

COMMUNITY STRUCTURE

OF

CLIFF-TOP COASTAL HEATHLANDS

IN

BOTANY BAY NATIONAL PARK, SYDNEY

Robert Nigel Fullerton

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Declaration of originality

I hereby declare that the contents of this thesis, unless where otherwise cited, are the product of original research conducted by the author. I also hereby declare that the contents of this thesis have not been previously submitted for any award.

Robert Nigel Fullerton

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Abstract

This thesis examines community structure of cliff-top coastal heathlands in Botany Bay National Park, Sydney. Community properties of floristic composition, structure and species richness are investigated. This investigation is made in order to assess the justification for contemporary pre-emphasis in local studies on individual community properties. It is also made in order to assess the relative and independent contributions of individual properties to variance in overall community structure. It is also made in order to assess the relative utility of multi-property classifications in summarising community structure of cliff-top coastal heathlands.

First, the presence of determinable structure in each property is assessed through multivariate classification of respective data sets. Secondly, a new model of community structure is developed in which the hypothesis that community structure is a function of common (shared) and independent (unique) variance in each of the three properties is assessed. This is achieved through application of variance partitioning using correspondence analysis techniques. Thirdly, a matrix combining variance in all three properties is classified. This classification is compared with those of individual properties in order to assess the hypothesis that more ecologically cohesive classifications than those of single properties are obtainable. The ecological significance (environmental relativity) of all classifications and variance components is assessed through examination of relationships with variance in 20 environmental factors which encompass variation in maritime factors, soil physical factors, soil nutrition factors and effects of time since fire.

Classifications of individual properties showed the presence of determinable structure in each. Eleven floristic complexes, nine structural complexes and eighteen species richness complexes were recognised. Nineteen community complexes were recognised from the classification of the combined property matrix. All complexes were shown to differ significantly with respect to multiple environmental factors.

Variance partitioning showed the presence of both independent and common variance components with respect to properties compared pairwise. These were all shown to differ in magnitude. Examination of environmental correlates showed ecological differentiation of all properties and most variance components. Maritime and fire factors provide a major axis of environmental differentiation for most properties and

variance components. A second major axis was resolved with respect to physical soil factors. With the exception of variance in species richness, major soil nutrients were generally of secondary importance to community structure. Low soil nutrients may demarcate heathlands from other vegetation types. However, this study shows elevated importance of other major areas of environment for community structure within cliff-top coastal heathlands.

Comparisons of environmental homogeneity characteristics between all classification systems showed the classification of the combined property matrix to be more ecologically robust than those of structure or species richness. Homogeneity characteristics of the combined classification remained statistically inseparable from that of floristic composition. However, studies provided some evidence suggesting greater robustness of the combined classification with regard to fine-scale variance in community structure.

This thesis shows that variance in all major community properties of the studied vegetation to be of ecological significance. It also shows that this significance is differential with respect to properties and their variance components. Pre-emphasis on individual properties in syntheses of local systems thus involves the loss of ecological information. I thus conclude that if adequate ecological syntheses of cliff-top coastal heathlands are to be obtained which are appropriate to their scale of distribution and functioning in the Sydney area then inclusion of attributes of multiple properties is required. Equally, multiple sources of environmental variation need to be examined.

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