FPP PROJECT NUMBER 8

CONTROL AND ECOLOGY OF THE RED FOX IN WESTERN AUSTRALIA

FOX POPULATION DYNAMICS AND CONTROL

A Report Submitted
to the

AUSTRALIAN NATURE CONSERVATION AGENCY

by the

WA DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

and

AGRICULTURE WA

for the period 1995-96

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BACKGROUND

This experiment will determine whether foxes can compensate for reductions in density to the point of effectively countering control measures. The field work is being undertaken at Carnarvon WA and involves imposing a substantial reduction (about 80%) on a large fox population, then later sampling it and comparing its demographic parameters with those from an intact (experimental control) population (Fig. 1). Compensation will be identified by differences such as a higher proportion of first-year recruits in the reduced population. The research is highly relevant to both lethal control and the development of biological control for foxes, and is consistent with ANCA's commitment to fox control under its Threat Abatement Plan. Field work for this study commenced in June 1995.

The Carnarvon study sites were chosen because they are sufficiently large to investigate fox populations at an appropriate scale. Previous studies have been hampered by sites that were too small and had too few foxes for statistical analyses. Immigration into the study area can be manipulated by strategic re-baiting of the 15 km buffer zone surrounding it. Valuable background information is available on the vegetation, rainfall, stock numbers and pastoral productivity of this region. Pastoralists in the area have a history of co-operation with Agriculture Western Australia and this is essential for any long-term fox research project. The limited number of land holders and sparse human population increases our chance of obtaining general approval for activities such as aerial baiting and cyanide baiting.

The density of foxes in the study area is approximately 1 adult to 2 sq km. This is probably typical of vast tracts of the Australian landscape and is comparable to densities found in some agricultural areas of south western Australia. Valuable background data on the fox population at Carnarvon was collected during an intensive sampling in 1992 (eg. age-specific mortality and fecundity and deduced social system: see report May 1993).

Background data on diet, general condition and breeding are being collected from foxes killed on cyanide transects established in similar habitats to the experimental sites. Samples were collected from 206 foxes during the 1995 breeding season. From these the number of embryos per litter (Fig. 2) and the estimated parturition dates for the 1995 breeding season (Fig. 3) were obtained.

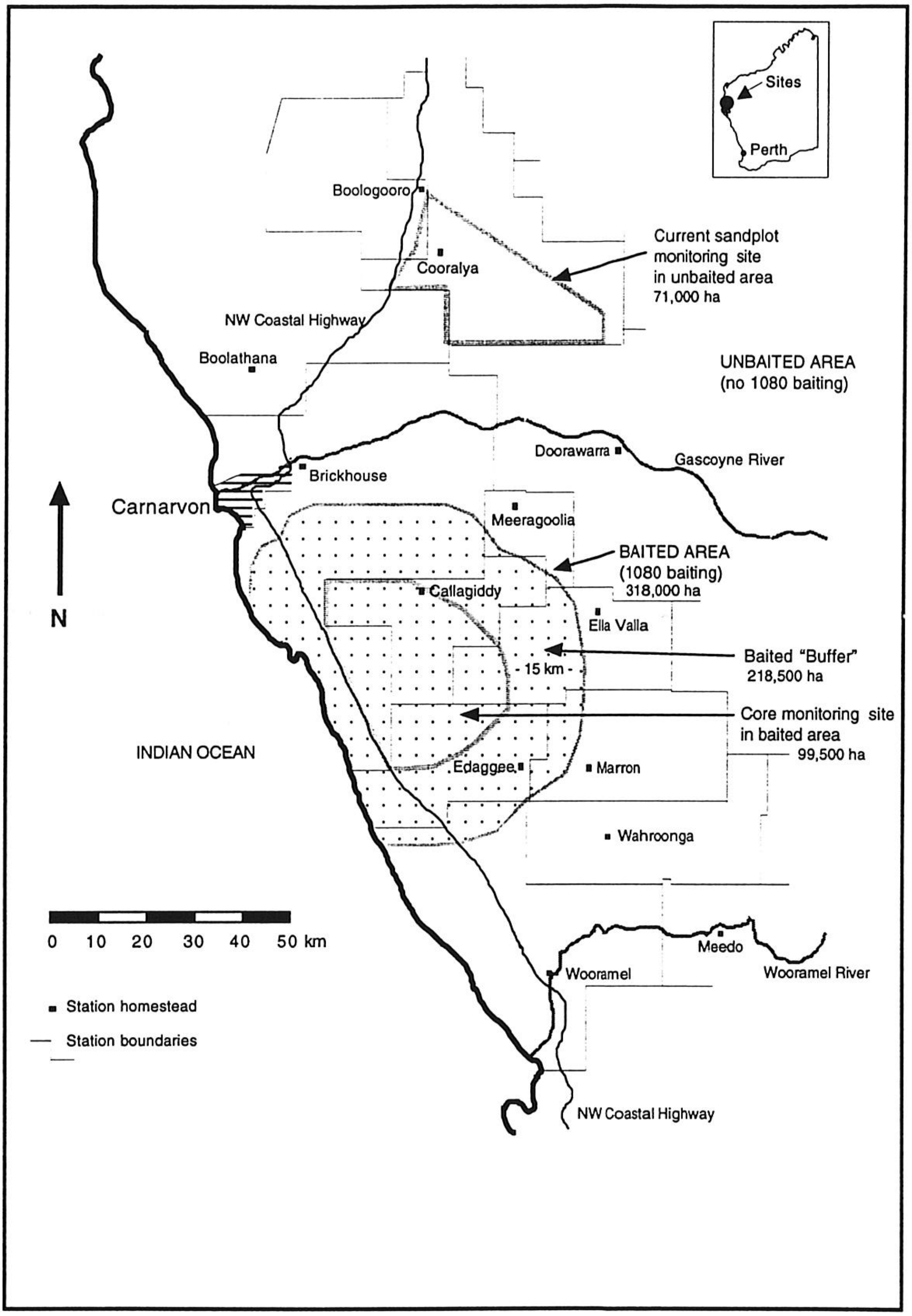


Fig. 1: Map of study areas

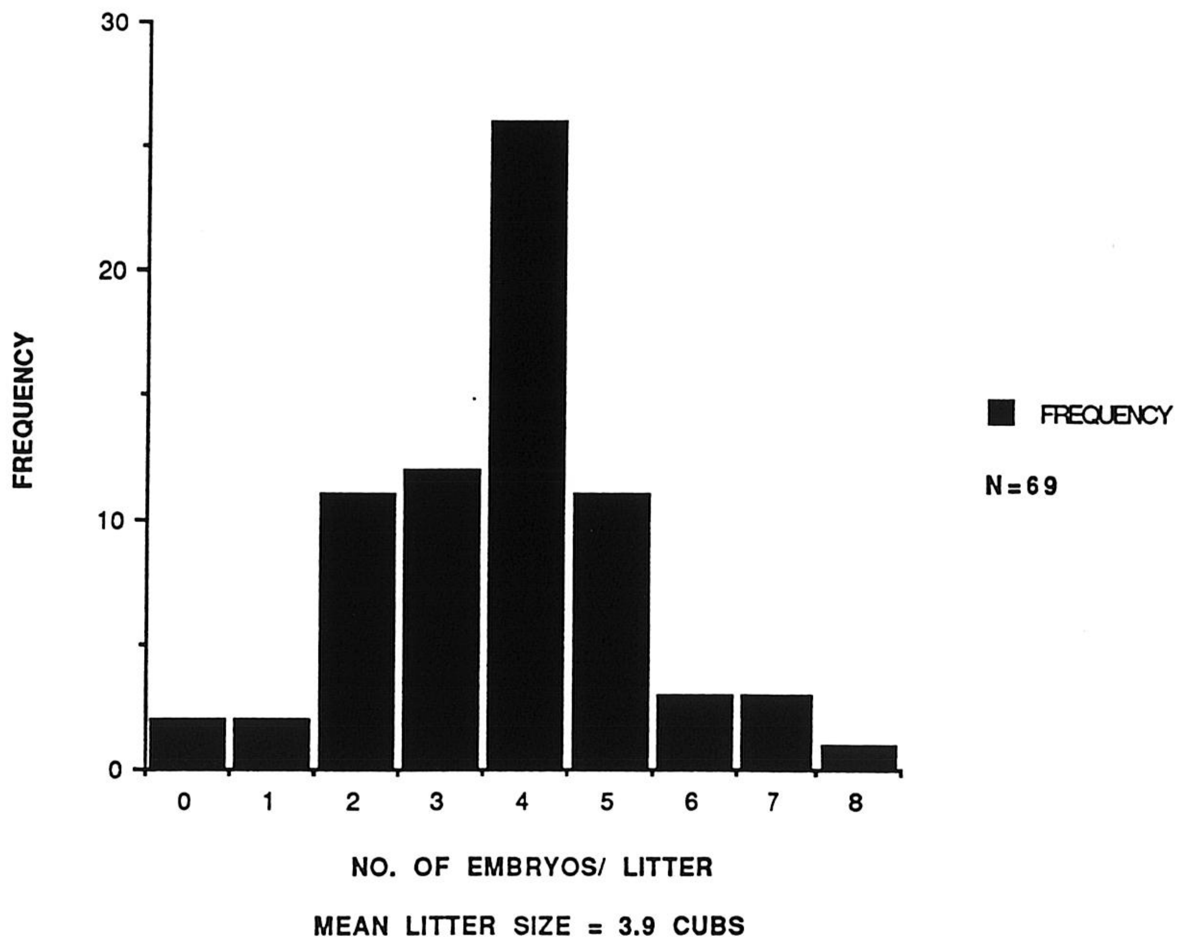


Fig. 2: Number of embryos per litter from Carnarvon Foxes (August 1995)

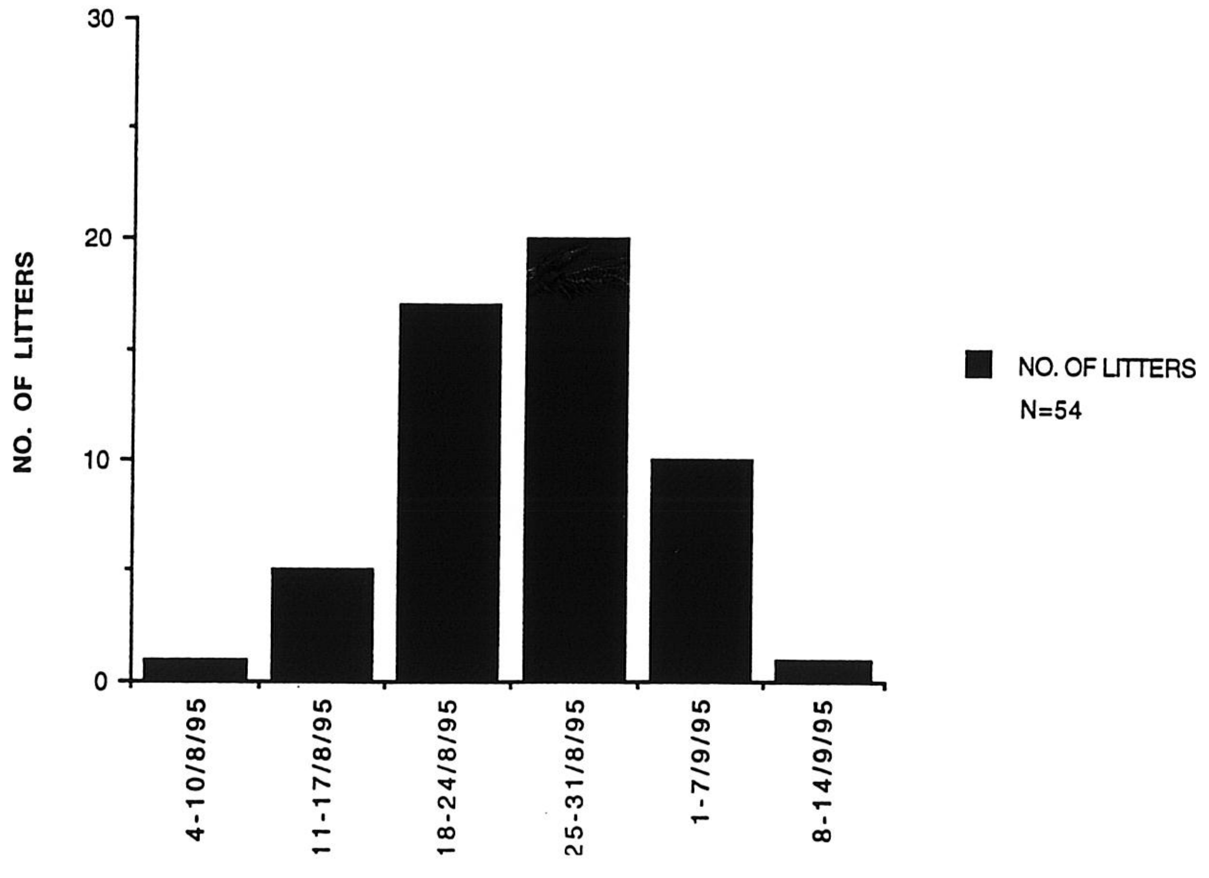


Fig. 3: Estimated parturition dates for foxes at Carnarvon
(1995 Breeding season)

Before the population reduction was undertaken, two teams of two experienced trappers worked for four days and caught a total of 51 foxes in the treatment site. Each fox was fitted with a radio-collar that contained a mortality sensor and the status of all foxes was monitored regularly. Forty-five foxes were known to be alive the day before the population reduction commenced.

Aerial baiting, using dried meat baits containing 1080, was used to reduce the population in the treatment site. The baiting extended 15 km beyond the main treatment area so as to provide a buffer against the unchecked immigration of foxes from unbaited areas nearby. The effectiveness of the baiting campaign was measured directly by monitoring the status of the radio-collared foxes. Population changes in both the control area and the treatment area were also monitored indirectly by track counts on a series of sand-plot transects that have been established across both areas.

The experiment was to be finished in August 1996 (see amended proposal and report July 1995) but this has now been delayed by one year. The fox population reduction was more effective than expected and at least 95% of foxes were killed. As a consequence, few resident breeders survived the baiting, and most, if not all, 1995 cubs were killed. This outcome meant that there were too few foxes in the study site to enable us to obtain a statistically meaningful sample if we did not modify our experimental approach. Consequently, we decided to allow the population in the baited area to increase back to about 20% of its original density by permitting immigrants to recolonise the area. This gives us an extremely valuable opportunity to monitor immigration of foxes into a large cleared area and thus has immediate practical relevance to current fox control campaigns (see scope item 1).

The final destructive sampling will now be done in August 1997. Data will then become available on the effect of population reduction on the productivity and survival of foxes (see scope item 2).

A funding proposal for the continuation of this work has been submitted to ANCA via the Co-operative Research Centre for the Biological Control of Vertebrate Pests. A preliminary project proposal for future research that investigates the field effectiveness of a bait-delivered immunocontraceptive vaccine for foxes was also included.

PROGRESS ON SCOPE ITEMS

1 & 3 Dispersal patterns of foxes into large baited areas and the effectiveness of buffer zones.

Immigration is one of the key factors influencing fox population dynamics and the long-term effectiveness of control campaigns. Until we have Australia-wide fox control we will always have to consider immigration into controlled areas. We know little of the efficacy of control work over large areas, or of the most appropriate frequency for re-treatment. Ongoing monitoring at Carnarvon will give us the opportunity to assess the timing, incidence, and distances involved in immigration. Routine monitoring in the surrounding buffer zone will indicate whether it is feasible to use population reduction areas to control the movement of foxes into baited areas.

Aerial baiting was used to reduce the fox population in a 3180 sq km area that comprised a 'core' area of 1000 sq km surrounded by a 15 km wide baited 'buffer' zone (Fig. 1). Approximately 95% of foxes were killed.

We now plan to allow the population in the baited area to increase by permitting immigrants to recolonise the area. Immigration is being monitored by means of sand-plot transects and these have been set up throughout the baited core area, the baited buffer and in an unbaited site. There are 4 x 40 km of sand-plot transects in the baited core site; 7 x 40 km transects in the baited buffer zone; and 4 x 40 km transects in the unbaited site. Plots are at 1 km intervals within the transects and are monitored for 3 consecutive nights on a regular (six-weekly) basis (Fig. 4).

The results indicate that the buffer zone was effective in slowing immigration into the core area. Foxes started to re-colonise the buffer in November 1995 but did not occur significantly in the core area until March/April 1996. The majority of immigration occurred from the north-west of the site. This was not surprising because the town site of Carnarvon is in this direction and there is an abundance of food for foxes at the town rubbish tip and the plantations. The highway (Fig. 1) may act as a focus for fox dispersal, given the presence of kangaroo carrion along its length. There is also a high density of rabbits on the nearby coastal dunes.

There are now sufficient foxes in the core area to enable the investigation of compensatory survival to proceed as planned. The outer 5 km of the buffer will now be re-baited (May 1996) to prevent further immigration of foxes into the core site. It will also be re-baited in January and May 1997 when dispersal of juveniles is greatest. The effectiveness of this buffer in maintaining the fox density at a reduced level will be monitored on a regular basis until at least August 1997.

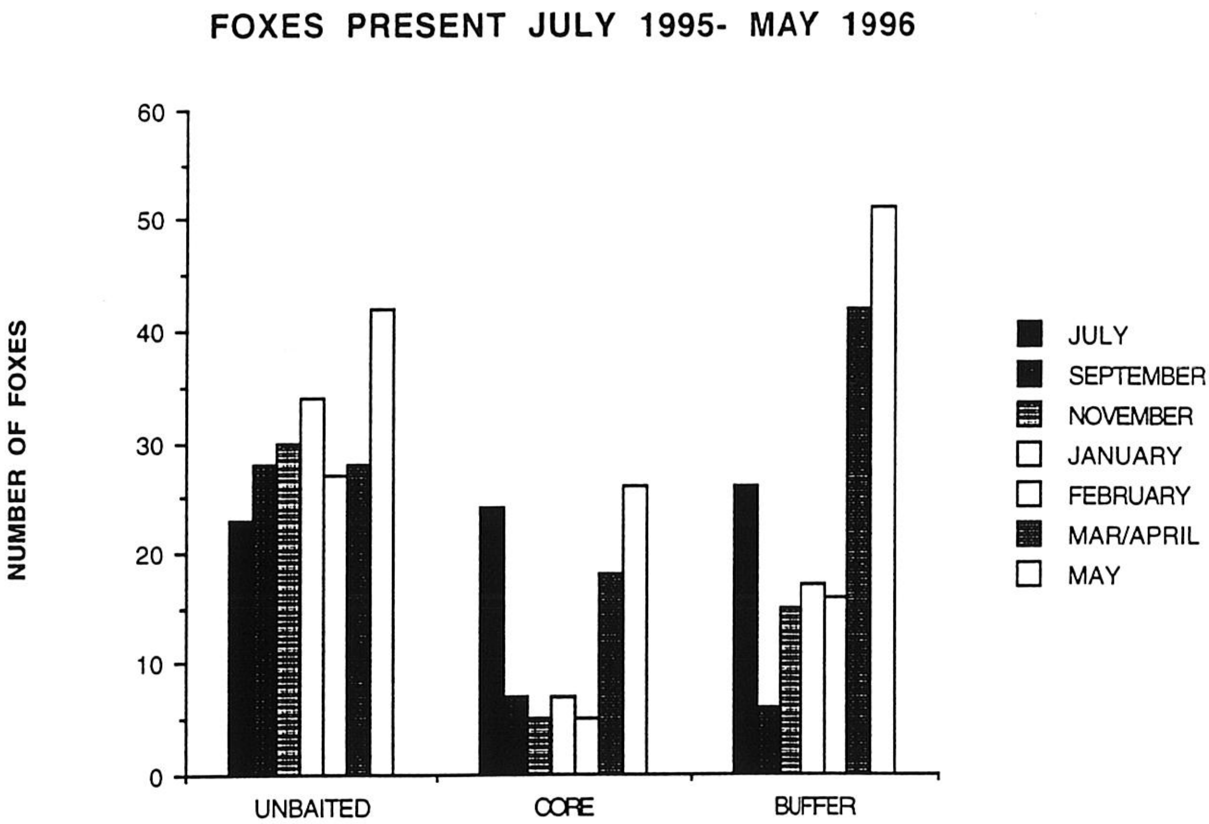


Fig. 4: Foxes present at sand-plots in baited core, baited buffer and unbaited sites. (Baiting undertaken in August 1995).

2. The effect of population reduction on the productivity and survival of foxes.

Animal populations tend to compensate to overcome any substantial reduction in their numbers. Mechanisms include an increase in the survival of both adults and young. As well, the population can be boosted by an increase in litter size. It is likely that the initial compensation by a population of foxes will be through an increase in cub survival and increased recruitment of vixen cubs into the breeding population. It is important to know to what extent foxes can compensate, to determine whether fertility control, or large-scale baiting is really worthwhile.

Data are being collected and compared under two regimes; one where the fox population has been left intact (4 sites) and the other where the population has been reduced to well below the carrying capacity of the area (a single treatment site). Any differences between the reduced and intact populations in the overall proportion of vixens breeding or in the proportion of first-year vixens breeding will be quantified. Compensation will be identified by differences such as a higher proportion of first-year recruits in the reduced population. Immigration into the reduced population area will be prevented by repeated baiting of a buffer zone (see scope items 1 & 3).

Before the population reduction was imposed, cyanide baits were used to ensure that a relatively uniform fox population density occurred throughout the chosen habitat (the Sandal land system). This baiting was done outside the study sites but within the same land system. Fox populations were then cyanide-sampled monthly from June to August 1995. This sampling provided background data on an intact population. It was timed to maximise information on the date of breeding, on pregnancy rates and on the average litter size for the 1995 breeding season. A total of 206 foxes was obtained and these are being aged to annual cohorts by counting cementum layers in their teeth. A life-table will be constructed and compared with similar tables obtained for August 1996 and August 1997.

A sample of foxes will be obtained in August 1996 using cyanide- baiting outside the study sites. It will provide background data for the 1996 breeding season and it will indicate whether the data collected in 1995 is comparable with data collected during the final sampling in August 1997. At least 150 foxes will be collected for life-table analyses (see Caughley 1977). By comparing the life tables for 1995, 1996 and 1997 it will be possible to estimate the rate of increase (r) of intact populations for three successive years.

In August 1997 the major destructive sampling for the experiment will be undertaken. Cyanide baiting and trapping will be used to collect as many foxes as possible from the reduced and intact sites. This sampling will also be timed to maximise the information obtained on fecundity. Life tables will be generated for the populations at the two different population densities. The maximum rate of increase (r_m) will be derived from the comparison of data from the intact and reduced populations.

Life tables will be compared using hierarchical log-linear analysis (Norusis 1985, "SPSSx: Advanced Statistics Guide"). The proportion of yearling vixens recruited into the study populations can be compared using standard Chi-squared or *G* -test contingency table analyses (Pyke and Thompson 1986, Ecology 67: 240-245). T-tests will be used to compare the number of embryos / placental scars within age-classes between unbaited and baited sites, and between years. Any difference in age-specific mean litter size as a result of the baiting will also be tested. The results obtained from these analyses will determine whether foxes can compensate for fewer vixens breeding and will indicate whether immunocontraception is a feasible method of fox control.

4. Estimation of bait uptake by foxes.

A baiting campaign was undertaken in August 1995 to reduce the fox population across 3180 sq km of pastoral land. Dried meat baits containing 3 mg of 1080 were aerially delivered at the rate of 5 per sq km. Transects were 1 km apart. The effectiveness of the baiting campaign was quantified by measuring changes in the level of activity of foxes at sand-plots and by determining the proportion of a sample of radio-collared foxes killed.

Sand-plot transects were positioned throughout the site before the baiting was undertaken (see scope item 1). Forty-five adult foxes were caught and radio-collared and were known to be alive when the baits were delivered.

From previous trials (see report May 1993) we expected to kill approximately 80% of the foxes across the entire baited area. However, the baiting proved to be more effective than expected with all of the 45 radio-collared foxes dying from 1080 poisoning. At least 50% of the radio-collared foxes died within the first three days after the baiting. The rate of deaths then slowed and the last fox died 44 days after it was first exposed to baits (Fig. 5).

Although all of the radio-collared foxes died, not all foxes within the site were killed. Changes in activity at the sand-plots indicated that approximately 85% of foxes took baits (Fig. 6). However, we estimated from observations of tracks throughout the site that probably 95% of foxes had been killed. The difference in the number of foxes indicated by sand-plot monitoring and those actually present can be accounted for by the fact that the few foxes remaining increased their activity at the sand-plots.

The higher than expected mortality resulting from the baiting may be explained by the fact that the baits remained lethal for longer than usual. When baits are exposed to rain the 1080 leachs out and they become inactive. It did not rain at Carnarvon for three months after the baiting and so the baits remained toxic for longer than they do in more mesic areas.

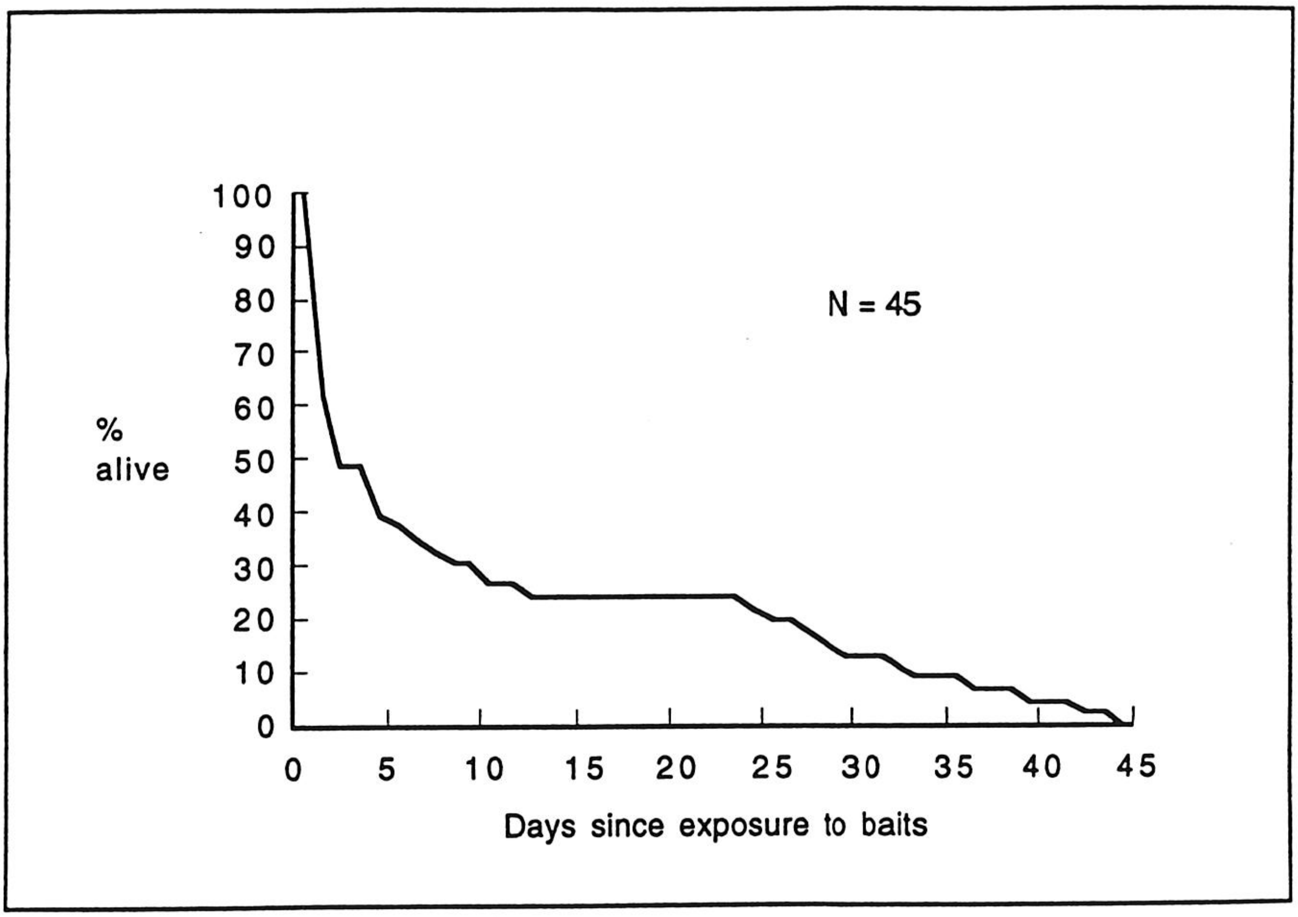
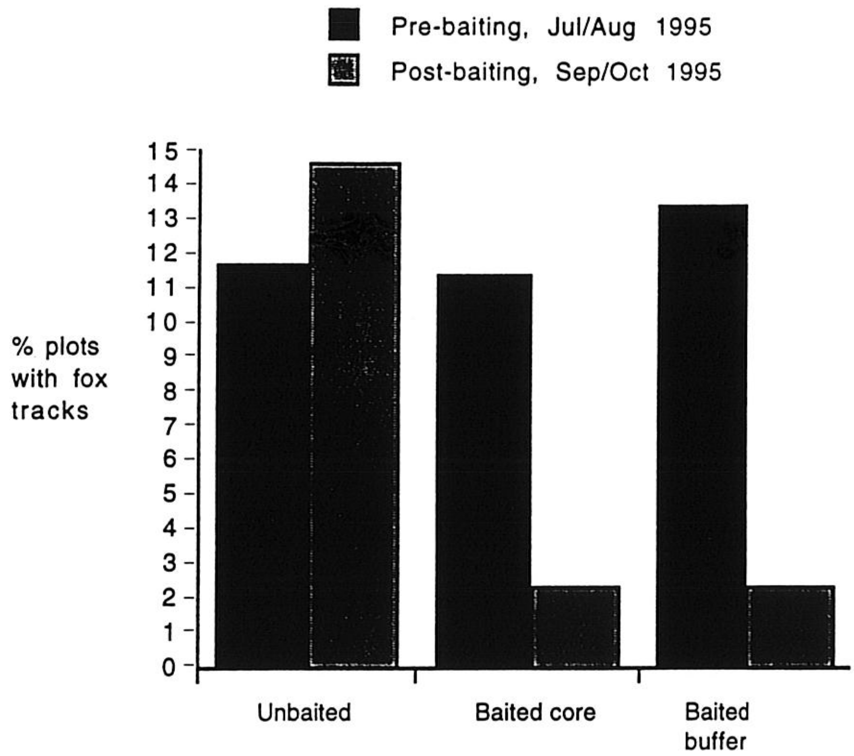


Fig. 5: Survival of radio-collared foxes following a 1080 baiting campaign



Based on mean of counts for 3 days, 4 transects per site, 40 plots per transect

Fig. 6: Carnarvon track-count data

5. Population density estimates

The research for this scope item was completed in 1994/95. However additional information will be obtained when fox trapping is undertaken in July 1996 and July 1997. The number of foxes caught by 4 experienced trappers during 4 days will be correlated with fox activity at sand-plots and with trapping data for July 1995. This index of fox density will be calibrated against actual density when the final destructive sampling is undertaken in August 1997. The density of the fox population during the breeding season of 1996 must be known accurately because this will determine the extent of the compensatory response.