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THE WINTER DIETS OF FALLOW DEER (*DAMA DAMA*) AND FORESTER KANGAROOS (*MACROPUS GIGANTEUS*) IN THE MIDLANDS OF TASMANIA

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INTRODUCTION

Deer were first introduced into Australia in 1812 and the most successful introduction was of fallow deer (*Dama dama*) into Tasmania in 1836 (Bentley 1978). The Forester kangaroo (*Macropus giganteus tasmaniensis*) is Tasmania's largest native herbivore. It is thought that such grazing herbivores evolved to fill a niche which became available when large areas of grasslands developed in the dry Miocene (Russell 1974). Eutherian ruminants like the fallow deer filled this grazing niche everywhere except Australia, where it was the marsupial Macropodidae which evolved a similar series of adaptations (Moir, Somers and Waring 1956). This paper details a comparison of the diet of the Forester kangaroo and fallow deer in an area in the midlands where these two species now both occur. The composition of their diets, their degree of selectivity and the extent of overlap between the two species was studied.

METHODS

The study was carried out on "Beaufront", a pastoral property near Ross in the midlands of Tasmania, from June to September 1987. The study site covered an area of introduced pasture and a dry sclerophyll woodland community. The dry sclerophyll community had been affected by grazing and burning and was dominated by *Eucalyptus viminalis* with an upper shrub layer of species such as

Acacia mearnsii and *Banksia marginata* over a ground layer dominated by *Lomandra longifolia*. The most common grasses were wallaby grass (*Danthonia spp.*) and tussock grasses (*Poa spp.*). The pasture area consisted mainly of introduced grasses (e.g. *Holcus lanatus, Vulpia* spp.) and clover (*Trifolium subterraneum*) with some native wallaby grass.

Forester kangaroos and fallow deer were observed feeding in both pasture and woodland and appeared to use them in a similar way, that is resting in sheltered places in the woodland during the day and feeding in the open pasture at dawn and dusk.

The diets were studied using faecal analysis. This technique is based on the fact that plant epidermis' exhibit characteristics such as presence of silica bodies and hairs and the size, shape and arrangement of cells and stomates, which can be used to identify plant fragments in the faeces of animals. In order to do this a set of reference slides was prepared from all the possible food plants in the study area. Faeces were collected from an area of approximately one square kilometre, including both the pasture and the woodland, every six weeks from June to September 1987. The faeces collected were bulked each time and prepared and analysed as set out in Duncan (1987). The diet was estimated by recording the percent occurrence of plant fragment types in 300 fields of view for each herbivore at each collection period.

Food preferences were investigated by comparing the percent occurrence of plants in the faeces with an estimate of their availability on the study area. Availability was assessed by estimating the percent cover of plant species in quadrats laid out along transects which covered the variation in vegetation of the study area. Transects were laid out in both the woodland and the pasture.

COMPOSITION OF THE DIETS

The mean percent occurrences of different plant types in the faeces of kangaroos and deer are shown in Table 1. Grasses such as *Holcus lanatus, Vulpia* spp., *Danthonia* spp. and *Poa* spp. made up a major component of the diet of both species. However, they consistently formed a greater proportion of the composition of kangaroo faeces than deer. Kangaroos also included a greater variety of grass species in their diet and a greater proportion of native species as opposed to introduced species. Conversely dicotyledons (e.g. low-fibre herbs such as *Trifolium* spp., *Viola* spp. and *Geranium* spp. and high fibre "browse" species such as *Acacia* spp., *Banksia* spp. and *Leucopogon* sp.) occurred consistently more often in deer faeces than kangaroo faeces. Non-grass monocotyledons such as *Lomandra* did not occur frequently in the faeces of either species.

Herbivores can be classified as grazers or browsers (Hansen *et al.* 1985), where

Table 1 Mean percent occurrence (in 300 fields of view) of plant types in the faeces of kangaroos and deer recorded over three collection periods from June to September 1987. Values are means ± standard deviations.

	Grasses	Browse	Herbs	Non-grass Monocots	Bark	Bracken	Moss
Kangaroos	61±5	13±6	14±5	6±1	3±1	2±3	1±1
Deer	46±2	20±1	15±4	5±2	8±2	2±2	3±3

grazers eat more than 50% monocots and browsers eat more than 50% dicots. Their faecal compositions (Table 1) showed Forester kangaroos were definitely grazers whereas fallow deer were on the borderline between being a grazer and a browser. In Great Britain fallow deer have a large seasonal variation in their diet being a browser in winter and a grazer in summer (Chapman 1975). This difference is probably a result of the milder winter climate in Tasmania, where grasses remain accessible through winter.

Bark was found in small quantities in the faeces of both species but was observed to occur more often in deer faeces than in that of kangaroos (Table 1). This is probably due to their deliberately ingesting it (Chapman 1975) whereas kangaroos may only accidentally ingest it while feeding. Deer may consume bark for reasons such as obtaining some essential minerals, to slow digestion and promote a feeling of satiation when food is short and as a response to stress when disturbed (Jackson 1974).

Bracken (*Pteridium esculentum*) was also found in very small quantities in the faeces of both species (Table 1). It would not be expected to occur in large amounts since it is a cumulative poison, containing thiaminase, an enzyme which inactivates thiamine (Vitamin B1) (Hungerford 1967). However, toxicity varies with season and locality and is greatest in the young shoots.

Moss was another food type found in very small quantities in the faeces of both species (Table 1). It has very little nutritional value (Dearden *et al.* 1975) and may have been consumed accidentally. However, it is possible that it was consumed by deer for its moisture content since according to Chapman (1975) fallow deer rarely drink, getting their water from dew and vegetation.

DIETARY OVERLAP

Dietary overlap was examined quantitatively by calculating a similarity index between the faecal composition of each species at each collection period.

Overlap was very high during all periods being greatest (90%) in mid Winter (June) and lowest (75%) in September. Other studies of sympatric herbivores, both native and introduced, have also found high degrees of similarity, for example 75% between feral goats and Yellow-footed rock wallabies (Dawson and Ellis 1979), 66% between grey kangaroos and wallaroos (Taylor 1983). It has been suggested that the diets of sympatric herbivores should overlap least when food is short so as to minimise interspecific competition thus allowing continued co-existence (Leslie *et al.* 1984). In studies of introduced and native herbivores living sympatrically in Australia there are cases where this has been found to be true (e.g. Ellis *et al.* 1977; Barker 1987) and examples where the opposite appears to be the case, that is overlap is highest when food is short (e.g. Storr 1968; Dawson and Ellis 1979). In this study the overlap was highest when there was least food available.

FOOD PREFERENCES

When faecal composition was compared to the availability of food plants deer were found to have a high preference for "browse" species whereas kangaroos were found to prefer grasses, in particular native grass species such as *Themeda triandra*. Both kangaroos and deer selected against *Poa* spp., *Microlaena stipoides, Holcus lanatus, Lomandra longifolia, Juncus* spp. and moss. Additionally deer avoided the grasses *Danthonia* spp. and *Vulpia* spp. and kangaroos avoided bracken and non-leguminous herbs. However, some of these items that were selected against still comprised a major part of the diet because of their dominance in the vegetation. Thus, *Poa* spp. comprised almost 10% of kangaroo diets and *Holcus* spp. comprised 13% and 18% of deer and kangaroo diets respectively.

DIVERSITY OF DIET

The diversity of plant species eaten by a herbivore is useful as a measure of the breadth of its feeding niche. Deer were found to include a greater range of items in their diets and to have a more even representation of different items than did kangaroos, that is the kangaroos were much more selective in what they ate. Nevertheless, Forester kangaroos appeared to be less selective than other macropods in mainland Australia (Duncan 1987), possibly because the temperate climate of Tasmania provides a broader range of food than the more arid areas where most other studies have been carried out. Other studies (for example Schwartz and Ellis 1981) have also found that introduced ruminants have a broader feeding niche than native herbivores. It has been suggested that this is because the native herbivores are better adapted to the available food resource. It may also be that it is this characteristic which has enabled the introduced herbivore, in this case fallow deer, to survive in an alien environment.

CONCLUSIONS

Since it was not known whether food was limiting, it was not possible to conclude whether competition was occurring between fallow deer and Forester kangaroos. It appeared that the diet of each species was independently determined by factors such as feeding preferences, the nutritional value of plants and their palatability and availability. However, the high degree of overlap of diets indicates the potential for competition if food were limiting, either due to drought, harsh winter conditions or an increase in the populations of deer or kangaroos. Competition between deer and red-neck wallabies (*M. rufogriseus*) is also a possibility due to the greater reliance of wallabies on non-grasses in comparison to Forester kangaroos (Jarman and Phillips 1989). Given that such potential exists one wonders why the deer population is actively maintained, if not encouraged, by the system of seasons and licences operated by the Department of Parks Wildlife and Heritage.

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A TIGER SNAKE GOES TROUT FISHING

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At around 6.00pm on the evening of the 9th of March 1992 we were on a forestry road where it crosses the Wentworth Canal (AMG 4432 502243; altitude 670m), 11 km north of the township of Tarraleah on the Central Plateau. The water in the canal was shallow (20 cm) and fast flowing. An open slashed strip is maintained either side of the canal which passes through alpine ash (*Eucalyptus delegatensis*) dominated scrubby montane forest. The canal batter is formed from Jurassic dolerite rock.

We heard splashing from amongst the rocks forming the canal batter about 10m upstream from where the road crosses the canal. On closer investigation a small rainbow trout (*Oncorhynchus mykiss*), approximately 15cm in length, was found poking out from under a rock near the edge of the canal. On attempting to shift the fish back out into the canal, it was found difficult to dislodge. It was soon discovered why; a snake had the tail and part of the rear of the fish in its mouth. We let go of the fish and the snake disappeared back under the rock. The snake had been holding the fish while submerged under the rock. No part of the snake was visible from above. The rock was dislodged and a black Tiger snake (*Notechis ater*), approximately 1·2m in length, emerged and swam under some rocks nearby. It emerged again and swam downstream for 10m or so where it sought refuge in rocks on the opposite bank.

Tiger snakes inhabit the margins of watercourses and swamps. They prey mainly on vertebrates associated with these habitats, namely frogs, lizards and small mammals (Cogger 1983; Wilson and Knowles 1988). They have not been recorded preying on fish in the wild although they are known to take eels (P. Whittaker, Zoology Department, University of Tasmania, pers. comm.). The closely related mainland tiger snake (*Notechis scutatis*) preys on fish (Wilson and Knowles 1988). Worrell (1963) reported that Chapell Island tiger snakes (*Notechis ater serventyi*) kept in captivity ate "mice, fish, rats, strips of liver and horse meat, and sausages". Populations of tiger snakes which inhabit islands with mutton bird colonies feed on the young chicks (Worrel 1963). They also prey on petrel chicks on some islands off the coast of South Australia (Wilson and Knowles 1988). The King Island race of tiger snake (*Notechis ater humphreysi*) is cannibalistic (Worrell 1963).

The temperature of the water in the canal was measured on the 11th of March at 11.00am and found to be 11°C. Daily fluctuations in water temperatures of streams on the Central Plateau can be of the order of 5°C in summer (Peter Davies, Inland Fisheries Commission, pers. comm.). Thus it is likely that the water was warmer on the evening of the incident after a warm day. Tiger snakes have been recorded active at temperatures as low as 12°C on the Central Plateau (P. Whittaker, pers. comm.). However, they were generally active during the middle of the day when they had had the opportunity to bask. Tiger snakes are shuttling heliotherms (Rawlinson 1974), that is they will bask to raise their body temperature until it reaches their normal activity range. Once they have achieved this they can forage in shade, or the water as described above, where ambient temperatures are lower than their normal activity temperatures.

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