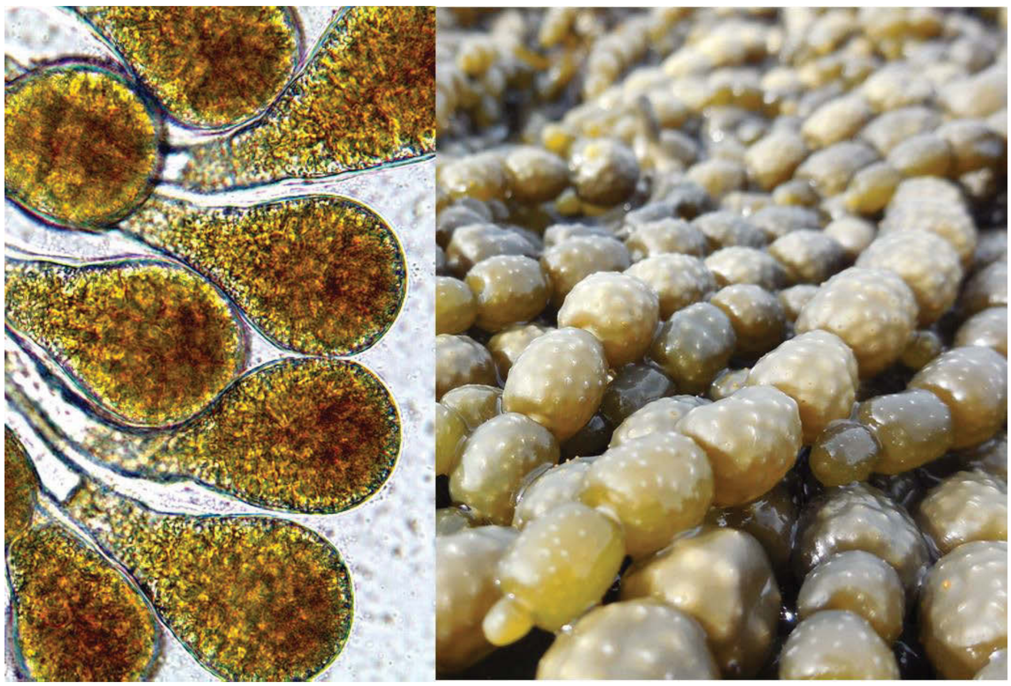
Assessing the vulnerability of a habitat forming macroalga to climate warming: Roles of physiology, ecology and evolutionary processes in determining resilience



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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as part of the collaborative doctoral degree and/or fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

Date: September 9th 2016

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ABSTRACT

Anthropogenically mediated climate change is having profound impacts on the distribution, abundance and functioning of species worldwide. Marine macroalgae are important foundation species due to their role in facilitating biodiversity through provision of resources and moderating stress. Accurate predictions of how macroalgae will respond to global warming require a better understanding of factors that lead to the vulnerability of species. This thesis aimed to examine the exposure and underlying biological traits that explain the sensitivity and resilience to warming in a dominant and endemic intertidal macroalga, *Hormosira banksii,* with the ultimate goal of assessing its vulnerability to changes in climate regime.

H. banksii populations inhabiting two spatial scales, regional (central (cooler) and marginal (warmer)) and local (between tidal heights) were sampled. At each spatial scale, the performance of *H. banksii* was assessed to determine whether morphology influences function (relative water content and photosynthetic efficiency of PSII) in adults while the traits (growth and photosynthetic efficiency) of early life history stages (< 5 days old) were assessed to determine thermal niche. Adults in marginal populations had smaller thallus and vesicle size, which affected the ability of *H. banksii* to recover photosynthetically from thermal and desiccation stress. Distinct thermal performance curves of growth and photosynthetic efficiency of early life history stages revealed the marginal population had lower thermal safety margins and lower thermal optima compared to the central population that has broader thermal safety margins and higher thermal optima. The genetic structure was characterised among regions, locations and tidal heights to test the hypothesis that genetic diversity would decrease towards distribution limits and differ between tidal heights. Marginal populations had lower estimates of genetic diversity than central populations, and there was evidence of isolation by distance – i.e., limited gene flow over long distances (~500 km). Genetic differentiation was not found between tidal heights, suggesting gene flow is not restricted by reproductive strategies of *H. banksii*. Furthermore, maternal provisioning of eggs did not indicate advantages in performance such as faster growth rate of early life stages, which would aid in recruitment. Physiological tolerances of adults and embryos, population genetic structure, inbreeding and limited gene flow all suggest that the warm marginal populations of *H. banksii* are vulnerable to changes in temperature regime. Local habitat effects such as topography and tidal cycles, however, are potentially more important in governing the physiology of *H. banksii* and can buffer the full extent of climate change occurring at the regional scale. In view of this, changes in the distribution and abundance of some populations of *H. banksii* with global warming, along with changes in the functioning of ecosystems which *H. banksii* support may be observed in the near future.