IN27 The feeding behaviour of herbivorous fish and their role in maintaining reefs

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Coral reefs exist within a dynamic equilibrium, their form and function being driven by environmental conditions and interactions between the species that inhabit them. Factors that disrupt this balance can have severe consequences for the biodiversity and productivity of reef systems. Disrupting factors are unfortunately numerous and range from changing local environmental conditions such as turbidity and nutrient concentrations, overexploitation of taxa that play important functional roles and keep the system in check and also large scale acute and chronic environmental change such as that caused by the 2016 Godzilla El Niño which brought about the collapse of many reefs around the world including the northern Great Barrier Reef. Understanding threats, and their causes and consequences is key to the successful management of tropical reefs on which so many millions of people survive for food and income.

One of the main reasons for the loss of reef biodiversity and productivity is the decline in dominance of reef building corals, the key ecosystem architects, across the world. At the same time other taxa such as algae, that actively compete with reef building corals, are starting to dominate. The shift from coral to algal dominance has been well documented in the Caribbean and appears common place. However within the mega biodiverse reefs of the Wakatobi, at the present time, there has been no such shift. Generally algae are better space competitors that corals and when kept unchecked, are able to rapidly grow and expand thereby reducing available space for coral recruitment and growth. Such competition leads to a decrease in reef building structures and the physical complexity of reefs leading to an overall loss of biodiversity and other ecosystem services provided by tropical reefs.

One hypothesis put forward for why the Indo-Pacific has generally not witnessed a regime change (ie phase shift) from reef building corals to reefs dominated by algae is the high abundance and biodiversity of species that graze algae and thereby reduce their competitive advantage. The key herbivores of the Indo-Pacific are fish and is has been hypothesized that the high levels of algal removal by herbivorous fish species reduce their capability of overgrowing corals thus preventing a phase shift. However, as many species of larger fish herbivores, especially parrotfish and surgeonfish, are heavily exploited it is possible that algae will increase in abundance, start to dominate benthic systems and bring about a decrease in reef biodiversity.

There is an urgent need to quantify the amount of herbivory and to explore the relationship between herbivore biomass, rates of herbivory and habitat quality. Levels of herbivory can be estimated through examination of the biomass of herbivores present on reefs coupled with studies of feeding behaviour. It remains unknown whether different fish species exploit the same algal species and therefore it is quite possible that it is the assemblage of herbivores present that is key as well as the overall biomass of this functional group combined. The high levels of functional redundancy, due to the large number of herbivorous fish species, reported in the Indo-Pacific might be overestimated if each herbivore plays a different role due to selective feeding on algal species. Managers therefore need to know whether conservation of herbivore biomass, biodiversity or both are needed to ensure that reef building corals are able to actively compete with other taxa and are

therefore able to continue to provide the physical complexity that underpins so many of the services provided by reefs.

Numerous dissertations could be implemented around this subject matter. Dissertations could make use of the long standing reef fish monitoring programme to determine changes in herbivore biodiversity, biomass and composition in relation to changes in habitat features. Dissertations could estimate current biomass of herbivorous fish and determine their specific functional role through observations of feeding behaviours. Dissertations could examine the most abundant reef fish herbivores and through behavioural studies determine the selectivity of grazing across this functional group and across reefs subjected to different environmental conditions. Previous experiments have been documented within the literature that use an experimental approach to examine herbivore fish selectivity and research undertaken by dissertation students could utilise both an experimental and study based approach. Overall researchers working in this area will help managers to identify the key species and critical biomass of herbivores needed to ensure reef building corals remain competitive and continue to underpin the extreme globally important biodiversity of reefs within the coral triangle.

Reading list

Bellwood DR, Hughes TP, Folke C and Nyström M. (2004) Confronting the coral reef crisis. *Nature*, 429: 827-833.

Bellwood DR, Hughes TP and Hoey AS. (2006). Sleeping Functional Group Drives Coral-Reef Recovery. Current Biology. 16: 2434–2439

Edwards CB, Friedlander AM, Green AG, Hardt MJ, Sala E, Sweatman HP, Williams ID, Zgliczynski D, Sandin SA, and Smith JE. (2013). Global assessment of the status of coral reef herbivorous fishes: evidence for fishing effects. Proceedings of the Royal Scoeity B. 281: 20131835

Fabricius KE, De'ath G, McCook L, Turak E and Williams D. (2005). Changes in algal, coral and fish assemblages along water quality gradients on the inshore Great Barrier Reef. *Marine Pollution Bulletin* 51(1-4): 384-398

Hughes TP. (1994) Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science*, 265(5178): 1547-1551.

Hughes TP , Graham NAJ, Jackson JBC, Mumby PJ, Steneck RS (2010). Rising to the challenge of sustaining coral reef resilience. Trends in Ecology and Evolution. 25: 633-643.

McCook LJ. (1999) Macroalgae, nutrients and phase shifts on coral reefs: scientific issues and management consequences for the Great Barrier Reef. Coral Reefs 18, 357– 367.

Mumby, P.J., Hastings, A., Edwards, H.J. (2007) Thresholds and the resilience of Caribbean coral reefs. *Nature*, 450: 98-101.

Unsworth RSK, De León PS, GarrardSL, Smith DJ, Bell JJ. (2009). Habitat Usage of the Thumbprint Emporer *Lethrinus harak* (Forsskål, 1775) in an Indo-Pacific Coastal Seascape. The Open Marine Biology Journa.l 3: 16 – 20.