ECOLOGY OF PLANT COMMUNITIES IN KU-RING-GAI CHASE NATIONAL PARK, NEW SOUTH WALES: AN EXAMINATION OF VEGETATION AND ENVIRONMENTAL PATTERNS

by

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1995

Submitted in fulfilment of the degree of Doctor of Philosophy (PhD),
University of Technology, Sydney.

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ACKNOWLEDGEMENTS

I would like to thank my supervisor, A/Prof. Rod Buckney for enabling me to undertake this research, for his support and advice, and for reading and re-reading all the drafts of this thesis. I am also grateful for Rod's continued assurances that I would complete this project. I would particularly like to thank Dr David Morrison, who gave much critical input into the design and numerical analyses of this research and for his valuable comments on drafts of this thesis. David constantly gave his advice even though my constant bothering, resulted in his constant (good-humoured?) abuse and sarcasm.

I thank my fellow post-graduate students for their support and for putting up with me for a seemingly endless candidature, particularly, Ricky Krassoi, Rob Paterson, Rob Fullerton, Ben Pearson, Rebekah Gomez-Forte, Craig Allen, Ian Anderson, Geoff Cary and Stuart Pengelly. Rob Fullerton and Ben Pearson also willingly reviewed early drafts of the thesis, and gave some valuable comments. Geoff Cary and Stuart Pengelly also gave valuable feedback on this research. Ricky Krassoi gave me suitable distraction in the form of arguments against a holistic approach in the study of ecology and discussions on general philosophy.

I thank the National Parks & Wildlife Service (NSW) for permission to sample within Ku-ring-gai Chase National Park and the staff of NP&WS, Northern Metropolitan Region for access to fire history data.

Narelle Richardson assisted with AAS and freely gave advice in regards to general laboratory analyses for which I am grateful. The technical staff (Dept. of Applied Biology), Sue Fenech, Barbara Almond, Jimmy Carey and Peter Ralph were helpful in the carrying out of this research. I thank Sally Scholfield and Greg Hampshire (Gore Hill Library, UTS) who assisted greatly in going out of their way to ensure access to the relevant literature and for not imposing fines for grossly overdue items.

I am grateful to the late Dr Sam Huxham (Dept. of Statistics, UTS) for access to the GLIM3.77 computer package and technical manual.

I would particularly like to thank my family for their support. Robyne Callinhan provided valuable input into the phrasing and grammar of parts of this thesis for which I am grateful. My parents, David and Sylvia, greatly supported and constantly encouraged me in my studies, and always provided a hearty meal when I was visiting. Lastly, I thank my wife, Kathy, whose love and encouragement enabled me to complete this project. Kathy always provided positive support when I was finding things difficult, even though my demands on her patience and understanding often conflicted with her own studies.

This research was undertaken while in receipt of a University Doctoral Scholarship provided by the University of Technology, Sydney, for which I am grateful. I would also like to thank the Dept. of Applied Biology which financially supported this research.

STATEMENT OF AUTHORSHIP

I, Andrew Francis Le Brocque, declare that, except where acknowledged, all work presented in this dissertation is original. I claim full right of ownership of all intellectual property in relation to this dissertation. No part of this dissertation is to be copied without prior written consent.

I also certify that this thesis has not already been submitted for any degree and is not being submitted as part of candidature for any other degree.

With respect to originality, the multivariate classification system developed in Chapter 4 is, in part, the result of collaboration with Robert Fullerton, PhD student at the University of Technology, Sydney. The multivariate approach was developed independently; however, the final structural formulae presented is the result of discussions with Robert.

Signature of Candidate

Production Note:
Signature removed prior to publication.

5 / 2 /1995

Andrew F. Le Brocque

Parts of the research reported here (sections of Chapter 3) have been published in the *Australian Journal of Ecology*:

Le Brocque A.F. and R.T. Buckney (1995) Vegetation and environmental patterns on soils derived from Hawkesbury Sandstone and Narrabeen substrata in Ku-ring-gai Chase National Park, New South Wales. *Australian Journal of Ecology*, **20**: -

'Trees seek the environment suited to them, and this does not only apply to rare and special trees .... but even to common species which spring up everywhere. Some like dry places, others prefer wet or cold or sunny or shady places. Natural affinity draws each species to an appropriate and suitable locality when wild plants grow on their own accord.'

Theophrastus *c.* 320BC

ABSTRACT

Patterns in the floristic composition, stand structure, species richness and environmental characteristics of plant communities at a number of spatial scales were examined in Ku-ring-gai Chase National Park, New South Wales. Vegetation patterns in eastern Australia have often been related primarily to a single environmental variable, soil phosphorus concentration. This study examines the 'single-nutrient' hypothesis regarding the distribution of plant species. If soil phosphorus concentration is the major factor affecting the distribution of plant species, then this variable should be highly correlated with spatial patterns in the floristic composition of plant communities within the study area.

Floristic composition was determined as the frequencies of all vascular species occurring within duplicate 500 m^2 quadrats from fifty sites within the Park. Environmental data consisted of 21 variables, including soil physical and chemical characteristics, from each quadrat. The patterns in floristic composition and environmental factors are described and the relationships between composition and environment were examined through indirect and direct gradient analyses. The measured environmental factors showed strong correlations with floristic patterns; however, two scales of species distributions were apparent: between and within soil type. Direct gradient analyses of composition and environmental data showed soil phosphorus concentration was inadequate in explaining the observed patterns in floristic composition. An alternative hypothesis suggests that patterns in the floristic composition of plant communities are a response to complex multivariable environmental gradients.

The structural characteristics of vegetation stands were examined through the development of a multivariate approach to the classification of stand structure. This multivariate approach is essentially a modification of an existing scheme utilising foliage projective cover of various recognisable strata within the stands. Multivariate classification and ordinations of plant communities based on structural characteristics showed strong correspondence to that obtained by compositional analyses. The complex multivariable environmental gradient hypothesis is supported from results examining stand structure-environment relationships.

The relationship between species richness and richness of three growth-form types (trees, shrubs and herbs) and environmental variables were examined through

generalised linear models. The measured environmental variables showed strong relationships with species richness, consistent with the results found multivariately with floristic composition and stand structure. No single measured environmental variable adequately predicted the observed patterns in species richness, rather species richness showed strong relationships with complex multivariable environmental gradients.

This study clearly demonstrates that the 'single-nutrient' or 'phosphorus' hypothesis is inadequate in explaining all the patterns in the various components of vegetation within Ku-ring-gai Chase National Park. The complex multivariable environmental gradient hypothesis suggested by the relationships between floristic composition and environmental variables is supported by the relationships exhibited by two other attributes of vegetation communities: stand structure and species richness. Further studies testing the significance of the complex multivariable environmental gradient hypothesis are required.