Physical Conditions on Marginal Coral Reefs

Thesis submitted by

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The contributions of others towards this thesis included knowledgeable discussions, proofreading of manuscripts, and manual help with field work.

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Abstract

The Great Barrier Reef Lagoon (GBRL) is an area of great biodiversity containing 350 species of corals, 10 of which are endemic to the region. In recent years many threats to this ecosystem have been revealed, such as crown-of-thorns starfish and coral bleaching as well as excess concentrations of nutrients and sediments. Information on the effects of water quality and also the amounts of nutrients and sediments that reefs are subjected to is limited. This is especially true for inshore reefs where issues of water quality are most important.

This work focuses on the Rockingham Bay and Family Islands region. In this region a reef in Lugger Bay near Mission Beach was selected for a detailed study. It is a highly marginal reef (a reef occurring close to perceived environmental thresholds for coral survival) with high levels of sediments and organic matter and close to the mouths of two rivers: the Tully and the Hull. This makes the reef one of the most at threat from eutrophication and increases in sediment. Part of this work was to document all the physical conditions of the reef including currents, wind speed and direction, light levels, temperature, nutrients, and suspended sediment concentration (SSC). The reef's health and age were also found by means of photographic surveys and core samples respectively.

The main results from the study showed a reef surviving in extreme physical conditions. The SSC on the reef were very high, exceeding 200 mg/l for 28% of the time. Light extinction was common, occurring on 49% of the days that data was recorded. The local rivers did not have much effect on the SSC or nutrient concentrations on the reef. The Tully River only has a wet-season average SSC of 23 mg/l and a maximum of 230 mg/l; resuspension was much more significant. Coral cover on the reef was reasonable, about 57%, and algae only covered 12% of the coral. However, coral species biodiversity was low, with one species of *Porites* making up 85% of the coral cover. These results indicate that some species of coral are able to survive in areas of high sediment and nutrient concentrations, and that clean rivers in the GBRL are not a great threat to coral reefs.

The SSC data was also used to develop an empirical model, which predicts SSC for a specific site using just wind data. The model is accurate enough to be used in environmental monitoring to predict an expected SSC, which can be prepared with observed SSC from a site where marine construction is taking place so it can be determined whether the work has increased the SSC to a dangerous level. This makes it an important tool as many such construction projects occur in the GBRL each year and there is no other accurate method of determining what the natural SSC would be if work was not taking place.

A new instrument was also developed to infer nutrient concentrations in the water column, to try to overcome problems with existing methods. The instrument works by measuring the speed at which algae grow on a glass plate using a fluorometer. Tests were made to determine how well algal growth would relate to nutrient concentrations, if other factors like temperature, light levels and algal type were not controlled. Results showed that growth was too dependent on these other factors to be a good indicator of nutrient concentrations. The sensor could, however, be used to determine the effect nutrients have on algal growth, which in itself is a potential threat to corals.

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