994 KTBA on each reserve, and on the difference between 1995 and 1994 KTBA on each grid (there are two grids per reserve). A one-tailed t-test was applied and no differences were significant at the 0.05 level.

Newly baited reserves vs. all other reserves $t_7 = 0.013$, P = 0.50 ns

Newly baited reserves vs. unbaited reserves $t_4 = -0.998$, P = 0.187 ns

Newly baited grid vs. all other grids $t_{16} = 0.698$, P = 0.248 ns

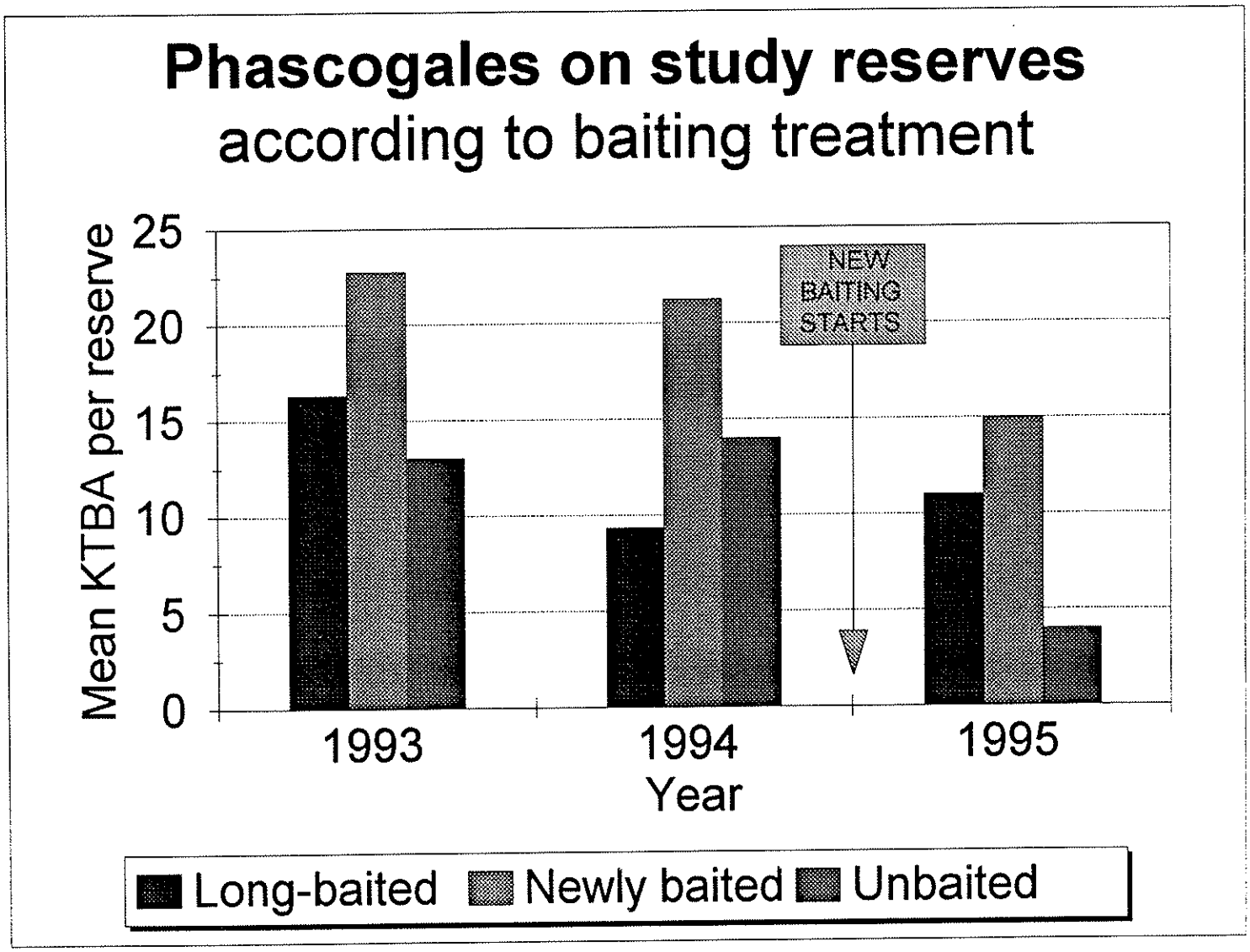

Figure 6. Mean number of red-tailed phascogales known to be alive on both trapping grids per reserve under each of the baiting treatments. 1993 data represents only one trapping session, 1994-5 data is the KTBA at the second of three trapping sessions. Baiting commenced on four of the reserves in October or December 1995.

Recaptures between years

In the first detailed account of the biology of *P. calura*, Kitchener (1981) speculated that the species was semelparous, that is, males died after their first breeding season but females survived at least to rear their young. He also drew attention to the fact that in semelparous species living in unpredictable environments, some females need to breed in a second or even a third year to insure against the effects of reproductive failure in occasional years. Bradley (1985 and 1995) stated that in *P. calura*, some females survive to a second or third year, but provided no data.

Trapping data collected in this study provides proof that a significant number of females survive to their second year and some to their third year. In 1994, over 30% of the females captured in 1993 were caught in 1994, and these 2+ year females comprised 19.4% of the female population in that year. In 1995, only 3.8% of the 1993 cohort survived, and made up only 4.3% of the female population. At that stage, 14.3% of the 1994 cohort of females survived and made up 20.2% of the population.

It is clear from Figure 3 that there was a much greater recruitment of females into the population in 1994 (ie the young of 1993) than in 1995. There was also a lower survival of females first captured in 1994 into 1995 than of females captured in 1993 into 1994. Survival of both females from the previous year and young of the year was lower between the 1994 and 1995 trapping seasons. This may have been due to the significantly lower rainfall during 1994.

Further breakdown of the data is necessary to separate the effects of the drought of 1994 from any effect of the baiting.

REDUCTION OF INTERFERENCE ON TRAPPING GRIDS (SCOPE ITEM 2)

Scope item 2) *Cage traps are to be set on each grid to reduce interference by non-target species.*

Previous reports have indicated that interference with traps by woylies *Bettongia penicillata* and common brushtail possums *Trichosurus vulpecula* has reduced trap success on several reserves, notably those long-baited reserves on which the numbers of these mammals have built up (Dryandra and Tutanning). This problem has been addressed by setting 10 cage traps (Mascot Wireworks collapsible bandicoot traps) on each grid on those reserves during trapping sessions. Possums and woylies captured are released each morning, and this strategy has considerably reduced the amount of trap interference encountered. During the 1994 trapping season, interference by possums was also encountered at Boyagin and Dongolocking, indicating that this behaviour may continue to increase across the study reserves. A modification to the method was proposed for 1995, whereby cage traps will be set on every grid, in order to prevent the introduction of bias through the use of different trapping methods on different grids. This was implemented in 1995.

Methods

Cage traps were set on each grid during the 1995 trapping season. On some grids however, possum numbers have reached such high levels that despite the capture of individuals in most cage traps, there was interference with up to 90% of the Elliott traps. In such cases, possums were held for one night or two nights, before release. Another strategy trialed during 1995 on reserves where disturbance was encountered was the release of possums at varying distances from the trapping grid. This was also successful in reducing interference on subsequent nights as the possums took a night or so to return and be retrapped. Either way, the possums and woylies were prevented from interfering with traps for the remaining nights of the trapping session. The method finally adopted for possums (and woylies, at Dryandra) captured on the first night of trapping was to release them away from the grid, on the second night to hold them in hessian bags until the next morning, and those caught on third and last night of trapping were released immediately.

Results

The success of this strategy could not be assessed rigorously because that would have required that grids be given different treatments. However, on some grids there was a marked decrease in the number of traps disturbed by possums or woylies (Figure 7).

Discussion

The level of interference has increased during the period of the study on both baited and unbaited reserves. It appears that the possums become more liable to disturb traps

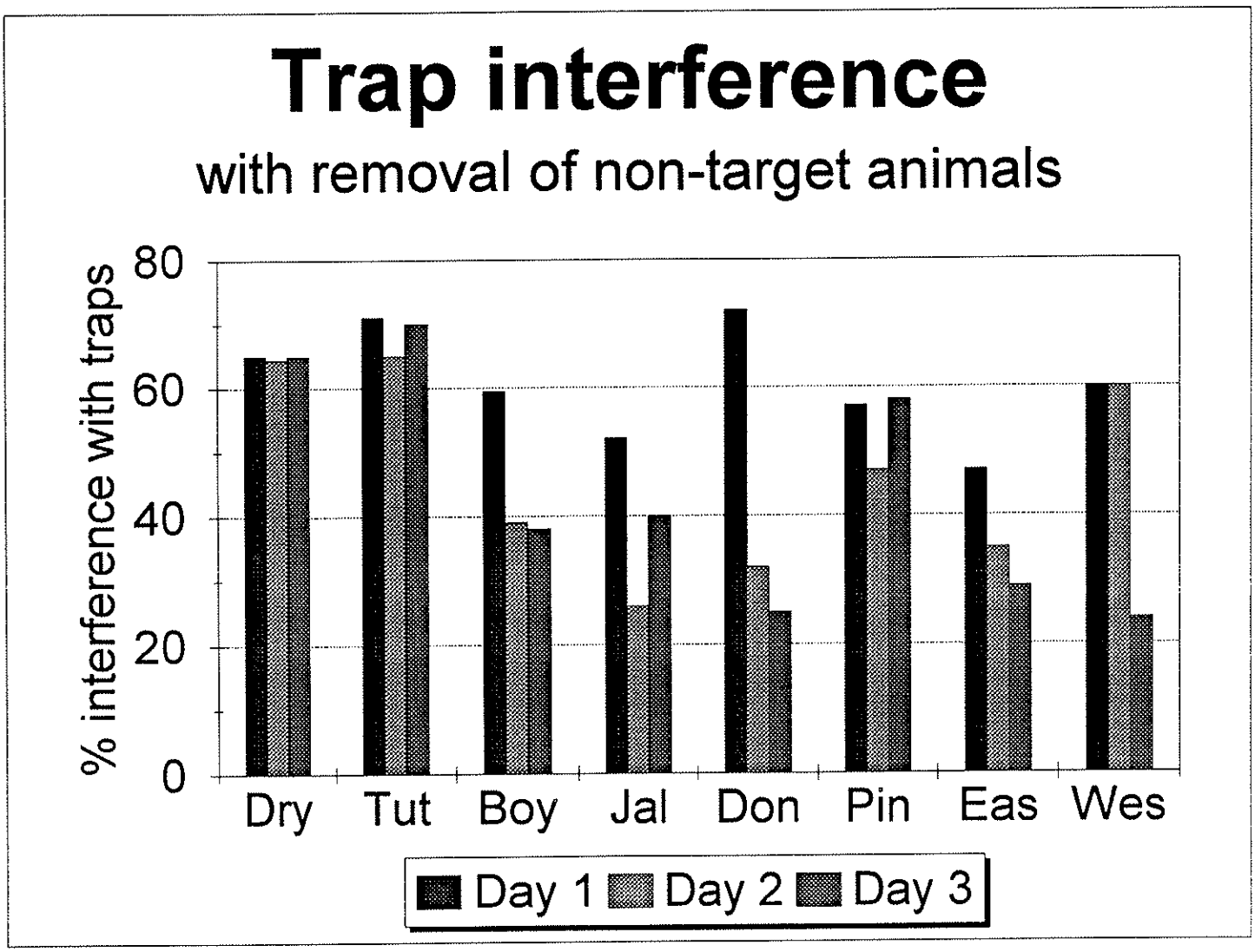

Figure 7. Percentage of traps disturbed by non-target animals during the second or third trapping session at each reserve in 1995, when possums and woylies caught in cage traps were being held or released away from the grid. No animals were held or moved at Yilliminning.

after a few trapping sessions, possibly through some learned behaviour. There were only two grids on which no interference was recorded during 1995. It is strongly recommended that strategies to reduce interference be continued. The most effective and least disruptive procedure is to release away from the grid animals caught on the first night of trapping, and to hold through the day animals caught on the second night, before release on the third morning.

RESPONSE OF *P. CALURA* TO FOX BAITING (SCOPE ITEM 3)

Scope item 3) ***Evaluate the response of*** **P. calura** ***to fox baiting.***

This experiment was designed to run for at least four years, giving one year's pre-baiting data and at least three years' post-baiting data. As explained in previous reports, it was not possible to collect a full set of pre-baiting data during Phase 1 of the project, so those data were collected during Phase 2. The first post-baiting year's data were collected during Phase 3, but newly baited reserves had only been subject to 4 months' baiting by the commencement of the Phase 3 trapping program. There are not sufficient data at this point to run a full analysis to examine the effect of fox control on red-tailed phascogale populations, especially after a year in which weather has clearly had a strong effect on numbers, regardless of baiting regime. Nevertheless, significance testing carried out under Scope Item 1) showed that there were no significant differences in the changes in KTBA from 1994 to 1995, between the newly baited and control reserves.

However, it is interesting to examine the changes in phascogale numbers on individual reserves between 1994 and 1995 in the light of the baiting regimes in place on each of them.

Long-term baited reserves: There has been no change on Dryandra, and small increases on Tutanning and Boyagin.

Newly baited reserves: Jaloran has had a massive decrease and East Yornaning has experienced a smaller drop in numbers, while on Dongolocking and Pingeculling there have been small increases.

Unbaited reserves: There have been significant decreases on both unbaited reserves, including a massive crash on Yilliminning.

Comparing the 1995 post-dieoff trapping results with the 1994 figures (Table 6), only the long-term baited reserves show similar phascogale population levels. Both the newly baited and unbaited reserves support substantially lower numbers of females in 1995 than in 1994.

In summary, between 1994 and 1995, populations on the long-term baited reserves have remained stable, despite the year of low rainfall. Amongst the newly baited and unbaited reserves, there have been some substantial decreases; populations have remained stable on only two of the newly baited reserves. Again, after only 3-5 months from the commencement of baiting until the first trapping period, it is probably far too early for significant effects of the baiting to be apparent.

Trapping under FPP funding will continue for another year and it is hoped that by June 1996 an indication of the effect of fox control on *P. calura* populations will be measurable. Continuation of the monitoring program after that time, however, will greatly increase the likelihood of detecting any effect.

PRODUCTION OF YOUNG ON STUDY RESERVES

During 1994 trapping was carried out in August and September to check the production of young on baited and unbaited reserves. This was carried out in response to suggestions based on studies on sub-lethal effects of 1080 on a variety mammals and birds that there may be some reduction in fecundity amongst so-called tolerant species as a result of ingesting 1080 baits (King *et al.* 1989; Twigg and King 1991). *Phascogale calura* was nominated as one of the species possibly at risk.

Trapping in August-September 1994 showed that females on all newly baited and all but one long-term baited reserve carried young. The only exception was Grid 1 on Boyagin, where none of the five females caught was carrying pouch young. The suggestion was made that as this was such an anomalous result, it may have been explained by a stochastic event, such as a chance absence of males on the grid at the mating period. The conclusion of the 1994 study was that fox-baiting was not causing an obvious disruption to the production of young by *P. calura* on the long-baited or newly-baited reserves.

The same trapping program was implemented August-September 1995 in order to monitor the production of young. However, the 1995 trapping program commenced nearly two weeks later than the 1994 program, on August 29, as compared with August 17 in 1994.

Methods

One trapping session of three nights duration was carried out on each of the nine study reserves during 1995 on the dates shown in Table 6. Trapping methods were as described earlier for the main trapping program.

Results

A total of 28 individual *P. calura* were captured. All were adult females. Table 6 shows the dates of trapping sessions in 1994 and 1995, the number of captures and the percentage of those females that were carrying young when captured.

Discussion

In work on this project in 1994, 57 of the 63 females captured during post-dieoff trapping were carrying young (Friend and Scanlon (1995a). In 1995, no females captured had young attached. During the second week of the trapping period in 1995, a method was developed to express milk from the teats to demonstrate that lactation was occurring. All females captured after that time were found to be lactating. This implies that most if not or all females were suckling young, deposited in the nest before the trapping period.

Although the 1994 trapping period commenced two weeks earlier in the year (16 August) than the 1995 trapping period (29 August), the two trapping periods

Table 6. Number of female *P. calura* caught on study reserves during August-September trapping in 1994 and 1995 (no males were caught), showing percentage of females with litters at each reserve.

Reserve	Treatment	Trapping sessions (nights)	1994		Trapping sessions (nights)	1995	
		1994	Females caught	% with litters	1995	Females caught	% with litters
Dryandra	Long-baited	12-14 September	1	100	27-29 September	0	0
Tutanning	Long-baited	16-18 August	4	100	13-15 September	5	0
Boyagin	Long-baited	12-14 September	9	44	13-15 September	7	0
Jaloran	Newly baited	23-25 August	6	100	20-22 September	2	0
Dongolocking	Newly baited	6-8 September	7	100	29-31 August	2	0
Pingeculling	Newly baited	16-18 August	6	100	13-15 September	0	0
East Yornaning	Newly baited	30 August-1 September	25	100	27-29 September	12	0
West Ashby	Unbaited	23-25 August	2	100	20-22 September	1	0
Yilliminning	Unbaited	6-8 September	3	100	29-31 August	1	0

overlapped the same dates substantially. It appears that in 1995 the young were deposited before trapping commenced on 29 August, substantially earlier than the 1994 young, some of which were still being carried on 15 September. Table 7 shows the collated records of female *P. calura* with pouch young, from several sources.

Table 7. Records of female *P. calura* with pouch young. Sources of information include the 1989-91 Tutanning records of Friend and Friend (1992), records from Friend and Scanlon (1995a) and WA Museum records.

Tutanning 1989-91	This project 1994	Museum records
		03-Aug-72
		06-Aug-79
		10-Aug-84
14-Aug-91		
16-Aug-90		
17-Aug-90	17-Aug-94	
	18-Aug-94	
22-Aug-90		22-Aug-67
	24-Aug-94	
	25-Aug-94	
	31-Aug-94	
	01-Sep-94	
	02-Sep-94	
05-Sep-89		
	07-Sep-94	
	08-Sep-94	
	09-Sep-94	
	13-Sep-94	
	14-Sep-94	
	15-Sep-94	
19-Sep-90		
20-Sep-90		

In 1994 the only females captured without young attached were the six individuals caught on Grid 1 at Boyagin during the last week of post-dieoff trapping (12-14 September 1994). Given that no females were carrying young but most were lactating between 29 August and 29 September 1995, it appears that the breeding season was earlier in 1995 than in 1994, and that the females caught without young at Boyagin in 1994 had deposited their young before the trapping session.

It has already been pointed out that the 1994 annual rainfall in the study area was extremely low. It is likely that this reduced food availability, which then slowed the development of young and extended the lactation period in 1994. Young have been recorded as early as 3 August (Table 7), presumably in a good year.

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