# THE COMPARATIVE ECOLOGY OF THE EASTERN GREY KANGAROO AND WALLAROO IN THE NEW ENGLAND TABLELANDS OF NEW SOUTH WALES

by

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# PREFACE

The work reported in this thesis was conducted by the author while enrolled in the Department of Ecosystem Management at the University of New England. I certify that the substance of this thesis has not already been submitted for any degree and is not being currently submitted for any other degree. I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

[redacted]

R.J. Taylor
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## SUMMARY

Studies of large mammalian herbivores point to the importance of food quality and quantity in determining population size. Graziers in the New England Tablelands of New South Wales claim that an increase in numbers of eastern grey kangaroo and wallaroo occurs after pasture improvement measures are adopted on a property. In this region properties are present which differ in pasture management and also support sympatric populations of grey kangaroo and wallaroo. This allowed a study to be made of the comparative ecology of the two kangaroo species in areas differing in the quality and quantity of food present in order to investigate the graziers' claims.

The study was conducted on two properties which were within 40 km of each other. These properties had similar rainfall and temperature regimes but differed markedly in the intensity of pasture management for domestic stock. One of the properties, Lana, had been selectively cleared of trees and an intensive program of fertilization of pastures and introduction of exotic pasture plants had been carried out. The other property, Newholme, had had no application of fertilizers and no exotic pasture plants introduced. On Newholme large areas with a dense tree canopy remained and other areas had been totally cleared of trees. The grey kangaroo population on Lana was regularly culled. No grey kangaroo on Newholme, or wallaroo on either property, were harvested. Within their occupied habitats the density of wallaroo was estimated to be seven times greater on Lana than on Newholme and the density of grey kangaroo on Lana was estimated to be double that on Newholme.

A study was made, on the two properties, of the biomass and quality of food available, habitat use by the two kangaroo species and their diet, and the quality and quantity of food eaten and its relationship to the kangaroos' nutritional status and condition. Aspects of reproduction and mortality rates of young animals were investigated. Data were gathered, whenever possible, on aspects of the social organization of the two species.

The two study areas were divided into habitat types based on slope, tree cover, size and density of rocks, shrub density, and biomass and composition of the pasture. These factors were chosen as being the most likely to influence the distribution of kangaroos on these two areas.

Pasture samples were separated into six categories based on the type and quality of plant and plant part. These were: (1) grass stem and infloresence; (2) low-fibre grass leaf and sheath; (3) high-fibre grasses; (4) tussock grasses; (5) non-grass monocotyledons; and (6) forbs. Data on the abundance of each plant category in each habitat in each season on Lana and Newholme are presented. The biomass of tussock grasses is greater in most areas on Newholme than on Lana. Four major groups of pasture species were recognized on the basis of their abundance at different seasons. These were: (1) warm season annuals; (2) cool season annuals; (3) warm season perennials; and (4) cool season perennials. Warm season and cool season annuals account for a much larger proportion of the pasture biomass on Lana compared to Newholme. The nitrogen and fibre contents of plant species and plant parts were used as an index to their quality as these factors are most relevant to animals with forestomach fermentation. The quality of plant species occurring on both properties was higher on Lana than on Newholme.

The diet of kangaroos on Lana was quantified in each season with the winter sample being repeated to assess the effects of an unusually wet winter. On Newholme the diet of kangaroos was quantified in summer and two winters. The diet of both species of kangaroo contained a large proportion of grass in all seasons (grey kangaroo, 77%-98%; wallaroo, 77-97%). On Newholme there was no difference in the diet of kangaroos between the two winter samples. On Lana there was a greater proportion of tussock grasses in the diet of kangaroos during the wet winter in comparison to the second, drier winter sample. The diet of the grey kangaroo and wallaroo contained many plant species and plant parts in common. However there were major differences between the two kangaroos in the proportions of a few species in the diet. The plant species favoured only by the wallaroo were of a higher quality than those species favoured only by the grey kangaroo. There was no difference between the kangaroos in their use of plant parts. The major difference in the diet of the kangaroos on the two study areas occurred in winter when the diets of kangaroos on Newholme contained greater amounts of tussock grass and less low-fibre grass leaf and sheath. In some seasons there were significant differences in the proportions of various plant categories in the diet of males and females for both species. However these differences were due to differences in the proportion of the two sexes sampled in different pasture types. Both kangaroos consistently selected for low-fibre grass leaf. Selection and avoidance of other plant categories is discussed.

The density of grey kangaroo and wallaroo in each habitat on Lana and Newholme was estimated during three periods of the day (i.e. early morning, day, late afternoon) for each month of the year. The pattern of habitat use for grey kangaroo was not significantly different between early morning and late afternoon on either Lana or Newholme. The pattern of habitat use for grey kangaroo was significantly different between feeding periods (i.e. early morning and late afternoon) and sheltering periods on Lana and Newholme. The density of grey kangaroo in dense woodland areas and areas with a low sight distance increased and their density in open woodland/grassland areas decreased during sheltering periods compared to feeding periods. The pattern of habitat use for wallaroo during late afternoon was significantly different from the pattern of habitat use during early morning on both Lana and Newholme. The pattern of habitat use during late afternoon was taken as best representing the feeding habitat preferences of wallaroo. The pattern of habitat use for wallaroo was significantly different between feeding and sheltering periods on both properties. The density of wallaroo in dense rock areas increased and their density in sheep camp areas decreased during sheltering periods compared to feeding periods.

During feeding periods differences in the use of habitats over seasons for both species can be related to differences in the degree of biomass changes between habitats due to differences in pasture composition. The minor changes in the pattern of habitat use between seasons during sheltering periods for both species were probably related to the need for shade or sunny areas depending on the temperature.

Differences between the two properties in the pattern of habitat use during feeding periods for both species were related to the effects of differences in the quality of pasture on the two areas. Habitat use during sheltering periods differed little between the two properties for both species.

The pattern of habitat use for wallaroo was significantly different from that for grey kangaroo on both Lana and Newholme during both feeding and sheltering periods. Wallaroo utilized steep slope areas extensively whereas grey kangaroo avoided these areas. During feeding periods wallaroo made greater use of *Microlaena*-dominated pasture than did grey kangaroo. The greater use of this pasture by wallaroo is consistent with the greater proportion of *Microlaena* in the diet of wallaroo compared with grey kangaroo. Wallaroo occurred in woodland only if it was close to rocky hills. Grey kangaroo utilized all areas of woodland.

During feeding periods the density of grey kangaroo in a habitat was significantly correlated with the biomass of low-fibre grass leaf present. For a given biomass of low-fibre grass leaf the density of grey kangaroo was significantly greater on Lana than on Newholme. This is probably related to the higher quality and greater productivity of grasses on Lana. Differences in density within some habitats also indicate that grass quality is influencing density. For the wallaroo differences in the percentage of time spent feeding in each habitat, rather than just the number of sightings of animals, would have to be examined before the correlation between the biomass of low-fibre grass leaf and habitat preferences for feeding could be properly investigated. However the data indicate that, as for the grey kangaroo, wallaroo density for a given biomass of low-fibre grass leaf is greater on Lana than on Newholme.

There was no evidence of a difference in fecundity for females of either species on Lana and Newholme. The small number of pouch young examined precluded a meaningful comparison of mortality rates on the two properties. The weight for age curves for pouch young on the two properties were the same. Data collected for wallaroo indicated that the proportion of adult females accompanied by young-at-foot was 2.6 times greater on Lana than on Newholme. Grey kangaroo pouch young have a slower growth rate and a higher weight at the end of pouch life in comparison to adult female weight than do wallaroo pouch young. This may be related to the higher proportion of lower quality items in the diet of grey kangaroo compared to wallaroo. The sex ratio of pouch young and young-at-foot was not significantly different from parity. Most births in both species lead to emergence of young-at-foot in spring. This strategy will maximize the time available to the young for growth before periods of reduced availability of food ensue. Testis growth curves for grey kangaroo and wallaroo appear to differ. However a larger sample size is needed to confirm these differences.

The stomach contents of shot kangaroos were analysed for nitrogen and fibre. The nitrogen content of unwashed stomach digesta was closely correlated with the nitrogen content of washed stomach digesta for both species. The quality of food in the stomach (as assessed by the above-mentioned factors) of kangaroos on Lana was higher than for animals on Newholme. Faecal nitrogen was also higher for kangaroos on Lana than on Newholme. Stomach and faecal % dry matter were negatively correlated with nitrogen content. UR ratios (i.e. the ratio of urea-nitrogen to total

nitrogen in the urine) were measured to examine nitrogen recycling. Grey kangaroo on Newholme were recycling a greater proportion of urea than were grey kangaroo on Lana. Wallaroo on Newholme during the drier winter were recycling virtually no nitrogen due probably to an acute shortage of energy. No correlation was found between plasma urea-nitrogen and protein intake, in contrast to other studies. This is thought to be due to the confounding effects of changes in the energy content of food. The ratio of stomach contents weight to empty stomach weight was used as an index of stomach fill. Although the level of stomach fill for kangaroos on Newholme was influenced by their being shot earlier in the feeding cycle, stomach fill was still greater for wallaroo and grey kangaroo on Newholme than on Lana. There were significant differences in the level of stomach fill for different sex and reproductive classes of grey kangaroo on Lana.

The body weight, kidney fat index, bone marrow fat content, leg muscle to bone ratio, liver and spleen weight, and haematocrit and haemoglobin levels were used to assess the condition of kangaroos. Small sample sizes and differences in the condition cycle of sex and reproductive classes hampered the comparison of the condition of kangaroos between seasons and between properties. The condition of kangaroos was highest in summer and lowest in winter. The condition of kangaroos on Lana was higher than on Newholme except for grey kangaroo during the wetter winter. Grey kangaroo on Lana during the wetter winter were probably affected by the reduced biomass of low-fibre grasses available at this time compared to normal winters. Wallaroo were less affected by these conditions on Lana than were grey kangaroo. This difference could have been related to differences in the digestive strategy of the two species. Two young-at-foot sampled in winter which had finished pouch life in autumn were in poor condition. The implications of the poor condition of these animals on the reproductive strategy of the grey kangaroo and wallaroo are discussed. Energy appears to be a major limiting factor on both properties. A causal relationship is hypothesized between the higher quality of food and the better condition of kangaroos on Lana compared to Newholme.

It is hypothesized that the higher quality food present on Lana leads to a higher survival rate for pouch young and/or young-at-foot on Lana compared to Newholme. A higher mortality rate for young animals on Newholme is probably primarily responsible for the lower density of grey kangaroo and wallaroo on Newholme compared to Lana.

Animals on Lana were captured and collared. Movements were studied indirectly by recording changes in the percentage of animals collared over time. A drop in the percentage of animals collared over time for wallaroo could be explained by collar loss of some individuals on Lana. A drop in the percentage of animals collared over time for the grey kangaroo was thought to be due to movement of transient animals off Lana. These interpretations are supported by collar returns of animals seen off Lana.

Grey kangaroo occurred in non-overlapping group home ranges. The boundaries between group home ranges occurred in continuous habitat. Wallaroo occurred in overlapping home ranges with the boundaries of individual home ranges being completely independent of each other.

For both the grey kangaroo and wallaroo the frequency of occurrence of groups of different size was significantly different from that expected if group size occurrence were random. For the grey kangaroo on Lana, mean group size was smaller during early morning than during the rest of the day. Mean group size was significantly greater on Lana than on Newholme for both species. Mean group size was smaller for wallaroo than for grey kangaroo on both properties. For both species, the mean group size was significantly correlated with the density of kangaroos in each habitat.

Wallaroo were divided into six social classes. Social classes differed in the extent to which they were found alone. Social classes did not associate randomly. Large adult males were found with adult females and adult females with young-at-foot more than expected. Adult females with young-at-foot were found with other adult females less than expected in large groups. Medium adult males were found together more than expected. Sub-adult females, in contrast to sub-adult males, were found with adult females more than expected. Adult females were found together more than expected in small groups. Males of different social classes occurred together less than expected in small groups. The adaptive significance of this pattern of association of social classes is discussed. The main difference between the association pattern for animals on Lana and Newholme was in the greater percentage of animals seen alone on Newholme. This increase in the percentage of animals seen alone on Newholme was not uniform over the social classes. No difference in habitat use by social classes was found during feeding periods. During sheltering periods, however, a greater proportion of large adult males was found in dense rock areas compared with medium

adult males or adult females with young-at-foot.

For the wallaroo the ratio of adult males to sub-adult males was significantly greater on Newholme than on Lana. It is hypothesized that adult male mortality is greater on Lana than on Newholme due to higher levels of competition between males on Lana.

Three factors appear to be primarily responsible for the grey kangaroo being harvested as a pest species to a greater extent than are wallaroo. These are: (1) different habitat requirements lead to grey kangaroo being present on larger areas of stock grazing country than are wallaroo; (2) differences in group sizes and visibility in pasture areas lead to differences in the perceived pest status of the two species by the grazier; and (3) grey kangaroo are more easily commercially harvested than are wallaroo due to temporal and spatial differences in habitat use.

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