PhD Project available immediately, July 2013

University of Queensland

Bio-eroding Sponges: Using historical records and experimental manipulations to predict future accretion-erosion dynamics on coral reefs.

Coral reefs exist in a dynamic balance moderated by processes of accretion and erosion. The construction of reefs occurs predominantly through the build-up of scleractinian coral skeletons, but this process is mediated by reef bio-erosion. Reef destruction occurs through the actions of bio-eroding organisms and physical environmental events that are influenced by climate. The sediment budget of coral reefs is determined by the relative contribution of constructive and destructive processes. A large focus for assessing reef resilience in the face of climate change has been on processes governing accretion in coral reefs, particularly those that contribute to the maintenance and persistence of hard corals. Bio-erosion has been much less intensively studied, resulting in significant knowledge gaps about the overall growth dynamics of coral reefs, thereby constraining efforts to manage and conserve these ecosystems.

Bio-eroding sponges are one of the most conspicuous groups involved in reef erosion. Bio-eroding sponges are particularly adept at competing for space, and by boring into both dead and live coral surfaces they contribute to the degradation of coral reef frameworks. Most reef organisms currently face pressures associated with elevated sea surface temperatures and ocean acidification, yet little is known about how bio-eroding sponges respond to a rapidly changing climate. Whilst the effects of ocean acidification may enhance the ability of bio-eroding sponges to erode coral substrates, few studies have assessed the effects of climate change on the ecological dynamics of bio-eroding sponges, and more importantly, how any potential effects translate to broader coral reef stability.

This project will compare the current and historical importance of sponge mediated bio-erosion by detailed analysis of sediment cores over millennial time scales and surveys of modern reef environments. Manipulative laboratory experiments at the new state-of-the-art experimentation facility, SeaSIM, at the Australian Institute of Marine Science in Townsville will be used to empirically determine the key ecological traits of bio-eroding sponges under future environmental conditions and present-day anthropogenic stressors associated with changes in water quality. Historical and empirical data will be used together to model the effects of future climate change on bio-eroding sponges and the broader coral reef accretion–erosion dynamic.

This PhD project will be jointly supervised by Prof. John Pandolfi and Dr Nicole Webster. In the initial stage of this project, emphasis will be placed on surveying historical sediment cores for evidence of bio-eroding sponges. In the latter stages of the project, empirical data will be obtained from field surveys and manipulative laboratory experiments.

John Pandolfi's Marine Paleoecology Laboratory at the University of Qld investigates the effects of climate change on coral reef and sub-tropical habitats using sediment coring and analysis of fossil assemblages as well as modern ecological surveys. These cores provide important historical information about how coral reef communities respond to natural and anthropogenic climate change, as well as other anthropogenic stressors.

Nicole Webster's laboratory at the Australian Institute of Marine Science focusses on understanding how sponge holobionts (host and associated symbionts) respond to environmental stressors. This research includes microbial, genomic and physiological measures of stress response in the holobiont. Experimental manipulations of modern bio-eroding sponges will be performed in the recently completed National SeaSIM, enabling precise control over all environmental variables.

The successful applicant is expected to have completed a recognised undergraduate degree in Science with an Honours degree (or equivalent) in marine biology and/or ecology. Overseas applicants would need to apply for a highly competitive IPRS scholarship – see http://www.uq.edu.au/grad-school/international-student-scholarships.

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