Floristics and Biogeography of the Granitic Outcrop Flora of the New England Batholith of Eastern Australia

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STATEMENT OF ORIGINALITY

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

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

Some of the work presented in this thesis has been published. Relevant publications are included at the back of this thesis in Appendix H.

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John Thomas Hunter

DEDICATION

This thesis is dedicated to
Karmanina Dorinia (Schwaski) Hunter

My mother, who passed away during the research of this thesis.

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ABSTRACT

This study investigates the distribution of richness and diversity within a continental insular environment and the processes and mechanisms that maintain them. The flora of the granitic outcrops of the New England Batholith of eastern Australia is used as the case study. The study region represents an area that is 400 km in length and 110 km in width. Within the batholith 24 aggregated granitic plutons are investigated.

The general aims of the investigation were to reveal the nature of vascular plant biodiversity on the 'archipelagos' of granitic 'islands' (outcrops), and the factors associated with its development and maintenance, and to explore the implications of these findings for conservation of plant biodiversity generally.

A quantitative fixed quadrat based sampling strategy was employed to survey the vegetation both on and off the granitic outcrops of the batholith. In total 522 quadrats were placed across the batholith with 399 being placed on 216 outcrops and 123 within the surrounding vegetation. This survey design allowed 'zoom sampling' techniques to be used, enabling correlations to be tested across different scales.

Numerical analysis techniques were used to define 28 floristic units within 9 major Element classes. These units were used in subsequent analyses performed throughout the investigation.

A method of quantifying the insular nature of outcrops was derived and subsequent analyses proved that the granitic outcrops of the New England Batholith provide an appropriate example of a continental insular environment. These analyses showed that the degree of insularity changed across the batholith. Outcrops became more insular towards the north east of the batholith at higher altitudes and in more mesic surroundings. Conversely, insularity was noted to decrease as the surrounding environments became more arid. It was found that species restricted to the outcrop environment are more common in the north east and are more abundant than other species on outcrops. Additionally, some species from more arid areas are disjunct or at their distributional limits on outcrops.

Measures of evenness, richness and diversity were taken and compared across the batholith both on and off outcrops. Outcrops were found to be less rich at 0.1 ha (alpha diversity), less even in their species distribution of rank order abundances and to have a high beta diversity compared to the surrounding non-outcrop vegetation.

Tests at different scales of grain and extent indicated that habitat heterogeneity was a primary factor influencing outcrop species richness. The insularity of outcrops also played an important role with richness declining with increasing insularity. Correlations with climatic variables as measured by temperature, radiation and rainfall were important at all scales of analysis in determining species richness. The species/genus ratios were found to be higher on outcrops, and particularly on outcrops with higher insularity indicating that speciation may be an important factor contributing to species richness in the north east of the batholith.

Deterministic structuring of species richness was investigated by the analysis of nested subset patterns and species saturation. Statistically significant nested subset patterns were found on outcrops however these were all of comparatively low nestedness. Species saturation curves indicated that in all situations, spatial fragmentation of outcrops significantly effected species richness. The low nestedness values, high beta diversity and saturation results indicated that in all cases, despite the existence of different floristic alliances across the batholith several small outcrops will always contain more species than the same sized large outcrop.

A new measure, species range saturation, was derived to describe species range sizes. Species range size tended to increase towards the western side of the batholith, being associated with increasing incident radiation loads. Using this measure it was found that species range size could not be used to predict species abundances at the local level. No correlations were found between species range sizes and floristic richness.

Fire was found to be an important factor influencing species richness and diversity in a number of analyses. Before and after control incident (BACI) fire trials were conducted along with germination trials and the collation of anecdotal information. This process revealed that species richness and diversity is highly influenced by the surrounding species pool and the pre-treatment composition. A distinct short-lived fire ephemeral flora was noted to occur sporadically on outcrops. This flora when present increased the levels of beta diversity within a community.

It was discovered that floristic richness and diversity were maintained by proportionately different means across the batholith. However, universally richness is structured by the fragmented and semi-arid nature of the outcrop environment, which produces a high beta diversity, thereby maintaining high levels of gamma diversity, despite low alpha diversity.

Some implications of this research indicate that the species within naturally fragmented environments have evolved over millennia to cope with a disconnected landscape. As such, the results of investigations into such systems may not prove to be of direct relevance to anthropogenically disturbed habitats. Within a single insular system the mechanisms that maintain richness and diversity may change proportionately across the landscape, and as such, detailed investigations are needed even within a single system. In systems with a high beta diversity and low nestedness, any patch is a valuable resource and several small reserves will always conserve more species.

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