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JAMES COOK UNIVERSITY AUSTRALIA

Spatial Patterns of Vertebrate Biodiversity and Assemblage Structure in the Rainforests of the Australian Wet Tropics

Stephen E. Williams B. Sc. (Hons.)

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Submitted for the degree of Doctor of Philosophy
in the Department of Zoology and Tropical Ecology,
Cooperative Research Centre for Tropical Rainforest Ecology and Management
and the Department of Tropical Environmental Studies and Geography,
James Cook University of North Queensland
Townsville, Qld 4811
Australia

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Abstract

This study examined the spatial patterns of vertebrate biodiversity, with an emphasis on mammals, in the Australian Wet Tropics biogeographic region over a range of spatial scales. Regional patterns of diversity were described on the basis of a review and collation of all available data on vertebrate distributions. The highest species diversity of vertebrates was found in sclerophyll habitats (approximately 388 species). Rainforest was considerably less species-rich with about 259 vertebrate species; however, regional endemism was much higher in rainforest (25%) than in the combined sclerophyll habitats (4%). Although there was no consistent latitudinal or altitudinal cline in diversity, there was a consistent turnover in the assemblage composition of vertebrates, both altitudinally and latitudinally. Habitat diversity at the landscape scale was consistently important in explaining the variance in patterns of species richness.

The number of regionally endemic species of vertebrates and the proportion of regional endemics present in each sub-region were both related to the geographic shape and area of sub-regional patches of rainforest. Shape had a more significant influence on regional endemism than area, while area had a stronger influence on species richness. These patterns were similar for all terrestrial vertebrate classes.

Mammal assemblages were examined in more detail: multivariate analyses suggested five different geographically separated rainforest mammal assemblages. The most diverse was found in the central uplands (Atherton Tableland) with a decrease in diversity to the north and south, and with decreasing altitude. The most diverse areas were characterised by large areas of rainforest with a rounder shape (low shape index), high annual rainfall, consistent rainfall in the dry season and a diversity of rainfall regimes.

The combination of rainforest area and shape explained most of the variance (r^2 = 0.74) in the patterns of species richness of rainforest mammals. Various measures of habitat diversity were also dependent on area, and a similar degree of the variance in species richness (r^2 = 0.78) was explained by using rainforest shape and habitat

diversity variables (rainfall and vegetation diversity) and excluding area. This suggests that the effect of area on the patterns of species richness was primarily due to its positive influence on habitat heterogeneity. Analysis of the mammalian guild structure indicated that it was the number of species within guilds that most strongly affected patterns of species richness, although the number of guilds also had an effect. Most of the variance in species richness could be attributed to three guilds: arboreal folivores, small scansorial and small scansorial folivore-omnivores .

The results suggest that habitat heterogeneity and patterns of localised extinctions (species sifting) during historical contractions of the rainforest have been extremely important processes in determining regional patterns of vertebrate biodiversity in Australia's wet tropical rainforests.

An investigation of the local-scale patterns of mammal diversity was undertaken on the southern Atherton Tableland. Spotlighting and live trapping were used to examine the relationships between the composition of the mammal assemblage and habitat structure over several spatial scales. The results showed that the structure of the mammal assemblages was closely correlated with vegetation structure. The presence or absence of specific guilds was related to vegetation complexity, although total species richness was not. Local species richness of ground-dwelling mammals was mostly a product of the spatial variability in assemblage structure (^{b}diversity), which was related to the spatial variability in vegetation structure.

The effect of spatial scale is crucial to the understanding of the generality of processes which limit or promote biodiversity. Each spatial scale represents a nested hierarchy within the larger scales. The available species pool at a given spatial scale constrains the upper limit of species richness possible at the smaller scales while spatial patterns within a scale are determined by processes acting at that scale. This study examined patterns of diversity over a range of spatial scales and conceptual models are presented which describe the different spatial scales and the variety of processes which act at each spatial scale.

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Dedication

I would like to dedicate this thesis to my daughter Anna. She has been my most loyal and loving supporter for the last eight years. Anna taught me the truth in something that was said by Charles Darwin ..... 'Talk of fame, honor, pleasure, wealth, all are dirt compared with affection'.

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On patterns in nature ...

".. causality would be merely a name for something that exists only in our partial and biased mental reconstructings. The pattern which it indexes, however, would be real, but not intellectually apperceivable because the pattern goes everywhere and is everything and cannot be encompassed by finite mind or by anything short of life - which it is."

John Steinbeck (1958), p.212 *in* "Log from the Sea of Cortez"