ECOLOGICAL ENERGETICS OF WOMBATS

Murray C. Evans
B.Nat.Res.(Hons), M.Res.Sci.

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DECLARATION

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, to the best of my belief have been acknowledged in this thesis.

Murray Evans

Frontispiece Tracks in the snow leave a tell-tale sign of a wombat's nocturnal foray.

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ABSTRACT

The three extant species of wombats are unique amongst mammals in being large, burrowing grazers that exhibit physiological and behavioural characteristics indicative of extreme energy conservatism. Previous energetics studies of wombats have been limited to their basal metabolism under laboratory conditions. In this study, the energetics and feeding ecology of free-living wombats of each species were examined by investigating field metabolic rates, water turnover rates, diets, food resources, ranging and behaviour. The three species differ markedly in the environments they inhabit; hairy-nosed wombats (*Lasiorhinus krefftii* and *L. latifrons*) are arid-adapted (dry Mediterranean or dry tropical climates) whereas common wombats *Vombatus ursinus* are adapted to cool, mesic climates. Their habitats are characterised by seasonal or intermittent productivity, in which food quality and availability fluctuate strongly. Wombats in the semi-arid environments also face lack of free surface water for weeks or months. Where possible, data from each species and habitat were collected during 'good' and 'poor' seasons. The species also differ markedly in their conservation status; two species are still reasonably abundant, but the northern hairy-nosed-wombat is on the brink of extinction with a single free-living population of about 60 individuals. Energetics information was collected for all three species, whereas common wombats were the focus of the dietary and ranging studies (time and resource constraint precluded extending these studies to all three species).

Water flux rates and metabolic rates of all three species of wombat in the field were measured using the isotope (doubly-labelled water) turnover method. Water flux rates of southern hairy-nosed wombats during the dry season (12.11 ± 1.36 $mL.kg^{-1}.d^{-1}$) are amongst the lowest recorded for mammalian herbivores. During 'normal' dry seasons in their hot, semi-arid habitats, these species can probably survive without drinking. Water flux rates for common wombats were comparable with other marsupial herbivores such as the macropodoids. Southern hairy-nosed wombats and common wombats were apparently able to maintain body condition between seasons. Field metabolic rates were similar between wombat species, and differed strongly between seasons, with wet season rates approximately double those of dry seasons. Field

metabolic rates during the wet season were slightly above the marsupial 'mean' whereas dry season FMR's were well below the mean and, for the southern hairy-nosed wombat, were amongst the lowest recorded for herbivorous mammals. Feeding rates were well below values predicted for herbivorous marsupials and feeding rates also varied interspecifically and were highly seasonal. When drinking water is not available, southern hairy-nosed wombats are apparently able to survive on forage of lower moisture content than can other grazing mammals, including ruminants. Wombats' ability to maintain condition during the dry season was apparently achieved by 'switching off' activity (reducing energy expenditure) during the dry (poor) season to maintain energy balance.

To better understand how wombats are able to cope with foods that are of poor quality and often dry, information on diet of common wombats was compared to seasonal variability of food resources. Seasonal biomass and species composition of the herb layer were quantified using the Dry-Weight-Rank and Comparative Yield methods, and the data were analysed using the BOTANAL program. Seasonal fluctuations in food quality were assessed from laboratory nutrient analyses. It was evident that common wombats inhabited a seasonally variable environment, which affected pasture quality and growth. Pastures were dominated year round by snow grasses (*Poa* spp.) which were lower in nutritional quality than almost all of the other ground-layer species present, and were avoided as food by cattle and sheep. The diet of common wombats was determined from analysis of plant epidermal fragments in faeces. Common wombats were found to be grass specialists with the dominant *Poa* spp. providing the dietary staple, though a wide range of other monocotyledonous species were also eaten. Common wombats were moderately selective feeders, and demonstrated higher selectivity (narrower niche breadth) when pasture diversity was highest (summer). Factors influencing the choice of dietary items by herbivores are notoriously complex, and common wombats were no exception; the nutritional parameters measured in food items did not significantly explain the variations in the diet or in feeding selectivity. It is clear that common wombats are flexible in the food resources able to be utilised, enabling them to vary their diet in response to seasonal pasture composition.

Ranging and burrow-use behaviour of common wombats was studied by radio-tracking. Home-range area was extremely conservative, with no intersexual distinction in ranges. Ranges and core areas extensively overlapped between and within sexes indicating undefended ranges. Eucalypt forest and open (cleared) pasture were clearly important habitats for common wombats. Despite occurring in a seasonal environment, common wombats appear to be remarkably invariant in where they range and the distribution of activity within the range. Burrow-use for common wombats was not exclusive, with some burrows being used by a number of individuals on different days.

Activity levels of common and southern hairy-nosed wombats were studied using miniature, motion-sensitive, data-logging computers attached to radio collars worn by wombats. Activity was characterised by a strong diel cycle with limitation of most activity to the night. Activity occurred throughout the night, with a pattern consistent with a 'travelling out to graze, graze, travelling back' pattern. Nightly activity was highly variable, even within short periods. Most individuals of these species showed a shorter mean nocturnal activity period in winter than in summer. Activity levels for southern hairy-nosed wombats during the hot, dry summer fell to about half the level of that for cool, wetter winter (when plants grew). Trapping, handling and collaring possibly disrupted normal behaviour of some individuals, as evidenced by apparently high levels of activity recorded during these periods.

All facets of the study were synthesised to describe an hypothesised unique energy-conserving adaptive syndrome that enables these extraordinary animals to 'bend the rules' of the general relationship between body mass and ecological energetics.