PART 2 - FACTORS AFFECTING MULGARA OCCURRENCE

CHAPTER 4

AIMS AND GENERAL METHODS FOR FIELD STUDIES

1.0 Introduction

Part 1 of the thesis considered the geographical range occupied by mulgara and ampurta, and assessed the overall decline and potentially threatening processes. Part 2 focuses on assessing the habitat requirements and threatening processes affecting individual populations and identifying management criteria to protect individual populations.

The identification of persistent populations is crucial to any national management strategy, as it is these populations from which the intermittent populations will derive. Due to the broad geographical range that mulgara/ampurta potentially inhabit, it is important that management be focussed on protecting the core persistent populations and their habitats rather than trying to manage the entire mulgara/ampurta population. The locations of most of the persistent populations are not known, and with the large geographical area involved, we need to be able to predict the types of habitats and localities where persistent populations of mulgara and ampurta might be, so that these core populations can be located and effectively managed.

At the time of the selection of study sites, the species separation between mulgara and ampurta had not been recognised. Sites were therefore selected as though for a single species and resulted in a strong bias towards sites representing *D. cristicauda*. The name mulgara will be used as the general term throughout Part 2, unless ampurta are specifically referred to.

2.0 Aims of the field studies

The general aims of the fieldwork were to:

- identify the habitat requirements of mulgaras at various locations in the arid zone;
- assess, where possible, whether populations were persistent or intermittent;
- identify, where possible, the boundaries of particular mulgara colonies and ascertain the factors determining the boundaries;
- assess introduced predator and herbivore numbers on these sites;
- identify threatening processes and management issues for each colony; and
- develop a predictive habitat model to assist in locating other persistent populations.

3.0 Selection of study sites

Most of the potential study areas were geographically remote which imposed limits on access through financial and logistical restraints. Uluru National Park (UNP) was selected as the primary study site as it was known to support a persistent mulgara population, the area was already familiar to me and resources and access were readily available. A second site was established at Sangster's Bore in the Tanami Desert, as a persistent mulgara population was known in the area and resources were available through other research projects being conducted in the area.

The remaining research sites were selected to include areas in which mulgaras had been recently recorded, or where the opportunity arose to join other researchers in the field at potentially suitable locations. This often meant that there was only an opportunity to visit a site once and repetitive sampling was not possible. The Western Australian Regional survey of the Gascoyne region was initiated in response to the location of mulgaras within a proposed goldmining lease and concerns for the conservation status of that population. The only sites surveyed for ampurta were Witjira National Park and Andado Station. Figure 9 presents the locations of sites which were surveyed for mulgara and ampurta and Figure 10 presents the principal study sites discussed in Chapters 5-7.

4.0 General Methods

Researching a small rare species brings with it a number of inherent difficulties, particularly when trying to locate populations across a large area. Techniques were required which would determine whether mulgaras were detectable. It is much more difficult to be certain that a species is absent as there are potentially many factors that could contribute to a failute to detect presence (i.e. a false negative): the use of inappropriate techniques, seasonal conditions, activity levels, behaviour at the time of sampling, and the probability of locating animals when they are present in very low numbers.

A standard sampling methodology was developed at Uluru National Park (UNP) (Baker and Jarman, 1995) and adopted for all the surveys; however, some methods included in the UNP study were not carried out elsewhere.

4.1 Mulgara distribution

4.1.1 Elliott trapping

'Elliott' box trapping is an established technique for surveying small mammal populations in the arid zone (Gibson and Cole, 1992; Reid *et al.*, 1993). In 1991, 'Elliott' box trapping was undertaken at UNP and Sangster's Bore to assess the potential of this technique for this study. Twenty five traps were set per transect at 25 m intervals, giving an overall transect length of 600 m. Trap sites were run for three consecutive nights. Trials showed that baits such as mealworms, bacon, sardine oil and cat biscuits did not improve trap success and so a standard bait of peanut butter and oats was used. Any mulgaras captured were temporarily marked with a coloured

Figure 9: Location of sites surveyed for mulgara and ampurta, 1991-1995

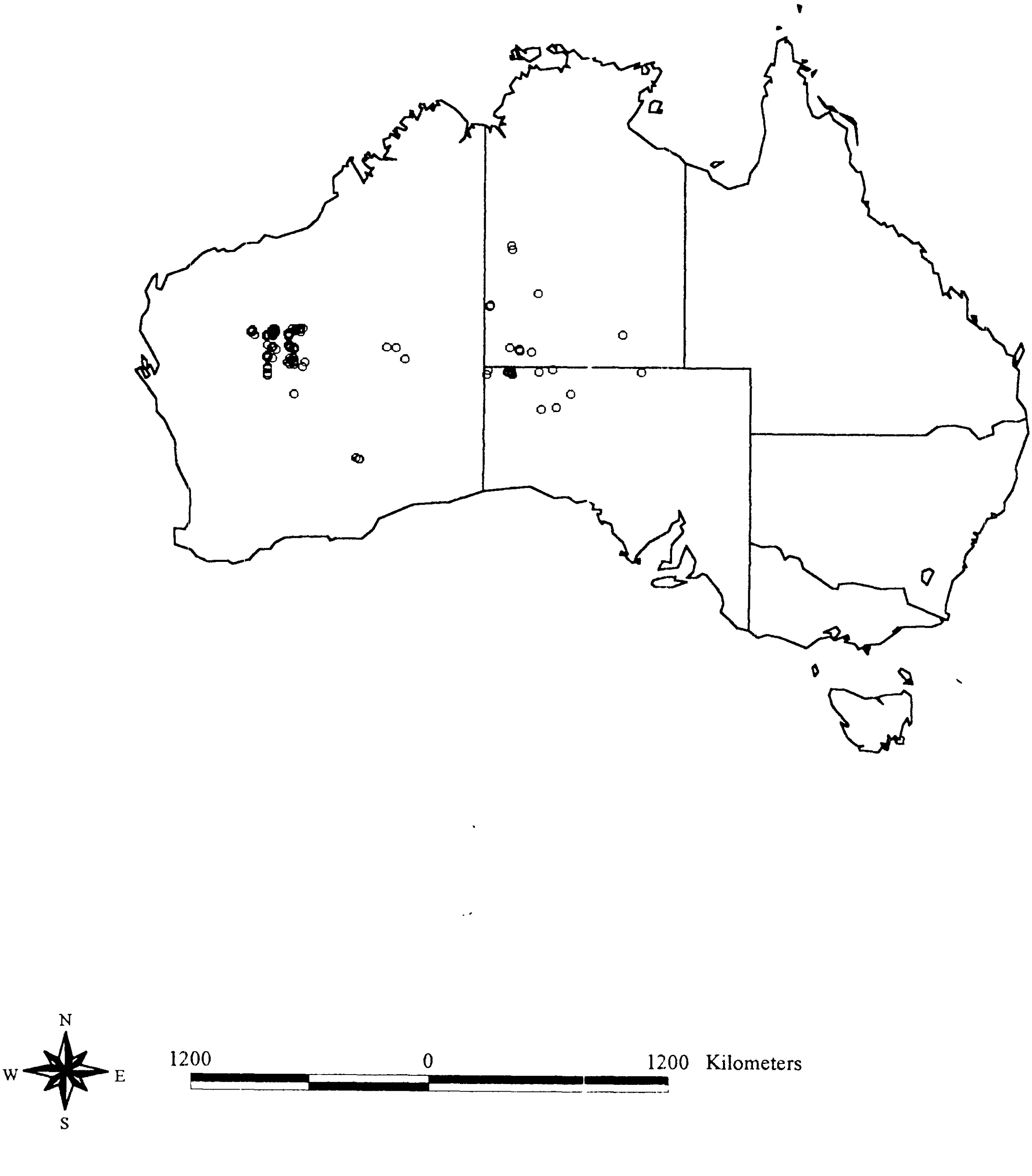
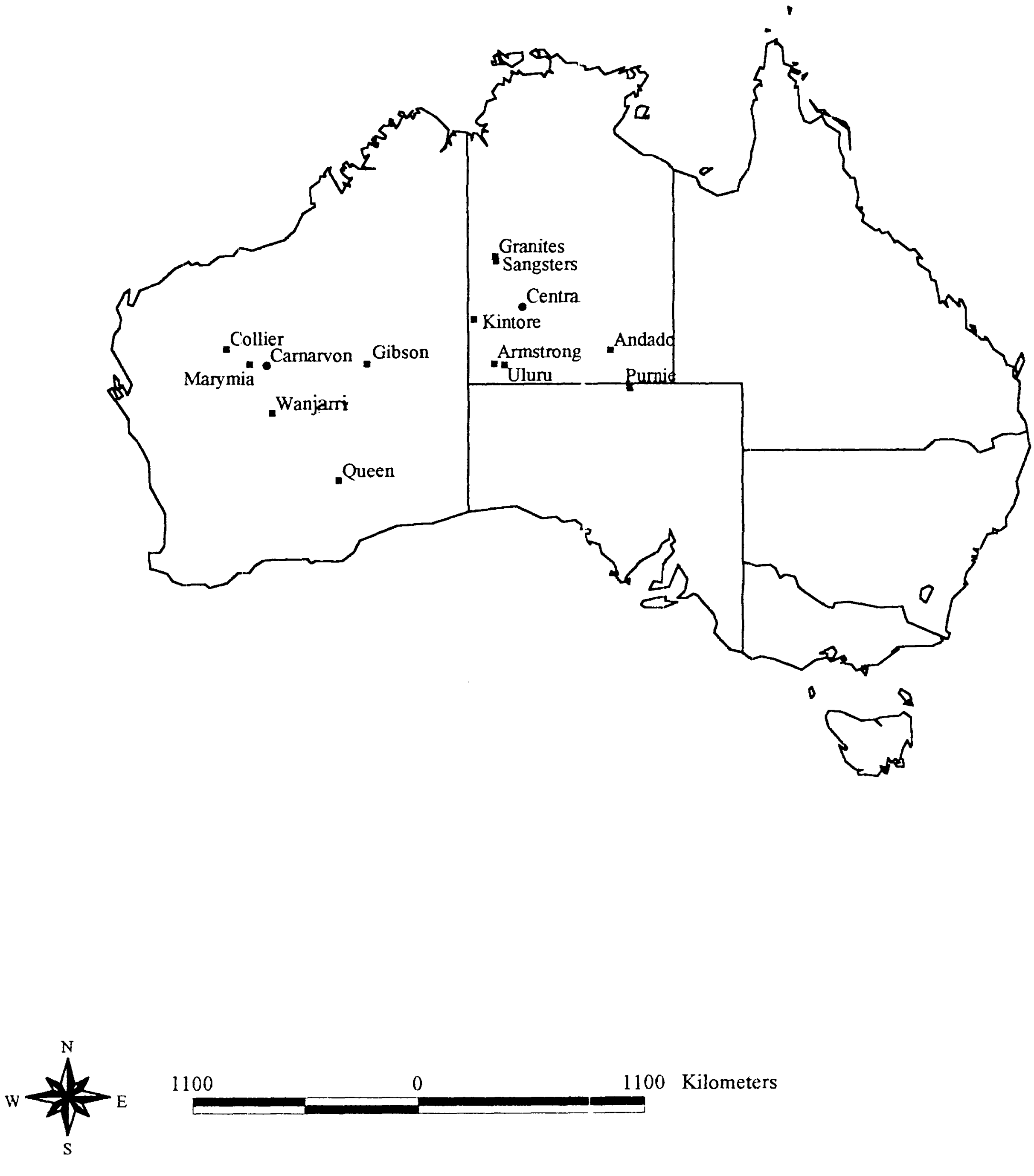


Figure 10: Location of the principal study sites, 1991-1995



marker pen, to avoid counting recaptures as new individuals. Trapping results were recorded per the number of trap nights or as percent trap success.

As a means of detecting the presence of a species, box trapping has a number of limitations, including the "trappability" of the species and the time and number of traps required to reasonably assess the presence of a species. As with most survey techniques, there is no absolute certainty that a species is not present on the site. The use of box trapping was determined to be an inefficient technique for this study as it limited the areas which could be covered during a field trip to a small number of sites and was costly in time required for maintenance and clearing of the trap lines. It was therefore decided that other techniques should be investigated which would allow larger areas to be covered within a field trip.

4.1.2 Sign searches

The most promising option for rapid assessment of the presence or absence of mulgaras appeared to be searching for mulgara sign. This technique required the researcher to be able accurately to identify mulgara tracks, burrows and scats. Aboriginal co-workers at UNP and Sangster's Bore taught me how to identify signs of mulgara, fox, cat and dingo. They also participated in many of the surveys.

While this technique potentially offered a quick and reliable way of assessing the presence of mulgara and predators, confirmation was required that we were accurately identifying mulgara sign. This was achieved by following several putative mulgara tracks to burrows from which mulgaras were then dug.

Limitations of sign searches

The detection of mulgara tracks is dependent on the surface conditions, with tracks being easily seen in soft sand or crusted earthy sands, but difficult to detect on hard surfaces. Mulgara burrows are more consistently recognisable across a variety of habitats. They can, however, differ in their number of entrances and can also be renovated burrows of goanna, *Egernia* spp. or rodent which have different configurations. Mulgara scats were readily recognisable though they can possibly be confused with some reptile scats if the urea spot on the reptile scat had been blown away by the wind. Foraging scrapes were more difficult to identify and can be confused with diggings by reptiles and other small mammals.

Heavy rain and strong winds can affect the amount of sign detectable. Where possible sites were not searched for up to one week after rain or strong winds to maximise opportunities to detect sign. Also sign searches were confined to mornings and afternoons to maximise the contrast of tracks due to sun-angles, and sign searches were not conducted on heavily overcast days

Whilst I was confident of my ability to recognise mulgara and predator sign, it was clear that my Aboriginal co-workers were able to detect more obscure sign that I could, especially on hard ground. They were also more adept at interpreting what the animals were doing from the sign. When searching for sign by myself, the location of two sign, e.g. two sets of tracks or tracks and a burrow or scat, was preferred for a site to be identified as a 'positive' site, unless the single sign was very clear. In some cases sites were designated 'possible' if only one unclear sign was located.

The advantages of recording mulgara presence and absence by sign surveys were that sites could be rapidly assessed, especially when Aboriginal co-workers were present. This meant that large areas could be surveyed in one field trip, thereby allowing time for the collection of habitat data.

On the basis of field trials, discussion with other researchers who were familiar with mulgara sign (Gibson pers. comm.) and with researchers who had used the recording of sign to detect other species (e.g. bilby research by R.Southgate (1987) and mala research by G. Lundie-Jenkins (1989), it was decided this was the most appropriate technique for recording the distribution of mulgara and predators on my study sites.

Sign survey techniques

To develop a standardised technique for searching and recording mulgara sign three techniques were assessed:

- Twenty-five 2 m-radius circles were sampled at 25 m intervals along each 'Elliott' trap line;
- Sign was recorded within a 600 m by 2 m belt transect along each trapline;
- Sign was recorded while observers walked randomly around an area of approximately 500 m^2 over a twenty minute period (adopting Aboriginal people's approach to searches).

The first two techniques were not effective when working with Aboriginal people as they were too restrictive; relying on artificial boundaries and limiting the search to a small section of the site. To maximise efficiency and to ensure compatibility between searches with and without Aboriginal people being present, I adopted the third approach. Initial searches were conducted for up to 40 minutes, with the amount of sign being recorded in 5 minute intervals. Analysis of the results indicated that the most productive search time was a 20 minute period, in terms of maximising opportunity to record sign and in retaining a strong search effort. Where surveys were conducted in the company of Aboriginal people I only analysed sign that I personally recorded to ensure compatibility with surveys conducted on my own.

The starting point for survey transects was set within areas where mulgaras had been previously recorded by Aboriginal people or other researchers. The transects were then established along roads and tracks but also on occasion overland. Sites were selected at 2 km intervals while sign was being detected and thereafter at 5 km. These sites were searched irrespective of vegetation, fire age, soil or topography.

Six categories of mulgara sign were recorded: tracks, freshly dug burrows, current burrows, disused burrows, scats and foraging digs. The frequency of each type of sign was recorded in 5 minute intervals over a 20-minute search.

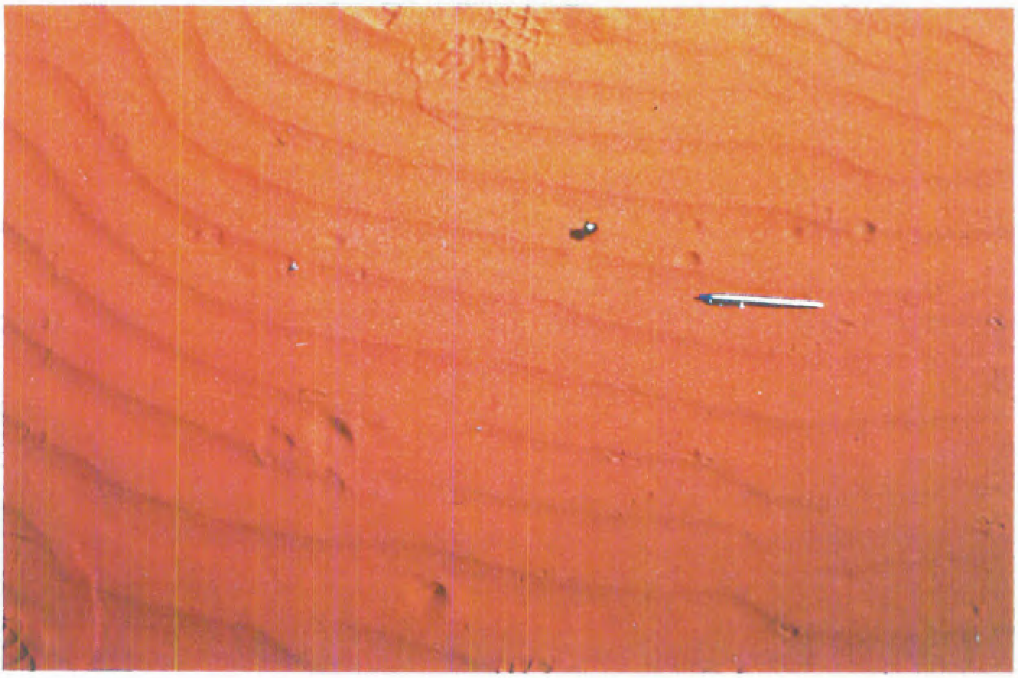


Plate 2: Mulgara tracks (near pen) and rabbit tracks

Plate 3: Fresh mulgara burrow with scats

4.2 Sign of introduced predators, herbivores and other species

Sign of introduced predators and herbivores were also recorded during the twenty minute search period. Unusual sign, such as bilby sign, was also recorded when located and an index of other sign such as goanna burrows, rodent and reptile activity was also recorded. Notes were made for each site on the suitability of the ground surface and weather conditions for tracking.

4.3 Habitat assessment

Habitat attributes recorded per site were based on the Australian Soil and Land Survey Field Handbook (McDonald *et al.*, 1990) and a proforma sheet used by the S.A. Department of Environment and Land Management for biological surveys of the AP Lands (Copley pers. comm.). Attributes included:

- landform
- soil texture
- surface condition (i.e. soft, crusted, hard etc.)
- size of surface strew (stones-boulders)
- presence and percentage cover of surface strew
- fire history ranked into years since fire (i.e. 0-10 years, 11-20 years etc)
- vegetation structure and cover based on Muir's classification system (1976)
- spinifex species
- spinifex growth form (see table 4)
- spinifex hummock height
- percentage cover of the vegetation strata

An index of spinifex hummock growth form was developed (Table 4) based on growth from seedlings to senescence.

Table 4: Spinifex growth form index

Class 1	Seedlings.
Class 2	Small well formed hummocks, no central die off.
Class 3	Well formed hummock, commencement some internal die off.
Class 4	Hummocks well formed, some ring formation.
Class 5	Senescing hummocks forming rings with dead matter in the centre.
Class 6	Stoloniferous spinifex, from runners or merged hummock rings.
Class 7	Senescent hummock, large open empty-centred rings.

At selected survey sites a wheelpoint apparatus was used to record percentage cover, height and species frequency of plants, as well as continuous cover and open space (Griffin, 1985). This technique records species occurrences in three layers: ground stratum (including bare ground), shrub stratum and tree stratum. Data are then transformed through a program written by Griffin (1985) to percentage cover values for the three strata. Two hundred and fifty points per site were sampled at one metre intervals, except for the Western Australian regional survey where only 200 points per site were sampled.

Continuous spinifex cover and continuous bare ground were ranked into seven classes commencing from 1 strike (<1 m) to greater than 6 consecutive strikes (>5 m continous cover or bare ground).

Spinifex hummock heights were ranked in classes with Class 0 = 0-0.05 m, Class1 =0.06-0.25 m, Class 2 = 0.26-0.50 m, Class 3 = 0.51-0.75 m, Class 4= 0.76-1 m, Class 5=1-2 m and Class 6 > 2 m.

4.4 Invertebrates

An invertebrate sampling program was set up at Uluṟu National Park to assess whether sites which persistently supported mulgara could be differentiated from sites not supporting persistent mulgara populations by their respective invertebrate communities. The timing, effort and resources required for this program precluded its use elsewhere except UNP. Sampling methodology is detailed in Chapter 5.

4.5 E-RMS: Geographical information system

Data from the UNP study was put into a geographical information system (E-RMS, NSW NPWS). E-RMS contains a predictive modelling module which is particularly useful for predicting the potential distribution of rare species based on habitat variables. A similar database is currently being developed for the Sangster's Bore by the Conservation Commission of the Northern Territory (CCNT) and will incorporate data from my research. Details on the use of E-RMS at UNP are provided in Chapter 5.

5.0 Statistical analysis

A multivariate approach was adopted for the data analysis based on the assumption that a combination of factors was likely to be influencing the presence or otherwise of mulgaras. Multivariate methods are designed to handle data sets that are complex, noisy, or contain internal relations and outliers; all of these were likely to be true of the data collected. Of the available multivariate techniques, regression analysis was selected as the best suited for assessing which environmental variables best explain a species' abundance and which environmental variables appear to be unimportant (Jongman *et al.*, 1987).

The mulgara sign data were recorded as count data which included numerous zeros. Jongman *et al.* (1987) and Statistix (1990) recommended a Poisson (Discrete) Regression as the most suitable for discrete (count-based) dependent variables. Poisson regressions were therefore selected as the most appropriate regression technique, but some exploratory sub-set regressions and stepwise regression were run with logarithmically transformed mulgara count data.

A computer-generated program Statistix (1990) was used to run the regressions. Poisson regression equations were developed by testing for the combinations of variables which contributed most significantly (Chi square) to a decrease in the deviance. The statistical significance of each individual variable was assessed using a Student's t-test. All analyses used during the study were based on $p=0.05$ as the level of acceptance of significance of probability.

Habitat variables and predator sign were assessed and transformed where necessary (Jongman *et al.*,1987; Tabachnick and Fidell,1989; Crawley, 1993). The habitat variables were mostly categorical, i.e. classes to which arbitrary numbers had been assigned, and for the regression analyses were therefore required to be transformed to dichotomous variables, i.e. presence /absence variables (Jongman *et al.*,1987). The remaining independent variables, such as increasing height or percent cover, were left untransformed and were treated as continuous variables. The predator and rabbit count data were treated as continuous variables and in some cases were logarithmically or inversely transformed after assessment for skewness and high numbers of zero values.

Analysis of residuals using Wilk-Shapiro/rankit plots and visual assessment of histograms led to the transformation of some variables to reduce skewness, reduce the number of outliers and improve the normality, linearity and homoscedasticity of residuals.

Spearman Rank correlations were also used to assess associations between the number of mulgara sign and environmental variables. Spearman Rank correlations were selected as the mulgara sign was not normally distributed (many zero values), the data were bivariate and not all the independent variables were generally ranked rather than continuous (Tabachnick and Fidell, 1989; Zar, 1974; Statistix, 1990).

6.0 Presentation of results

The results of the detailed study conducted at Uluru National Park are presented in Chapter 5. Chapter 6 presents the results from Sangster's Bore and Chapter 7 presents results from the regional surveys. Chapter 8 provides a synthesis of the findings of Chapters 5-7 and outlines the factors which were found to be most significantly affecting mulgara distribution.