DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY. BUREAU OF RURAL RESOURCES

WILDLIFE AND EXOTIC DISEASE PREPAREDNESS PROGRAM - 1988/89

Title

FOX CONTROL: DETERMINATION OF DENSITY AND DISPERSAL, A PREREQUISITE FOR DISEASE CONTROL

Principal Investigator: Dr. D. Algar
Chief Investigator: Dr. J.E. Kinnear
Subject: 1989 Final Report

[The following report is divided into sections as defined under Clause 6(1) of the Principal Agreement.]

RESEARCH OBJECTIVES

The major aim of the Fox Research Progam is to develop an effective and economic fox control strategy in areas of conservation priority. The key objective to fox control strategies is population reduction, given that predation pressure in the majority of cases, is functionally related to fox abundance. To assess the effectiveness of any control procedure, knowledge of fox density and dispersal is required as these two factors will determine the intensity, frequency and timing of control programs. Knowledge about these factors would also be of critical importance in the control of sylvatic rabies, should an outbreak occur in Australia.

Methods -- rationale

Foxes are primarily solitary and nocturnal, very secretive and although widespread, they exist at relatively low densities. Enumeration fox populations is seldom possible.

The approach we have adopted for estimating absolute density involves determining the home ranges of foxes by radiotelemetry under the assumption that territories are occupied by a mated pair. This approach is laborious, slow and inefficient but there are simply no alternatives if one wants to estimate absolute density.

In an effort to overcome the limitations inherent in measuring absolute densities, we have investigated ways to relate absolute density to indices of abundance that are more readily measured. The technique that has shown the most promise is cyanide baiting. The use of cyanide as a research tool has been sanctioned by the appropriate W.A government authority.

METHODS

CYANIDE BAITING PROCEDURES

The principle is similar to that used by Knowlton (1972) to measure coyote densities by "coyote-getter" or M-44 lines. The methodology and technology is much simpler and acessible; it involves laying capsules containing dry sodium cyanide. The capsules are made of a mixture of paraffin and micro wax blended to make a sufficiently robust, but brittle capsule, with a relatively high melting point. Capsules coated with an attractant are placed at 200m intervals along firebreaks or tracks at dusk and retrieved at dawn. Foxes are attracted to the stations by dragging a strongly-scented lure along the track. When a capsule is taken by a fox, it crumbles in its mouth and death is virtually instantaneous thus assuring retrieval of all victims.

Calibrating the CPUE index

The indice generated by cyanide bait stations is called the CPUE (Catch Per Unit Effort) and is described by the number of foxes killed per 100 bait stations. The basic assumption is that the index is proportional to fox density given a constant sampling effort. In this study we have endeavoured to test or 'calibrate' this assumption by carrying out trials on fox populations differing in density. Population density was manipulated by 1080 baiting.

The study area

Watheroo National Park (44,512 ha), situated in the northern wheatbelt of W.A. was selected as the study site. Foxes were captured using padded leg-hold traps and then radio-tagged. In total, 54 foxes were captured of which 36 were collared with radio transmitters.

The experimental design was as follows: the park was divided into two equal areas -- north and south. In April 1989 three cyanide transects were conducted to determine the CPUE index for the northern area. Following this, both the north and south areas were aerially baited with 1080 meat baits at an intensity of 6 baits/km^2 and the number of radio-collared victims were recovered.

When all to the victims of the 1080 baiting were located, cyanide transects were carried out in the southern region of the park and a CPUE index was determined.

Population recovery rates

All cyanide transects were repeated in September 1989 to estimate by CPUE indices the extent of immigration into the

park following the initial April baiting. Following this, the park was again baited with 1080 baits as before to estimate both recruitment and immigration six months (i.e. Feb./90) post-breeding. The CPUE data for February 1990, although not part of the scope of this initial study, are summarized in this report for completeness. Full descriptions of these results will be found in subsequent reports.

Population biology

The near 100% recovery of cyanide victims make it possible to collect data on a number of demographic parameters relevant to control strategies such as: population age structure; sex ratio; reproductive status and fecundity; diet and the incidence of disease. Foxes retrieved along the cyanide transects were sexed and weighed. Heads were removed for age determinations, stomachs for diet analysis, and uterine tissue examined for placental scars.

RADIOTELEMETRY -- rationale

Radiotelemetry allows one to gather data on:

1/. Fox Spatial organization (i.e home range)
2/. Social structure
3/. Density
4/. Activity over time
5/. Dispersal

Our inital pioneering efforts were not notably successful, but nonetheless these efforts yielded valuable insights and lessons on how to track the movements of foxes. We soon realized that transmitter range was a serious limiting factor and that tracking on foot or from a vehicle was not particularly satisfactory. These experiences have led us to develop a transportable system consisting of three 33m towers fitted with a high gain yagi antennae. This system along with some transmitter enhancements now enable us to locate foxes up distance of 16 km.

In January 1989, after a three month delay due to the late delivery of the antenna systems, the home ranges of 6 foxes were determined Watheroo National Park. Monitoring of fox movements was conducted, at 30 minute intervals, from dusk to dawn over a ten day period in February 1989. Fewer foxes were tracked than planned because a manufacturing fault in the phasing harnesses made one tower inoperative.

In November 1989 the towers were relocated to an area of Kalbarri National Park baited for foxes 20 months previously. Eight foxes were fitted with transmitters and monitored over a 10 day period.

RESULTS

Assessment of the effectiveness of 1080 baiting trials

A total of 11 radio-tagged foxes was resident within the Watheroo study area on the day of the aerial baiting with 1080 meat baits. By four days, 8 radio-tagged foxes were confirmed dead and 2 more by 14 days. Assuming that untagged fox population was equally vulnerable, these data indicate a mortality rate of 91% as a result of the baiting with 1080 meat baits.

CPUE density indices in Watheroo National Park

CPUE indices (mean $\pm$ s.e.) for the cyanide baiting exercise at Watheroo are presented in Figure 1. The CPUE index for northern area of the park immediately prior to the 1080 baiting trial was 11.4 $\pm$ 1.9. The post-1080 baiting CPUE for the southern area of Watheroo National Park measured 1.5 $\pm$ 0.6. This reduction in the CPUE index is comparable to the population reduction caused by 1080 baiting.

Watheroo - dispersal and recruitment of foxes into a previously baited area

The CPUE index in September 1989 was 3.1 $\pm$ 0.8 -- a considerably lower fox density compared to the original unbaited population (i.e. 11.4). The CPUE index in February 1990 was 3.6 $\pm$ 1.0.

Population biology of the fox - Watheroo

Social structure

It is not possible to reliably define the social structure of the fox population from the radio-tracking data alone. However, supplementary information on sex ratios, the locations of these kills and the percentage of vixens producing young, suggest a mated pair structure rather than the sibling/helper society as defined by MacDonald (1987). This pattern of social structure was apparent in both the non-disturbed population, (i.e. previously non-baited, Watheroo National Park study site) and the heavily culled population in Kalbarri National Park.

Sex ratio

A total of 44 foxes was collected along the Watheroo CPUE cyanide transects during the April baiting exercise. The male to female ratio of these foxes did not differ significantly from unity nor did the 23 foxes collected during September 1989.

Fecundity

Ninety one percent of the adult females collected in April 1989 produced young during the previous September. The litter size was of 4.5 ± 0.5. Eighty three percent of the females (presumably immigrants) collected in September 1989 produced a litter (4.1 pups ± 0.5). These data and others collected elsewhere do not indicate any changes in fecundity as a result of fox control.

The above values however could be too high as it is based on placental scar counts. We have since learned (Harris, pers com) that some females may re-absorb the young *in utero* or destroy their litter after giving birth.

Age structure

Analysis of the age structure of the fox population is still incomplete. Results of age determinations based solely on skull suture closure have shown ambiguity. Currently we are evaluating the use of canine pulp cavity closure, pulp cavity ratios and annular rings to determine age class. These techniques, which when used in jointly have considerably improved our discriminatory powers for age classification. At present we are only able to present data, on year age classes, for the initial baiting exercise (see Figure 2).

Approximately half of the foxes collected in April 1989 were classified as juveniles. These results, based on mean litter size, suggest that some dispersal of juveniles out of the park had already occurred. Radio-tracking of a number of immature individuals supports this hypothesis, as certain individuals had dispersed out of the park prior to the baiting program. Foxes collected in September 1989 were all classified as adult.

Home range determinations

Preliminary assessment of radio-tracking techniques provided information for a number of foxes at Watheroo and Kalbarri. The data are by no means complete, as this was an evaluation stage rather than a comprehensive study; however we are able to present limited data for the two different populations.

Of the foxes radio-tagged at Watheroo, sufficient radio-locations, for home range determinations, were available for four animals. The mean home range, minimum polygon method, for these foxes was 8.5 ± 0.7km^2. Radio-tracking of five foxes at Kalbarri indicated a mean home range of 19.0 ± 4.2.

However, if these data are compared by using the 90% utilization areas for Kalbarri, the two popualtions do not

differ significantly. This suggests that foxes in the previously culled Kalbarri Park tend to be more exploratory in their behavior. .

Activity patterns

Data from the radio-tracking exercise at Watheroo indicated that foxes partition their living space. An individual fox will use different areas of its total home range on a day to day basis. A similar pattern of home range usage was also observed at Kalbarri. These findings explain the high variability observed in track count data for earlier studies.

DISCUSSION

Similarity between the changes in the CPUE index and the percentage kill of radio-tagged foxes, in this study, highlight the index's potential as a convenient and practical measure of fox density. The results are very encouraging however, we still need to calibrate the index against actual density; more studies are planned and will be elaborated on in the following report.

Cyanide baiting procedures also enable retrieval of foxes at individual bait stations. Thus, it would be possible to assess the incidence of rabies within a population and also its rate and degree of transmission.

Equipment malfunctions limited our ability to estimate home ranges of sufficient numbers foxes at Watheroo to determine absolute density for the area. On the basis of the data collected, we estimate the density to be 0.2 foxes/ km^2 assuming mated pairing, and 0.7 foxes/km^2 seasonally given a mean litter size of 4.5. We caution that these values need to be confirmed.

The Kalbarri data is similar at the 90% level of utilization, but the there is some indications (100% utilization home ranges 19.0 km^2) that foxes from the previously culled Kalbarri population range more widely. The CPUE values are lower indicating the population density is still low and hence the range expansion.