CONTROL AND ECOLOGY OF THE RED FOX IN WESTERN AUSTRALIA

23.11

A Report Submitted
to the

AUSTRALIAN NATURE CONSERVATION AGENCY
by the

WA DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
and the

AGRICULTURE PROTECTION BOARD OF WA

for the period 1993-94

Chief Investigator:	Dr. J.E. Kinnear
Research Scientists (Fox group):	Dr. N. Marlow (CALM), P. Thomson (APB)
Research Scientist (Prey group):	P. de Tores (CALM)
Support Staff:	9 Technicians

FOX RESEARCH

PROGRESS ON SCOPE ITEMS

A1. & A2. The effect of population reduction on the productivity, survival and dispersal of foxes.

The population reduction site (150 km^2) is located near Beverley, WA. Trapping began in January 1994 and to date 52 foxes have been captured and radio-collared (7 adult males, 6 adult females, 18 female cubs and 21 male cubs). These individuals have been monitored for two or three nights every two weeks. Home-range areas have been calculated for all individuals with at least 20 independent locations. The minimum convex polygon method of home-range analysis has been used. The average home ranges areas are: adult males 3.3 km^2; adult vixens 10.0 km^2; female cubs 3.5 km^2 and male cubs 4.2 km^2. The areas of the home-ranges of cubs are comparable to those from other studies in Australia. However, the ranges of adult vixens are larger, and those of adult males smaller, than found in other studies. One male cub has a home-range area of 55 km^2 and is presumably in his pre-dispersal phase. Forays where the dispersing individual leaves the site and then returns have been observed for one female and two male cubs. Five foxes have died.

To date, 12 foxes have dispersed from the site. Dispersal distances for 7 male cubs were 9, 10, 10, 14, 15, 70, and 170 km (average = 43 km), and for 4 female cubs were 6, 12, 20 and 22 km (average = 15 km). (One adult male fox moved 40 km). The 8 longest dispersals from the Beverley site are shown in Fig. 1. Several foxes cannot be located and are presumed to have dispersed, although collar failure cannot be discounted.

At the North Bannister site (40 km^2) the fox population will be left intact. We plan to radio-collar 10 adult female and 10 adult male foxes in this area and so far have caught 7 female and 9 male foxes. The monitoring of cub production, the survival of cubs and adults, and dispersal will be undertaken in the same way as in the Beverley site.

The radiotracking system developed for this project is performing extremely well. The radio-collars are proving to be more powerful than expected, and appear to be very reliable. The ground-based receiving system has been modified and fine-tuned. Although a motorised rotator system was developed for use on multi-section, commercial radio masts, we have managed so far to rely on the more reliable and accurate manually-operated shorter masts. Additional masts are to be acquired to increase the coverage around both study

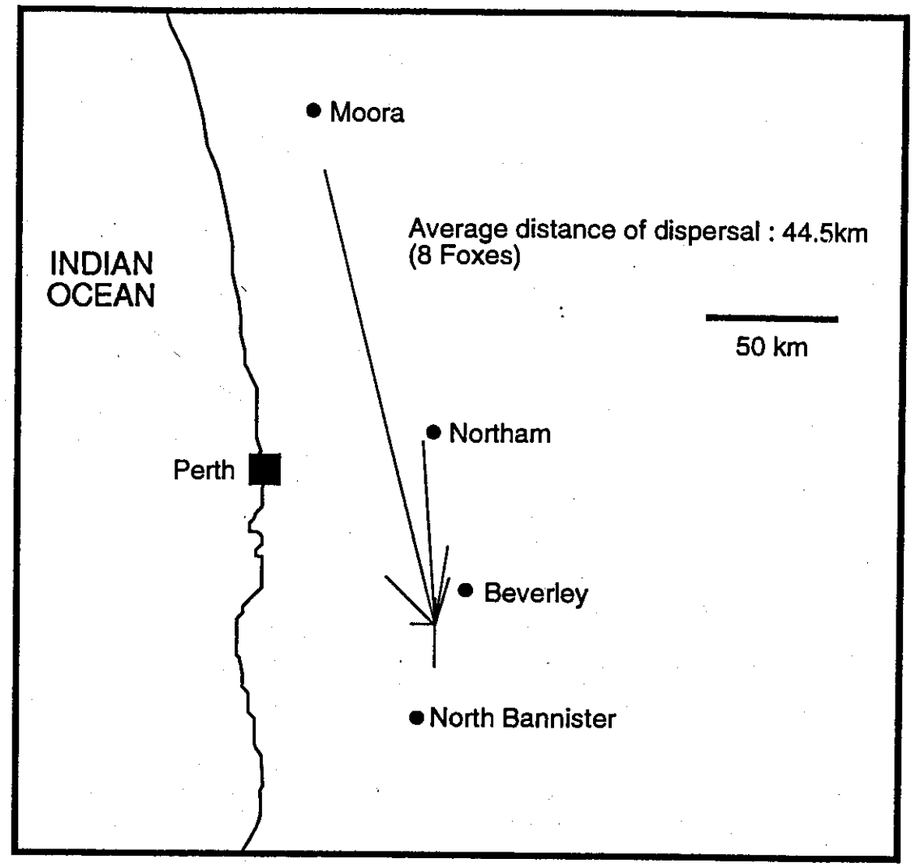


Fig. 1: Long distance dispersals of juvenile foxes from the Beverley site (January - June 1994)

sites. Additional radio-collars will be made up to fit to the offspring from this year's breeding.

N B. Our experimental protocol will be modified for the 1995 fox breeding season so that a sterility component will be added to our population reduction treatment in the Beverley site. This alteration will make the Eastern and Western CRC fox experiments more comparable and it will provide replication for our treatment site. Seventy-five percent of the vixens remaining in the site after the 75% population reduction will be sterilised. Monitoring of cub mortality and survival will continue unchanged in both sites except that only 5 litters of cubs will be monitored in the treatment site instead of 10 as planned for 1994. (See more detail in 'Revised Protocol' below).

A3. Estimation of the effectiveness of buffer zones in reducing the level of control required in conservation areas.

By comparing the incidence, timing and distance of dispersal movements of foxes from intact and reduced populations, it will be possible to determine if buffer zones (population reduction) are useful in controlling fox movements into baited reserves. This work will be undertaken, as planned, in the next phase of dispersal which will be from December 1994 to May/June 1995.

A4.& A5 Estimation of the density, distribution and bait uptake of foxes within forested areas.

Cyanide baiting was carried out in the Northern Jarrah Forest. Fox densities were highest at the forest/farmland interface, and were extremely low at intermediate transects (5-10 km into the forest) and core transects (15-25 km into the forest). Respective kills were 22 foxes in 158 km, 0 in 94 km, and 1 in 134 km. The exceptionally dry conditions (the lowest November-April rainfall on record) may have contributed to the low numbers of foxes in the forest.

Non-toxic, bio-marked dried meat baits, as used in previous trials, were aerially dropped through the forest prior to the cyanide baiting. However, too few foxes were retrieved from intermediate and core transects to allow bait uptake to be assessed.

A6. Completion of the Watheroo study and testing the effectiveness of 'FOXOFF" baits.

Radiotracking was discontinued in this site due to further problems with radio-collars and tracking equipment. Cyanide baiting of the area, undertaken to provide a large sample of the study population, was carried out during October 1993. This trial included a further

assessment of the uptake of conventional meat baits by foxes. Given the possibility of bait delivery of an immunogen to sterilise foxes (a project currently being undertaken by other members of the CRC), a second site adjacent to Watheroo was used to test a bait more suited to the incorporation of an immunogen, the Victorian "FOXOFF" bait. Both trial sites were aerially pre-baited at a rate of 5 baits km^{-2} with non-toxic, bio-marked baits, then later subjected to cyanide baiting to provide samples of the fox population.

A total of 31 foxes were collected from the 'meat bait' site and 23 from the "FOXOFF" site; respective uptake of the marked baits was 68% and 57%, a non-significant difference. This suggests that the "FOXOFF" bait can be considered as a candidate for field delivery of oral immunogens to foxes, though further trials are warranted. The results were unusual in that the uptake of the meat baits was considerably lower than the average of about 80% recorded consistently in earlier trials. There was no obvious reason for this, as food supply for the foxes did not appear to be abnormally high. In the main site fewer foxes were killed with the cyanide baiting than expected; we estimate that only 30-50% of the population was collected. However, too few radio collars were still operating to assess the cyanide technique more precisely. It is possible that the large amount of research activity (particularly trapping) throughout the year made some foxes wary of the cyanide bait stations. This factor must be taken into account when cyanide baiting is used to obtain an index of fox density.

A7. DNA profiles of foxes

At present, six microsatellite probes are working well and are providing good resolution between DNA samples from different foxes. 150 DNA samples have been re-extracted after the original extractions yielded no DNA. Analysis of all the 209 DNA samples from Carnarvon is currently under-way and this process will clarify the social organisation of foxes in that area. A further 130 samples from Kalbarri and Nambung National Parks are being extracted. These samples were obtained from pregnant vixens to determine mating strategies and sexual contact rate. A computer program has been written to analyse the relationships between foxes based upon their DNA profiles.

MILESTONES (FOX WORK)

The milestones for the fox research are all currently being met. Trapping and radio-tracking are on schedule and the population reduction and buffer baiting are organised to be under taken as planned. The appraisal of the

tracking system and the collation of the dispersal data are ongoing. The manuscripts for the Watheroo, North Jarrah forest density and bait uptake experiments are being compiled. The final DNA data analysis and manuscript preparation will be completed by October 1994.

REVISED PROTOCOL (FOX WORK)

Various discussions have been held within the CRC during the past year concerning details of the east and west fox experiments (predator work), including replication, comparability of the treatments, and the need for resources. In the west, we have a single control and treatment site. The treatment to be imposed this season is a population reduction, details of which have been previously circulated. One of the problems with the fox experiments in general is the relatively low numbers of animals that we can realistically handle. This means that the critical monitoring of cub production/survival/dispersal is restricted to only a handful of litters. Our current treatment maximises the chances of monitoring sufficient litters (10) to achieve meaningful results. The details of the treatment to be imposed in the second and subsequent years had not been decided.

We have now decided to introduce a sterility component to the treatment site in the second year (beginning early 1995). This will match the eastern CRC fox project, and will include sham operations being carried out in the control site. This site will then act as a replicate for the east and vice versa. One consequence of this work is that we will need to almost double the area of the current treatment site, to ensure that sufficient fertile vixens remain after the imposition of population reduction and sterilisation. We need an area that prior to any treatment would have contained about 80 breeding females. After reduction, this would leave 20 females, of which 15 would be sterilised, leaving 5 litters to monitor.

Sterilisation of foxes will commence at the beginning of 1995, when we will be collaring juvenile and adult foxes. Actual numbers will have to be fine-tuned following dispersal, which may involve the loss of some collared/sterilised foxes.

A number of changes have also been made to our planned field work protocols. Our major field activities have been thoroughly reviewed and fine-tuned.

Trapping.
The need to work over a larger area to provide sufficient vixens for the sterility regime at Beverley has meant a large increase in the trapping effort that will be required. However, the costs of this increase have been offset by proposed changes to our mode of operation. Instead of being processed at the trap site, foxes will now be carried back to base camp/vet for processing/surgery. This means that 1 instead of 2 people will run each trap line. Traps will still be

checked at night and in the morning; 1 person checking both lines, and the 2 people rotating morning and evening checks to minimise overtime.

Radiotracking.
In the past, one of the greatest costs to the project has been the regular radiotracking of foxes; each trip requiring 2 people working simultaneously. We have now revised our schedule. One outcome is that foxes will be monitored more regularly than before, though fewer precise fixes will be obtained. The precision tracking has been restricted to critical times (fixing natal ranges and identifying breeding dens). Other tracking has been largely transferred to one-day trips and the checking for presence and status of foxes (alive or dead, using mortality-sensing transmitters). This cuts down considerably on staff requirements, overtime and travel costs, though vehicle running costs do rise. Aerial tracking has been budgeted as before, and will continue to be used to locate dispersing individuals, as well as assisting in the precise location of breeding dens.

Spotlighting.
The regime has been revised in relation to our previous Timetable (which inadvertently differed from the former budget, the latter being incorrect). Spotlighting will now be undertaken 4 and not 6 times annually at each site. This will allow sufficient opportunity to assess population level, the potential influx of immigrants, and the presence of unidentified breeding units.

Cub monitoring.
This activity has been expanded to allow observations of litters once they have become more mobile. This is expected to entail concurrent ground radiotracking and spotlight observation.

Buffer control, population reduction.
These activities remain similar to before.

On-site maintenance.
This was not allowed for previously, but found in 1993/94 to be essential. It includes time to set up additional radiotracking towers.

Veterinary costs.
This is a new cost as a result of altered treatment. It is estimated that we will sterilise/sham operate on 35 vixens @ $100 per animal.

Equipment costs.
Savings made by constructing our own radio-collars resulted in a surplus in the WA Dept. Commerce and Trade funding in 1993/94. These funds will be used to fund additional radio-collars needed in 1994/95. Thus, despite a greater need for equipment in 1994/95

than previously foreshadowed, the actual cost to 1994/95 funds is reduced.

Staff costs.
One of the consequences of the general savings made in our revised workplan was that we could fund some casual labour. This became necessary given the staff shortfall that the project was inevitably facing.

PREY STUDIES

Scope Items A3, A9, A10, A11 and A12.

Project Leader:

Paul de Tores		CALM

Technical Staff:

Corey Watts	(from 30 Nov 1993)	CALM
Paul Van Heurck	(1 March to 29 April '94)	CALM
Phil Fuller	(24 Jan. to 8 Feb. and 9 to 13 May '94)	CALM
Mike Onus	(from 18 April to 6 May '94)	CALM
Kathy Himbeck	(from 31 Jan. '94)	ANCA funded
Frank Obbens	(from 31 Jan. '94)	ANCA funded
Suzanne Rosier		Volunteer

Scope Item A3

Estimate the effectiveness of buffer zones on reducing the level of fox control required in conservation areas

Scope Item A11

Investigate the survival of resident and translocated native prey species in forested areas abutting a farmland buffer zone of fox control.

Scope items A3 and A11 are dependent on the buffer zone being maintained by the fox research component of the Fox Control and Ecology Research Team. See previous discussions on proposed research on incidence, timing and distance of fox dispersal.

Work has commenced on fox density reduction within the buffer area.

The effectiveness of the buffer zone will be assessed over the longer term by two independent measures:

1. Deriving an index to fox density within two areas within the same treatment (i.e. two areas within the two baitings per year treatment). One of these areas will abut the fox density reduction site on agricultural land at Beverley (see table 1 & fig. 1). The other will abut agricultural, land where landholders may undertake some fox control, but at a level far less than the intensive fox density reduction undertaken at Beverley. Progress towards deriving an index to fox density is discussed in Scope Item A12; and
2. Estimating native fauna population densities and monitoring native fauna survivorship (resident and translocated species) within the two different areas.

Monitoring sites have been established in both areas in the two baitings per year treatment (see table 1 & fig. 1). Each site is comprised of 3 grids, with each grid comprised of 15 pitfall traps (20litre plastic buckets each with a 7 metre drift fence), 15 medium size Elliott traps and 25 Sheffield wire cage small mammal traps. The design of the monitoring grids is shown in figure 2.

Initial (pre baiting and pre fox density reduction) fauna survey work has been completed in both areas.

Initial survey work indicates low densities of native fauna throughout both areas. Capture rates were too low to perform any meaningful capture/mark/release/recapture density estimates (see also Scope Item A9).

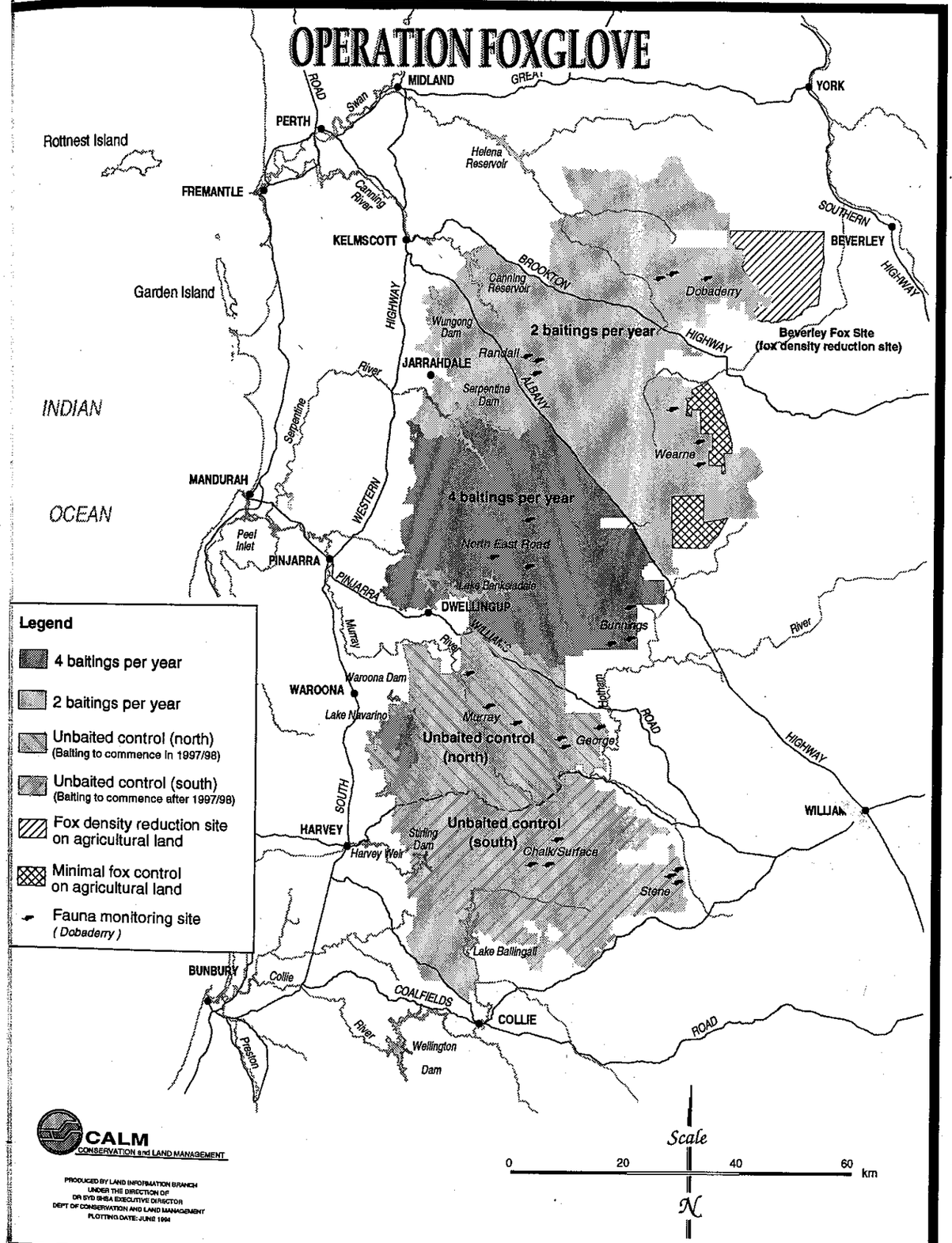
Trapped species within the Critical Weight Range (CWR) were to be radio-collared for monitoring of survival. The only trapped and collared species within the CWR in these two areas was *Trichosurus vulpecula*. A total of 5 individuals is collared. Survivorship monitoring has commenced and is on-going. Supplementary trapping is now scheduled to increase the sample size of CWR fauna monitored for survivorship analysis.

The *Bettongia penicillata* translocation has not taken place and is scheduled for October 1994 (subject to final endorsement by CALM).

Table 1: **Survey and Monitoring Sites within each Treatment**
(see figure 1 for locations)

Site Name	Treatment and Description of Site
Dobaderry	Perimeter site in 2 baitings per year treatment. Site abuts the Beverley fox density reduction site.
Wearne	Perimeter site in 2 baitings per year treatment. Site abuts agricultural land where some fox control may occur but at a level far less than the intensive fox density reduction undertaken at Beverley.
Randall	Central core site in 2 baitings per year treatment.
Bunnings	Perimeter site in 4 baitings per year treatment. Fox control in abutting agricultural land is as described for Wearne site.
North East Road	Central core site in 4 baitings per year treatment.
George	Perimeter site in unbaited control (north). Fox control in abutting agricultural land is as described for Wearne site.
Murray	Central core site in unbaited control (north).
Stene	Perimeter site in unbaited control (south). Fox control in abutting agricultural land is as described for Wearne site.
Chalk/Surface	Central core site in unbaited control (south).

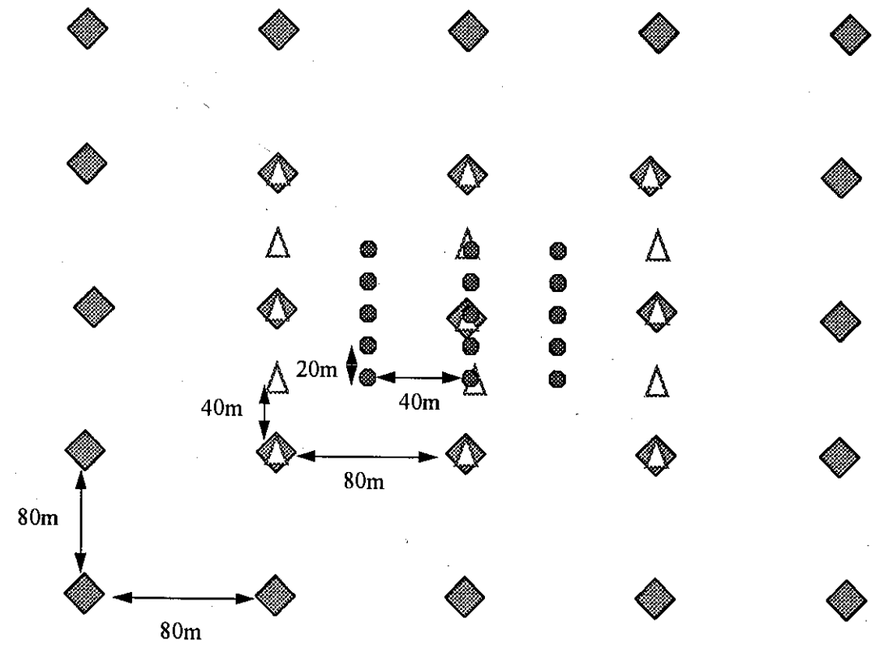
OPERATION FOXGLOVE



CALM
CONSERVATION and LAND MANAGEMENT

PRODUCED BY LAND INFORMATION BRANCH
UNDER THE DIRECTION OF
DR SYD SHEA EXECUTIVE DIRECTOR
DEPT OF CONSERVATION AND LAND MANAGEMENT
PLOTTING DATE: JUNE 1994

Figure 2: Integrated trapping grid consisting of 25 Sheffield wire cage small small mammal traps, 15 medium size Elliott traps and 15 pitfall traps.



- 15 pitfall traps at 20m x 40m spacings. Each trap consists of a 20litre plastic bucket and a 7 metre fibreglass flyscreen wire drift fence.
- 15 Elliott traps at 40m x 80m spacings.
- 25 wire cage traps at 80m x 80m spacings.

Scope Item A9

Investigate the survival, population increase and habitat use of resident and translocated native prey species in large forested areas, when subjected to different 1080 baiting frequencies for fox control.

The three treatment areas have been established (see fig. 1.). The treatments are four baitings per year, two baitings per year and an unbaited control.

Permanent trapping grids have been established within each treatment (see table 1 & fig. 1). The integrated trapping grid design is shown in figure 2.

Pre baiting survey work (trapping and spotlighting) is complete for both baiting treatments.

Trapping data indicate low CWR fauna densities. Capture rates are too low to derive a meaningful index to density. However, trap capture data are shown as percentage capture rates in table 2.

Spotlight data also indicate low CWR fauna densities throughout both baiting treatment areas.

Changes in density in each treatment will be monitored through twice yearly trapping sessions and annual spotlight surveys.

A total of 11 individual animals from 3 CWR fauna species (*Dasyurus geoffroii*, *Trichosurus vulpecula* and *Isoodon obesulus*) have been trapped. Ten of these (6 *T. vulpecula* and 4 *D. geoffroii*) have been radio-collared for monitoring of survival. Supplementary trapping is now scheduled to increase the sample size of CWR fauna monitored for survivorship analysis within each treatment.

Table 2: Trap Capture Success for Critical Weight Range Fauna Within The Baiting Treatment Sites (pre first baiting)

Site Name	Capture Success (combined percentage capture rate for wire cage and Elliott traps) (n) = no. of trap nights	
Dobaderry	**0**	n=875
Wearne	**1.04**	n=865
Randall	**0.43**	n=930
Bunnings	**0.12**	n=869
North East Road	**0**	n=872

Scope Item A10

Investigate differences in survival of native prey species (resident and translocated) at the boundary and central zone of large areas subject to baiting for fox control.

Monitoring of survival through use of radio-telemetry has commenced. Currently only 10 individuals over all treatments are fitted with radio-collars.

Supplementary trapping is now scheduled to increase the sample size of resident CWR fauna monitored for survivorship analysis.

The proposed translocation of *Bettongia penicillata* has been modified to restrict translocation to sites on the eastern side of the study area, i.e. boundary or perimeter sites only. The rationale for this is:

- the increased cost of using mortality sensors prohibits the use of core and perimeter sites. The increased costs resulting from the use of mortality collars are (i) increase in purchase price per unit (ii) increase in the frequency of monitoring each site. Monitoring of mortality sensors returns greater reward with increasing frequency of monitoring.
- site selection for the *B. penicillata* translocation has identified perimeter areas as the most suitable in terms of rainfall, overstorey, ground cover, access for monitoring (jarrah dieback hygiene restrictions prohibit access to much of the central core area during winter), fire history, proposed burning patterns and security of land tenure.

Therefore it is proposed to modify existing Scope Item A10 by deleting the reference to translocated species. Although now not relevant to this Scope Item, the *B. penicillata* translocation is still scheduled and is an integral component of Scope Items A3, A9 and A11. Scope Item A10 should now read *"Investigate differences in survival of resident native prey species at the boundary and central zone of large areas subject to baiting for fox control"*.

Scope Item A12

Derive an index to fox densities within forested areas.

This Scope Item was subject to endorsement and funding from the CRC (VBC). Endorsement has been given and funding approved from the CRC '94/95 budget.

Preliminary work has commenced at the fox density reduction site at Beverley (see fig. 1.). The work has been aimed at modifying the sandplot/fox presence detection technique and validating this modified technique to derive an index to fox density.

The validation is scheduled for completion by early September '94.

Annual replicated sand plotting (scheduled to commence mid-September 1994) will be used to derive an index to fox density within the jarrah forest.

Milestones

Progress towards milestones targeted for achievement by 30 June 1994 is shown in table 3 (below).

Table 3: Progress towards achieving targeted milestones

Milestone	Targeted achievement date	Target achieved Yes/No	Comments
1. Site selection for seven prey monitoring sites	Dec. '93	Yes	Nine sites have been established (see table 1 & fig. 1). Each site consists of three integrated trapping grids (pitfall, Elliott and wire cage traps).
2. Complete radio-telemetry trials	Feb. '94	Yes	A combination of AVM (USA) mortality sensing radio-collars (two size ranges), Bio Telemetry Tracking (SA) receivers and Sirtrack (NZ) aerials has been adopted.
3. Commence census of rabbits and monitoring for fox presence	Feb. '94	Yes	Rabbits were not detected at any of the forest sites. Fox presence was detected at all sites.
4. Radio collaring of resident indicator prey species and commencement of telemetry monitoring and spotlight transects	March '94	Yes	Resident fauna within the Critical Weight Range (CWR) were detected at 3 of the 5 sites within the baiting treatments. All trapped brushtail possum (*Trichosurus vulpecula*) and chuditch (*Dasyurus geoffroii*) have been radio-collared and monitoring has been ongoing. Annual spotlight transects completed for 2 and 4 baiting per year treatment sites.
5. Derive density estimates for resident fauna	March '94	Yes	Initial density estimates indicate that resident CWR fauna is at low density throughout the jarrah forest.
6. Commence baiting at treatment sites 1 & 2	March '94	No	Baiting commenced in June '94.
7. Translocation of *Bettongia penicillata*	March/April '94	No	Translocation is now proposed to be conducted in stages, with the first stage in October '94.
8. Preliminary analysis of radio-telemetry, spotlight, rabbit and fox presence data	June '94	Yes	Preliminary analysis of trapping and spotlight data indicates low CWR fauna densities and shows no evidence of rabbit presence throughout both baiting treatments. Radio-telemetry monitoring has recently commenced and trends in survivorship are not yet evident. Sandplot data showed fox presence at all baiting treatment sites. Spotlight data showed fox presence at perimeter sites only.

Scope Item A12

Objectives: *To investigate the response of native fauna (including species not yet shown to have responded to fox control) to twice-yearly 1080 baitings of a large area of Fitzgerald River National Park (FRNP).*

Project leader	Jack Kinnear	CALM
Technical Staff	Mike Onus	CALM

Effectiveness Of The Baiting Protocol

The baiting protocol for the FRNP — six 1080 meat baits/km², twice yearly over one-half of the park — was based on previous research that showed that the above protocol removed 70-80% of the fox population (see ESP Project No 38; Midyear Report, Dec. 1992). Cyanide transects carried out in the FRNP supported this conclusion; for example, the sample size from cyanide bait stations in the unbaited area of the FRNP ranged from 9-12 foxes per 20km transect while in contrast, after a 1080 baiting, the sample size ranges from 1-3 foxes/20km — an 80% reduction of fox cyanide victims (see ESP Project 38; End-of-Year Report, June 1992).

Baitings are carried out at 6 monthly intervals and are designed to remove foxes during the breeding season (Sept-Oct) thus reducing both adults and the recruitment of young, and during the peak dispersal phase (Feb-Mar). This protocol — six months between baitings — raises the following question: Is there a significant increase in foxes due to immigration and or recruitment during the period between baitings?

This question was addressed by carrying out cyanide transects immediately before a scheduled baiting on both the baited and unbaited sections of the park. The results are presented in Table 1.

Table 1. Results from cyanide baiting transects in the baited and unbaited areas of FRNP (Sept 93) approximately six months after the last baiting.

Area of FRNP	Fox Victims Per 20km Transect
Control area (no baiting)	12 foxes
Treatment area (last baited Mar 93)	3 foxes

These findings imply that recruitment into the park interior within the baited area is negligible, and that the initial 70-80% suppression of fox density has been maintained by the twice yearly baiting regime for more than 2.5 years.

This highlights a leading question that this project seeks to answer: Is this reduction in fox density sufficient to enable marsupial indicator species (eg, wallabies, possums, bandicoots, malleefowl) to increase?

At this stage, we have not observed any increases in indicator species except for an upward trend in mallee-fowl sightings.

There are 3 possible reasons for the lack of a detectable increase in indicator prey species:

1. Insufficient time to detect a significant increase due to low initial densities of prey and low intrinsic population growth rates of indicator prey spp. (Other predator removal experiments have been assessed after 5 yrs).

2. Low carrying capacity of FRNP habitat ie, prey indicator spp currently at carrying capacity densities. (This has not been shown to be the case in any other predator removal experiment to date).

3. Baiting regime not frequent enough to reduce the predation pressure to a level that allows population growth. (It should be noted, that successful control programs which have led to marked prey increases, have employed baiting frequencies ranging from 4-12 times[1] per year).

Comments

Point 1. A low initial density of prey indicator species coupled with low fecundity could be the reason for the lack of a response at this stage. If this is the case, time will tell as upward trends should become apparent in the future (1994-95 and beyond).

Point 2. If an increasing trend is not evident for indicator prey spp, then the next logical step is to carry out supplementary baitings (ie, more frequent baitings) in selected localised areas carrying indicator prey. If prey populations fail to increase in these selected areas, then other factors limiting population growth must be operative.

More significantly, if prey numbers *only* increase in response to more frequent baitings, then it does not augur well for fertility control using immunogenic baits as proposed by the VBC. Given the above scenario ie, no prey response to a 70-80% population reduction as achieved by lethal controls, a similar reduction in fox density achieved through fertility control would also fail to promote population growth of prey spp.

Conversely, if prey indicator spp increase in the near future, then there is possibility that immunogenic baiting programs ***may*** produce a similar result (however, see following comment).

An additional point worth emphasising is that lethal control methods periodically perturb fox demographics by turning over (ie remove) a proportion of the population; in contrast, fertility control would

[1] One the objectives of this experiment is to define the minimum baiting frequency required for large areas of conservation estate that enable prey spp to increase — hence the 2 baitings per year.

presumably promote stability at some lower density. The latter form of control would not remove "rogue killers" — that is, foxes that learn to focus on vulnerable wildlife as their principal prey when circumstances permit. Furthermore, if surplus killing[2] by foxes is shown to be commonplace, then this distinction becomes even more significant.

Point 3. Baiting frequency insufficient: more frequent baitings in selected areas supporting indicator prey spp will test this hypothesis. This is feasible as experience elsewhere has shown that predator control can be localised.

Effect of Baitings on the Abundance of other Mammalian Species

The FRNP supports an array of smaller mammals (10 spp; some being rare) about which little is known concerning the impact of baitings on their population dynamics. The FRNP project is also designed to compare the abundance of this group in the baited and unbaited areas using permanent pit-trap lines (some 32 fenced lines; ≈380 pit traps) that were installed across all habitat types during a previous biological survey of the park.

Most of these lines were located during the 1993-94 dry period[3] . The pits were excavated and capped — a step that will greatly facilitate future trapping sessions.

Preliminary trapping results have not yet yielded any indications that small mammals have increased as a result of the baiting regime. The 1994-95 monitoring across all habitats should provide more definitive evidence. If there are no apparent benefits in relation to the baiting regime, then areas surrounding selected trap lines will receive supplementary baitings.

Pit-trapping Innovations: a new design

Small mammals are routinely captured in pit-traps. Fenced pit-trap lines are more productive than unfenced lines, but require more time and effort to setup and dismantle. It was soon realised, that the use of conventional fencing was a laborious time-consuming procedure that needed streamlining, if we were to service the full 32 lines across all habitats in any given year.

Accordingly, we have designed a new type of fencing, incorporating new materials and features, that greatly facilitate the erection and removal of

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[2] Recently, 11 rock-wallaby carcasses were discovered on the periphery of Mt. Caroline near Kellerberrin WA. Some were partly consumed, others were intact. This carnage appears to be the work of a single fox which killed 25% of the known population. A routine baiting took place and the killing ceased.

[3] Access to most sites in the FRNP is only permitted under dry conditions because of quarantine regulations in force designed to contain dieback (*Phytophthora spp*). These conditions can constrain research activities sometimes considerably.

fences. It is proposed to publish a description of this new design after field testing.

Milestones Achieved — a summary

Two baitings of the FRNP were carried out according to established protocols.

Evidence was collected, which indicates that the baiting protocol in train in a 160,000ha section of the Fitzgerald River National Park during the past 2.5+ years, has reduced and maintained the fox population at 20-30% of its original level.
Indicator prey spp have yet to respond to this baiting regime apart from malleefowl which are now sighted more frequently. Three likely hypotheses that may account for this lack of prey response are discussed:

(1) insufficient time for prey to increase significantly (2) habitat and or environmental limitations (3) predator control inadequate (ie, baiting frequency insufficient). Measures are proposed which will test these hypotheses.

If the level of control, as achieved by the current baiting regime, is shown to be insufficient, then it is doubtful that immunogenic baits will be effective as a *sole* means of fox control.

More than thirty established small mammal pit trap lines have been located and re-activated across all habitat types throughout the park. Preliminary trapping results have not yet indicated a response to baitings. The 1994-95 trapping program will provide more definitive results.

A new and improved pit-trap fence has been devised which greatly facilitates the setting-up and the dismantling of pit-trap lines; it will be field tested during the 1994-95 season and a description will be submitted for publication.

Scope Item A14.

Objective: — *Undertake 1080 baiting for fox control at boundaries of Perup Nature Reserve, and investigate the response of faunal density throughout the reserve.*

Subsequent policy changes by CALM managers of the Perup has made this project untenable and hence, this scope item was abandoned. None of $2,000 allocated to this project were expended on this project. Permission was sought and received to utilise the funds for the development and manufacture of the new pit-trap fences discussed above. More details may be found in a letter to J. Hicks dated 18 April 1994.