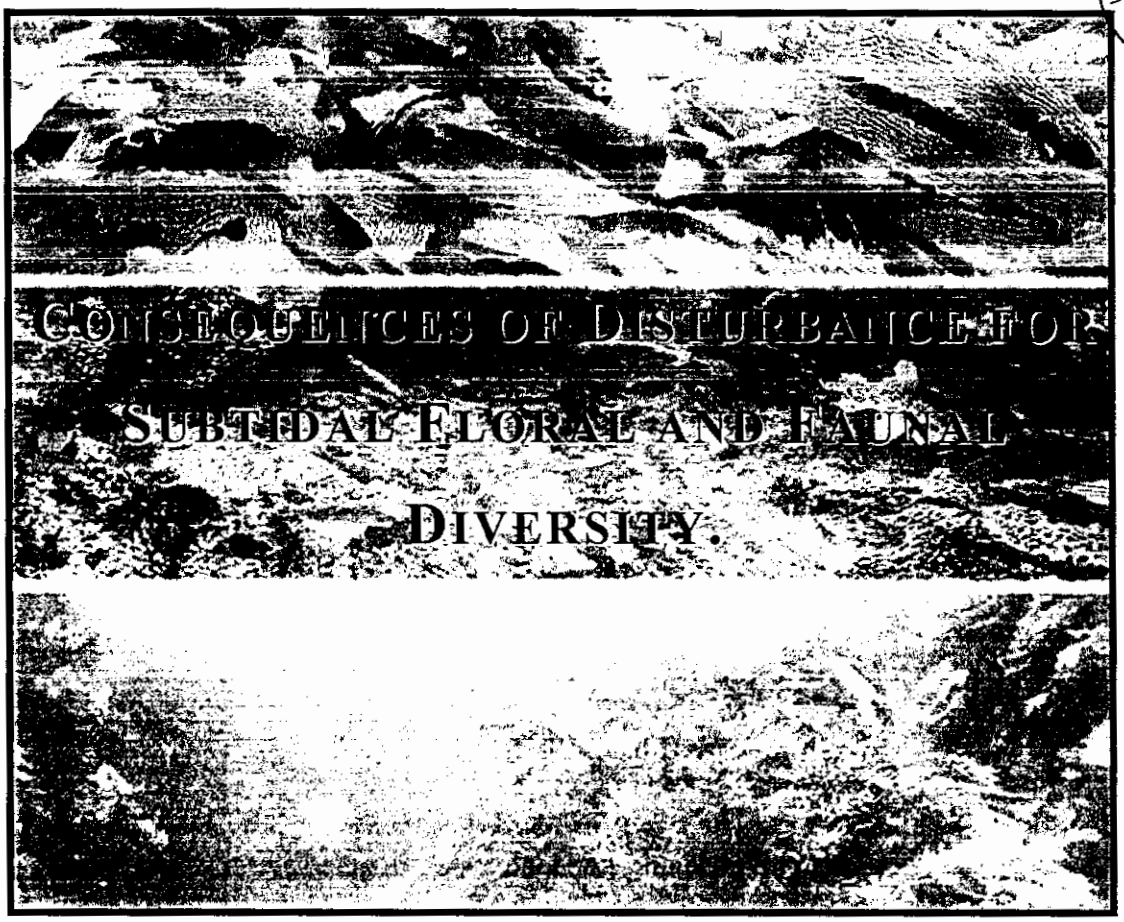

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ABSTRACT

Disturbance is a key determinant of the organisation of many natural systems, yet our ecological understanding of the response of mobile animals to disturbance in subtidal systems is limited. I assessed the impact of common disturbances (storms and herbivory) on subtidal forests of canopy-forming algae, *Ecklonia radiata* (Phaeophyta) and the consequences of disturbance and subsequent habitat modification on the diversity of associated invertebrates. This was done by testing hypotheses derived from a series of models that attempted to account for (i) the ways in which the composition of habitats of *E. radiata* are affected by disturbance, (ii) the effects of disturbance to habitat on the diversity of mobile invertebrates, (iii) the consequences of variation in composition of habitat for invertebrate diversity at local through to regional scales and (iv) whether the patterns of invertebrate diversity between habitats of different composition are a result of changes in local turnover.

Localised loss of monospecific canopies of *E. radiata* initiated a diverse recruitment of canopy-forming algae (taxa of fucalean algae) to potentially create mixed stands (i.e. species of fucalean algae interspersed with *E. radiata*). Such mixed-species stands were found to be equally as extensive as monospecific stands of *E. radiata* across temperate Australia (32% of reef covered by monospecific stands vs 31% stands of mixed algae). This thesis provides a unique assessment of whether such complexity in the composition of algae affects the diversity (composition and relative abundance) of invertebrates that rely on canopy-forming algae for habitat.

The next step was to determine the impact of disturbance events on the diversity of invertebrates associated with the holdfast of *E. radiata*. The initial loss of *E. radiata* habitat had important consequences for the diversity of mobile invertebrates, but their response was largely dependant on the configuration of habitat (density) prior to the disturbance. Considering that differences in the configuration and composition of habitat can be driven by disturbance and can influence the outcome of future disturbance events, ecological models that account for the dynamics of kelp systems will be stronger if we incorporate small-scale complexity in the structure of subtidal habitats.

Subsequently, I investigated the consequences of complexity in the structure of habitat (as driven by disturbance) on the diversity of mobile animals. Differences in invertebrate diversity between monospecific stands of *E. radiata* and stands of mixed algae were identified at a single location in South Australia. I therefore, tested the hypothesis that differences in invertebrate diversity between monospecific stands of *E. radiata* and stands of mixed algae are evident at local through regional scales across the temperate coastline of Australia. The composition and relative abundance of invertebrates differed between monospecific stands of *E. radiata* and stands of mixed algae, at most sites, most locations and all regions across Australia. There was a greater richness of taxa in monospecific stands than stands of mixed algae. This result highlights that complexity in the composition of subtidal habitats at small-scales, has important implications for patterns of animal diversity in ways predictable across broad scales. Finally, I investigated whether differences in mixed-species stands and monospecific stands of *E. radiata* were influenced by differences in local turnover of invertebrates among habitats of *E. radiata*. I tested the specific hypothesis that colonisation of distant habitats of *E. radiata* is affected by the nature of the intervening habitat (fucalean algae vs relatively bare space). The presence of fucalean algae between distant habitats of *E. radiata* (e.g. mixed stands) allowed for greater colonisation of *E. radiata* than a matrix of bare substratum.

I conclude that localised disturbance can generate considerable patchiness in the structure and composition of subtidal habitats which is a key determinant of differences in the diversity of associated assemblages of invertebrates. Consideration of such small-scale complexity within subtidal forests of algae and its affect on animal diversity not only strengthens our understanding of the ecology of subtidal forests, but will also increase the predictive capacity of further research in this system.

TABLE OF CONTENTS