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

Thesis submitted by

**James McLellan MOLONEY
B.App.Sci. (Hons).**

In December 2005

**for the degree of Doctor of Philosophy in the
School of Tropical Environment Studies and Geography,
James Cook University of North Queensland.**

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Date

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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.

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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, granivores, 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 granivores 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.

Table of Contents

STATEMENT OF ACCESS	ii
DECLARATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT.....	v
TABLE OF CONTENTS.....	viii
List of Figures	xii
List of Tables	xiv
Chapter 1. General introduction.....	1
1.1 Rainforest conservation.....	1
1.2 Habitat fragmentation.....	2
1.3 Natural versus human disturbance.....	4
1.4 Diversity and community stability.....	6
1.5 Aims.....	7
1.6 Thesis outline.....	8
Chapter 2. Study Area.....	10
2.1 Wet Tropics biogeographic region overview.....	10
2.2 Study area.....	12
2.3 Geology and soils.....	14
2.4 Climate.....	16
2.5 Vegetation.....	18
2.6 Disturbance.....	20
2.7 Site Selection and Sampling Design.....	24
2.8 Subregion characteristics.....	26
Chapter 3: Spatial patterns in the study region: regional, subregional and site characteristics.....	31
3.1 Introduction.....	31
3.2 Spatial measures as applied to faunal assemblages in landscapes.....	32
<i>Introduction to landscape metrics</i>	32
<i>Area measures</i>	34
<i>Isolation measures</i>	35
<i>Edge effects</i>	36
<i>Conclusion</i>	38
3.3 Methods.....	39
3.3.1 Habitat coverages.....	39
<i>Coarse-scale coverage</i>	39
<i>Fine-scale coverage</i>	39
3.3.2 Calculation of spatial measures.....	42
<i>Patch area</i>	42

<i>Isolation measures</i>	42
<i>Edge measures</i>	44
<i>Core area measures</i>	46
3.3.3 Relationships between spatial measures.....	46
3.3.4 Patterns of clearing with respect to environmental variables.....	47
<i>Geology</i>	47
<i>Slope</i>	47
<i>Altitude</i>	48
<i>Modelling clearance patterns</i>	49
3.4 Results.....	49
3.4.1 Landscape fragmentation patterns.....	49
3.4.2 Landscape patterns among the sites.....	50
3.4.3 Relationships between spatial measures, and variable reduction.....	51
3.4.4 Patterns of clearing with respect to environmental variables.....	53
<i>Geology</i>	53
<i>Topography</i>	54
<i>Predictors of landscape clearing</i>	54
3.5 Discussion.....	55
<i>Landscape fragmentation patterns</i>	55
<i>Landscape variables and site descriptions</i>	56
<i>Methodological issues and limitations</i>	58
<i>Practical applications</i>	59

Chapter 4. Vegetation structure in lowland rainforest patches..... 60

4.1. Introduction.....	60
<i>Rainforest vegetation and bird assemblages</i>	60
<i>Environmental determinants of rainforest structure</i>	61
4.2 Methods.....	63
<i>Vegetation sampling</i>	63
<i>Environmental Variables</i>	65
<i>Data Analysis</i>	66
4.3 Results.....	68
<i>General characteristics</i>	68
<i>Vegetation similarities and characteristics at the transect and site levels</i>	69
<i>Structural heterogeneity</i>	78
4.4 Discussion.....	80
<i>General characteristics</i>	80
<i>Vegetation similarities and characteristics at the site and transect levels</i>	81
<i>Environmental variables</i>	81
<i>Variable reduction</i>	83
<i>Structural heterogeneity and sub-transect (point) patterns</i>	83
<i>Conclusions</i>	84

Chapter 5: Characteristics of the lowland bird assemblage..... 85

5.1 Introduction.....	85
<i>The lowland avifauna</i>	85
<i>Density and extinction vulnerability</i>	87
<i>Aims</i>	88
5.2. Methods.....	88
<i>Bird Counts</i>	88
<i>Guild Delineation</i>	92
<i>Abundance and richness calculation</i>	92

<i>Mesophyll rainforest versus mixed forest assemblages</i>	93
<i>Natural density and patch occupancy</i>	94
5.3. Results.....	94
<i>Overall Richness and Abundance</i>	94
<i>Species Abundance and Prevalence</i>	95
<i>Habitat and Functional Guild Summaries</i>	96
<i>Mesophyll rainforest and mixed forest assemblages</i>	97
<i>Natural density and patch occupancy</i>	102
5.4: Discussion.....	104
<i>Sampling issues</i>	104
<i>Upland and introduced species</i>	105
<i>Overall Richness and Abundance</i>	107
<i>Species abundance and rarity</i>	109
<i>Guild structure</i>	109
<i>Mesophyll rainforest versus mixed forest assemblages</i>	112

Chapter 6. Edge effects..... 114

6.1. Introduction.....	114
<i>Aims</i>	116
6.2 Methods.....	117
<i>Vegetation</i>	117
<i>Bird abundance and richness</i>	117
<i>Bird assemblage responses</i>	119
6.3 Results.....	120
<i>Vegetation</i>	120
<i>Bird richness and abundance</i>	123
<i>Assemblage responses</i>	126
6.4 Discussion.....	127
<i>Vegetation</i>	127
<i>Bird richness and abundance</i>	129
<i>Assemblage responses</i>	131
<i>Conclusions</i>	134

Chapter 7. Determinants of bird assemblage diversity and composition..... 135

7.1 Introduction.....	135
7.2 Methods.....	139
<i>Study sites</i>	139
<i>Independent variables</i>	139
<i>Bird richness and abundance</i>	141
<i>Analyses</i>	142
7.3 Results.....	143
<i>Assemblage responses</i>	143
<i>Guild responses</i>	149
<i>Individual species' responses</i>	151
7.4 Discussion.....	152
<i>Species/area and density/area patterns</i>	152
<i>Assemblage responses</i>	154
<i>Guild responses</i>	156
<i>Data issues</i>	158
<i>Conservation implications</i>	159

Chapter 8. Summary and General Discussion.....	161
8.1 Introduction.....	161
8.2 Major findings.....	161
<i>Spatial characteristics and vegetation of the study region.....</i>	<i>161</i>
<i>Bird assemblages of the region.....</i>	<i>162</i>
<i>Effects of edges.....</i>	<i>164</i>
<i>Determinants of bird assemblages.....</i>	<i>165</i>
8.3 Influence of natural disturbance.....	166
8.4 Diversity and stability.....	168
8.5 Conservation implications and concluding remarks.....	169

List of Figures

Figure 1.1 Conceptual flow chart of the relationship between natural and anthropogenic disturbance in Wet Tropics lowland forests.....	6
Figure 1.2 Thesis chapter structure.....	8
Figure 2.1 Location of the Wet Tropics biogeographic region (darker green) in Queensland.....	10
Figure 2.2 Original and standing (circa 1983) areas of rainforest in the Townsville to Cooktown region (adapted from Winter <i>et al.</i> 1987).....	11
Figure 2.3 Location of the study area in the coastal lowlands of north-eastern Queensland, showing the current distribution of forest, and the locations of Sites.....	13
Figure 2.4 Underlying geology of the study area. Study sites are represented as points.....	14
Figure 2.5 Mean driest quarter rainfall (mm) in the study area. Study site locations are indicated as points. Rainfall comes from interpolation from recordings at a series of locations throughout the region from 70 years of records (from Turton <i>et al.</i> 1999).....	17
Figure 2.6 Mesophyll vine forest near Babinda (Site 32).....	19
Figure 2.7 Mixed forest with a rainforest understorey and <i>Eucalyptus</i> spp. and <i>Acacia</i> spp. emergents near Gordonvale (Site 4), in the north of the study area.....	20
Figure 2.8 Mesophyll vine forest near Babinda (Site 32) showing the canopy gaps that are characteristic of much of this section of the Wet Tropics Lowlands.....	22
Figure 2.9 Mesophyll vine forest near Babinda (Site 32). Thick tangles of <i>Calamus</i> spp. are clearly evident in the understorey.....	22
Figure 2.10 Map of study region with subregions identified.....	27
Figure 2.11 Distribution of forest in the Gordonvale subregion (A), with sites identified in red.....	27
Figure 2.12 Distribution of forest in the Deeral subregion (B), with sites identified.....	28
Figure 2.13 Distribution of forest in the Garradunga subregion (C), with sites identified....	28
Figure 2.14 Distribution of forest in the Palmerston subregion (D), with sites identified.....	29
Figure 2.15 Distribution of forest in the Innisfail subregion (E), with sites identified.....	30
Figure 3.1 Schematic diagram of the relationship of shape to core area, where core area (stippled area) is defined by the same fixed distance from the edge, in each case.....	37
Figure 3.2 Flow chart of the development of the GIS coverages used in the spatial analysis.....	40
Figure 3.3 Flowchart summarising the steps involved in calculating the proportion of rainforest cover within differing radii of study sites.....	43
Figure 3.4 Site 4 pre- and post-conversion from raster grid to vector shape file.....	44
Figure 3.5 Scatterplot of the proportion of area forested as a function of slope.....	54
Figure 4.1 Non-metric Multidimensional Scaling plot of vegetation at all transects (n=137) based on all vegetation variables. K-means Classification groups are identified by symbols, and variables are standardized by maximum (0-1).....	70
Figure 4.2 Regression tree analysis of Axis 1 of the Non-Metric Scaling of all vegetation variables over all transects. Explanatory variables were altitude, landform, slope, soil nutrient status, mean driest quarter, drainage, northness and eastness.....	72

Figure 4.3 Numeric and categorical environmental variables responsible for regression tree splits, and their relationships to NMDS Axis 1 scores.....	74
Figure 4.4 Non-metric Multidimensional Scaling plot of vegetation at all sites (n=33) based on all vegetation variables. K-means Classification groups are identified by symbol, and variables are standardized by maximum (0-1).....	75
Figure 4.5 Regression tree analysis of Axis 1 of the Non-Metric Multidimensional Scaling of all vegetation variables over all sites. Explanatory variables chosen in the model are altitude, landform, slope, soil nutrient status, mean driest quarter, drainage, and two derived aspect variables (northness and eastness).....	76
Figure 4.6 Non-metric Multidimensional Scaling plot of vegetation at all mesophyll rainforest sites (n=27) based on all vegetation variables. K-means Classification groups are identified by symbol, and variables are standardized by maximum (0-1).....	77
Figure 5.1 Bird species accumulation curves for sites containing (a) two transects; (b) three transects; (c) four transects; and (d) six transects. Curves have been smoothed by subsampling.....	91
Figure 5.2 Frequency of bird species by numbers of occupied sites.....	95
Figure 5.3 Ordination biplot depicting two axes of the DCA (detrended correspondence analysis) of total bird presence/absence among sites. C = Unfragmented (control) sites.....	98
Figure 5.4 Ordination biplot depicting the two major axes of DCAs of (a) bird abundance per transect, and (b) bird presence/absence per transect, among unfragmented (control) sites.....	99
Figure 5.5 Numbers of patches occupied by rare and common species within continuous habitat.....	102
Figure 6.1 Structural vegetation measures as a function of location within mesophyll rainforest patches (Mean \pm 95% CI). a) Number of stems, b) Relative abundance of ground ferns, c) Relative abundance of shrubs, d) Relative abundance of moss, e) Relative abundance of pandans, f) Relative abundance of Calamus spp., g) Relative abundance of Lantana camera, h) Relative abundance of growth forms associated with cool, dark microclimates.....	122
Figure 6.2 Scatterplot showing multivariate dissimilarity as a function of fragment area. Sites are identified by edge architecture, and regression coefficients are displayed.....	126
Figure 6.3 Mean dissimilarity from control sites of bird assemblages at edges and bird assemblages in interiors, in a) mesophyll rainforest, and b) mixed forest.....	127
Figure 7.1 Ordination biplot depicting the first two axes of the DCA of total bird presence/absence among rainforest sites.....	144
Figure 7.2 Bird species distributions in relation to site characteristics. CCA ordination diagram with species identified by code (Appendix 5). Environmental variables are identified by vector.....	145
Figure 7.3 Ordination biplot depicting the first two axes of the DCA of total bird abundance among rainforest sites.....	147
Figure 7.4 Bird species abundance in relation to site characteristics. CCA ordination diagram with species identified by code. Environmental variables are identified by vector.....	148
Figure 7.5 Species-area relationships for birds in lowland (the present study) and upland (Warburton 1987) fragments in northern Queensland.....	154

List of Tables

Table 2.1 Number of sites in each geology/soil combination.....	15
Table 2.2 Approximate areas of vegetation types within the study area (bounded by the 300m contour).....	19
Table 2.3 Summary of numbers of transects at each site in relation to the size range of sites.....	25
Table 3.1 Summary of spatial measures.....	46
Table 3.2 Summary of fragments of rainforest remaining within each subregion. Measures include all remaining fragments (≥ 0.4 ha) within the cleared areas, and omit major unfragmented rainforest blocks (>1000 ha).....	50
Table 3.3 Summary statistics of patch sites (n=30).....	51
Table 3.4 Spearman rank coefficient matrix of r values for spatial variables for all study patches (n = 30).	52
Table 3.5 Spatial characteristics of landscapes on different geologies.....	53
Table 3.6 Logistic regression predicting habitat clearance in the Wet Tropics lowlands (<300m elevation) as a function of slope, geology, elevation and rainfall.....	55
Table 4.1 Summary of vegetation structural variables used in the overall classification and ordination of transects and patches.....	64
Table 4.2 Environmental variables within the study area.....	65
Table 4.3 Variables used in Principal Components Analyses to derive measures of heterogeneity at the transect and the site level.....	68
Table 4.4 Summary statistics of structural vegetation variables.....	69
Table 4.5 Spearman correlation coefficients between the three vegetation ordination axes (gradients) from the NMDS and the included vegetation components for all transects (n=137).....	71
Table 4.6 Spearman correlation coefficients between the two vegetation ordination axes (gradients) from the Non-Metric Multidimensional Scaling and the included vegetation components for all sites (n=33).....	76
Table 4.7 Spearman correlation coefficients between the three vegetation ordination axes (gradients) from the Non-Metric Multidimensional Scaling and the included vegetation components for mesophyll rainforest sites (n=27).....	78
Table 4.8 Spearman rank coefficients of heterogeneity measures against patch area and core area measures.....	79
Table 5.1 Richness and abundance of birds over all sampling periods.....	94
Table 5.2 Prevalence and abundance of birds grouped by habitat guild.....	96
Table 5.3 Prevalence and abundance by birds grouped by feeding guild.....	97
Table 5.4 Significant indicator value results for bird species within mesophyll vine forest and mixed forest as per Dufrene & Legendre (1997), based on presence/absence.....	98
Table 5.5 Mean abundances of birds grouped by habitat and feeding guilds/ha within continuous sites in mesophyll and mixed forest. Means compared using t-tests.....	100
Table 5.6 Mean richness of birds grouped by guilds per transect (0.5 ha) within continuous sites in mesophyll rainforest and mixed forest. Means are compared using t-tests.....	101

Table 5.7 Mean abundances of individual species (/ha) within continuous sites in mesophyll rainforest and mixed forest. Means are compared using Mann-Whitney U-tests.....	101
Table 6.1 Vegetation structural measures at edges and within interiors of rainforest and mixed forest, respectively. Columns represent mean ± SE, and p-values of Mann-Whitney U tests.....	121
Table 6.2 Vegetation complexity and heterogeneity measures at edges and within interiors of rainforest and mixed forest. Columns represent mean ± SE, and p-values of Mann-Whitney U tests.....	123
Table 6.3 Densities of different guilds at patch edges and interiors on a patch-by-patch basis. Comparison is by Wilcoxon sign-rank test (n = 22).....	124
Table 6.4 Densities of different species at patch edges and interiors on a patch-by-patch basis. Comparison is by Wilcoxon sign-rank test (n = 22).....	124
Table 6.5 Preference of different guilds (measured as richness) for patch edges and interiors on a patch-by-patch basis. Comparison is by Wilcoxon sign-rank test (n = 22).....	125
Table 6.6 Results of stepwise multiple regressions of relative species abundance and richness at patch edges (with respect to values in patch interiors) on spatial and vegetation variables.....	126
Table 6.7 Results of stepwise multiple regression of mean dissimilarity of bird assemblages at patch edges from corresponding patch interiors.....	126
Table 7.1 Spearman rank coefficient matrix for all final spatial variables for all patches (n = 27). P=.05 where r = 0.39.....	140
Table 7.2 Pearson correlations of patch variables with DCA Ordination Axes. The strongest correlations with each axis are shown in bold face. N= 27.....	144
Table 7.3 Eigenvalues, variance in species data, and variance in species-environment correlations for the Canonical Correspondence Analysis of bird presence/absence against environmental variables. The p-values from the Monte Carlo tests are indicated in brackets. The intraset correlations of environmental variables with the first three axes of the CCA are also included.....	146
Table 7.4 Pearson Correlations with Ordination Axes. The strongest correlations with each axis are shown in bold face. N= 27.....	147
Table 7.5 Eigenvalues, variance in species data, and variance in species-environment correlations for the Canonical Correspondence Analysis of bird abundance against environmental variables. The p-values from the Monte Carlo tests are indicated in brackets. The intraset correlations of environmental variables with the first three axes of the CCA are also included.....	148
Table 7.6 Species richness responses of the bird assemblage and of habitat and feeding guilds. Guilds were tested with stepwise multiple regression.....	149
Table 7.7 Species abundance responses of the bird assemblage and of habitat and feeding guilds. Guilds were tested with stepwise multiple regression, and models were accepted at $P \leq 0.05$. Habitat guilds as in Table 7.6.....	150
Table 7.8 Spearman rank correlations between species density per patch and patch area. Only species with correlations with $P < 0.1$ are listed. Habitat guilds as in Table 7.6....	151