

ESP PROJECT NUMBER 38

(file:700/3/9)

MID-YEAR REPORT (DECEMBER 1992) TO THE AUSTRALIAN NATIONAL PARKS AND WILDLIFE SERVICE

Project Title

**Control and Ecology of the Red Fox *Vulpes
vulpes* in Western Australia**

Nominated Officer

Chief Investigator: Dr. Jack Kinnear

Consultants: Dr. David Algar

Dr. Nicola Marlow

Western Australian

**Department of Conservation and Land Management, Wildlife Research
Centre, P.O. Box 51, Wanneroo, 6065.**

Ph. (09) 405-5137 ♦ Fax (09) 306-1641

TABLE OF CONTENTS

1. DISPERSAL.....	3
1.1 Radio-Tracking Study at Watheroo National Park (NP).....	3
1.2 Monitoring Immigration Of Foxes Into An Area Not Subject To Fox Control (Kalbarri NP)	3
2. SOCIAL ORGANISATION.....	4
2.1 Kalbarri NP Cyanide Kill.	4
2.2 Radio-Tracking Study (Watheroo NP).....	4
2.3 Large-Scale Intensive Sampling of a Fox Population	4
3. BAIT-UPTAKE TRIALS.....	5
3.1 Large-Scale Intensive Sampling Of Foxes	5
3.2 Watheroo NP Radio-Tracking Study.	6
4. REFINEMENT OF THE CYANIDE TECHNIQUE.....	6
4.1 Cyanide Capsules.	6
4.2 Cyanide Additives.....	6
4.3 Scent Trials	6
4.4 Food Lures	7
4.5 Risk To Non-Target Species	7
5. POPULATION DENSITY (CALIBRATION OF THE CPUE INDEX)	8
5.1 Large-Scale Intensive Sampling Of Fox Populations	8
5.2 Radio-Tracking Study (Watheroo)	8
6. DEVELOPMENT OF THE MICROSATELLITE AND PCR TECHNIQUE FOR OBTAINING DNA PROFILES FOR FOXES.....	8
6.1 Development Of The Micro-Satellite And PCR Technique	8
6.2 Analysis Of DNA Samples To Determine Sexual Contact Rate And Parentage Of Fox Litters.....	9
6.3 Analysis Of Samples To Determine The Relationships Between Cubs And Vixens For Social Organisation Investigations.....	9
7. SAMPLING (Biological Materials for VBC Investigations).....	9
8. COMPLETION OF TOOTH ANALYSIS (Age, Biomarker Labels)	10
9. GIBSON DESERT PROJECT	10
10. 1080 BIOASSAY	10
11. FITZGERALD RIVER NATIONAL PARK (FRNP).	11
12. PREDATOR-PREY STUDIES	11
13. LIAISON	11

SCOPE ITEMS

Please note this report covers the period July 1 to November 15, 1992.

1. DISPERSAL

1.1 Radio-Tracking Study at Watheroo National Park (NP)

Capture of cubs for radio-collaring has begun and will be continued until the end of November. To date, 8 animals have been captured and a further 22 are sought to attain a statistically viable sample. New expandable collars are being fitted to each cub and blood samples for DNA analysis and viral screening have been taken. The movements of radio-tagged foxes will be monitored during the dispersal phase.

1.2 Monitoring Immigration Of Foxes Into An Area Not Subject To Fox Control (Kalbarri NP)

Thirty-six foxes were collected from cyanide transects in the northern area of Kalbarri NP during August 1992. In total, 72.6 km of transect was baited over a three day period in an area of approximately 180 km². Five transects were used and their respective CPUE indices are 4.2, 2.2, 4.9, 2.2, 1.5.

Examination of the canines of the Kalbarri sample to determine the presence of the tetracycline biomarker is underway but is not completed. Similarly, the aging analysis for the population is underway (See Section 8). These results will be presented in the final report.

The demographic information obtained for the Kalbarri sample is presented in Section 2.1.

2. SOCIAL ORGANISATION

2.1 Kalbarri NP Cyanide Kill.

Of the 36 foxes collected, 22 were vixens and 14 were males. This ratio was not significantly different from a 1:1 ratio ($X^2=1.78$, $p>0.05$). 86% of the vixens had either cubs in utero or had given birth. The litter size (mean $\pm$ s.e.) was 3.5 ± 0.4 . Spleen samples were taken from all individuals and these await analysis as soon as the new micro-satellite and PCR technique for obtaining DNA profiles is completed (See section 6). Blood samples and ovarian tissue have been sent to the Vertebrate Biocontrol Centre (VBC: CSIRO Division of Wildlife & Ecology, Canberra) for viral antibody analysis and for reproductive protein sequencing.

2.2 Radio-Tracking Study (Watheroo NP).

An area of approximately 80 km² has been selected within Watheroo NP for this study. To date, 20 adult animals have been fitted with the newly developed proximity radio-collars (See previous report). Further trapping is being conducted for cub dispersal and this will allow more adults to be captured. An attempt will be made to radio-collar the entire population of foxes within the study site. This will allow us to determine social organisation from location data, home-range, and contact-rate between individuals. Intensive radio-tracking will commence in January 1993.

2.3 Large-Scale Intensive Sampling of a Fox Population

The study site has been selected and mapped at Carnarvon. Biomarker baits were laid in November and the sampling will commence in December 1992. The timing of this experiment is critical, because during this period, cubs are mobile but have not yet dispersed. This enables the foxes' social organisation to be identified as either socially regulated or environmentally regulated. Equipment is on site and liaison with local land holders has been completed.

3. BAIT-UPTAKE TRIALS

3.1 Large-Scale Intensive Sampling Of Foxes

Analysis of tetracycline biomarker in canines from wide-area baiting intensity trials (see section 2 of previous report) has been completed.

Bait uptake refers to the percentage of the fox population that are labelled with the biomarker i.e., those foxes that have eaten a bait, not the number of baits that were consumed.

The results indicate that bait uptake is predominantly in the range of 80-90% for the two baiting intensities; indeed, uptake tends to be higher at the lower baiting regime. At this stage, these results suggest that bait consumption may reach an asymptote at application rates of about 5 baits/km².

Data from Big Soak Plains indicate a lower bait uptake (65%) but a wind-shift during the baiting programme caused baiting intensity to be lower than the stipulated 5 baits/km² across the entire site. In fact, baiting intensity was only 3.3 baits/km², implying that uptake drops rapidly at a baiting intensity of less than 5/km².

These results may well be conservative, because foxes are not killed by the non-toxic baits, and therefore they are able to consume more baits over time thereby reducing bait availability to other individuals in the area.

Significantly, our baiting uptakes are considerably higher than those reported overseas. The mean for overseas bait uptake is 63.8 ± 8.76 (s.d.) percent.

Even more striking is the difference in the density of baits laid (baits/km²). The overseas mean value is 21.1 ± 9.75 . vs 5 baits/km² in WA.

The high baiting uptake achieved in WA augurs well with regards to the bait delivery of a sterility antigen that is being developed by Dr. Mark Bradley of the VBC Fox Group, Canberra.

Additional data on baiting efficiency will be collected during the large scale intensive sampling of foxes in Carnarvon this December. Tetracycline baits were laid over this study area in November.

3.2 Watheroo NP Radio-Tracking Study.

Tetracycline labelled baits are to be laid prior to the calibration of the CPUE index in August 1993. This trial, which is part of a multi-purpose experiment, will yield additional data on bait uptake.

4. REFINEMENT OF THE CYANIDE TECHNIQUE

4.1 Cyanide Capsules.

Attempts to develop a more robust cyanide capsule capable of surviving more than one day's field usage will be undertaken following the results of the Carnarvon experiment.

4.2 Cyanide Additives

Commercial grade (98% pure) sodium cyanide is hygroscopic, causing the cyanide powder to cake. This caking results in fewer fox kills. Use of free-flowing agents (e.g. Tixalex) has overcome this problem as shown by field trials. Also, the incorporation of this agent into the cyanide results in better capsule quality control.

4.3 Scent Trials

Examination of different scent trails was conducted along 300 km of railway reserves. Five treatments were used:

- 1) freshly killed sheep.
- 2) tyre drag.
- 3) tyre drag plus meat-meal lure.
- 4) tyre drag plus fish-meal lure.
- 5) control- no treatment

Both these artificial lures (meat or fish meal) were laid at a rate of 5litres/km. Treatments were randomised within a block: each block was

separated by a buffer of >3km. Each treatment was run for 1 km, and immediately followed by the next treatment. Within each treatment, raked plots (1m wide and the width of the track) were established at 100m intervals. Analysis was based upon the presence/absence of fox tracks at each station.

The results demonstrate that scent trail created by dragging a sheep was the most effective lure for attracting foxes to bait stations. A statistical analysis will be presented in the final report.

4.4 Food Lures

Two sites were selected to test fox preferences for different food lures. The lures comprised:

- 1) condensed milk combined with icing sugar.
- 2) raw liver blended with blood to form a paste.
- 3) cooked liver in vegetable oil.
- 4) sardines blended in fish oil.

A smorgasbord presentation was used at each site and appropriately coloured wax capsules were used to contain the cyanide. The order of placement of the lures around the central peg was randomised at each site. Data interpretation is based upon the number of foxes killed per attractant type.

The results indicate that there was no significant difference in the preference by foxes for milk and the two liver types of lure. However, the fish based attractant was significantly less attractive. A full statistical analysis will be included in the final report.

4.5 Risk To Non-Target Species

Alternative ways of presenting cyanide baits to avoid risks to non-target prey will be investigated later in this financial year.

5. POPULATION DENSITY (CALIBRATION OF THE CPUE INDEX)

5.1 Large-Scale Intensive Sampling Of Fox Populations

This experiment will be performed during December 1992. It will enable the estimation of population decline due to cyanide baiting. Additionally, it will increase our knowledge about the relationship between CPUE indices and known fox densities.

5.2 Radio-Tracking Study (Watheroo)

This experiment will commence in January 1993.

6. DEVELOPMENT OF THE MICROSATELLITE AND PCR TECHNIQUE FOR OBTAINING DNA PROFILES FOR FOXES

6.1 Development Of The Micro-Satellite And PCR Technique

The application of DNA fingerprinting (DNA profiles) to fox populations requires an efficient fox sampling technique. Cyanide bait transects sample fox populations efficiently without serious bias, but the use of cyanide leads to DNA degradation within six hours after death which negates the use of standard (Jefferies) probes.

This situation has necessitated the development of a new system that is not affected by cyanide induced degradation of DNA. Research on the development of a microsatellite and PCR method of obtaining profiles has been progressing well, and several promising results have been obtained. A poly CA probe has been very successful in identifying the presence of DNA sequences suitable for producing DNA profiles. Sequencing of the appropriate DNA primer for these fragments is being done by the VBC in Canberra. It is anticipated that this method of obtaining profiles from samples may be available for use in January 1993.

6.2 Analysis Of DNA Samples To Determine Sexual Contact Rate And Parentage Of Fox Litters

Spleen samples for DNA analysis were obtained from all of the 36 foxes killed by cyanide in North Kalbarri NP (See Section 1.2). Spleen samples from the embryos of all of the pregnant vixens were obtained to determine the relationships between the foxes in that population using DNA profiles. Seventy-three embryos were sampled and from these it will be possible to determine if there was multiple paternity of single-litters of cubs and also whether one male sired more than one litter. These results will determine the minimum contact rate that must have occurred to account for the observed relationships and will reveal the mating strategies that occur in wild fox populations.

It is important that we have a thorough understanding of mating strategies because these will largely determine the level of sterility that must be imposed upon a fox population to successfully reduce that population with biological methods.

6.3 Analysis Of Samples To Determine The Relationships Between Cubs And Vixens For Social Organisation Investigations

Because the ratio of vixens to cubs and vixens to male foxes is different for the mated pair social system and the dominance hierarchy system, we are interested in determining the sex ratio of the population and how many viable cubs are produced by each vixen. The large-scale kill at Carnarvon in December will provide a comprehensive sample of foxes and from these, the sex and cub:vixen ratios will be obtained. If environmental factors cause high cub mortality to occur, DNA profiles from each cub can be used to determine whether only a few vixens were responsible for producing most of the cubs, which would indicate that a dominance hierarchy was operating, or else if most vixens produce only a few cubs each, then a mated pair system would be operating.

7. SAMPLING (Biological Materials for VBC Investigations)

Blood samples have been obtained from all individuals collected along cyanide transects or captured as part of the radio-tracking studies. These

samples have been sent to the VBC Canberra for viral antibody analysis as have fox ovaries and testes for reproductive protein sequencing.

8. COMPLETION OF TOOTH ANALYSIS (Age, Biomarker Labels)

Since delivery of the *Isomet* saw and barrier filters intensive analysis of previously collected canine samples has been undertaken. A VBC appointed Laboratory Technician has been trained in aging and biomarker detection techniques. The majority of the tetracycline samples have been completed and age analysis is currently underway. Detailed results will be presented in the final report

9. GIBSON DESERT PROJECT

This study has continued in association with the translocation of Boodie (*Bettongia lesueur*) and Golden Bandicoot (*Isoodon auratus*) to a site in the Gibson Desert.

Following unseasonable heavy rain throughout winter months, a prolific rejuvenation of plant and animal activity resulted. Attempts to visit the site were aborted because of the wet conditions, and the effort to test the effectiveness of aerial baiting had to be abandoned.

An aerial baiting was successfully carried out in August when 2500 baits were dropped in the 40 x 40 km zone around the release site.

Cyanide transects through the baited area yielded no predator victims. It was concluded that the baiting was largely effective in removing foxes.

Later inspections for fox and cat footprints yielded one fox track and eleven cat tracks. No interest in baits was evident by the resident cat population.

Monitoring of predators will continue and predator control will be implemented as required.

10. 1080 BIOASSAY

Work is continuing on the refinement of the assay for dried meat baits. The assay works well for soil and other biological materials, but in the

case of meat, recovery of known amounts of 1080 have been low and variable. New methods are being trialed.

11. FITZGERALD RIVER NATIONAL PARK (FRNP).

The FRNP was baited during October. This was the forth baiting over a 2 year period with the object of testing a prescribed baiting frequency (spring/autumn baitings, 6 baits/km²) over a large area to determine if this level of baiting is adequate to produce prey responses. Censuses of prey populations will begin in February 1993.

12. PREDATOR-PREY STUDIES

Forty woylies (*Bettongia penicillata*, sourced from Dryandra State Forest) were released into Boyagin Nature Reserve. The objective of this translocation is to allow woylies to increase to the carrying capacity (K) of the reserve while the reserve is under predator control. Once K is reached, it is then planned to perform some manipulative experiments recommended by the VBC as described previously under this Scope item.

13. LIAISON

The Fox Group attended the opening of the Vertebrate Biocontrol Centre held in Canberra in October. Intensive discussions with VBC colleagues and advisers took place. It was agreed that a greater research emphasis on predator-prey relationships was necessary. Such studies are planned for the next fiscal year.

Dr. Mark Bradley of the VBC Canberra, paid a visit to WA and participated in a CALM workshop designed to inform CALM regional managers about the latest developments and future plans regarding fox research and control. His presentation was well received. A field trip to Dryandra State Forest was made to illustrate the prey response to fox control.

Discussions involving Dr. Bradley were held with Professor Wetherall at Curtin University regarding the DNA profiling research described in Scope item 6.1. As a result of this meeting, it was agreed that VBC would assist in regard to DNA sequencing — a step that will speed up the

development. There is a possibility that the Curtin Research may prove useful with regard to problems associated with immune response heterogeneity.

A meeting with Professor Shellam and staff (UWA Department of Microbiology) involving Bradley, Kinnear and Marlow was held at Queen Elisabeth Medical Centre regarding fox virology. Prof. Shellam offered to screen fox sera for antibodies to Cytomegalovirus (CMV). If foxes are shown to carry CMV, then it might prove to be a virus suitable for genetic engineering. Arrangements were made to provide samples and to collect salivary glands.

J. Kinnear presented a seminar to Murdoch University Veterinary staff and students. Prof. Clark has since written offering their assistance in regard to fox research.

J.E. Kinnear
D. Algar
N. Marlow
20 November, 1992.

