The effects of restoration on the structure and function of litter invertebrate communities in New Zealand native forest remnants

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Abstract

Much of New Zealand's remaining lowland forest exists as small, often degraded and heavily disturbed remnants on private farmland. Disturbances, such as livestock grazing and browsing by mammalian pests, are known to have a detrimental effect on native vegetation of these remnants. However, it is unclear what impact these disturbances have on the structure and function of forest floor invertebrate communities. Existing studies of forest fragmentation have predominantly focused on the effects of remnant area and shape, rather than remnant condition. This study examines how litter invertebrate habitat, community structure, and leaf litter decomposition, vary between grazed and ungrazed (fenced) remnants of differing size, and nearby forest reserves. Secondly, I examine how invertebrate community structure and function recover with time since livestock exclusion, with and without additional mammalian pest control.

I found that grazed remnants provide dramatically altered habitat for litter invertebrates, compared to fenced remnants and large forest reserves. Grazed remnants are typified by having higher soil compaction, minimal understorey vegetation, and reduced litter cover. Consequently, grazed remnants have depauperate, yet highly variable invertebrate communities, compared to fenced remnants and forest reserves. Even very small forest remnants can support litter invertebrate communities very similar to that of larger forest reserves, provided they are protected from livestock grazing. Furthermore, invertebrate communities show strong recovery over time since livestock exclusion, particularly when livestock exclusion is combined with mammalian pest control measures. I found that litter decomposition rates did not differ between management treatments in my first observational study. However, in the second observational study, leaf decomposition rates at the edge of remnants increased with time since livestock exclusion, suggesting that restoration actions can lead to changes in ecological functioning.

Small native forest remnants have high ecological value and substantial restoration gains can be made through the relatively simple action of fencing to exclude livestock.

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Preface

Each chapter of this thesis has been written as a stand-alone chapter. As a consequence, there is some repetition of material between chapters, particularly in the methods. Chapters 1-6 are primarily my own work, with guidance from my supervisors and external mentors, as outlined below.

My chief supervisor, Russell Death, provided guidance on methodology and study design, and advice with data analysis, manuscript development and editing for Chapters 1-6. My co-supervisor, Masha Minor, provided helpful advice on methodology and study design, and manuscript editing for Chapters 1-4.

Drs Raphael Didham (University of Western Australia, formerly at University of Canterbury, New Zealand) and Gary Barker (Landcare Research, Hamilton, New Zealand) provided advice on study design, manuscript development and editing for Chapters 5 and 6. Chapter 6 is a more detailed classification and examination of millipede communities that were collected as part of a larger study of invertebrate communities (Chapter 7). Raphael and Gary were primarily responsible for designing the original study. I made a significant contribution to the original study (outlined below), and was solely responsible for all of the laboratory identification work of the millipede specimens. Russell, Raphael, and Gary provided guidance and advice with regards to data analysis and manuscript editing of Chapter 6.

I am the third co-author of Chapter 7, which has been published in the New Zealand Journal of Zoology. Raphael Didham and Gary Barker are the first and second authors of this paper, as they were primarily responsible for designing the study, data analysis, and the writing of the manuscript. I made a significant contribution by coordinating and undertaking fieldwork, laboratory work, and data entry, and provided input on study design, manuscript preparation and editing. Lisa Denmead, Corinne Watts, and Chris Floyd are also co-authors, and made significant contributions towards study design, fieldwork, laboratory work, and manuscript development.

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