Kangaroo faeces: a reflection of kangaroo nutrition

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ABSTRACT

Little is known about the effect of environmental variables on the nutrition of large numbers of wild kangaroos. Faecal Near Infrared Reflectance Spectroscopy (FNIRS) can predict dietary and non-dietary data on free-ranging deer and cattle and assist with management. Why not other over-abundant species, like kangaroos? I applied FNIRS to kangaroos in drought affected south-east New South Wales to explore dietary and non-dietary information. The data suggests that:

a) Eastern Grey Kangaroos mostly eat high quality 'green' feed,

b) Eastern Grey Kangaroos start to lose body condition when sufficient 'green' feed is unavailable,

c) rainfall and subsequent plant growth have a positive effect on body condition,

d) the age and sex of individuals, and abundance of forestomach worms affect body condition,

e) pouch young have no effect on body condition, and

f) FNIRS is an effective tool for monitoring over-abundant wild populations, allowing for the early implementation of management options.

Key words: kangaroo, nutrition, faecal, FNIRS

Introduction

Little is known about the nutritional ecology of wild kangaroos. Despite this, there is often a need for managers to make decisions based on nutritional ecology, such as during droughts where large numbers of kangaroos on public lands appear to be facing starvation. The subjective nature of the opinions of different interest groups makes management decisions for kangaroos difficult and often contentious. For example, general opinions about the effect of large numbers of free-ranging kangaroos include:

- kangaroos cause pasture damage and production loss in domestic stock, especially during drought (rural managers);
- kangaroos starve during droughts due to apparent food shortages (wildlife managers); and
- kangaroos can survive droughts because they eat tree bark (animal welfare groups).

Managers often make decisions based on perceived impacts, needs and conditions of kangaroos. Up-to-date field data is needed to inform land managers and animal welfare organisations of the actual nutritional status of locally over-abundant kangaroo populations. Thus, a method is required to quickly assess the nutritional ecology of free-ranging animals

How can we determine the diet of wild kangaroos?

The answer to this question lies in the animal's faeces, and the possibility they may contain information on the nutritional status of the animal. Faecal analysis is not new, but its application to physiological questions about free-ranging wild animals certainly is. Previously, obtaining dietary and physiological data from wild animals has involved invasive capture and handling techniques, sometimes resulting in the animal's death.

This note highlights the potential to monitor wild free-ranging animals using Faecal Near Infrared Reflectance Spectroscopy (FNIRS). By this I mean the potential to predict a range of dietary and physiological information about an individual using data obtained from a scan of the animal's faeces. For example, in the United States, FNIRS has been applied to free-ranging cattle and wild deer. Wildlife managers use FNIRS to predict the sex, reproductive status and tick loading of the individuals that produced the faeces (Tolleson *et al.* 2000; 2001a; 2001b). In addition, predictive equations can now be used to determine a range of dietary information such as the protein and fibre content eaten, and in some cases the amount eaten by individuals in grams per day (Suth and Tolleson 2000; Tolera and Sundstol 2001; Kamler *et al.* 2004; Landau *et al.* 2005).

All this can be achieved, not from long hours of observation and tediously repetitious laboratory work, but from a scan of the animal's faeces. One aim of my study is to apply FNIRS technology to populations of wild kangaroos, as has been done with deer and cattle. If we know the demography of the cohorts (e.g. sex, age, reproductive status), as well as their dietary needs, modelling population dynamics should be easier and give better information on which to base management decisions. Some preliminary findings of the work are outlined below.

Pp 182- 184 in *Pest or Guest: the zoology of overabundance,* edited by Daniel Lunney, Peggy Eby, Pat Hutchings and Shelley Burgin. 2007. Royal Zoological Society of New South Wales, Mosman, NSW, Australia.

How does FNIRS work?

Briefly, equations are developed by regressing the infrared spectra of the scanned faeces against known laboratory reference values for the animal that produced those faeces (Figure 1). Thus, to obtain the laboratory reference values captive kangaroos were fed a range of known quality diets. That is, diets that were analysed for organic matter, protein and fibre content. The amount of food eaten was recorded and the resultant faeces collected. The faeces were scanned with a NIR Spectrometer to obtain a pattern of infrared light reflectance from the faecal sample. These infrared spectra were then regressed against the reference values for that sample. This enabled me to develop a predictive equation that could be applied to subsequent faeces collected from wild populations.

What do wild eastern grey kangaroos eat?

Wild eastern grey kangaroos *Macropus giganteus* typically eat any high quality 'green' grass that is available. Daily food intake varies between seasons in line with expected trends in the amount of food available; low availability in autumn/winter relative to spring/summer (Table 1). The fibre content of the grass consumed does not vary between seasons (Table 1), although protein is higher in spring/summer and may be the more important of the food quality variables measured.

Consequently, dry grass may be rarely eaten by choice, and individuals may be unable to survive for a prolonged period on dry grass alone. I predict that the amount of high quality food available is a limiting factor during periods of environmental stress, such as occurs in autumn/winter in SE Australia or during drought.

Table 1: Averaged crude protein, neutral detergent fibre and digestible dry matter intake per kangaroo.

Diet	Autumn/Winter	Spring/Summer
Protein %	5	16
Fibre %	63	65
Intake $g/kg^{\hat{}0.75}/d$	40	75

How does food intake affect condition?

Body condition was recorded as a tail fat index (TFI), which was standardised for body size by a regression of tail thickness against (log) head length. The residual values from this regression form the condition index, with a positive value representing an animal in better than average condition, and a negative value an animal in worse than average condition.

Figure 2 shows the trend in body condition and food intake for a kangaroo of mean body weight (30 kg). The trend in body condition seems to follow food intake after a two-month lag. Thus, two months after an increase in

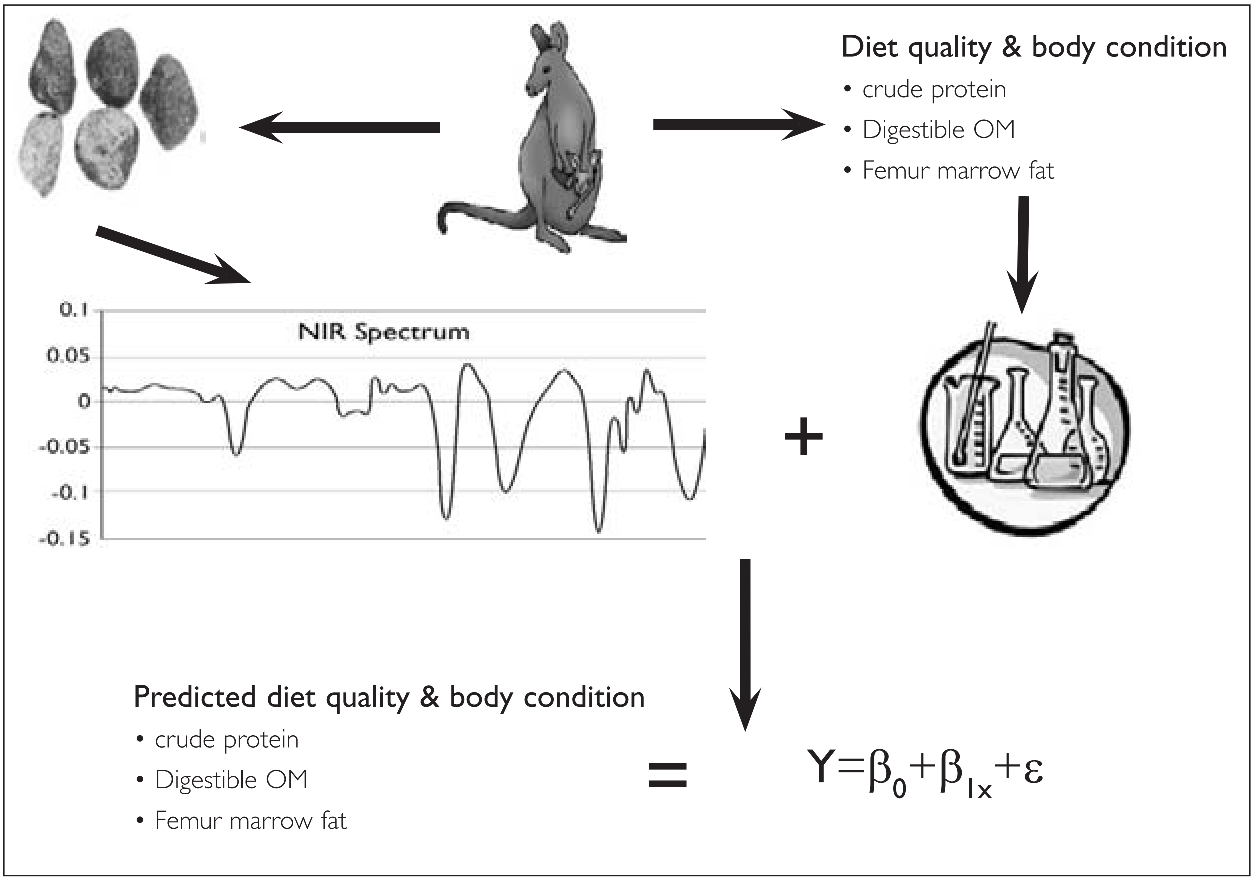
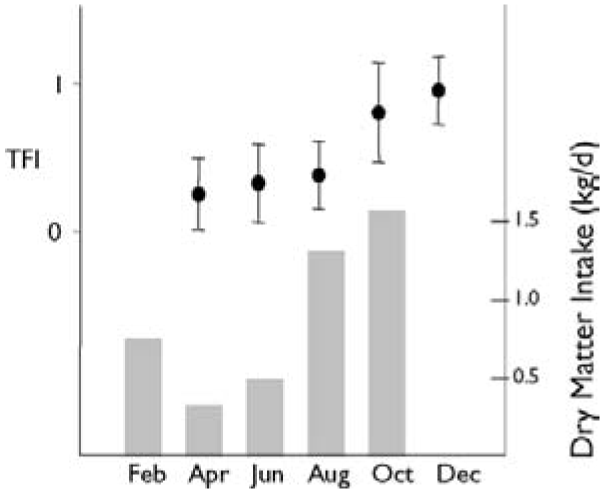


Figure 1. The procedure for Faecal Near Infrared Reflectance Spectroscopy.

Figure 2. Averaged food intake (bars – right axis) and tail fat index (points – left axis) at two-month intervals for kangaroos of mean body weight (30kg). The tail fat index is the residual values from a regression of tail thickness against (log) head length.



'green' plant biomass, such as that expected after rain, we see a similar rise in tail fat thickness, likely brought about by the increased availability and consumption of high quality 'green' feed. This is further supported by EnvACT Ecologist and kangaroo researcher Don Fletcher (Pers. Comm. 2005), who indicated kangaroos appear on a 'negative plane of nutrition until the next rain and resultant plant growth'.

What else affects body condition?

Averaged across the year, females had a higher TFI than males. This appears not to be related to the presence of a pouch young, probably because pouch young are generally timed for the period of greatest food availability, i.e., spring.

Other findings include that juveniles have lower TFI than adults, which may be due to a lower food intake; and a high level of worms in the forestomach had a negative affect TFI, but this did not seem to be related to the level of food being eaten.

Conclusion

These are preliminary results from an ongoing study. However, they indicate that FNIRS is an effective tool for monitoring over-abundant populations of wild kangaroos, and that the technique will allow for the early implementation of management options.

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