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

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"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.

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