Influence of Macroalgal Cover on Coral Colony Growth Rates on Fringing Reefs of Discovery Bay, Jamaica: A Letter Report

M.J.C. Crabbe*

Luton Institute for Research in the Applied Natural Sciences, Faculty of Creative Arts, Technologies & Science, University of Bedfordshire, Luton, Bedfordshire, LU1 3JU, UK

Abstract: In this study I investigated the hypothesis that alterations in macroalgal cover significantly influenced the growth rates of coral colonies on the fringing reefs of Discovery Bay, Jamaica. For colonies of *Montastrea annularis*, *Porites astreoides*, and *Sidastrea siderea*, radial growth rates were significantly ($p<0.02$) higher at Dairy Bull (where *Diadema antillarum* had removed macroalgal cover) than at either M1 or Rio Bueno (where there was c. 80% macroalgal cover). For colonies of *Colpophyllia natans* and *Montastrea fankseii*, radial growth rates were significantly ($p<0.02$) higher at Dairy Bull than at Rio Bueno. It has been suggested that macroalgal shading as well as contact is a significant inhibitor of coral growth, and our results are in accord with that hypothesis. These studies suggest that marine park managers should foster macroalgal predation wherever possible, in order to limit the irreversible decline of coral reefs.

INTRODUCTION

The growth and subsistence of coral depends on a number of requirements: temperature, irradiance, calcium carbonate saturation, turbidity, sedimentation, salinity, pH, and nutrients. These variables influence the physiological processes of photosynthesis and calcification as well as coral survival [1, 2]. Ecosystem thresholds have been modelled to identify targets for reef restoration [3], and it appears that grazing, particularly by scarids (parrotfish), but also by urchins, is critical to reef resilience and restoration in the face of multiple stressors, including hurricanes [3,4]. Macroalgal competition has been shown to reduce the survivorship and growth of corals in forereefs in Roatan, Honduras [5] and in Florida [6]. In this study I investigated the hypothesis that alterations in macroalgal cover significantly influenced the growth rates of coral colonies on the fringing reefs of Discovery Bay, Jamaica.

METHODS

The study was undertaken from between July 2001 to September 2004, using techniques identical to those described previously [7-9]. The five study sites (Rio Bueno, M1, Columbus Park, Dairy Bull and Pear Tree Bottom) were on the fringing reefs around Discovery Bay [8] as shown in Fig. (**1**). At each of the five sites, three haphazardly allocated transects, each 12m long and separated by at least 5m, were laid at 8.5 m depth. Corals at M1, Dairy Bull and Rio Bueno were photographed, subjected to image analysis using the Image Tool software obtained from the University of Texas Health Science Centre, San Antonio, Texas, and physically measured using measuring tapes as described previously [8, 9]. Fish sizes were determined by visual inspection, and by video as described previously [10], where 4 x 4 x 4 m 'boxes' were videod for 5 min each, at Rio Bueno, Diary Bull, M1, Pear Tree Bottom, and Columbus Park. Urchin (*Diadema antillarum*) counts at Rio Bueno, Diary Bull, M1, Pear Tree Bottom, and Columbus Park were by inspection. One or two-factor ANOVA was used to compare data among sites; +/- error values in Figs. (**3-5**) represent standard deviations of the data.

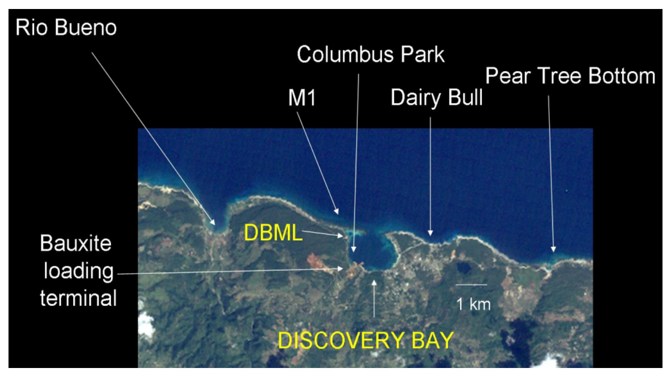

Fig. (1). Satellite image of the coral reef study sites around Discovery Bay on the North coast of Jamaica. DBML, Discovery Bay Marine Laboratory. The Bauxite loading terminal for ships is located in Discovery Bay.

RESULTS

Macroalgae (notably *Lobophora* and *Dictyota* species) were dominant (c. 80% cover) along the transects at M1 and Rio Bueno, whilst being almost absent (<1% cover) at Dairy Bull (Fig. **2a-c**). From 2002 to 2003, there were no significant changes in the numbers or species of corals recorded along the transects, with the singular exception of an increase in *Agaricia agaricites* numbers at M1 (Fig. **3a-c**). Macroalgal cover was insignificant along the transects in Columbus Park and Pear Tree Bottom. Radial growth rates of non-branching coral colonies are shown in Fig. (**4**) for the three sites. For colonies of *Montastrea annularis*, *Porites astreoides*, and *Sidastrea siderea*, radial growth rates were significantly ($p<0.02$) higher at Dairy Bull than at either M1 or Rio Bueno. For colonies of *Colpophyllia natans* and *Montastrea fankseii*, radial growth rates were significantly ($p<0.02$) higher at Dairy Bull than at Rio Bueno. Only in the

*Address correspondence to this author at the Luton Institute for Research in the Applied Natural Sciences, Faculty of Creative Arts, Technologies & Science, University of Bedfordshire, Luton, Bedfordshire, LU1 3JU, UK; E-mail: James.Crabbe@beds.ac.uk

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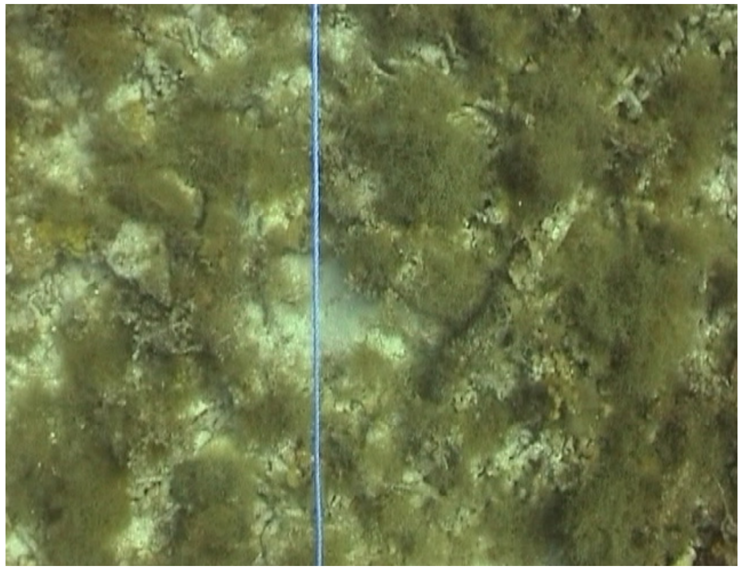

Fig. (2a). Macroalgal cover along one of the transects at M1.

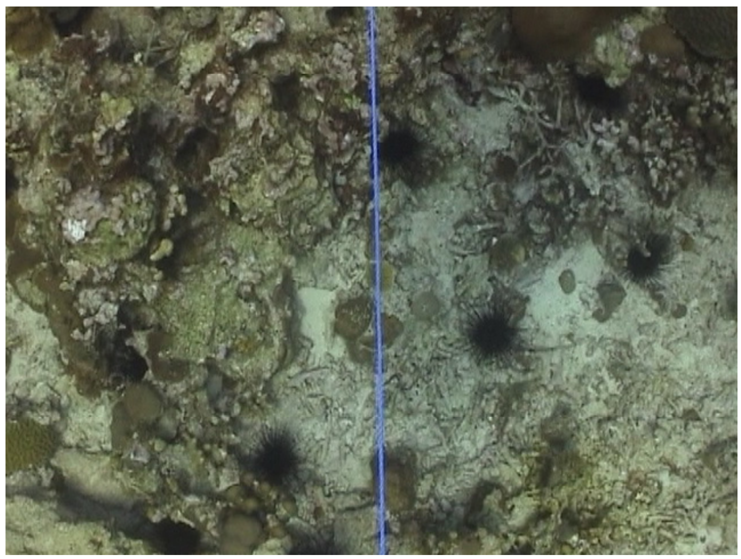

Fig. (2b). Absence of macroalgal cover along one of the transects at Dairy Bull.

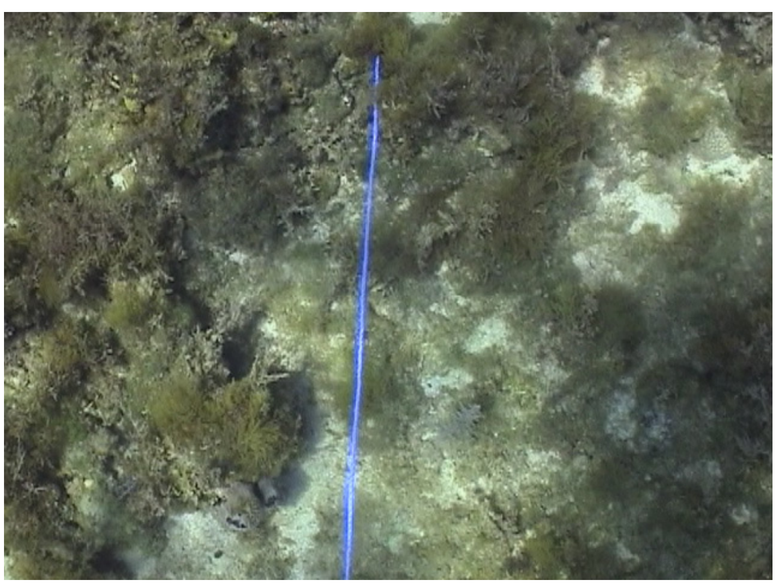

Fig. (2c). Macroalgal cover along one of the transects at Rio Bueno.

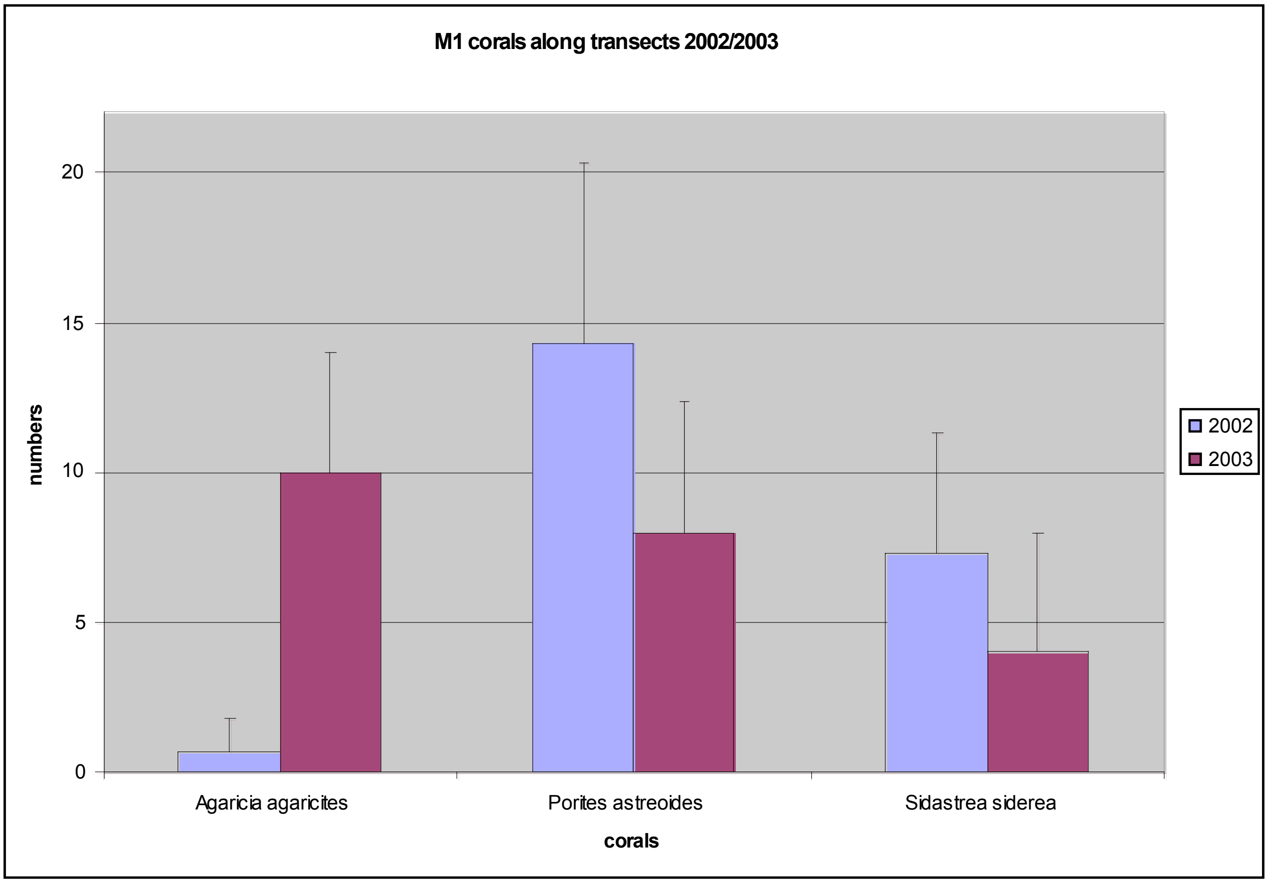

Fig. (3a). Numbers of *Agaricia agaricites*, *Porites astreoides* and *Sidastrea siderea* corals (mean ± s.d. of data) along the transects at M1.

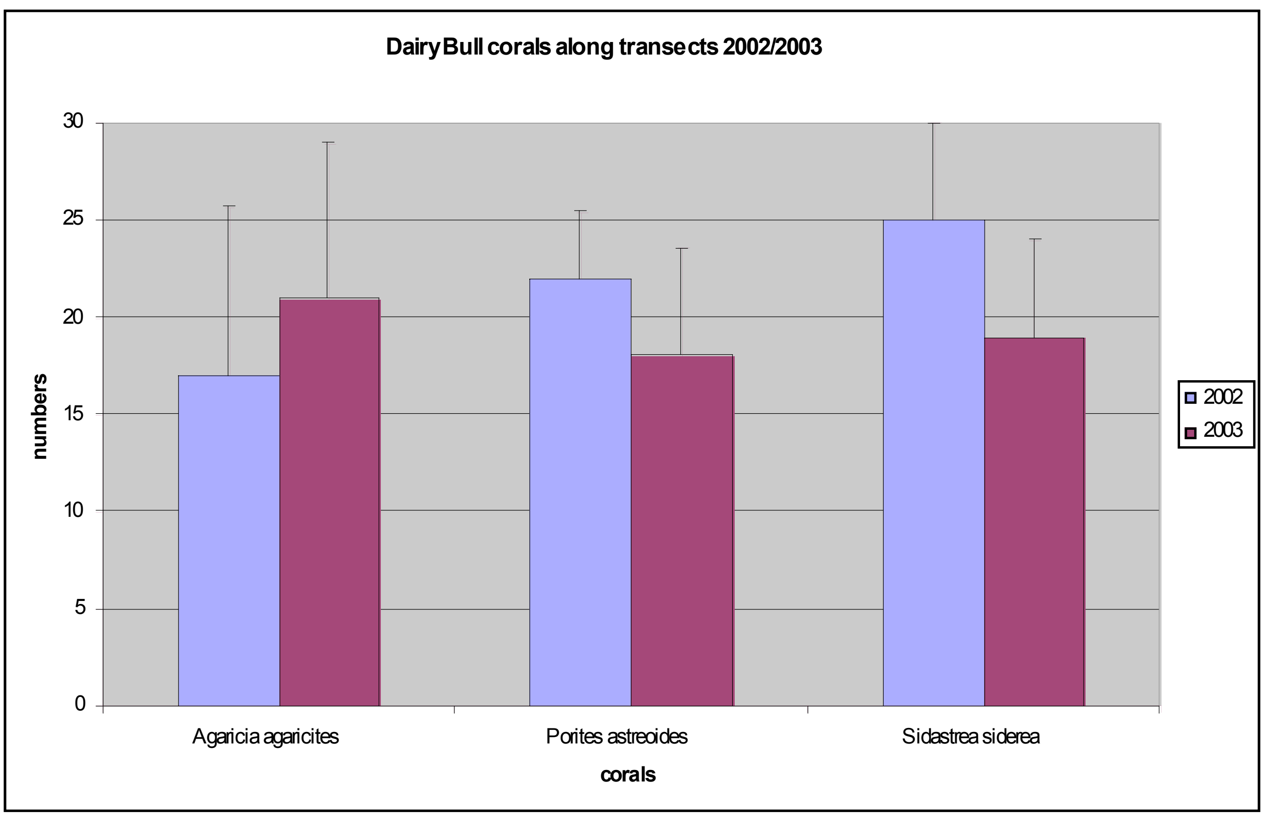

Fig. (3b). Numbers of *Agaricia agaricites*, *Porites astreoides* and *Sidastrea siderea* corals (mean ± s.d. of data) along the transects at Dairy Bull.

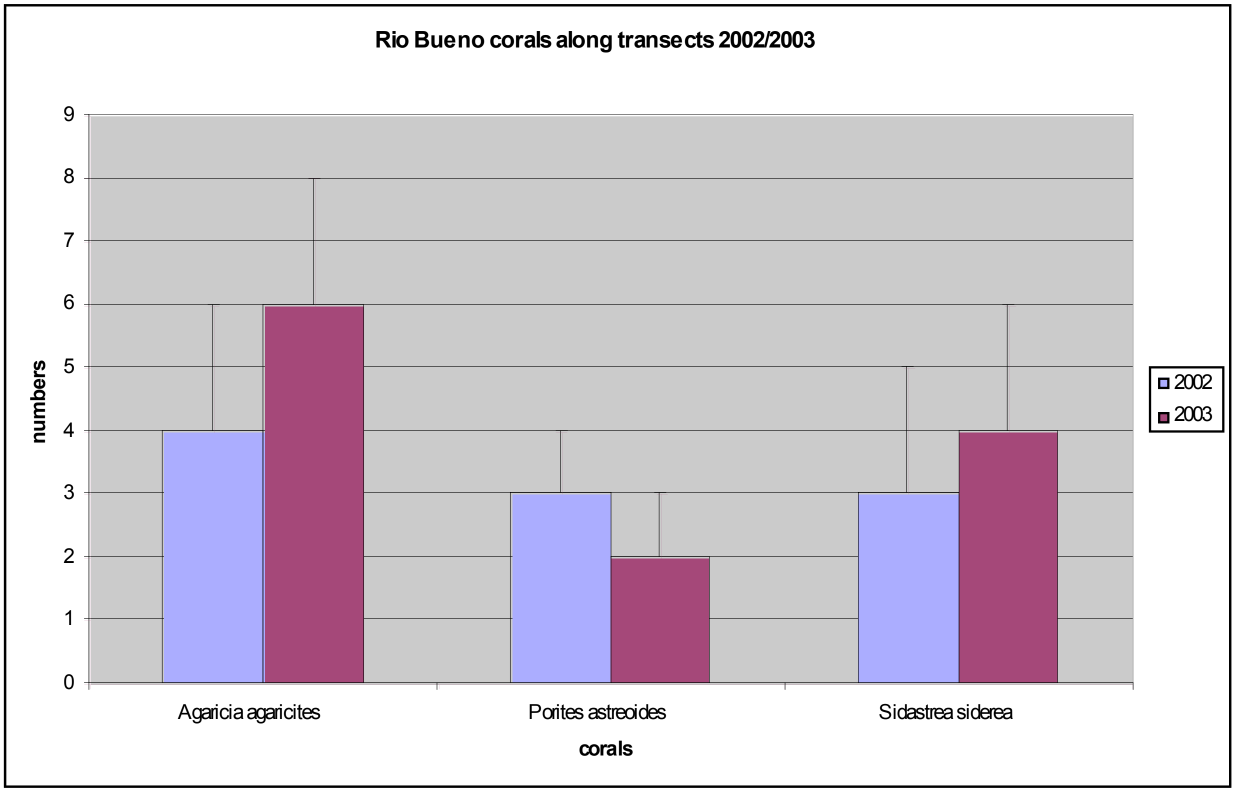

Fig. (3c). Numbers of *Agaricia agaricites*, *Porites astreoides* and *Sidastrea siderea* corals (mean ± s.d. of data) along the transects at Rio Bueno.

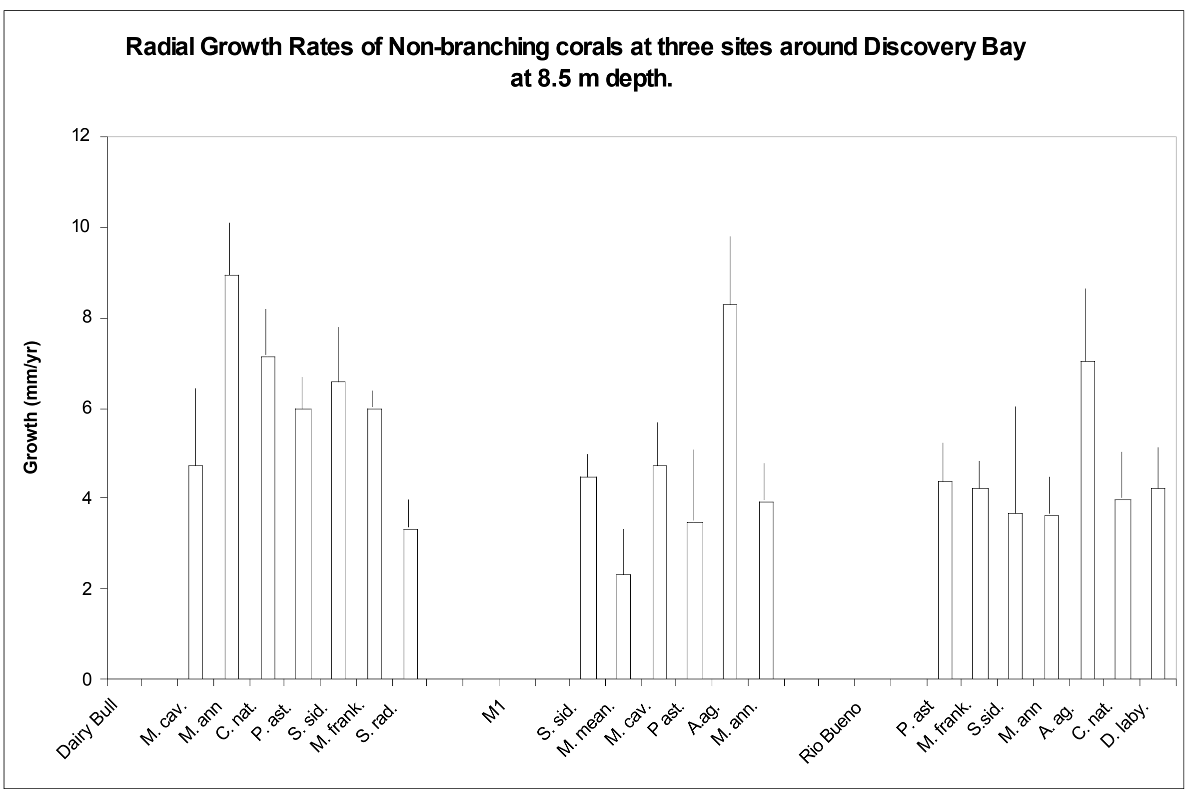

Fig. (4). Radial growth rates (mm/yr) of non-branching corals at Dairy Bull, M1 and Rio Bueno, at 8.5 m depth. Corals were: *Montastrea cavernosa* (M. cav); *Montastrea annularis* (M. ann); *Colpophyllia natans* (C. nat); *Porites astreoides* (P.ast); *Sidastrea siderea* (S. sid); *Montastrea frankseii* (M. frank); *Siderastrea radians* (S. rad); *Meandrina meandrites* (M. mean); *Agaricia agaricites* (A. ag); *Diploria labyrinthiformis* (D. laby).

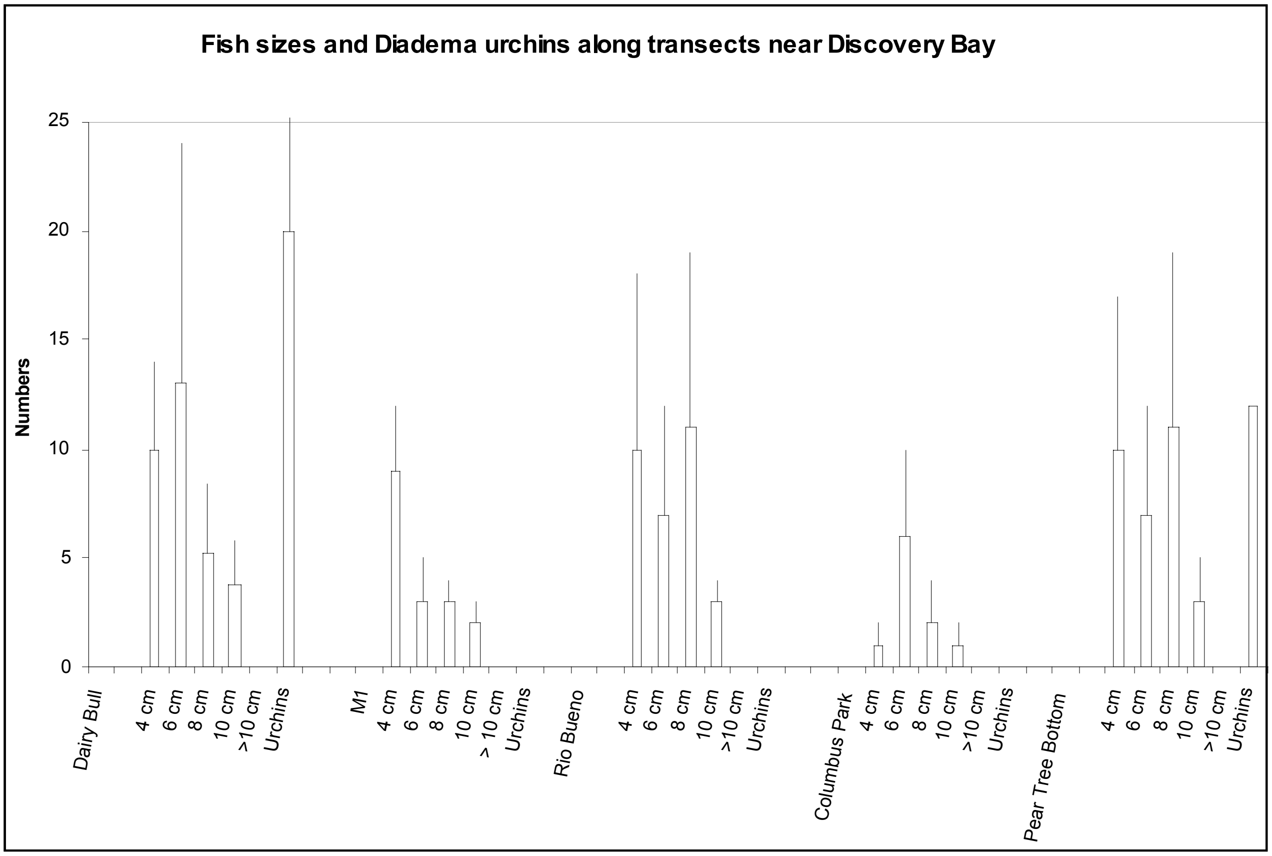

Fig. (5). Fish size and urchin (*Diadema antillarum*) number counts along transects at Dairy Bull, M1, Rio Bueno, Columbus Park, and Pear Tree Bottom. The y-axis refers to the mean abundance of fish and urchins along the 12 m transects, 2 m either side of the transect line, and, for fish, up to 4 m in height.

case of *Montastrea cavernosa* was there no significant difference in radial growth rates between the three sites.

The majority of fish at all sites studied were *Pomacentridae* (damselfishes and wrasses) and *Scaridae* (parrotfishes). While there were no significant differences in fish size counts over the sites studied, Dairy Bull showed by far the highest number of *Diadema antillarum* urchins, followed by Pear Tree Bottom (Fig. **5**). There were no urchins along the transects at M1, Columbus Park or Rio Bueno.

DISCUSSION

There have been numerous studies on environmental and other parameters on the fringing reefs of Discovery Bay, Jamaica (see e.g. [11, 12]). Competition with algae can play a significant role in structuring coral communities [13] and in extreme cases can lead to significant decline [14]. While fish of the genus *Scaridae* are important for algal predation [3,4], they can also be detrimental to corals [15]. In this study the Scarids were generally small at < 8 cm in length, with overfishing limiting their beneficial effect on the reef, as elsewhere in the Caribbean [16]. It has been suggested that macroalgal shading as well as contact is a significant inhibitor of coral growth, and our results are in accord with that hypothesis. Indeed, only *Montastrea cavernosa* colonies showed no significant difference in radial growth rates where there was high macroalgal cover. This may have been because the *Montastrea cavernosa* colonies were generally tall, with the majority of coralites well above the macroalgal cover. The fringing reefs of Discovery Bay are prey to both chronic and acute disturbances [17], as elsewhere in the Caribbean [18,19]. The major macroalgal grazer was *Diadema antillarum*, and that species had removed all macroalgae from our transect sites at Dairy Bull, allowing coral growth at rates higher than those at other sites where there was greater macroalgal cover. These studies suggest that marine park managers should foster macroalgal predation wherever possible, in order to limit the irreversible decline of coral reefs.

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