The swamp wallaby *Wallabia bicolor*: a generalist browser as a key mycophagist

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A thesis submitted for the degree of Doctor of Philosophy

University of New England

Armidale, New South Wales, Australia

February 2011

Thesis Abstract

Mammal-macrofungal interactions are integral to ecosystem function in landscapes dominated by ectomycorrhizal (EM) plants. EM fungi, critical symbionts with forest plants, produce sporocarps (fruit bodies) which are an important food resource for a variety of mammals. These mammals in turn play an important dispersal role, particularly for truffle-like (below-ground fruiting or hypogeous basidiomycetes) sporocarpic fungi that do not actively discharge their spores (sequestrate). This thesis examines interactions between truffle-like fungi and a non-specialist, mycophagous marsupial, the swamp wallaby *Wallabia bicolor*. The availability of truffle-like fungi sporocarps as a food resource for mycophagous (fungus-feeding) mammals, the macrofungal diet of the swamp wallaby, and gut-retention and potential dispersal of macrofungal spores by swamp wallaby are examined.

Surveys for truffle-like sporocarps in three eucalypt-dominated forest types at two sites over summer and winter revealed high diversity and productivity with strong seasonality. Among forest types, variation in community composition was associated with variation in microhabitat and landscape-scale environmental attributes, although composition was most variable at a fine spatial scale.

Faecal pellet analysis revealed a total of 62 truffle-like and epigeous spore types in swamp wallaby diet. Macrofungi were consistently consumed over multiple seasons and the majority of spore types were attributed to truffle-like fungi. Comparison of available and consumed sporocarp genera revealed that, overall, swamp wallabies consumed ~60% of available genera and did not consume sporocarps according to their frequency. A number of genera not detected in surveys were consumed. At a local scale, diet richness was similar to sporocarp richness and differences in composition varied by forest type and season.

Mycophagous animals facilitate dispersal of truffle-like fungi because spores of consumed sporocarps remain intact through the gut and are deposited in the faeces some distance from the point of consumption. For the first time, gut-passage of truffle-like fungal spores is examined in the swamp wallaby. Mean retention times of marker spores in two wallabies were 27 and 35 h. A small number of spores were found in faecal pellets up to 69 h after ingestion, indicating potential for even longer distance dispersal of fungal spores by swamp wallabies. Swamp wallabies carry ingested fungal spores for lengths of time comparable to smaller mycophagous marsupials, including the strongly mycophagous potoroids.

Spore dispersal between EM communities is vital for maintenance of populations and ecosystem functioning. GPS-telemetry and camera trapping in a patchily cleared agricultural landscape revealed that swamp wallabies occasionally used isolated forest patches. Models of spore dispersal potential ('dispersal kernels'), based on swamp wallaby movement data from GPS-telemetry and observed spore gut-retention times, predicted a mean spore dispersal distance of 187 m and maximum distances of more than one 1000 m. Swamp wallabies thus perform an important spore dispersal function in this landscape, in which few other mycophagists occur, and this work demonstrates they have the capacity to carry spores great distances, including across barriers to mycelial spread, such as open agricultural lands.

Swamp wallabies consume macrofungi as part of a generalist browsing diet and, like other non-specialist mycophagists, are often overlooked as consumers and dispersers of truffle-like fungi. As dispersers of truffle-like fungal spores in forest interior and edge habitats, swamp wallabies undoubtedly contribute to maintenance of diverse truffle-like fungi communities and functioning forests, and influence vegetation dynamics at habitat boundaries. In landscapes from which other mycophagists have been extirpated, swamp wallabies may be key spore dispersers.

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, have been acknowledged in this thesis.

Melissa Danks

Preface

This thesis is written in the style of a thesis by manuscript or thesis by journal article, and therefore some repetition of the study rationale, aims, and site descriptions occurs among chapters.

Fungal nomenclature used in this thesis follows that of the Interactive Catalogue of Australian Fungi (ICAF, Royal Botanic Gardens Melbourne 2011). Exceptions to this nomenclature include the use of *Cortinarius* for sequestrate species previously in *Thaxterogaster* (Francis and Bougher 2003) and the use of *Russula* for sequestrate species previously in *Macowanites* (Lebel and Trappe 2000; Lebel and Castellano 2002; Lebel and Tonkin 2007). I acknowledge that further changes to fungal nomenclature have occurred and are not recognised in ICAF, for example the transfer to *Arcangeliella* of many species previously in *Zelleromyces*, however I followed ICAF in these cases.

Research was conducted under University of New England Animal Ethics Committee approval (AEC07-191 and AEC09-023) and New South Wales National Parks and Wildlife Service scientific license (S12493), and all procedures involving animals meet guidelines of the American Society of Mammalogists for animal care and use (Gannon *et al.* 2007).

This thesis is based on the following articles:

CHAPTER 2:

Danks, M., Lebel, T., Vernes, K. & Andrew, N. Truffle-like (sequestrate) fungi sporocarps in a eucalypt-dominated landscape: patterns in diversity and community structure. *Manuscript*.

CHAPTER 3:

Danks, M., Vernes, K., Lebel, T. & Andrew, N. Landscape and local-scale patterns of mycophagy by a generalist browser macropod. *Manuscript*.

CHAPTER 4:

Danks, M., Vernes, K., Lebel, T. & Andrew, N. A comparison of truffle-like fungi sporocarp diversity and diet of a non-specialist mycophagist. *Manuscript*.

CHAPTER 5:

Danks M. A. (2011) Gut-retention time in mycophagous mammals: a review and a study of truffle-like fungal spore retention in the swamp wallaby. *Fungal Ecol.* doi: 10.1016/j.funeco.2011.08.005. [Accepted in revised form]

CHAPTER 6:

Danks, M., Vernes, K., Lebel, T. & Andrew, N. Short-term movement and potential dispersal of truffle-like fungi spores by a generalist mycophagous macropod in a variegated landscape. *Manuscript*.

Other publications arising from this thesis:

APPENDIX 2:

Danks M., Lebel T. & Vernes K. (2010) 'Cort short on a mountaintop' - Eight new species of sequestrate *Cortinarius* from sub-alpine Australia and affiliations to sections within the genus. *Persoonia* **24**, 106-26.

Acknowledgements

I am grateful to my supervisors, Dr Karl Vernes, Dr Nigel Andrew, and Dr Teresa Lebel, for their expert guidance, valuable insights, constructive criticism, humour, and encouragement during this study, and without whom this study would not have been possible.

This work was funded by a Hermon Slade Foundation grant (HSF08-6) to Dr K Vernes, Dr T Lebel, and I, and an Australian Research Council Discovery Grant (DP0557022) to Dr K Vernes. University of New England provided facilities, additional funding, and supported me through an Australian Postgraduate Award. New South Wales National Parks and Wildlife Service (NPWS, DECCW) provided access to parks and reserves. UNE provided access to Newholme Field Station. Thanks to NPWS Armidale and Narrabri staff for information and assistance in accessing parks, and to Stuart and Karen Hutton for access through their property to Booroolong Nature Reserve.

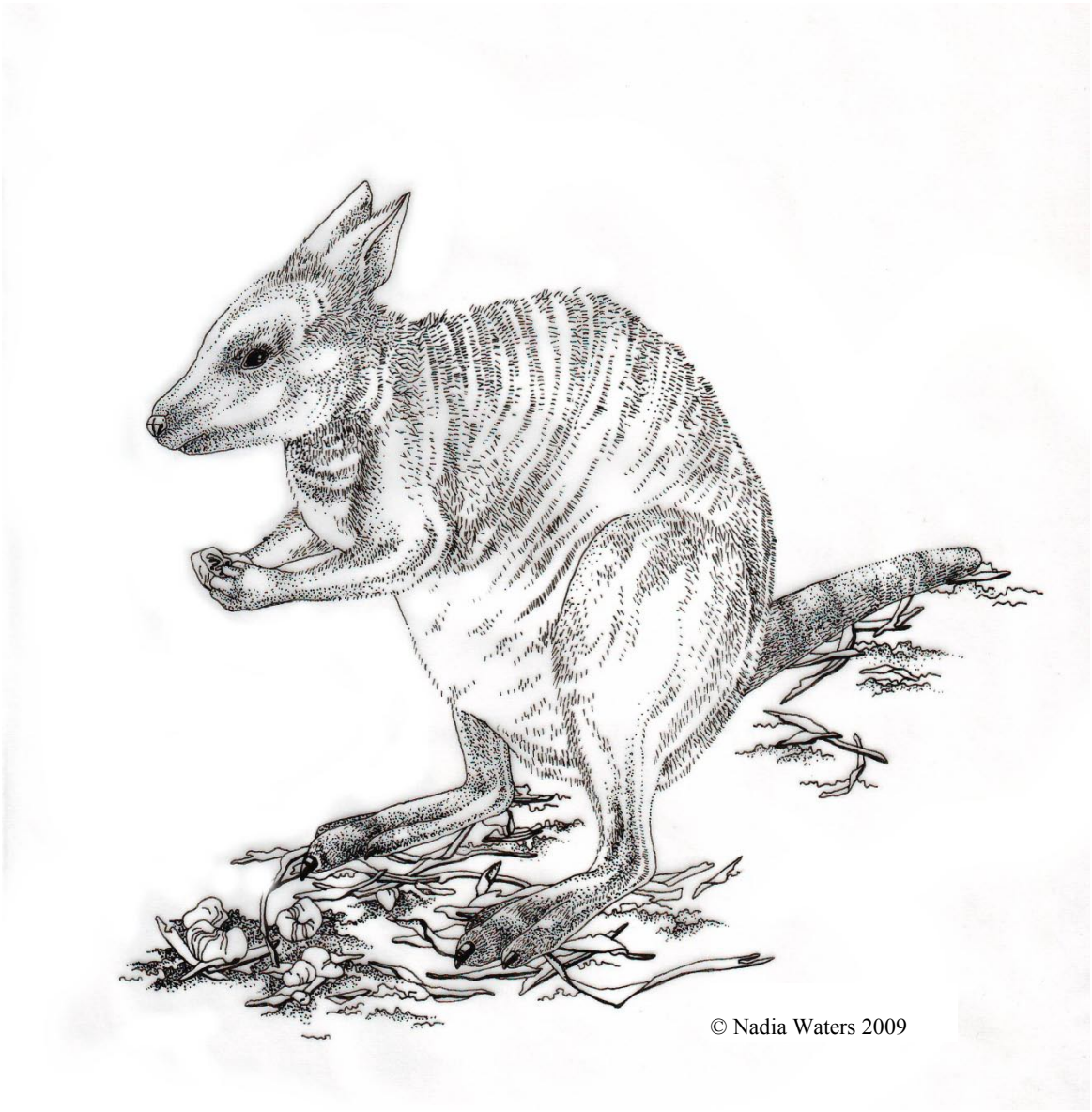
For assistance in the field and laboratory I thank Dr K Vernes, Dr T Lebel, Prof Jim Trappe, Lisa Warnecke, Sven Steinhart, Fiona Bowie, Ian Simpson, Stuart Green, Alan Danks, Rob Veal, Katrina McGrath, Jonathan Ford, Jamie Turner, Dr Peter Hancock, Nick Schultz, Megan Good, and Carlos Alfonso Muñoz Robles. Particular thanks to Dr T Lebel for sharing her extensive knowledge of truffle taxonomy and ecology and for assistance and encouragement in identifying truffles.

Thanks also to Prof Trappe and Dr Mike Castellano for identifying some truffle specimens, Ian Simpson and Ian Telford for assistance with flora identification, NSW Department of Environment Climate Change and Water for GIS imagery, Bradley Dawson for building GPS-telemetry units, Dr Mark Trotter for GPS-telemetry technical advice, Prof Dan Haydon, Doug Kerlin, and Dr K Vernes for constructing the dispersal model, and Dr Matt Tighe for ‘R’ help. Among the many people with whom I had constructive discussions about

my research, particular thanks to Drs N Andrew and M Tighe for valuable discussions about statistical approaches and advice on specific techniques, and to Dr Peter Clarke for early advice on survey design. Prof Marti J Anderson provided inspiration and advice at a PERMANOVA+ multivariate statistics workshop.

This thesis was greatly improved by suggestions and comments made by Dr K Vernes, Dr N Andrew, Dr T Lebel, Dr J Price, M Good, and Dr Darren Ryder on earlier manuscripts.

Thanks to fellow students or research fellows Megan, Nick, Jodi, Rhiannon, Lisa, Jamie, Morag, Carlos, Peter, and Jo for many inspiring discussions. Your friendship, fresh perspectives, ecological insights, and chats over coffee and cupcakes have kept me going through difficult times. Thanks also to my family and other friends, near and far, for your support. Finally, special thanks to Sven for continuing support, encouragement, and reminding me of the bigger picture. Namaste.



In nature we never see anything isolated, but everything in connection with something else which is before it, beside it, under it and over it.

Johann Wolfgang von Goethe

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