

The trophic ecology of the grazing sea urchin *Echinometra mathaei* within Ningaloo Marine Park, Western Australia: comparing the effects of different closure regimes on urchin distribution, recruitment and settlement

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Project contributions and collaborations

Research undertaken for this PhD project will be in part funded by the Ningaloo Collaboration Cluster (NCC), Component 1: Habitat Mapping and Biodiversity at Ningaloo Marine Park Western Australia, a CSIRO “Wealth from Oceans” initiative. This project will contribute to Component 1 of the NCC (Habitat Mapping and Biodiversity) which will provide a broad-scale, high resolution understanding of coastal habitats, biodiversity and land-use and how they affect the choice of human activities in the area and conversely, identify areas of high biodiversity that might be vulnerable to increased human use. Outcomes from this PhD project will also contribute to current marine science research initiatives conducted by the WA Department of Environment and Conservation (DEC) Ningaloo Research Program (NRP) and the W.A. Marine Science Institution (WAMSI Node 3). Data on bathymetry and the digital elevation model developed in Component 1 by Curtin University will also be made available for this project as well as be provided to the DEC NRP (WAMSI Node 3). Close links are also being established with the biodiversity component of the NRP to develop shared methods and joint research plans with Component 1 of the NCC.

Project description

Sea urchins can have a significant influence upon the ecological structure of coral reefs through bioerosion of substrata and also by affecting competition for space between corals and algae (Bak 1990, McClanahan 1998, Mapstone et al. 2007). However, the relative importance of the role of sea urchins in influencing the composition and structure of coral reef habitats has rarely been explored (Mapstone et al. 2007).

Urchins may be herbivores, omnivores, scavengers or deposit feeders depending on their habitat (Emlet 2002). They are mostly non-selective, opportunistic feeders that will browse on whatever plant or animal material is available (Baker 1982). Tropical species tend to have a prolonged to continuous spawning season, while temperate species reproduce annually

with distinct spawning seasons (Emlet 2002). Non- brooding females are capable of producing thousands to millions of eggs, depending on their size and species. Some species with lecithotrophic (egg yolk feeding) larva take only a matter of days to develop and settle (Williams 1975, Scott et al. 1990, Emlet 2002). Unusually large urchin settlement events or population increases (e.g. caused by trophic cascades) can consequently result in overgrazing in a variety of benthic marine communities such as tropical coral reefs (McClanahan et al. 1996).

Ningaloo Marine Park provides an opportunity to study a near-pristine tropical coral reef environment that has not been affected by the over- exploitation of natural resources that has occurred in most other tropical reef systems of the World. Furthermore, this allows for comparisons in reef community structure between Ningaloo and other degraded systems.

The overall objective of this research project is to add to the general understanding of coral reef ecology and more specifically, advance the existing knowledge of the role of sea urchins in coral reef ecology at Ningaloo Marine Park. This study will examine marine grazers (particularly sea urchins), investigating their habitats, home range, reproduction, distribution, larval recruitment and settlement, and trophic relationships at Ningaloo Marine Park. The indirect effects of different closure regimes (e.g. Marine Protected Areas (MPA's) such as sanctuary zones) on urchin ecology within Ningaloo Marine Park will be examined at length, both temporally and spatially over the next two to three years and will provide important new information which will aid in the formulation of future management strategies for the conservation and stewardship of Ningaloo Marine Park.

The proposed aims of the project will be achieved by:

1. Field validation and refinement of an original Hyper-spectral data library from which new, state of the art, custom-made benthic habitat maps of the Ningaloo Marine Park will be created for use in this and other related projects.

2. Identifying various coral reef habitats, macro-algae assemblages and macro-invertebrate populations in selected areas within Ningaloo Marine Park (back reef, lagoon and near-shore areas), with a view to targeting urchin habitats both in and out of MPA's.
3. Identifying typical urchin habitats and comparing variability of urchin habitat community structure between MPA's and non-protected areas.
4. Investigating any differences in trophic relationships of urchins in MPA's and non-protected areas to determine trophic structure variability between similar habitats.
5. Determining the possible impacts of current and future closure regimes on lagoonal trophic structure within Ningaloo Marine Park.

Field of research

The field of research contributed to by this project can broadly be described as coral reef ecology; more specifically it will contribute to the fields of coral reef lagoonal trophodynamics and marine macro-invertebrate ecology, particularly in relation to sea urchin predation, distribution, reproduction, larval recruitment and settlement. The hyper-spectral habitat mapping component of the study will also contribute to the field of coastal geography and geomorphology.

Proposed outcomes

Each component of the study should provide data for at least one manuscript to be submitted to a high impact international refereed journal. An overview will be presented at the 12th International Coral Reef Symposium in 2011. Presentations will be made to the annual Ningaloo Symposium in 2009, 2010 and 2011. This will ensure the results are communicated to a wide range of marine scientists internationally and within Australia.

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