THE ECOLOGY OF FERAL CATS, FELIS CATUS, IN OPEN FOREST IN NEW SOUTH WALES: INTERACTIONS WITH FOOD RESOURCES AND FOXES

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STATEMENT OF RESPONSIBILITY

This thesis is my own original work, except where specifically acknowledged

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ABSTRACT

Despite increasing evidence for the impact of feral cats Felis catus on native fauna in Australia, little is known of the ecology of cats, particularly factors that limit cat abundance. The ecology of the feral cat in Australia is represented by just 15 published studies on diet, only one of which has examined diet in relation to prey availability, and one study of home range behaviour. The red fox Vulpes vulpes is a significant pest to agriculture and native fauna in Australia and widespread fox removals have been proposed by the Vertebrate Biocontrol Cooperative Research Centre (VBCRC). However, there is concern that feral cats may increase compensatorily when fox populations are reduced, as has occurred in Western Australia, and therefore that predation pressure may not be alleviated on native fauna following fox control programs.

This thesis is divided into two parts. First, the diet and home range size of cats is examined in relation to prey availability, and home range overlap and habitat use are determined. In the second part, several niche parameters (diet, home range and habitat use) that were potentially important resources for foxes and cats were quantified to assess the potential for competition. Avoidance and aggression between cats and foxes was examined using simultaneous radiotracking techniques and video observations. The hypothesis that foxes limit cats through interspecific competition (exploitation and interference) was then tested using a fox removal experiment. Finally, three further hypotheses were tested using a fox removal experiment to determine which factors limit feral cats at Burrendong. The four hypotheses tested were thus: i) Cats are limited independently of foxes through other factors such as food availability; ii) Foxes limit cats through interspecific competition (exploitation and/or interference); iii) Foxes limit cats through intraguild predation; iv) Cats benefit from the presence of foxes through facilitation.
The diets and spatial use of feral cats were examined on agricultural land on the eastern shore of Lake Burrendong, New South Wales (32° July 1994 and June 1997. The major land use for the area is water catchment under the agistment of sheep Ovis aries and cattle Bos taurus. The study area encompasses about 90 km² of hilly terrain with undulating slopes that extend down to a flat foreshore area that has been extensively cleared of trees for grazing. The slopes are generally well timbered and dominated by white box Eucalyptus albens woodlands with some yellow box E. melliodora associations. Stands of cyprus pines Callitris spp. are also common. Feral cats and red foxes are established throughout the study area, and the European rabbit Oryctolagus cuniculus was abundant until the arrival of Rabbit Calicivirus Disease (RCD) in June 1996.

The diet of feral cats was determined from the analysis of 499 scats. Rabbits were the staple prey of cats, with occurrence (O) in 81.6% of scats and comprising 68.4% by volume (V). Carrion (mostly eastern grey kangaroo Macropus giganteus and sheep) (O 21.5%, V 11.5%) was an important secondary food, particularly in winter and spring. Other mammalian prey included brushtail possums Trichosurus vulpecula (O 4.6%, V 2.4%), house mice Mus domesticus (O 6.2%, V 3.2%), black rats Rattus rattus (O 2.6%, V 1.4%) and a dunnart Sminthopsis sp. (probably S. murina) (O 0.2%, V 0.006%). Invertebrates (mostly Orthopterans) (O 41.5%, V 7.5%), vegetation (O 26.3%, V 3.6%), birds (O 4.2%, V 0.8%) and reptiles (O 3.4%, V 0.3%) were generally of minor importance in the diet. Few significant seasonal differences were found, although invertebrates contributed significantly less, and possums more, to the mean scat volume in winter and summer respectively.

A significant dietary response was found for changes in rabbit abundance, but not for the other prey groups. Cats continued to prey heavily on rabbits after the arrival of Rabbit Calicivirus Disease, despite the relatively low numbers of rabbits. Ten months post-RCD, house mice increased in importance in the diet. However, it was not known whether this represented prey switching sensu stricto or opportunistic predation on an increased mouse population, as mouse abundance was not measured during this period.
Seventy-seven cats (48 recaptures) were caught in 6762 trap nights between November 1994 and August 1996 using both cage traps and leg-hold traps. A further 18 individual cats were trapped as non-target animals by the VBCRC Fox Sterility Project and used in this study. Trapped adult cats were fitted with radio collars and their home range size, overlap and habitat use examined. Home ranges and core areas were quantified using 95% and 50% kernel utilisation distributions (KE 95 and KE 50) and minimum convex polygons (MCP 100, MCP 95, MCP 50). Four habitat types (grassland, open woodland, open forest, and mudflats) were delineated on aerial photographs and a habitat map produced using ARC/INFO. Compositional analysis was used to examine habitat preference in cats.

Home range sizes of cats (n = 15, 598 fixes) in winter 1995, prior to fox removal, were similar to those reported in the only published study of cat spatial use in Australia, but larger than those recorded elsewhere. This may have reflected more dispersed food resources in Australia, although home range size was not correlated significantly with rabbit abundance. Male ranges (MCP 95 \( \bar{x} = 284 \text{ ha}, n = 11 \)) tended to be larger than females (\( \bar{x} = 151 \text{ ha}, n = 4 \)), but no differences were detected between young (1-3 years, \( \bar{x} = 271 \text{ ha}, n = 7 \)) and old (>3 years, \( \bar{x} = 221 \text{ ha}, n = 8 \)) cats. Cats were active both by day and night with no temporal differences being detected in range size. Both adult male and female cats tended to be solitary, although home ranges overlapped extensively. Kin groups were indicated (but not confirmed) as most inter-sexual overlap occurred between young and old cats.

Habitat composition of home ranges generally reflected the availability of habitats at the study site, although cats significantly avoided mudflats. Home ranges comprised mostly open woodland and open forest habitats with smaller areas of grassland and mudflats. However, within individual home ranges, cats used grassland and open woodland habitats most often where rabbits were more abundant. Inter-individual (sex, age) or temporal (day/night) differences in habitat use were not detected.

Comparison of resource use between cats and foxes indicated a large overlap in diet, home ranges and habitat use. Dietary breadths and overlaps between cats and foxes increased when rabbit availability declined in autumn and post-RCD. Dietary overlap was high overall (75%), although some resource partitioning was detected.
Rabbits were more important in the diet of cats than foxes, particularly in summer, when foxes ate more grasshoppers. Carrion, invertebrates and vegetation were more important for foxes than for cats overall. Home ranges of both cats and foxes comprised mostly open woodland habitats followed by grassland, open forest and mudflats, which largely reflected their relative availabilities. However, within individual home ranges, cats showed a preference for grassland habitats. In addition, cats tended to deposit scats more often than foxes at rabbit warrens and at hollow log entrances, while foxes deposited scats more often than cats on sand plots, tracks and at dams. The large overlap in resource use between cats and foxes indicated a high potential for exploitation competition.

Foxes may attempt to lessen competition by killing cats (interference competition). Three radiocollared cats were killed by foxes and aggression was observed toward cats. Home ranges overlapped extensively, but avoidance was indicated from the simultaneous radiotracking of both predators, as greater separations and lower overlaps in home ranges and core areas were recorded between species than within species. In addition, video observations suggested avoidance of carcasses by cats in the presence of foxes.

The hypothesis that foxes limit feral cats through interspecific competition was then tested using a fox removal experiment. Foxes were reduced at two of the four sites Predator-Prey project. Resource use and abundance of cats were compared before and after fox removal and between treated and untreated sites. Although no increase in cat abundance followed the removal of foxes, significant behavioural changes by cats strongly suggested interspecific competition operating via exploitation and interference. Exploitation competition was supported by the increased consumption of carrion by cats at the treated sites after fox removal, while support for interference competition came from the increased use of grassland habitats at night after fox removal. The direction of the resource shifts to more prey-rich habitats indicated asymmetry in the relationship between the two predator species. Although the null hypothesis of no limitation of cats by foxes could not be rejected, as no increase in cat abundance was recorded after fox removal, interspecific competition was considered to be the most likely mechanism limiting feral cats at Burrendong. Intraguild
predation was not indicated as no cat remains were found in any of the 343 fox scats or 255 fox stomachs that were examined. In addition, minimal evidence was found for facilitation between cats and foxes, or for food limitation.

The potential for foxes to limit cats, as shown in this study, indicates that cats need to be considered in future fox control operations. Integrated pest management, where foxes, cats and rabbits are controlled together, is strongly proposed if the objective is to safeguard native fauna in Australia. Further research is required to improve the effectiveness of current techniques for censusing cat populations, particularly in forested areas. This is essential for monitoring the effectiveness of control campaigns and quantifying factors that limit cat populations, and ultimately for effective protection of susceptible native fauna.
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