DISCUSSION

We found that parrotfish preferentially grazed on blades with epiphytes. For a given grazing effort, the energy return is higher on these blades than blades without epiphytes, so they should be preferred by fish which forage optimally. Additionally, among epiphyte laden blades, the taller blades were preferred by grazers. Since parrotfish select blades visually (J. J. Gilbert, *pers. comm.*), the easily seen tall blades are expected to be most heavily grazed. Emergent blades would be less apt to be passed over because they stand out from the rest of the bed.

These data suggest that the parrotfish may be foraging optimally, by minimizing search time and foraging preferentially on those blades offering the highest energy return. The grazing levels on the two epiphyte-free treatments further support this possibility, since fish almost never graze on the blades providing low return if they have to search for them in the bed, but they will graze occasionally above the bed.

This continuum of choice suggests that the energy return of the epiphytes is the factor which most strongly determines grazing choices, but that reducing search time is also important. If parrotfish are actively foraging for most of the day, they would be expected to put a higher premium on a high energy return than slightly decreasing their search time. Therefore, while the fish appear to be opportunsitic grazers of emergent blades, they seem to allocate most of their foraging effort in searching for high energy, epiphyte-laden blades.

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Density and size structure of two sea urchin populations in back reef seagrass beds

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Abstract: The sea urchins *Lytechinus variegatus and Tripneustes ventricosuss* (Temnopleuroida: Toxopneustidae) are two coexist in Caribbean back reef turtle grass (*Thalassia testudinium*) beds. Since both species feed on *Thalassia*, inter- and intraspecific competition may be influencing the two populations. We examined the density and population size structure of the two species within *Thalassia* beds. *Tripneustes* occurred at higher densities than *Lytechinus* in our transects and may be a better competitor in this environment. Size distributions of the two species differed; *Tripneustes* had a bimodal frequency distribution with peaks at 3 cm and 8 cm test diameter. The smallest sizes may represent the youngest cohort. *Lytechinus* showed only one peak in its size distribution at 6 cm test diameter. At high conspecific densities, *Tripneustes* had a smaller mean test diameter than at low densities; reasons for this are unclear.

Key Words: abundance, competition, Lytechinus, *size distribution,* Tripneustes

INTRODUCTION

Lytechinus variegatus and Tripneustes ventricosus (Temnopleuroida) are two coexisting sea urchin species found in Caribbean back reef *Thalassia* seagrass beds. *T. ventricosus* feeds predominantly on *Thalassia* and other plant material, while *L. variegatus* is a generalist feeder (Keller 1983). Past studies at Discovery Bay examined urchin densities at different locations along the reef and found the highest urchin densities to be in grass beds (Eaken et. al., 1998). Interspecific competition may influence the respective densities and population size structure of the two species, and lead to competitive dominance by one species. At high densities, intraspecific competition may also influence population structures of the two species.

We hypothesized that the similar feeding ecologies and habitat requirements of the two urchin species would lead to similar population structures, and that competitive dominance would lead to higher relative abundance of one species. Specifically, we predicted that *T. ventricosus*, a specialist *Thalassia* feeder, would occur at greater densities in the grass beds than *L. variegatus*. We further predicted that intraspecific competition would lead to smaller sized individuals in areas of high conspecific density for both species.

METHODS

On 28 February and 1 March 1999, we established four 2 x 10 m transects in the western back reef basin at Discovery Bay, Jamaica. The transects were placed perpendicular to the reef crest, beginning at the margin of the *Thalassia* turtle grass beds nearest the reef and extending into the grass beds. Using both sight and touch,_we located each individual of the two urchin species and measured test diameter.

RESULTS

We found 183 individual urchins, 143 *T. ventricosus*, and 40 *L. variegatus*. The mean population density of *T. ventricosus* was significantly greater than the density of *L. variegatus* (Fig. 1; mean ± SE: 1.75 ± 0.45 and 0.54 ± 0.61 per m^2, respectively; t-test: $t = 3.17$, $df = 6$, $P = 0.02$). The frequency distribution of test diameters differed greatly between the two species. *L. variegatus* showed a unimodal distribution of diameters, with a peak at 6 cm (Fig. 2a). *T. ventricosus* diameters fell into a bimodal distribution, with peaks at 3 and 8 cm (Fig. 2b). There was a significant inverse relationship between test diameter of *T. ventricosus* and conspecific density in each transect (Fig. 3; $r^2 = 0.91$, $F = 20.06$, $P = 0.05$). For

L. variegatus, the relationship between test diameter and conspecific density was not significant (P > 0.50). No relationship between mean test diameter of each species and total density was found (P > 0.20 for both species).

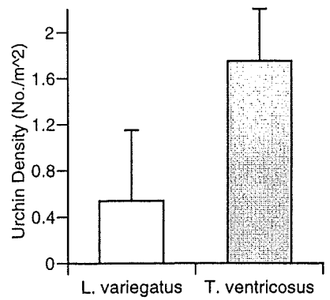

Fig. 1. Density of two sea urchin species at Discovery Bay , Jamaica. Bars show mean density (± SE) at four 2 x 10 m transects (t- test, t = 3.17, df = 6, P = 0.02).

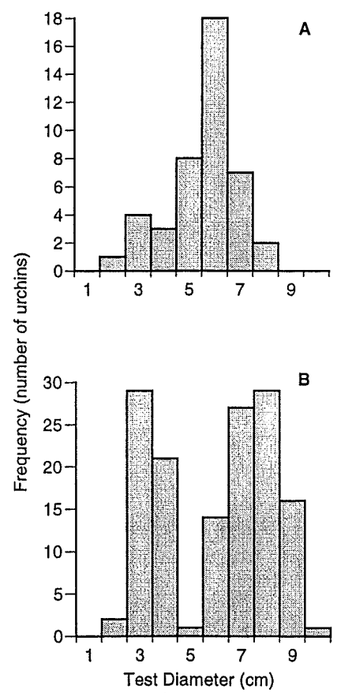

Fig. 2. Frequency distribution of test diameters for two species of sea urchins at Discovery Bay, Jamaica. A: *L. variegatus* B: *T. ventricosus* .

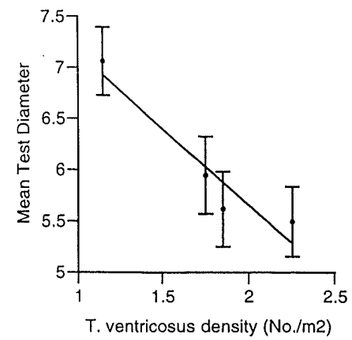

Fig. 3. Mean test diameter (± SE) of *T. ventricosus* as a function of conspecific density at Discovery Bay, Jamaica. The inverse correlation is significant (r2 = 0.91, F = 20.06, P = 0.05).

DISCUSSION

The higher densities of *T. ventricosus* compared to *L. variegatus* suggest that *T. ventricosus* may be the superior competitor in *Thalassia* beds. *T. ventricosus* feeds almost exclusively on *Thalassia* while *L. variegatus* is more omnivorous (Keller 1983). Therefore, one might expect to find higher *T. ventricosus* densities in these seagrass beds. Other areas should be surveyed to see if this pattern is general.

The size distribution of *L. variegatus* (Fig. 2a) showed a single peak in the number of urchins around 6 cm test diameter. High adult survivorship, along with a decline in the growth rate of the test with increasing size could result in an accumulation over time of individuals of a certain size class. Alternatively, this peak may represent a cohort of a year with a disproportionately high recruitment.

The size distribution of *T. ventricosus* was bimodal (Fig. 2b). This could indicate selective pressure (e.g. predation) is acting disproportionately on *T. ventricosus* with intermediate-sized test diameters (~ 5 cm). More plausibly, this pattern may represent distinct cohorts from different years.

Different reproductive patterns have been reported for the two species in different areas

in the Caribbean, although no patterns have been reported for Jamaica. In Panama, spawning of *L. variegatus* appears linked to the lunar cycle throughout the year (Lessios 1991). In Florida, *T. ventricosus* spawns during the spring and summer (Moore et. al. 1963).

T. ventricosus exhibited an inverse correlation between test size and conspecific density (Fig. 3) but not between size and total urchin density, suggesting that intraspecific interactions are more important than interspecific interactions in determining *T. ventricosus* densities. The reasons for this correlation are unclear, as food does not appear to be a limiting resource in seagrass beds. No relationship between test diameter and total or conspecific density was found for *L. variegatus*. This suggests that intraspecific competition is less important for this species, possibly due to its low densities in seagrass beds.

Differences in size distribution and densities, as well as differences in the relationship between test diameter and density, indicate differences in population dynamics between *T. ventricosus* and *L. variegatus*. These differences suggest niche partitioning in terms of life history strategies and resource use, which may help explain the coexistence of these competing urchin species in *Thalassia* seagrass beds.

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