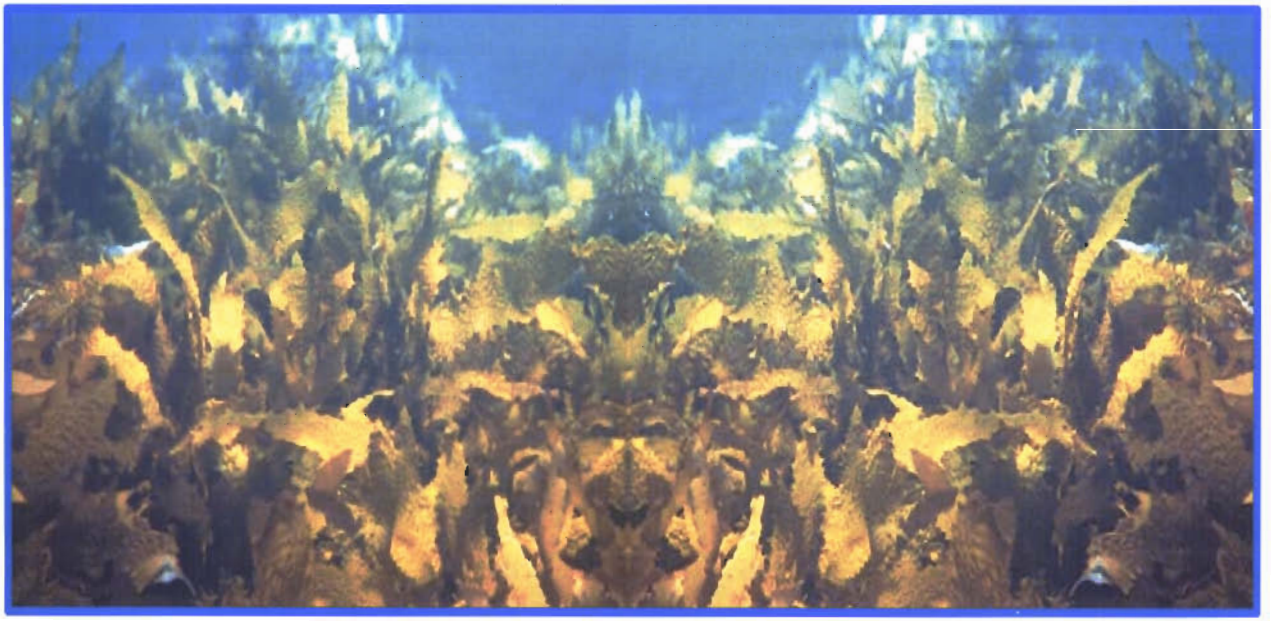
REGIONAL AND LOCAL PATTERNS IN KELP MORPHOLOGY AND BENTHIC ASSEMBLAGES



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DECLARATION OF AUTHORSHIP

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Meegan Fowler-Walker

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ABSTRACT

Most ecologists work at scales where complexity is greatest (i.e. local), and it is not surprising, therefore, that we tend to be captivated by the description and explanation of local variation whilst being pessimistic about the existence of broader patterns. Using a character (kelp morphology) known for its local and unaccounted variation, the morphology of the canopy-forming algae *Ecklonia radiata* (Phaeophyta) was quantified across > 5000 km of temperate Australian coastline, (i) between different configurations of algal stand (i.e. monospecific *vs* mixed-species stands) and (ii) across multiple spatial scales. A key result was that despite variation at local scales (km), differences between stands became increasingly clear at broad scales (1000's km), which supports the idea that large-scale patterns can emerge from apparent stochasticity at small scales.

Within each stand, regional scale differences in morphological characters were evident (i.e. Western Australia = South Australia ≠ Eastern Australia). These characters correlated with geographic and environmental variables to indicate that the majority of morphological variation across temperate Australia was accounted for by longitude, wave exposure, water temperature and plant density. Morphological differences associated with environmental factors may reflect a plastic response to the local environment, or alternatively may reflect genetically fixed traits (i.e. ecotypes). An independent test of morphological variation associated with wave exposure environments, using a reciprocal transplant experiment, revealed that morphological plasticity was the mechanism enabling *E. radiata* to adopt different morphologies between exposure environments.

The presence of kelp canopies has strong spatial relationships with organisms growing underneath them, and variation in the morphology of these canopies may facilitate distinct assemblages within the understorey habitat. Variation in the morphology of *E. radiata* was found to be associated with the structure of understorey assemblages, over broad spatial scales. This canopy-understorey association revealed two 'types' of kelp forest; one characteristic of Western and Southern Australia and the other of Eastern Australia. Patterns of canopy-benthos association have mostly been done on

horizontal surfaces and experimental tests showed that such patterns on horizontal surfaces were not representative of vertical surfaces, which enables us to recognize the conditions for which we can reliably anticipate the structure of benthic organisms, thereby improving the predictive power of models that account for widespread patterns in subtidal heterogeneity.

In conclusion, this thesis suggests that there are fundamental differences between the ecology of kelp forests at local scales (i.e. between types of stand) and at regional scales (i.e. between the south and east coast of temperate Australia), reflecting differences in kelp morphology that may be caused by environmental conditions (e.g. exposure) and may influence associated taxa (e.g. understorey). Consideration of such local-scale variation (specificity) when testing for the existence of broad-scale phenomena (generality) not only strengthens our understanding of the ecology of subtidal forests, but will also improve the predictive power of further research in this system.

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