Tropical Hypogeous Fungal Sporocarp Distribution in Time and Space.

Implications for an Endangered Specialist Mycophagous Marsupial, *Bettongia tropica.*

Thesis submitted by

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in November 2008

For the degree of Doctor of Philosophy

in the School of Marine and Tropical Biology

James Cook University

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ACKNOWLEDGEMENTS

I would first like to thank Earl Davis for his faithful trust in my ability to do whatever I set my mind to. Everything that I have achieved would not have been possible without this loyal support. Not to mention his efforts as THE champion truffler (yes you still collected the most truffles in one patch!). Together we can get through anything that life throws at us.

I am also very grateful to my family, Donny who we sadly miss, Vanessa and Anthony, my Mum, Dad, brothers: Rodney, Mick and Quinten, sister Marianne, along with their wonderful families, and also my friends Megan and Paul for the patient support and encouragement over the years.

My PhD journey would not have been as rewarding without fellow students/ colleagues and the best of friends sharing every step of the way; Dr Anna Koetz, Romina Rader, Kylie Brown, Jenni Paul, Kylie Anderson, Leanne Shillitoe, Dr Barbara Paulus, Sue Mathams, Carol Devney, Dr Katie Irvine, Sarah Kerr (artist extraordinaire!), Dr Petrina Johnson and Dr Luke Rapley. Thanks for the kind words of encouragement during the difficult times and for being there to celebrate my successes.

I would like to thank Dr Will Edwards, Dr Peter Franks, Prof Chris Johnson and Dr Darrell Kemp for their professional assistance with data analysis, general encouragement and good advice. Thanks also to the SMTB undergraduate students that I hope I have passed on my love of biology to, and also for reminding me of how far I have traveled.

The home stretch to the completion of my thesis also would not have been nearly as interesting without mentoring from my cheerleader (and conscience) Prof David Largent.

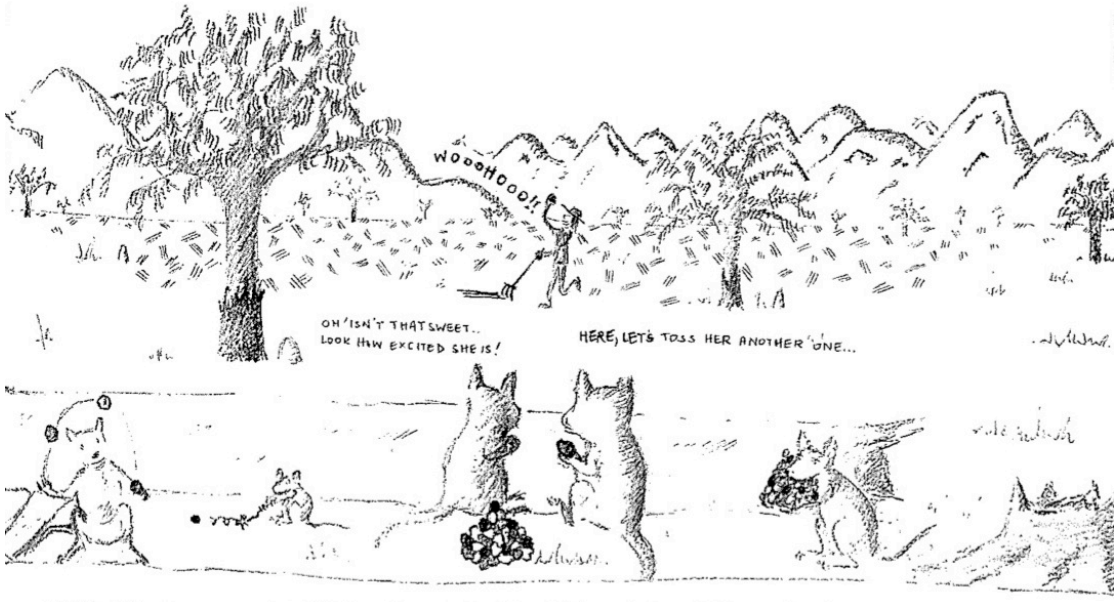
I have been fortunate to have the guidance of the perfect complement of supervisors. Thanks to Dr Ceridwen Pearce for giving me the idea for the project, for help with my pilot study field work (sorry I got you stung!) and for opening doors for me within the amazing world of mycology. Dr Bradley Congdon's ability to put everything in perspective, focus my thinking and writing has been invaluable. I can only hope to be a fraction of the incredible teacher and ecologist that he is. Prof Paul Gadek has been supporting me from the first day I enquired about completing my undergraduate degree. Thanks for believing in me and pushing me to continue with my studies further than I ever imagined I could.

Special thanks for teaching me how to truffle and for the expert taxonomic assistance and professional advice from Dr. Teresa Lebel of the Royal Botanic Gardens, Melbourne, Australia. Thanks also for the extra guidance with my truffle identifications from Prof James Trappe of the Department of Forest Science Oregon State University, Corvallis, USA and for the hospitality of Judith Curnow and Heino Lepp during my stay at the Australian National Herbarium.

This project was undertaken in collaboration with the Environmental Protection Agency Threatened Species Unit and could not have been completed without assistance from Mr Peter Latch, Dr John Winter and Dr Scott Burnett. Bettong group discussions held with Peter Latch, Sue Mathams and Brooke Bateman were simply inspiring.

Last but not least, the efforts of my many truffle hunting volunteers were greatly appreciated; Earl Davis, Anna Koetz, Sue Mathams, Romina Rader, Patricia Voigt, Zsuzsi Hegedus, Dan Murphy, Flo duc-Goninaz, Anne-marie Mckinnon, Asami Sakamoto, Barbara Paulus, Carissa Fairweather, Jenni Paul, Layla Wenitong, Lisa Derby, Lynne Jones, Silvana Spena, Zoe Baron, Sarah Walker, Bonnie Tilse, Greta Kading, Margaret Barker, Sapphire McMullan-Fisher, Brooke Bateman, Kelly Kong, Nina Babiuk, Martina Koch, Peter Siemsen, Amber Grimley, Sophia Carroll, Sue Foley, Denise Maltomini and Pamela Ortega.

Funding was provided by the Rainforest Cooperative Research Centre, Queensland Parks and Wildlife Service and the School of Marine and Tropical Biology, James Cook University, Australia. Scientific Purposes and Collection permits (WISP01562903; WITK01565603) were issued by the Environmental Protection Agency and permission to collect (ATH 06/003; 05/005; 03/043) in State forest by the Queensland Parks and Wildlife Service. This project complied with all Australian laws and standards.



THE BETTONGS WATCHED AS SANDRA SEARCHED AND SEARCHED FOR TRUFFLES...

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Thesis Chapter Three

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Mathams, S., **Abell, S.E.**, Latch, P. and Winter, J., 2009. Potential reintroduction sites for the endangered northern bettong, *Bettongia tropica*, determined by fungal and plant resource availability. Wildlife Research. manuscript in final preparation.

THESIS ABSTRACT

This thesis examines the relative importance of abiotic and biotic factors in determining the temporal and spatial distribution of tropical hypogeous fungal sporocarps along an altitude gradient of ecotonal sclerophyll forest. The implications of the fungal distribution on the habitat restriction within this ecotonal forest for an endangered specialist mycophagous marsupial, *Bettongia tropica* Wakefield, were subsequently investigated.

Fungal availability was quantified in the Early-Wet, Late-Wet, Early-Dry and Late-dry seasons within known *B. tropica* habitat in seven surveys over a period of two years. A total of eighteen sites within three vegetation types, including wet sclerophyll forest, *Allocasuarina* forest and *Eucalyptus* woodland, were examined using the time standardised raking method, in Far North Queensland, Australia.

Bettongia tropica is thought to be restricted to habitats where seasonal availability of hypogeous fungi, their principal food resource, remains high. In the first year of sampling a relationship was found between precipitation and fungal availability. The abundance of hypogeous fungi was significantly lower in the late dry season. Fungal availability correlated strongly with the seasonal rainfall pattern determined from 74-year monthly means. *Alloteropsis semialata* R.Br. (cockatoo grass) use by bettongs increased significantly during the period of low fungal availability. *Bettongia tropica* appear to be restricted to habitats where seasonal availability of hypogeous fungi, in synchrony with the availability of critical grass resources, remains high.

Temporal fruiting and availability of ectomycorrhizal hypogeous fungal species has previously been linked with both temperature and moisture (season) in temperate northern and southern hemisphere ecosystems. In contrast, the first year of data suggested that precipitation may be the sole factor influencing fruiting and diversity in tropical ecosystems. This hypothesis was tested using the data from all seven surveys. Season or temperature did not appear to be associated with fruiting of tropical hypogeous fungi. Instead, highly significant correlations between precipitation and abundance as well as biomass of sporocarps were detected. Precipitation also correlated with species richness and significantly influenced hypogeous fungal taxonomic assemblage. Availability of moisture appears to be the sole factor influencing the temporal distribution of fruiting and diversity of hypogeous fungi in this tropical ecosystem.

Spatial patterns of animal and plant diversity are used to infer mechanisms underlying community composition. Species distributions, associated with latitude and altitude gradients, are often positively correlated with moisture availability. Fungal taxonomic assemblage did not differ between the three contiguous vegetation types. Counter-intuitively, less fungal productivity occurred in one of the wettest forest types; wet sclerophyll forest. Higher sporocarp abundance and biomass were found in the *Allocasuarina* forest that had equivalent soil moisture levels. Fungal abundance and biomass appeared to be reduced by high inorganic nitrogen and phosphorous in the wet sclerophyll forest, while the effect of high nitrogen was counteracted by low phosphorous in the *Allocasuarina* forest.

The effects of soil phosphorous as well as other environmental variables on hypogeous fungal availability and richness were examined further at the micro-spatial scale of site. As predicted, negative correlations between phosphorous and fungal availability were also observed at this finer scale. However, phosphorous levels could not entirely explain the spatial patterns of fungal richness observed. Positive correlations were found for the mean number of *Allocasuarina* stems with the number of fungal genera as well as species. The most plausible explanation for the mean number of fungal species was an interactive effect between the number of *Allocasuarina* stems and a positive correlation with altitude. As well as strengthening the evidence that phosphorous levels affect the availability of hypogeous fungi, analysis at the micro-spatial scale allowed new information about fungal richness to be uncovered. An increase in host monodominance appears to increase fungal richness within this ecotonal sclerophyll forest.

These findings help to explain the habitat restriction of *B. tropica* within wetter sclerophyll habitats, increasing the temporal availability of their principal resource hypogeous fungi. The spatial distribution of fungal, as well as other important food resources, also explains *B. tropica* spatial habitat restriction within *Allocasuarina* forest and *Eucalyptus* woodland. The habitat restriction of the endangered *B. tropica* within a narrow band of ecotonal sclerophyll vegetation along the western margin of Wet Tropical rainforests in North Queensland Australia, can be attributed to the availability of their critical food resource hypogeous fungi, in both time and space.