What they do in the shadows: Habitat utilisation and diet of brown kiwi (*Apteryx mantelli*) adults within a high-density island population.

A thesis submitted in partial fulfilment of the requirements for the degree of

Master of Science in Ecology

Massey University, Palmerston North,

New Zealand.

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2015

"The natural world is the greatest source of excitement; the greatest source of visual beauty; the greatest source of intellectual interest. It is the greatest source of so much in life that makes life worth living."

Sir David Attenborough

Abstract

Exploring the complex interactions between an animal and its spatial environment can reveal much about its biology and behaviour and identify strategies to improve future management. Despite this, surprisingly little research has been undertaken in this field in respect to one of New Zealand's most iconic endangered species, the brown kiwi (*Apteryx mantelli*).

This thesis aims to produce the most comprehensive report to date of brown kiwi spatial behaviour, investigating the habitat utilisation of brown kiwi adults within a high-density population while they are active at night and when roosting during the day. Additionally, the study examines how habitat utilisation varies, and explores the likely drivers of brown kiwi spatial behaviour including food availability, social/reproductive cues, population demographics and environmental variables.

Forty seven radio-tagged brown kiwi adults were tracked across a 1.2km^2 study site on Ponui Island from March 2013 to February 2014. The utilisation of major habitat types (forest, scrub, pasture and swamp) by each bird was measured, plotted upon a generated habitat map, and compared to predicted rates based on habitat availability to assess habitat selection. To assess habitat selection while foraging, brown kiwi were tracked at night using radio telemetry and their positions estimated using a triangulation methodology. Exact bird locations were also recorded during the day to evaluate their roost habitat selection. Roost sites were also classified into four different types of roost (tree burrow, soil burrow, surface, swamp site). Brown kiwi faecal samples were collected over this time and compared with pitfall trap samples to analyse diet and identify spatial patterns in foraging behaviour.

As hypothesised, brown kiwi selected forest habitat most often for both foraging and roosting, also choosing the more structurally stable tree and soil burrow shelter sites. Other habitat types were utilised much less than predicted, though rates varied between seasons, gullies, demographics and behaviours. Pasture was identified as seasonally important for brown kiwi, utilised increasingly by study birds over summer and autumn when foraging. Additionally, a relationship between their spatial behaviour while foraging and while roosting was recognised for the first time, suggesting that these behaviours are not independent. Invertebrate availability was identified as the primary driver of brown kiwi spatial behaviour, with foraging behaviour trends closely matching nocturnal spatial

behaviour. Social and breeding behaviours were discussed as other potential drivers, though further research is required to fully understand these relationships. Research findings confirmed that brown kiwi have an opportunistic diet, appearing to select those invertebrate groups that provide the highest protein input more often in their diet. Foraging strategy changed between seasons and locations, likely driven by a combination of changing invertebrate lifecycles, environmental conditions and dietary requirements.

This study has improved our understanding of brown kiwi spatial behaviour, introducing new information and refining previous knowledge. The findings provide valuable information for managers as they work to conserve remaining brown kiwi populations, and will become increasingly relevant in the future as population densities begin to rise.

Acknowledgements

After almost 200 days spent in the field chasing kiwi and what feels like ten times that behind a computer or in the lab, I have finally reached the end of this great adventure! Luckily I have had people to help me every stage of the way. Firstly I need to thank my new family, the Ponui Family:

- To Isabel Castro, the mother of our group. Your supply of enthusiasm and advice is what started us up, kept us going, and helped see us home with a new qualification in tow. Thank you for your support both on and off the island, and for finding the right blend between being our kind mother and (only a little) feared supervisor. A big thank you for introducing me to the world of Kiwi.

- To my Ponui siblings – Alex Brighten, David Izquierdo, Kat Strang and Natasha Bansal, I am lucky to have found a bunch of fellow researchers with whom I get along with so well. Thank you for your companionship in the bush during the unholy hours we frequented, your advice and ideas for the study, and for being a big source of laughter and friendship. Be it poo collecting or finding birds, you all assisted me over my study, for which I am hugely grateful. I am sure we will remain close friends.

- Rounding out the family is the Chamberlin's. I have never met a finer group of people. Thank you all so much for letting us be a part of your island and your life. Dave and Ros, for this analogy to work you will have to be the Ponui Family Grandparents (apologies). Your combined font of knowledge is as unrivalled as it is freely given, and your advice was hugely appreciated throughout the study. Thank you for the time and effort spent transporting me, and ensuring I was never malnourished or lonesome. To the Chamberlin girls (our cousins), thank you for your friendship and advice. That I now consider myself part farm-boy is credit to just how much you and your parents have taught me.

To the other half of my supervisor team - Dianne Brunton, your immense brainpower, help and support during the analysis and write up period helped get me over the line. Thank you for giving up some of your much sought after time to help shape and edit this study.

Thanks also to my unofficial third supervisor – Alex Wilson. The time and energy you spent teaching me how to be an ecologist cannot be understated. Thanks also for your words of encouragement and advice throughout the study.

Thanks to Alisha Thomas, Emily Lindsay, Andrew Babbage, Matt Thomas, Jon Cope, Tracey and Chris Dixon, John and Inge Bolt and Simon and Christine Brotherton for donating some of your time to help in the field. The long days and nights spent in the bush were much brighter when you were around. I am glad you could all share in the Ponui experience. I also want to thank Emily Craig, Anne Kim, Arjane Kerkhoven, Nicki Van Zyl and Rebekah Ingrid for your help in the lab. Thanks also to Beatrix Jones, Daniel Thomas and William Ong for your help with stats, and Alisha Thomas and Aaron Harmer for proof reading drafts!

I had the pleasure of being part of both the Albany and Palmy Ecology groups during my time at Massey. Thank you to the technicians Cleland Wallace, Mark Delaney, Shaun Nielson and Tracy Harris for helping with lab equipment, invert analysis; and Sharon Wright for her tireless work behind the scenes. Huge thanks are required to my fellow postgrad students for forming such a tight knit group. The future of ecology & conservation in NZ looks bright if you lot are anything to go by. Special thanks to Jon, Jacqui, Alaine, Nicki, Lena, Emily, Jess, Luca, Viv and Wesley for your friendship over the study.

Thank you to all my friends who have put up with me constantly being away or else writing. Thanks to my parents and sisters for supporting my decisions and being there through the good and bad in this latest endeavour. I am lucky to have such fantastic family and friends.

Finally, thank you Alisha Thomas. You put up with me being away for weeks on end, every month without complaint, followed by months of write up. The fact you are so happy seeing me achieve my own dreams is just one of the reasons why I love you so much. Without you I would likely have been writing for all of time, so thank you.

This project was funded with the help of the Massey Masterate Scholarship, Lovell and Berys Clark Scholarship and the Ecology Bursary, without which the study would have been impossible. I am extremely grateful for each and every dollar.

Thank you to everyone involved for sharing in my epic adventure.

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