FROM MOLECULES TO BIRD COMMUNITIES:

A MISTLETOE STORY

This thesis was submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (Veterinary Studies), Murdoch University, by:

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June 2013
DECLARATION

I declare that this thesis is my own account of my research and contains as its main content of work, which has not previously been submitted for a degree at any tertiary education institution.

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ABSTRACT

Worldwide, mistletoes act as a keystone resource, providing food (nectar, fruit and foliage) and structural (nesting sites) resources to hundreds of fauna species. 75 species of ‘showy’ Loranthaceae mistletoes are native to Australia, and are found in wooded habitats throughout the mainland. The mistletoebird (*Dicaeum hirundinaceum*) is considered the primary disperser of mistletoe fruit in south-west Western Australia (WA). Other ‘generalist’ species, including several honeyeater species and the silveryeye (*Zosterops lateralis*), also regularly consume and disperse mistletoe fruits.

This thesis takes a broad, eco-physiological approach to investigate the interactions between two Australian loranthaceous mistletoes species (*Amyema miquelii* and *A. preissii*), their host plants and their avian consumers. This was achieved through a combination of intensive field surveys and sampling at five sites where mistletoe was extremely abundant, and laboratory experiments assessing various aspects of avian digestive physiology of three frugivorous bird species; the mistletoebird (specialised frugivore), silveryeye (generalist frugivore) and singing honeyeater (*Lichenostomus virescens*; generalist nectarivore).

A stable isotope approach was used to investigate the parasitic relationship between *A. miquelii* and *A. preissii* and their eucalypt or acacia hosts (respectively). Results demonstrate that these mistletoes regulate their water use in relation to the supply of nitrogen available from the host.

Next, the importance of mistletoe to bird communities in south-west WA was investigated through surveys and the use of stable isotopes. The presence of fruiting
(but not flowering) mistletoe was associated with significant changes in bird community structure. Mistletoebirds were more likely to be recorded during months when ripe mistletoe fruit was present, and overall bird species richness was higher for these survey months. The contribution of mistletoe fruit to the diet of mistletoebirds ranged from 33% to 55%, demonstrating that despite mistletoe fruit being low in nitrogen, it is an important source of nutrients. Fruiting mistletoes therefore provide important food resources to bird communities in south-west WA.

Various aspects of avian digestive physiology were compared for three species that include mistletoe fruit in varying degrees to their diet. Mistletoebirds, silvereyes and singing honeyeaters demonstrated similar patterns of sugar preferences with similarly high (>97.5%) apparent assimilation efficiencies (AE*) for sucrose, glucose and fructose and lower AE* for the pentose monosaccharide xylose (56-78%), yet demonstrated differences in their absorption of dietary sugars. Mistletoebirds, in contrast to the other two species, did not vary bioavailability (f) with diet concentration, and appear to absorb xylose through both mediated and paracellular mechanisms. This may be a result of the short, specialised intestinal tract of mistletoebirds, which facilitates faster transit rates of mistletoe fruit compared to silvereyes and honeyeaters.

This thesis presents new insight into the parasitic relationship between mistletoes and hosts, and the relationship between mistletoes and its avian consumers. Mistletoebirds differ from other opportunistic mistletoe feeders in their ability to process large numbers of mistletoe fruit quickly, while obtaining sufficient nutrients such as nitrogen and carbohydrates from these fruits.
ACKNOWLEDGMENTS

Firstly, I’d like to thank my supervisors – Patricia Fleming, Todd McWhorter and Carlos Martínez del Río. I don’t think I could express just how much I have enjoyed working with you over the last 6+ years. Trish, you have taught me more than I would have ever thought possible – your brilliant advice, encouragement, and unbelievable dedication to your students are such an inspiration. I would not be at this stage in my research career nor have experienced such fantastic opportunities without your constant encouragement, support, patience and friendship, and I will always be grateful.

Todd, I really appreciate the encouragement, support and advice given over the long distances between Perth, Laramie and Adelaide. Your patience, kind words and knowledge freely given have helped me immensely over the years. I have dearly missed working with you in person, and hope that I may rejoin you someday in the lab.

Carlos, you gave me the opportunity of a lifetime by accepting me into your lab group at the University of Wyoming. I thank you and Martha for the support and help you gave in those first few weeks at 2184 m! Laramie and Wyoming now have a special place in my heart, and the Medicine Bow Mountains are one of my favourite places on this earth.

My deepest gratitude is also given to my sources of funding and awards, without which this research would not have been possible: the 2010 Western Australian Fulbright Scholarship and Gregory Schwartz Enrichment Grant (Australian-American Fulbright Association), the Holsworth Wildlife Research Endowment, the Stuart Leslie Bird Research Award and travel grant (Birdlife Australia and Birdlife WA), and the
Jean Gilmore Postgraduate research bursary (Federation of University Women, SA). The financial support given by Murdoch University is also very much appreciated.

Sincere thanks are also given to the staff at the Araluen Country Club and Resort, Dr Manda Page and Jo Kuiper from the Australian Wildlife Conservancy, and Peter Monger and family in York for allowing access to their field sites. I would also like to thank reviewers whose comments greatly improved previous versions of the manuscripts in Chapters 3, 5 and 6.

I would also like to thank Suzanne Mather for her assistance with bird surveys (and your willingness to get up at 4 am!), the use of your ladder, and for worrying if I would fall off the ladder. You’re an inspiration.

I would also like to thank the following people for their assistance with various aspects of my research: Tony Start (Western Australian Herbarium, Department of Environment and Conservation) for his mistletoe knowledge and comments on a draft version of Chapter 3; Simon Cherriman, for climbing trees and tagging them for me at Paruna; Joao Paulo Coimbra (University of Western Australia) for the provision of avian intestinal tissues; Clare Auckland and John McCooke (Murdoch University) for their assistance with intestinal enzyme assays; Bill Bateman for demonstrating his sensational grasshopper catching skills and assisting with mist-netting; Shannon Dundas, Tracey Moore and Penny Nice (Murdoch University) for their assistance with field work; the staff at the Murdoch University Animal House, particularly Derek Mead-Hunter, for their assistance in keeping birds in captivity; David Perry (University of Wyoming Macromolecular Analysis Core) for HPLC analysis; and the staff at the University of Wyoming Stable Isotopes Facility for being so very patient with me while
we processed hundreds of samples. Special thanks must also go to Susan Nicolson (University of Pretoria) for her advice and collaboration.

To my fellow research students in the dungeon and bat cave offices, past and present, I thank you for your friendship and support. To Penny, Tracey, Narelle, Wil, Heather, Gill, Shannon, Ivan, Chelsea, Bryony, Renata, John, Kelly, Tegan (honorary dungeon member), Buddy and Rocket (dungeon mascots) – my time at Murdoch was a truly enjoyable experience thanks to you wonderful, fantastic people (and animals). To Jon and Brenna in Laramie, I thank you for your friendship and advice, and for not laughing at me (too much) during my first bear encounter. I look forward to future collaborations!

Last, but not least, I would like to thank my family and friends for their constant support and love: to my parents, Jeff and Clarice Napier, Sandy Chaney, siblings David and Alison Napier and future brother in-law Eddie Terry, friends Brett and Lois Andrijich and Liz Snyder-Campion, and my husband Simon Aplin. Simon, your love, our adventures, and your constant support of my academic endeavours enrich my life in countless ways. I thank you from the bottom of my heart.
DISCLAIMER

This PhD thesis consists of chapters that have been prepared as stand-alone manuscripts. These manuscripts have either been accepted for publication (Chapters 3 and 5), submitted for consideration of publication (Chapter 6), or are being prepared for future submission (Chapters 2 and 4). As a consequence, there may be some repetition between chapters. To reduce unnecessary replication of references between chapters, the references are compiled together in Chapter 8.

To maintain consistency in formatting throughout the thesis, the chapters may differ slightly from the future published manuscripts.
PUBLICATIONS ARISING FROM THIS THESIS


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