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Diet overlap and potential competition between
North Island brown kiwi chicks (*Apteryx mantelli*)
and ship rats (*Rattus rattus*) for limited resources on
Ponui Island, New Zealand.



A thesis in partial fulfilment of the requirements for the degree of
Master of Science in Ecology
at Massey University, Palmerston North, New Zealand.

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2005

Abstract

The introduction of mammals to New Zealand has devastated the native avifauna. Although not the most severely affected native bird species, all five species of kiwi (*Apteryx* Spp.) have sustained a severe loss of numbers and range. Kiwi have declined on the mainland from a failure to replace their numbers due to a high mortality rate of kiwi chicks. The main reason for this mortality is predation by introduced stoats (*Mustela erminea*). Many kiwi mainland populations have predator control enabling the recruitment of chicks. However a consequence of predator removal can be an explosion of rodent populations at control sites. Rodents do not directly prey on kiwi chicks but prey on invertebrates and these rodent population explosions may affect the number of invertebrates available to other forest dwelling animals such as kiwi. The potential exists for competition between rats and kiwi chicks as both feed on soil surface and leaf-litter invertebrates. Evidence from Kapiti Island where kiwi chick recruitment was high following rat eradication supports the competition hypothesis.

The aim of the current study was to investigate the diet overlap and thus establish whether there was potential for competition for food between rats and kiwi chicks on Ponui Island in Auckland's Hauraki Gulf. Ponui Island is an ideal location for this research because there is a rat population and a high density of North Island brown kiwi, but no stoats.

Kiwi chicks were measured and weighed weekly to determine growth rates, transmitters were changed every second week. Kiwi chick faecal samples were collected weekly from radio tagged individuals and the contents compared to those from ship rat stomachs, and the invertebrates available. Kiwi chicks and ship rats overlapped in the surface dwelling invertebrate component of their diets. Pitfall traps revealed no overall difference in the number and type of invertebrates found in bush and scrub habitat but weta and spiders were more abundant in scrub than bush, this was also the preferred kiwi chick habitat and was reflected in their diet.

The only rats caught in Ponui forest habitat were ship rats (*Rattus rattus*) and their diet was established from monthly kill trapping and by examining the contents of their stomachs. Ship rats ate mostly surface and litter dwelling invertebrates of the orders

Coleoptera, Orthoptera and of the class Chilopoda. The prey they consumed closely followed environmental abundance and availability of invertebrate species. The density of ship rats was estimated by carrying out a mark-recapture experiment over three months. Ship rat densities were found to be higher than most mainland ship rat density studies previously carried out in New Zealand. But the estimated density of ship rats on Ponui was similar to estimates undertaken for ship and Norway rats (*Rattus norvegicus*) on several New Zealand offshore islands including Campbell, Motutapere and Tawhitinui Island.

The environmental abundance of invertebrates was measured with the monthly collection of pitfall traps and soil core samples in bush, scrub and farmland habitat and leaf-litter samples in bush and scrub habitat where kiwi chicks and ship rats were monitored. There was no overall difference in the number and taxa of invertebrates found in scrub and bush habitat, however there were several individual taxa differences. There were significantly higher numbers of weta and spiders caught in pitfall traps in scrub compared to bush habitat over winter, spring and summer months. Recce plots were used to describe the vegetation composition in bush and scrub habitat across the study site and assess any impact this may have had on the make up and numbers of invertebrate taxa in those different habitats. Scrub and bush habitat differed in the plant species composition, average canopy height and percentage of leaf-litter ground cover. Although this did not have a significant effect on the overall invertebrate fauna of the two habitat types there were significant differences in the numbers of several key surface and soil dwelling invertebrate prey taxa.

Kiwi chicks on Ponui Island showed little growth over the four months they were monitored; the severity of their lack of sustained growth was illustrated when compared to the growth of chicks from the Warrenheip Operation Nest Egg crèche. Of the eight kiwi chicks that hatched from the monitored population on Ponui Island only one survived more than six months. There are several possible reasons for the lack of chick development; these include kiwi chick competition for invertebrate prey with ship rats, other kiwi chicks and adult kiwi and also low invertebrate prey availability and abundance.

Chapter Summaries

The overall aim of this thesis was to look at the potential for competition between North Island brown kiwi chicks and ship rats. The thesis is divided into the different aspects of kiwi and ship rat biology that are relevant to this aim. The thesis is composed of five chapters including:

- Chapter 1 Kiwi chick diet and morphometrics
- Chapter 2 Ship rat diet and morphometrics
- Chapter 3 The density of ship rats with relevance to potential competition
- Chapter 4. The number and type of invertebrates available along with vegetation composition of different habitat types in the study site
- Chapter 5. The potential for dietary competition between kiwi chicks and ship rats. The diets of both species were compared to the environmental abundance of invertebrates, the density of both species and any potential differences in the vegetation composition of the different habitat types. Also included are recommendations and research outcomes.

As the main thesis question is broken down into its individual components there is some repetition in the text between individual chapters. The layout of this thesis enabled a detailed look at each of the components involved in potential competition on their own merits but still with reference to the original question.

Acknowledgements

I am very grateful to all my supervisors for their help. Isabel Castro who has not only been my chief supervisor but a guiding force and true friend throughout this whole project. I only called Massey to find out whether I could turn my Pg.dip into an M.Sc and 5 minutes later Isabel was convincing me that for the good of the nation and worldwide conservation I had to do this project. Not only did she convince me that the project was for me but every time she spoke to me I came away motivated and reenergised. She was always willing to come out in the field and give advice when things went pear shaped.

Jonathan Miles who taught me the joys of staying up for nights on end and of course everything I needed to know about catching, handling and putting transmitters on kiwi chicks. Thanks to Rogan Colbourne for help with everything invertebrate related to kiwi diet, without him I would have spent years looking at kiwi pooh. Thanks to Dianne Brunton for all the advice on statistics and reading the never ending thesis drafts.

A huge thank you goes to the Chamberlin Family (all of them)

Someone once said that the only wealth that you ever truly possess is that which you share; the Chamberlins are the wealthiest people I know. They went out of their way not only to make this project a reality but to make my time on Ponui more than comfortable. Firstly Dave and Roz for letting us spend time in their big backyard and for opening their home and welcoming us. I can easily say I have never experienced such generosity, always a smile and an encouraging word. Dave's ability to fix anything and everything with little more than insulation tape and Roz who soon became the resident egg candling expert. Thank you for the hot meals, TV and endless help with everything.

Thanks to Peter for not only having the foresight to get the kiwi onto Ponui in the first place but for all your help and input throughout my project. Thanks to Pat for the constant help in the field and all the 'short' walks to parts of the island I may never have seen. Louise, Megan and Michelle for showing me that ponies can swim and for sharing their incredible playground with me. Pip, Xena, Spy, Taz and Troy for all their help and crazy antics.

Thanks to my fellow students who spent time on Ponui, firstly Anna Gsell who started the project with me and sadly was not there when I finished but I have a feeling you'll be back. Thanks for all the ideas, help and general inspiration, thanks for putting up with my insanity after spending too long alone on the island. Thanks for all the good food and for being a true friend, you really showed what can be achieved through sheer determination.

Kerri Morgan AKA Chopper, cheers for the laughs and all the help with the kiwi and the *rattus maximus*, sorry about the fleas and leptos. Carryn Hojem thanks for all the help, putting up with me and for not getting upset at my complete backgammon domination and for taking some great rat photos. Thanks to Elizabeth Jones for all the help in the field. Also thanks to Susie Cunningham for looking after my children when I left.

Thanks to Lance Dew and Murphy, the closet I ever got to meeting Barry Crump. The most amazing thing I have ever seen, a simple grunt from Lance and reminiscent of 'a dog show' Murphy proceeded to round up every kiwi in the vicinity. Without your help this project would have never got under way. Possibly one of the most under-utilised kiwi minds in the country.

The Tongariro crew Mike, Cindy and Robyn for showing us newbie's how to put transmitters on kiwi and all the little tricks of the trade. Thanks also for letting me use your kiwi chick data from Warrenheip. It should also be noted that the weights and bill measurements from kiwi chicks in Warrenheip were supplied by Jonathan Miles and collected by staff from the DOC Tongariro office.

Eco for finding numerous kiwi and especially chicks when they vanished. Thanks to Darryl Olsen at Kiwi Track Ltd for all the gear and crazy gadgets.

Scott Carver for the endless digging of pitfall traps and tracking me down countless pieces of gear at Massey, Cleland for orchestrating the vegetation sampling and loads of much needed gear and Tracy Harris for sorting out gear.

Thanks to Mike Sweet for helping out with all the exciting rat trapping, clearing pitfall traps and for being a complete random quantity. James Russell for the use of gear and all the rat advice.

Troy Makan for help at the end with stats from the other side of the world and with my final presentation.

Murray Efford for help with Density, and Maurice Alley for all the pathology work

Thanks to Forest and Bird for financial support from the J.S. Watson scholarship

A huge thanks to the staff at the Massey University Library who made being a distance student easy and supplied me with all my endless requests.

My family who acted as a taxi service and general support crew for the past year, my mum for all the motivation and input, my sister Kim for enduring vast quantities of kiwi pooh in the fridge and my travelling freak show of pickled rats and invertebrates, Paul for reading my thesis drafts and questioning my general literacy and of course my grandparents who were always interested in life on the island and gave me loads of support and food.

To my close friends Tim, Blackett, Craig, Chris, Cameron, Hadleigh and James who listened to my rambles on kiwi, acted as a taxi service and a welcome distraction from my thesis induced insanity.

And to min skattepige for giving me the motivation, for making me smile and for being the driving force behind me finishing this, without you I would have been lost.

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The diet, morphometrics and habitat use of North Island brown kiwi chicks (*Apteryx mantelli*) on Ponui Island, New Zealand.

Abstract The invertebrate diet of five North Island brown kiwi chicks on Ponui Island was examined over four months by comparing partial invertebrate remains from faecal samples to a reference collection of invertebrates from the same habitat. Soil dwelling larvae were found to be an important component of kiwi chick diet when available. Over the summer months these soil dwelling larvae emerged as adults and so their availability as prey decreased. In addition, the soil began to dry and probing was most likely restricted to softer areas. This is supported by the finding of an increase in the average number of several surface dwelling invertebrates per faecal sample from individual kiwi chicks. The weight and bill growth of chicks were recorded and compared to a group of kiwi chicks raised in a predator proof enclosure (Warrenheip) as part of Operation Nest Egg. The kiwi chicks on Ponui Island were found to consistently lose weight and as a result their overall growth was much slower than those in the Operation Nest Egg enclosure. The preferential use of scrub habitat by kiwi chicks for shelter and feeding was attributed to a higher number of several taxa of surface dwelling invertebrates found there compared to bush habitat. Kiwi chick diet was found to closely follow environmental abundance and availability of invertebrates.