

Marsupial Nutrition

Marsupial Nutrition describes the food resources used by marsupials as diverse as small insectivores and large folivores. It discusses the ways in which their digestive systems and metabolism are designed to cope with foods as different as nectar and fungus, tree sap and tough perennial grasses, and insects and eucalypt foliage. Although the subject species are marsupials the general principles of nutritional ecology and digestive strategies that are introduced at the beginning of the chapters are applicable to all mammals. Advanced undergraduates and graduate students at all levels in the areas of vertebrate zoology, nutrition, ecology and digestive physiology will find *Marsupial Nutrition* particularly instructive. Wildlife biologists, veterinarians and nutritionists will also find much of interest.

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Contents

Preface [ix]

- 1 Metabolic rates and nutrient requirements** [1]
 - 1.1 Concepts [1]
 - 1.2 Metabolic rates [3]
 - 1.3 Basal metabolic rates [3]
 - 1.4 Consequences of a low metabolic rate [8]
 - 1.5 Maintenance energy requirements of captive marsupials [10]
 - 1.6 Voluntary food intake [12]
 - 1.7 Field metabolic rates of marsupials [12]
 - 1.8 Metabolic scope [14]
 - 1.9 Torpor and hibernation in marsupials [15]
 - 1.10 Water turnover [18]
 - 1.11 Protein turnover and nitrogen requirements [25]
 - 1.12 Other nutrients [31]
 - 1.13 Summary and conclusions [33]

- 2 Carnivorous marsupials** [35]
 - 2.1 Concepts [35]
 - 2.2 Diets of carnivores [38]
 - 2.3 Diets of carnivorous marsupials [42]
 - 2.4 Dentition [53]
 - 2.5 Digestive tract morphology [54]
 - 2.6 Digestive function [60]
 - 2.7 Water and electrolyte metabolism [63]
 - 2.8 Energy relationships [66]
 - 2.9 Tolerance to fluoroacetate [73]
 - 2.10 Summary and conclusions [74]

- 3 Omnivorous marsupials** [76]
 - 3.1 Didelphid marsupials [76]
 - 3.2 Bandicoots and bilbies [82]
 - 3.3 Omnivorous possums and gliders [95]
 - 3.4 Summary and conclusions [123]

- 4 Hindgut fermenters – the wombats** [125]
 - 4.1 Concepts [125]
 - 4.2 Habitats and diets of wombats [127]
 - 4.3 The digestive tract [131]
 - 4.4 Digestive function [135]

Contents

- 4.5 Metabolism and nutrition [140]
- 4.6 Digestive and foraging strategies [145]
- 4.7 Responses to drought [146]
- 4.8 Summary and conclusions [148]

- 5 **Hindgut fermenters – the arboreal folivores [149]**
 - 5.1 Concepts [149]
 - 5.2 The arboreal folivores [150]
 - 5.3 Diets [150]
 - 5.4 *Eucalyptus* foliage as food [155]
 - 5.5 Digestion and metabolism in the arboreal folivores [165]
 - 5.6 Summary and conclusions [204]

- 6 **Foregut fermenters – kangaroos and wallabies [205]**
 - 6.1 Concepts [205]
 - 6.2 The macropodid digestive tract [206]
 - 6.3 Passage of digesta through the gastrointestinal tract [234]
 - 6.4 Digestion in the macropodid forestomach [240]
 - 6.5 Food intake and digestion [249]
 - 6.6 SCFA and carbohydrate metabolism [252]
 - 6.7 Lipid metabolism [255]
 - 6.8 Nitrogen metabolism and urea recycling [257]
 - 6.9 Conclusions [260]

- 7 **Nutritional ecology of kangaroos and wallabies [261]**
 - 7.1 Concepts – dentition and diet [261]
 - 7.2 Dentition of macropodid marsupials [262]
 - 7.3 Studies on macropodid diets [266]
 - 7.4 Nutrition and ecology [278]
 - 7.5 Summary and conclusions [313]

- 8 **Foregut fermenters – the rat-kangaroos [315]**
 - 8.1 Dentition [315]
 - 8.2 Diet studies [317]
 - 8.3 The potoroid digestive tract [324]
 - 8.4 Food intake and digestion [334]
 - 8.5 Nitrogen metabolism [336]
 - 8.6 Energy metabolism [336]
 - 8.7 The nutritive value of fungi [338]
 - 8.8 Summary [339]

- 9 **Evolution of marsupials and of digestive systems [341]**
 - 9.1 Outline of the origins of South American and Australasian marsupials [341]
 - 9.2 Australian marsupials in the Miocene [346]
 - 9.3 The Australian megafauna [346]
 - 9.4 Likely foraging and digestive strategies of extinct marsupials [348]

9.5 Evolution of herbivorous marsupials [351]

9.6 Conclusion [356]

10 Future directions [357]

Appendix [362]

References [367]

Index [418]

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978-0-521-59555-1 - Marsupial Nutrition
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Frontmatter
[More information](#)

Preface

Marsupial Nutrition is about the nutritional ecology and digestive physiology of marsupials. The nutritional ecology of a species describes the interface between animals of that species and their food resources. Their digestive physiology determines which resources in the environment are food. The roots of *Marsupial Nutrition* lie in its predecessor, *Digestive Physiology and Nutrition of Marsupials*, published in 1982, but the great increase in knowledge and understanding of the nutritional niches filled by marsupials, and their digestive strategies, over the last 16 years has led to a much more comprehensive treatment of marsupial groups, their nutritional ecology and their digestive physiology in the present book.

Nevertheless, the reasons for writing *Marsupial Nutrition* remain the same: to inform physiologists and nutritionists about how the digestive systems of marsupials work, and to help zoologists and wildlife managers understand how food resources in the environment are utilised by various groups of marsupials, and which elements of the landscape are likely to be critical to the well-being of populations of marsupials in terms of their nutrition.

The ecological niches filled by marsupials are many and varied. Marsupials include many more species and forms than just kangaroos and koalas. In fact there are approximately 180 species of marsupials in Australia and New Guinea, 78 in South America and 1 in North America. They range in body size from 3 g shrew-like planigales (*Planigale* spp.) to 70 kg red kangaroos (*Macropus rufus*). They are found in habitats as diverse as freshwater streams (*Chironectes minimus*, the water opossum of South America), alpine areas (*Burramys parvus*, the mountain pygmy-possum of south-eastern Australia), hot deserts (*Notoryctes*, the marsupial moles of central Australia) and tropical rainforests (dorcopsis wallabies of New Guinea). Their diets range from purely insects to vertebrates, fungi, underground plant roots, bulbs, rhizomes and tubers, plant exudates such as saps and gums, seeds, pollen, terrestrial grasses, herbs and shrubs and tree foliage. Adaptive features of marsupials often have analogues in eutherian (placental) mammals. These are examples of convergent evolution. Some of the convergences are obvious: the marsupial gliders resemble the flying squirrels and lemurs, the Tasmanian tiger or thylacine was dog-like, and marsupial moles are reminiscent of eutherian moles. Other convergences are at the physiological level. For instance, ringtail possums produce two types of faeces and consume only the soft faeces that are higher in nutrient content; eutherian rabbits do the same. The wombats process grasses and sedges in a greatly

Preface

enlarged colon, as do horses. Numbats feed on termites in much the same way that some eutherian anteaters do.

Marsupial Nutrition opens with a general chapter on metabolic rates of marsupials and their requirements for energy and nutrients such as water and protein. I deal principally with nutrition of the adult animal, and generally include the young only in so far as it affects the energy and nutrient requirements of adults (usually the lactating female). The next seven chapters deal with various groups of marsupials on the basis of their dietary and thus gastrointestinal tract specialisations. They begin with the relatively simple, the carnivores/insectivores, then progress through omnivorous groups to the most complex (several groups of herbivores). Most chapters open by introducing one or more general nutritional concepts pertinent to that part of the book. These concepts hopefully provide the framework for the rest of the chapter that follows. Most chapters conclude with a section on the nutritional ecology of each dietary group. The kangaroos and wallabies are an exception, for a separate chapter is devoted to their dietary niches and nutritional ecology. Chapter 9 provides an opportunity to review and compare the foraging and digestive strategies of the various groups of marsupials in the context of current thinking about marsupial evolution and the possible evolution of digestive strategies in mammals. The final chapter contains suggestions about where research in marsupial nutrition should head in the twenty-first century.

Readers familiar with its predecessor will notice that the material covered in *Marsupial Nutrition* is much more balanced in its treatment of carnivorous, omnivorous and herbivorous marsupials. This is because of the expanded research effort that has gone into marsupials other than kangaroos over the last 16 years. It has also been pleasing to be able to describe the work of, and refer to, many more South American authors than previously. Hopefully this book will stimulate further comparative studies on the digestive physiology, nutritional ecology and metabolism of a still wider range of species from South America in the future.

Within Australia, greater research effort recently has gone into marsupials from more mesic environments. Former research had been concerned more with arid-zone marsupials, not surprisingly so as two-thirds of the Australian land surface is classified as semi-arid or arid. Hopefully the greater coverage of more mesic forms in *Marsupial Nutrition* will stimulate even more studies on a wider range of species from across the broad spectrum of environments from rainforest to desert. Research on the nutrition and metabolism of New Guinean marsupials still lags, but again, recent work brought together in *Marsupial Nutrition* may also stimulate greater research effort on these fascinating animals.

The classification of marsupials to family level adopted in this book is based on that of Woodburne & Case (1996), and to species level on Eisenberg (1989), Redford & Eisenberg (1992), Strahan (1995) and Flan-

nery (1995). In three cases of Australian species I have deviated from Strahan (1995) on the basis of new information. Two species of marsupial moles are now recognised: *Notoryctes typhlops* (southern marsupial mole) and *N. caurinus* (northern marsupial mole) (Maxwell, Burbidge & Morris 1996). The kowari (formerly *Dasyuroides byrnei*) is now subsumed in the genus *Dasyercus* as *D. byrnei* (Maxwell *et al.* 1996). *Antechinus agilis* (agile antechinus) is recognised as a species separate from *A. stuartii* in southern Victoria and south-eastern New South Wales (Dickman *et al.* 1988). The common names used for American species are based on Eisenberg (1989) and Redford & Eisenberg (1992). The common names used for Australian species are based on Strahan (1995), and those for New Guinean species on Flannery (1995). A list of the marsupial species mentioned in the text, with scientific and common names, will be found in the Appendix.

Because of the very recent nature of some of the information contained in this book I have depended heavily on the work of several current graduate students and on that of other colleagues who have generously supplied me with unpublished manuscripts or manuscripts in the process of publication. For allowing me access to their unpublished results, I thank Chris Allen, Bruce Bowden, Don and Felicity Bradshaw, Terry Dawson, Chris Dickman, Bart Eschler, Tim Flannery, Bill Foley, Lesley Gibson, Ross Goldingay, Perdita Hope, Menna Jones, Chris Johnson, Jonathan Kingdon, Steve Lapidge, Ivan Lawler, Geoff Lundie-Jenkins, Diego Moraes, Kylie McClelland, Diane Moyle, David Pass, Georgina Pass, Ken Richardson, Myfanwy Runcie, Felix Schlager, Andrew Smith, Ian van Tets and Mike Wolin.

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Frank Knight provided the silhouettes of each species appearing in the figures, and most of the figures. Paulette Ripikoi and Sylvia Warren assembled most of the tables and references. My wife Desley provided the moral support needed to bring the book to fruition. To all these people my heartfelt thanks.

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Sydney