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An investigation of the factors regulating house mouse (*Mus musculus*) and ship rat (*Rattus rattus*) population dynamics in forest ecosystems at Lake Waikaremoana, New Zealand.

**A thesis presented in fulfilment of the requirements of the degree of
Doctor of Philosophy**

in

Ecology

at

Massey University, Palmerston North

New Zealand

Grant Leonard Blackwell

2000



Sunset in Wairau Arm, Lake Waikaremoana, New Zealand.

Photo by Pete and Judy Morrin

For Derek

General abstract

Factors regulating the eruptive population dynamics of house mice, *Mus musculus*, and ship rats, *Rattus rattus*, were investigated over 29 months in mixed forest at Lake Waikaremoana, New Zealand. Mice and rats are generally present at low density, but erupt periodically following synchronous southern beech (*Nothofagus* spp.) seeding. A range of factors proposed as important in shaping the population dynamics of these species was investigated. These included rodent diet and habitat use, and the roles of food availability and predation pressure. Changes in rodent population dynamics were investigated using three relative density estimates: footprint tracking tunnels; and two kill trapping indices. Tracking tunnels gave reliable density estimates, but were influenced by sampling effort and habitat type. Rats had an opportunistic, omnivorous diet, and had no measurable detrimental effects of stomach parasite infection. Rats were generally more common in forest with the most food, but became equally abundant in all areas following widespread synchronous tree seeding. Rats were more numerous in areas with predators removed. Mice were found in all areas following *Nothofagus* seeding. Mice became scarce as food levels dropped, suggesting that the forest habitat does not contain enough food to support them in most years. The roles of food limitation and predation in shaping rodent population dynamics were investigated initially by computer modelling. The model showed that predators could not prevent a rodent population eruption, nor limit peak prey-population density. However, predation may be important during the decline and low phases of the eruption. The predictions of the model were tested in a large-scale field experiment. Predators were removed from a 750 ha peninsula in the study area. Rodent population dynamics during an eruption were compared in large areas with and without predators present. Predators did not prevent a prey eruption or limit peak population size as predicted by the computer model. There was evidence that predators limited prey populations during the post-eruption low phase, but the role of predation during the rodent decline remains unclear. Thus, the eruptive population dynamics of mice and rats in forest ecosystems in New Zealand are driven primarily by spatial and temporal variation in food supply, with predation by a single common predator potentially important during the crash and low phases following a population eruption.

Thesis Format

The chapters of this thesis are presented in a self-contained paper format. Each chapter consists of an Abstract, Introduction, Methods, Results, Discussion, and Reference section. Inevitably, this does lead to some repetition, especially in the reference lists, but allows each section to become more focused on a specific topic, and more easily followed.

Acknowledgements

When something meanders as much as this seems to have, there is inevitably a multitude of people to acknowledge and thank; if I miss anyone out, then I humbly apologize!

First and foremost, I thank my supervisors, Dr Murray Potter and Dr Ed Minot from Massey University, and Dr John McLennan from Landcare Research, in conjunction with whose project this study was conducted. Without their continued support, advice, encouragement and humour, this project would not have been possible.

I would especially like to thank Lance Dew, Jonathan Miles and Sid Marsh from Landcare Research, and Ray Stevenson from the Department of Conservation for all their assistance and friendship at Waikaremoana. I would also like to thank Robert Waiwai and the Waikaremoana Conservation Corps for carrying a lot of junk up and down hills, Glenn Mitchell, Bruce, Richard and Julia, and Anita from DoC Aniwanuiwa for all their support, Chris Ward and Darren Peters from DoC Gisbourne for permits and advice, and members of Ngati Tuhoe and Ngati Ruapani for permission to work on their land. Thanks also to Tamsin Ward-Smith (keeping me fit carrying batteries), Pete and Judy Morrin (for photos and scones), Sue McLennan (many a coffee and meal in transit), and Graeme Franklin and Kate McNutt for assistance in the field (mind that stinging nettle Kate!).

At Massey University, I would like to thank Jens Jorgensen for all the weird and wonderful field gear (and conversations) produced, Cathy Lake for assistance sorting seed-trap samples (and stubborn printers), Ian Henderson and Alastair Robertson for statistical advice, Russell Death for help with the modelling chapter, Duncan Hedderley and Geof Jones from the statistics group for help with analysis of some of the more stubborn data, and Tony Charleston for assistance with the identification of stomach parasites. I would also like to thank Erica Reid and Jodi Matenga, for graciously answering many varied requests, and Barbara Just for assistance with all things financial.

For conversations great and small, and stories short and tall, I would like to thank the long and illustrious procession of ecology coffee drinkers; Mike Joy, Allison Hewitt and Meta, Viv Nicholls, Halema Flannagan, Jay McCartney, Kim Carter, Chris Devine, Nick Gillingham, Emma Barraclough, Penny Aspin, Isabel Castro, Matt and Kate the Aussies, Jarn Godfrey, Sara Treadgold, Rachel Standish and Tasman, Rob Davidson, and all the other assorted sorts known to haunt the place. And Adrian, who hasn't haunted the place for a while.

I would also like to thank Wayne Linklater and Elissa Cameron for their friendship and brilliant advice (most of it useful!) throughout the study and beyond. And the odd paper throwing competition.

I would like to especially thank my family; Pam, Len, Kerry (thanks for the map!) and Sally for their love, support, encouragement and food throughout the entire study. (and the odd loan of a car when the Orange Roughy got tired!)

Finally, I would like to thank Suzanne Bassett; who's smiles, good humour, encouragement (and unfailing optimism from one of us that I would finish), were there from the start until the end, and who always made life interesting 😊

The study was funded by a Massey University Doctoral Scholarship, the Massey University Graduate Research Fund, and awards from the Ecology Department Development Fund, and the Royal Society of New Zealand Young Scientists Fund.

A final no thank you to the none too clever persons unknown (or the exceedingly clever possums unknown) that repeatedly emptied pitfall traps and accidentally stood (repeatedly) on large white plastic tracking tunnels, and even larger seed traps.

But hey, enough of my yacking.

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