HABITAT SELECTION BY GROUND-FORAGING ROBINS IN EASTERN AUSTRALIA: SCALE DEPENDENCE AND HIERARCHICAL SELECTION.

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DECLARATION

I certify that the substance of this thesis has not already been submitted for any other degree and is not being currently submitted for any other degree.

I certify that any help received in preparing this thesis, and all sources consulted have been acknowledged in this thesis.

Jarrad Cousin

February, 2007

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A PhD degree really *is* a long and arduous voyage. They always begin by building on an idea and aiming for a destination. You climb on board and ride the waves of success and hold on in waves of despair. Occasionally you stray off course, but in the end you arrive at your destination, and even though it is not quite where you expected to be, it is still a fascinating and inspiring feeling to be there. The journey, as much as it is defined by its destination, is complemented with an enormous set of resources and support crew, without whom the voyage could never have been achieved!

Travelling across the Nullarbor from Perth to Armidale in April of 2003 was a difficult decision. Not only was this transition a hard one personally, but also professionally. Differences in variety of species, topography, species interactions, species ecology, vegetation, landscape morphology, landscape management and climate are just *some* of the factors that I needed to grasp, incorporate and overcome before commencing my PhD. However, these and other challenges I faced were made all that much easier by the friends and colleagues I made while in Armidale.

Firstly, I need to thank my two principal supervisors, Professor Hugh Ford and Dr Veronica Doerr, for all of their inspiration, support and guidance that they provided me, and continue to provide me. Hugh was the initial catalyst for my move to Armidale, with a rich history in woodland bird ecology and conservation fueling the interest I developed during my Masters. Veronica became my supervisor following my research proposal seminar, where my passion for all

things 'robins' saw me propose to research *everything* from fluctuating asymmetry of robins in various sized and quality remnants, to writing a review paper on the Petroicidae!! One of her many comments following that afternoon proposal seminar went along the lines of "...a PhD is a three-year degree. What you have proposed to do in that time represents a career." Without her expertise in avian ecology and patience with me in regards to statistics, I would not be in the same calm state of mind that I am today. Thank you to the University of New England, who provided financial support in the form of a University of New England Research Assistantship (UNERA) scholarship, and the provision of the Grant Initiative Scheme Research Encouragement Award, which provided funding for me to attend and present a spoken paper at the 2005 Australasian Ornithological Conference in New Zealand. Associate Professor Andrew Bennett (Deakin University), Dr Mark Whittingham (Newcastle University, UK) and Dr Richard Major (Australian Museum) not only provided valuable comments in the process of examining the thesis, but also provided constructive suggestions when preparing for publication, for which I am most appreciative.

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ABSTRACT

Throughout the world, the continued clearing and subsequent fragmentation of native vegetation has resulted in an unprecedented loss of biodiversity. While some species adapt to such habitat change, many others respond unfavorably; declining in distribution and abundance. To understand reasons for this response in such species requires an understanding of the processes governing habitat selection, which operate at multiple spatial and temporal scales. In birds, habitat selection is generally assumed to be hierarchical in nature. An inevitable consequence of such a hierarchical structure is that habitat selection at a given spatial scale is constrained by habitat selection at other spatial scales. Unfortunately, habitat selection studies are often limited in spatial scope, focusing on management units operating at the landscape scale. The problem with this approach is that it assumes a 'top-down' model of habitat selection, and focuses on species responses at the coarsest spatial scales (e.g., landscape and remnant scale), while underestimating the importance of responses at fine spatial scales (e.g., foraging microhabitat). Furthermore, it also underestimates the potential for fine scale selection to constrain selection at coarser spatial scales, represented by a 'bottom-up' model of habitat selection.

In the present study, I examined habitat selection at four spatial scales in two species of sedentary, ground-foraging birds in northern New South Wales; the Eastern Yellow Robin (*Eopsaltria australis*) and the Scarlet Robin (*Petroica multicolor*). I assessed habitat selection in the two species at the foraging microplot scale (pounce site, 0.3 m x 0.3 m), foraging mesoplot scale (foraging

area surrounding pounce site, 5 m x 5 m), territory scale (represented by 100 m x 5 m transects), and landscape scale (10 km x 10 km). In addition, in an attempt to provide information that might explain why particular foraging microhabitat was selected by the two species, I also investigated the association of microhabitat structure with the abundance of the invertebrate orders that constitute the majority of the robins' diet.

Both species selected their foraging microplot and mesoplot on the basis of habitat attributes that probably maximise the detectability of invertebrates at the microplot scale, rather than selecting foraging microhabitat with specific invertebrate prey. They selected areas with a greater cover of leaf litter, logs and canopy and a reduced cover of plant material which probably allowed greater detectability and chance of capture of epigeic prey. Eastern Yellow Robins selected sites at the mesoplot and territory scales with a greater density of sapling trees, subcanopy trees and a greater density of shrubs at the territory scale. This reflects the important roles that these habitat structural attributes also potentially play in maximising detectability and capture of epigeic invertebrate prey, by providing perches from which robins can search and pounce onto prey. Landscape scale occupancy by Eastern Yellow Robins was governed by selection of remnants with lower perimeter to area ratios, and thus a reduced amount of edge habitat. Edge habitat is typically characterised by reduced tree and shrub recruitment, a reduced cover of leaf litter and logs, and an elevated cover of ground plants and weeds; habitat attributes that are in direct contrast to those selected for by Eastern Yellow Robins at the scale of foraging sites. Selection at the landscape scale is thus potentially constrained

by habitat attributes selected for at the foraging microhabitat and territory scales, suggesting a potential 'bottom-up' model of habitat selection.

While Scarlet Robins are also predominantly ground-foraging, they occupy different habitat from Eastern Yellow Robins and also forage in other habitat strata, so they selected the same microplot habitat characteristics as Eastern Yellow Robins but preferred different habitat attributes at the mesoplot scale. At both mesoplot and territory scales, Scarlet Robins selected sites with a greater cover of leaf litter, and at the mesoplot scale they selected sites with a reduced density of shrubs. These choices allow a greater chance of detection and capture of epigeic invertebrate prey by the Scarlet Robin. At the landscape scale, Scarlet Robins tended to occupy larger remnants. Given that small remnants are usually characterised by degraded habitat (especially the ground substrate), selection for leaf litter at the foraging microplot, foraging mesoplot and territory scale may effectively constrain occupation of remnants at the landscape scale, also suggesting a potential 'bottom-up' model of habitat selection.

I suggest hierarchical habitat selection in the Eastern Yellow Robin and Scarlet Robin potentially operates in a 'bottom-up' manner. Both species select their foraging microhabitat first, in order to maximise detectability of epigeic invertebrates at the microplot scale. This then constrains their habitat selection at coarser spatial scales (e.g., territory and landscape). There are very few examples of ecologists suggesting a 'bottom-up' model of hierarchical habitat selection in the published literature, and species and landscape management plans (e.g., regional plans, catchment management plans etc) are usually

based on 'manageable scales' such as the regional or landscape scale. If hierarchical habitat selection in resident woodland birds is governed by 'bottom-up' processes, management at coarser spatial scales needs to consider the role of finer spatial scale information in constraining such coarse spatial scale selection. Even when coarse spatial scale data is not obviously associated with finer spatial scale attributes (e.g., area-sensitivity of Scarlet Robins), ignoring finer spatial scale information could lead to misinterpretation of the factors governing such coarse spatial scale habitat selection, and less than optimal management of the species.

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