Title

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Spatial organisation & habitat selection patterns of three marsupial herbivores within a patchy forestry environment

by

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Doctor of Philosophy

School of Zoology
and
Cooperative Research Centre for Sustainable Production Forestry

University of Tasmania

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Declaration

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief, the thesis contains no material previously published or written by another person accept where due acknowledgment is made in the text of the thesis.

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Abstract

In order to understand the ecology of a species, it is important to know how animals use their environment. This information can be determined at a range of spatial and temporal scales, and results may vary accordingly. The habitats that animals use determine resources available to them for different purposes (e.g. feeding and resting), and risks of predation to which they are exposed. Consequently, patterns of behaviour in relation to the environment are likely to influence survival and fitness. In Tasmania, Australia, three common and widely distributed native marsupial herbivores are the red-necked or Bennett's wallaby (*Macropus rufogriseus rufogriseus*), the red-bellied pademelon (*Thylogale billardierii*) and the common brushtail possum (*Trichosurus vulpecula*). Information on the behaviour of these species in relation to their environment is largely unavailable.

This thesis describes the abundance, spatial organisation and habitat selection patterns of these three species, within a patchy forestry landscape. The five major habitat types within this environment were: (1) a prepared site that was planted with commercial *Eucalyptus nitens* seedlings during the study (referred to as 'young plantation'); (2) 5-7 year old *E. nitens* plantation; (3) grassland; (4) native forest; and (5) harvested uncleared land.

Patterns of habitat use and selection were examined at three sequential spatio-temporal scales, within a hierarchy of decisions. These were: (1) location of home-range within the landscape, (2) feeding area within the home-range, and (3) vegetation consumed within one habitat, the young plantation. A radio-telemetry study of Bennett's wallabies, pademelons and possums was used to examine Scales 1 and 2 at the individual animal level. Animal surveys were carried out to examine Scale 2 for the entire herbivore community at the population level. These data were also used to estimate herbivore densities for the overall area and individual habitats. Fenced and unfenced vegetation plots, located within the young plantation, a highly used habitat, were monitored over time to examine Scale 3.

As part of this research, modifications to common line-transect sampling methods were made. These enabled methods that are usually applied to daytime surveys in open habitat, to be used in nocturnal surveys in densely vegetated habitats. Accuracy testing of the radio-telemetry system is also described, as the patchiness of the landscape required careful interpretation of results.

Results showed that, at night, wallabies and pademelons used all habitats, but consistently selected for open habitats (young plantation and grassland) across spatio-temporal scales. The use of these open habitats for feeding was confirmed by the large biomass of grass and forbs consumed by herbivores in a detailed study of vegetation on the young plantation. These patterns are consistent with their feeding strategies of grazer or mixed-feeder.

During the day, the two macropod species avoided open habitats and showed strong selection for closed habitats. Wallabies selected for older plantation, while pademelons selected for native forest. This difference reflects their respective predator avoidance strategy (crypsis for pademelons) or escape response (flight for wallabies). Although shelter habitat was important to the two macropod species, their lack of selection at the home-range scale was suggested to reflect the fact that resting animals require little space.

Patterns of habitat use and selection were difficult to interpret for possums, because results varied between the spatio-temporal scales. Spotlighting data showed that at night, possums selected for native forest, young plantation and particularly grassland at the population level. Radio-collared animals selected only for native forest. Older *E. nitens* plantations were avoided by possums at every level, and appeared to represent a biological desert to this species.

High overall densities of wallabies and pademelons (0.3 and 1.5 animals.ha^{-1}, respectively), and small, round, home-ranges (61.6 ha and 22.3 ha, respectively) suggested that these

species benefited from the patchiness of this environment. This is attributed to the highly heterogeneous habitats, providing complimentary resources in the absence of ecotones or transitional flora zones, existing side by side, over a small spatial scale. In contrast, extremely low possum population density (0.04 animals.ha^{-1}) and very large home-ranges (39.1 ha) suggested that resources, presumably den sites and/or food, were limited within this forestry environment.

Results on the ecological aspects of the three herbivore species, described above, are put in the context of the Tasmanian forestry industry, particularly in relation to management of herbivore browsing damage to planted seedlings. Based on this work, I suggest that future management strategies could involve: (1) reducing fragmentation of the natural environment, which supports small home-ranges and high macropod densities, by designing larger, rounder plantations; (2) considering the placement of plantations in relation to the proximity of open (feeding grounds) and closed (shelter) habitats; (3) reducing or removing windrows from newly established plantations to restrict pademelons to the plantation edge; (4) deliberately retaining groundcover or using cover crops to provision herbivores with an alternative food source, as grasses and herbaceous dicots are eaten in preference to *Eucalyptus nitens* seedlings; (5) recognising that wallabies and pademelons remove a large biomass of groundcover and therefore, could play a positive role in weed control, reducing the need to herbicide plantations; (6) monitoring newly planted plantations at short and regular time intervals so that damage caused by insects versus mammals can be differentiated; and (7) avoiding planting in winter when macropods may have little alternative food to eat on newly established plantations.

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