

ABSTRACT

JAMAICAN NORTH COAST REEFS: THE GRAZING POTENTIAL OF *Diadema antillarum* AND THE IMPLICATIONS FOR REEF COMMUNITY STRUCTURE

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The coral reefs of the North Coast of Jamaica and in particular Discovery Bay have suffered from large scale degradations since 1980 which resulted in a decline of coral diversity and abundance. Phase shifts in community structure resulted in macroalgae dominated reefs. This study was initiated to focus on the status of coral reefs (shallow fore reef) along the Jamaican North Coast between Rio Bueno and Pear Tree Bottom, with emphasis on Discovery Bay reefs. The survey of reefs along the 10 km strip of coastline, described here, was the first extensive and comprehensive assessment of fore reef communities on the North Coast of Jamaica. In addition it was comparable to previous studies at a few specific sites at Discovery Bay and provided useful insight into reef conditions, illustrating that values quoted previously for Jamaican reefs were not

representative. The reefs were found to be undergoing a process of recovery with significant increases in coral cover (from <5% to 13.8%) and reductions in macroalgae (from 79% to 50.6%) over the last 15 years. This increase in coral cover, particularly on the shallow reef, appeared to be was facilitated by the recovery of the sea urchin *Diadema antillarum*, which had suffered population collapse since the 1980s. The water quality of the Discovery Bay fore reef was found to be oligotrophic, while the western back reef area has received high nutrient inputs from groundwater since the last three decades.

The study investigated the relative roles of herbivory and nutrients in light of the significant increase in *Diadema* and the very low levels of nutrients on the reefs (<0.45 μMol Dissolved Inorganic Nitrogen (DIN) and <0.06 μMol Soluble Reactive Phosphorus (SRP)). Herbivore+nutrient manipulations demonstrated that *Diadema* effectively consumed and reduced macroalgal biomass exposed to nutrients above the “Critical Nutrient Threshold” of 1 μMol DIN and 0.1 μMol SRP and up to mean levels of 14 μMol DIN and 0.54 μMol SRP. This is substantial evidence which supports the position that these sea urchins exert greater “top down” control on macroalgal abundance than does “bottom up” control from nutrient enrichment.

The herbivore+nutrient manipulations were conducted under controlled laboratory conditions and *in situ* field conditions, where the effects of differing levels of nutrients on macroalgal communities at a standard grazing pressure was tested. Under controlled conditions, grazing on macroalgae was unaffected by low

nutrient enrichment. However at higher levels of enrichment, some effect from nutrient enrichment on algal communities was observed. This suggests that there is a “threshold” or limit for *Diadema* grazing under conditions of nutrient enrichment above 15 $\mu\text{Mol DIN}$ and 1 $\mu\text{Mol SRP}$ at grazing pressure of 3 *Diadema* m^{-2} .

The correlation of the observed recovery of Discovery Bay reefs with increasing *Diadema antillarum* populations and the fact that nutrients were close to or below detection limits, suggests that herbivory is the dominant structuring force on these coral reef communities. The data from the grazing+nutrient experiments provided more substantial support that indeed the loss of herbivores was perhaps the key factor in the degradation of Jamaican reefs. The discovery of *Diadema*'s ability to control macroalgae exposed to elevated nutrients presents important implications for coral reef communities. Further research on the specifics of algal nutrient uptake and a range of herbivores, can determine comprehensive grazing thresholds to serve as guides for coral reef monitoring and management.

Keywords: coral reefs, recovery, *Diadema*, macroalgae, nutrient enrichment, grazing threshold