The Effects of Habitat Fragmentation on Bird Communities in a Naturally Disturbed Environment: the Wet Tropics Lowlands

Thesis submitted by

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B.App.Sci. (Hons).

In December 2005

for the degree of Doctor of Philosophy in the
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Acknowledgments

It is never an easy road to completion of a PhD thesis, and this of course is no exception. A number of people have provided help along this interesting and challenging path.

Firstly, my supervisors, Richard Pearson and Adam Lewis, have provided great support over the years. Adam provided much assistance with the development of the spatial components of the thesis, while Richard's vast ecological knowledge was invaluable as this project evolved. In particular, Richard was prompt, patient, and encouraging in dealing with numerous drafts of chapters.

Thanks should also go to Steve Delean and Glenn D'eath for their sampling and statistical advice during the formative stages of this project, and the landholders of the Innisfail region who, perhaps contrary to my expectations, were almost without fail happy to have a student spend days or weeks tramping around their properties 'chasing birds'. In particular, Murray Broad, Garth Wolsey and the folks at Paronella Park were kind enough to provide accommodation for myself and my volunteers, and my field assistants, (Sue, Matt, Dan, Sarah, and Ameer) provided great assistance and, importantly, good cheer, while doing long hours of work in some rather hot, humid, mosquito-ridden places.

The folks in TESAG have been extremely supportive (and patient) over the years, and my office neighbour Scott Smithers gets a gets a gong for his (not so) gentle good humour and encouragement to keep things in perspective.

Final thanks should go to my family, Brendan, Geraldine, Chris and Ben. Their love, encouragement, support and advice can never be underestimated.
And of course, to Nanou.

Abstract

This project examined the effects of habitat fragmentation on bird assemblages in the Wet Tropics Lowlands. I quantified both landscape and vegetation patterns in the study area, described the bird assemblages, examined the effects of edges on the vegetation and avifauna, and analysed the response of the avifauna to the spatial and vegetation characteristics of fragments. Particular emphasis was given to comparisons between these responses and those of other tropical avifaunas to develop general theory, as the rules that apply in species-rich locations may not apply in highly disturbed, relatively depauperate areas such as the lowlands of northern Queensland.

Fine scale vegetation layers along a 70 km long stretch of the Wet Tropics lowlands were created, and from these, landscape indices were calculated to quantify the landscape at patch and landscape scales. Thirty fragments and three locations in continuous rainforest were sampled for vegetation structural attributes and bird assemblages using standard line transects at different distances from patch edges.

This region of the lowlands is very heavily fragmented by farming, with only 6.8% forest cover remaining, and most clearing in the region has occurred on alluvial and basalt soils with a slope less than 8°. Vegetation grouped broadly into two major types: complex mesophyll vine forest (with strong cyclone disturbance evident) in the south, and mixed forest in the north. Regression tree analyses suggested that while rainfall strongly influences rainforest structure in a non-linear fashion, differences among drier sites were mainly due to landform while the wetter sites were more influenced by altitude, most likely due to drainage factors. These differences occurred at a larger (landscape) scale rather than at the transect level, except for subtle edge effects. Through ordination, the 27 vegetation variables were reduced to three summary variables that explained 91% of the variation among the sites for later analyses.

Overall bird richness (102 species), while low compared to that of most tropical rainforests worldwide, is richer than most upland areas of the Wet Tropics due to greater numbers of open-country species in and around rainforest edges. However, the study area is particularly depauperate in both habitat specialists and feeding specialists compared to upland rainforests in northern Queensland. This is probably due to extinctions during historical rainforest contractions, the distance from source areas such as Papua New Guinea, and the high rates of natural disturbance in the lowlands (favouring more resilient generalists). Bird assemblages in mixed forest differed from those in mesophyll rainforest in having more habitat generalists and

fewer rainforest specialists and, among species found in unfragmented forest, rarer species were less able to persist in habitat fragments than more common species.

Surprisingly, no differences in canopy connectedness, foliage density or heterogeneity were evident between edge zones and interiors, which were probably due to the severe canopy damage from cyclones across rainforests in the study area rather than just around rainforest edges. Edge zones did, however, contain greater numbers of stems, shrubs, and in particular *Lantana camera*, but fewer ground ferns, mosses, and climbing palms. The microclimate changes leading to this gradient are probably caused by outside conditions permeating horizontally from the edge, rather than by secondary effects of canopy damage.

Total bird richness and abundance did not significantly differ between forest edges and interiors (unlike most other tropical rainforest studies), possibly reflecting the lack of structural vegetation contrast between edges and interiors, the open-country species that utilise the edge, and the generalist nature of the lowland rainforest community. Among guilds, however, some differences were apparent, with greater numbers of open-country species recorded at edges and rainforest specialists tending to favour patch interiors. Edges contained greater densities of frugivores, gramnivores, and nectarivores, whereas interiors contained higher densities of obligate insectivores and understorey species. Except for total richness and abundance, these patterns reflect those from other regions, but to a lesser degree, possibly due to the less diverse and specialised local species pool and to the regular disturbance to this area by cyclones, which appears to limit the strength and extent of microclimate gradients.

The major determinants of assemblage structure in isolates were a combination of patch (patch area) and landscape (proportion of rainforest within 1 km) variables. The degree of canopy connectivity, which is largely influenced by cyclone disturbance, also contributed (to a lesser extent) to assemblage structure. At a guild level, open-country species were minimally affected by landscape or patch characteristics, whereas species found in wide ranges of habitats were influenced by both patch and landscape variables. Rainforest specialists, on the other hand, were influenced solely by patch-level variables, including the degree of canopy closure. Of the feeding guilds, only the obligate gramnivores were less species-rich in larger fragments, because this guild comprised entirely open-country species and were concentrated along edges. These avian responses to patch and landscape characteristics are weaker than those of most other tropical assemblages, with smaller patches maintaining a relatively high proportion of species. This is probably due again to the low diversity and specialisation within this avifauna. In effect, those species that would be the most vulnerable to human-induced habitat loss would have already disappeared from previous natural disturbance.

In the Wet Tropics, Pleistocene climate fluctuations causing rainforest contractions to small refugia have led to a relatively depauperate and generalist avifauna, which is in turn more robust in the face of a range of anthropogenic disturbances. Hence, regional disturbances have influenced not only the composition of the lowland avifauna, but also the characteristics that make this bird assemblage more resistant to habitat fragmentation at the landscape scale. This study therefore provides an example of one type of change filtering out those species that are vulnerable to quite different human disturbances at different spatial and temporal scales.

Some areas of the Wet Tropics lowlands are still threatened by residential, agricultural, and tourism development, and this study has shown that bird assemblages suffer negative consequences from the fragmentation of remaining habitat. However, this avifauna is more resilient than those from diverse regions, so smaller, isolated patches may be of greater conservation value (with regard to the bird assemblage) than might be the case in other regions where assemblages are more diverse and, importantly, species are more specialised.

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