DIFFERENTIAL PATTERNS OF DISPERSION AND ABUNDANCE IN SEA URCHINS *TRIPNEUSTES VENTRICOSUS* AND *LYTECHINUS VARIEGATUS*

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Abstract: Differing physical attributes and behaviors may affect patterns of dispersion and abundance in taxa utilizing similar resources. Here, we examine these patterns in the *Tripneustes ventricosus* and *Lytechinus variegatus* sea urchins inhabiting turtle grass beds and rocky habitats in the back reef of Discovery Bay, Jamaica during both the day and night. We hypothesized that differences in grazing pressure, structural constraints, and other behavioral habits, would lead to differential abundance and dispersion not only between these two urchin species, but also within species depending on habitat and time of day. We found that in the turtle grass *T. ventricosus* was overdispersed during the day and near random at night, while *L. variegatus* remained near-randomly distributed regardless of time of day. In the rocky habitat, both *T. ventricosus* and *L. variegatus* were aggregated to some degree both during the day and at night. Habitat type seemed to be a better predictor of abundance than time of day for both species, as *T. ventricosus* and *L. variegatus* abundances varied more between habitats than between day and night. Further studies are needed to determine the forces driving habitat selection and dispersion in both urchin species.

Key Words: Discovery Bay, food limitation, habitat preference, nocturnal migration

INTRODUCTION

Two species of sea urchin, *Tripneustes ventricosus* and *Lytechinus variegatus,* coexist in the lagoon and back reef of Discovery Bay, Jamaica. Although these species are present in roughly the same area, taxon-specific behaviors and physical constraints that drive their habitat selection may lead to differences in their dispersion and abundance. Because the dominant forces behind habitat selection may shift over space and time, we examine distribution and abundance in two adjacent habitat types, turtle grass beds and rocky habitats, during both the day and night.

Both *L. variegatus* and *T. ventricosus* are grazers of turtle grass, *Thalassia testudinum,* although the former tends to select decayed blades (Monteque 1991) while the latter prefers live leaves (Klumpp 1993). This partitioning of turtle grass resources may reduce interspecific competition for food and promote the coexistence of these two species. Because *T. ventricosus* sometimes overgrazes turtle grass (Lilly 1975), which is also eaten by *L. variegatus,* food may be limiting for both of these species. We predict that both *T. ventricosus* and *L. variegatus* should be overdispersed in turtle grass habitat during both day and night in order to minimize intra - and inter - specific competition.

T. ventricosus is known to migrate from turtle grass beds to rock promontories when night falls, although the reasons for this movement are poorly understood (Todd and Kilmarx 1983, Tertschnig 1989).

We also observed that *T. ventricosus* tends to occupy patches of three-dimensional structure in rocky areas, which could generate an aggregated dispersion pattern of these urchins in rocky habitat. Thus, we predict that *T. ventricosus* would have an aggregated dispersion pattern in rocky habitat during both day and night, and should be more abundant on rocky habitat at night than during the day.

While *T. ventricosus* is found throughout the turtle grass lagoon and rocky back reef habitat, *L. variegatus* is less adept at attaching itself to substrates and thus cannot persist in areas of high wave action (Sharp and Grey 1962). *L. variegatus* is also intolerant of suspended silt and tends to abandon areas of high turbidity (Moore 1963). These findings suggest that *L. variegatus* should be largely absent from rocky, exposed areas of the back reef from which they would likely be dislodged, instead preferring the turtle grass beds where leaf blades slow water movement and cause silt to settle out of the water column (Gilbert, pers. comm.). Dispersion of *L. variegatus* is unlikely to change from day to night, as it avoids exposed rocky areas and does not exhibit diel migration, but we predict that *L. variegatus* will be less abundant in rocky habitats than it is in turtle grass beds.

METHODS

On 24–25 February 2005, we counted *Tripneustes ventricosus* and *Lytechinus variegatus* in 2 m^2, haphazardly-placed quadrats in turtle grass beds and rock habitats in the back reef of Discovery Bay, Jamaica. We sampled eight quadrats in each habitat type during one afternoon (1600) and one night sampling period (0400) for a total of 32 quadrats. As the urchins can be somewhat cryptic in both their appearance and their behavior, counts were made by two independent observers and averaged to more accurately determine abundance.

We used variance to mean ratios (VMR) to assess differences in dispersion patterns between species and substrate types at different times of day. A VMR equal to 1 indicates random dispersion, while a value > 1 indicates aggregation, and a value < 1 indicates overdispersion. We used two-way ANOVAs to determine how habitat type and time of day affect the abundance of each urchin species (JMP 5.0.1)

RESULTS

During the day, we found that *Tripneustes ventricosus* was clearly overdispersed in the turtle grass beds, while *Lytechinus variegatus* was only slightly overdispersed. In the daytime on rocky habitat, *T. ventricosus* was strongly aggregated and *L. variegatus* was slightly aggregated. Both urchin species were slightly aggregated in the turtle grass at night, and *T. ventricosus* was aggregated in the nighttime rocky habitat while *L. variegatus* was only slightly so (Table 1).

Location had a marginally significant effect on *T. ventricosus* abundance; this species was more abundant in rocky habitat than in turtlegrass ($F = 2.95$, $df = 3, 28$, P

= 0.097; Fig. 1). There was no effect of time of day (F = 0.87, df = 3, 28, P = 0.358), and no interaction between habitat and time of day (F = 0.48, df = 3, 28, P = 0.493). There were more *L. variegatus* in the turtle grass beds than in the rocks (F = 65.59, df = 3, 28, P < 0.0001; Fig. 1). Neither time of day (F = 0.22, df = 3, 28, P = 0.646) nor the interaction between time and location (F = 1.76, df = 3, 28, P = 0.195) affected *L. variegatus* abundance.

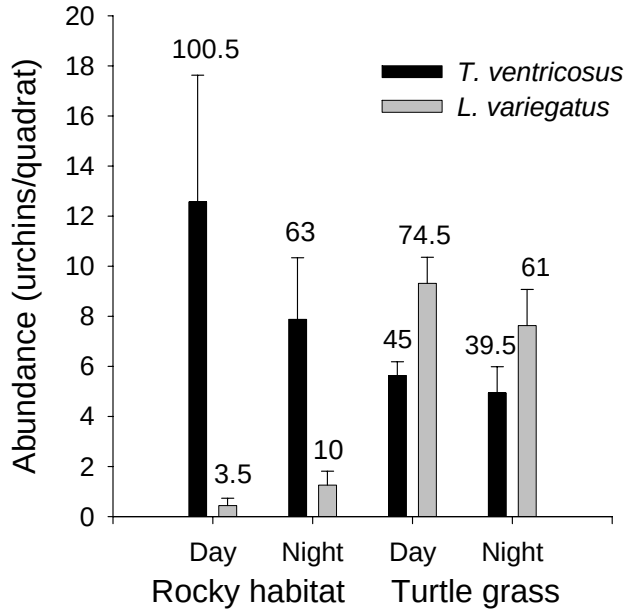

Figure 1. Day and night abundances of *Tripneustes ventricosus* and *Lytechinus variegatus* in turtlegrass beds and in rocky habitats. Error bars show mean ± 1 SE. Numbers indicate total urchins sampled in each habitat type and time of day.

DISCUSSION

Our results showed that *Tripneustes ventricosus* was strongly overdispersed in turtle grass habitat during the day and slightly aggregated in this habitat at night. Daytime grazing behavior could cause the overdispersion we saw in turtle grass beds during this time period. At night, urchins may not be grazing as actively, and thus would not overdisperse to reduce feeding competition. In the absence of grazing pressure, other factors such as mate location or distribution of predator refuges could lead to the more clumped dispersion pattern of *T. ventricosus* at night.

In rocky habitat, *T. ventricosus* was patchily distributed during both day and night. We observed that in rocky habitat, *T. ventricosus* was commonly elevated on rock promontories, rather than the benthos, suggesting that its distribution in this habitat may be driven more by preference for certain physical structures than feeding pressures.

Contrary to the finding that *T. ventricosus* nocturnally migrates to rocky habitat (Braden and Leander 2001), we did not find significantly more *T. ventricosus* in rocky areas or fewer in turtle grass beds at

Table 1. Dispersion patterns of *T. ventricosus* and *L. variegatus* in two habitats during the day and at night, as indicated by variance-to-mean ratios (VMR).

Urchin species	Time	VMR	
		Turtle grass	Rocky habitat
T. ventricosus	Day	0.44	16.33
	Night	1.77	6.15
L. variegatus	Day	0.92	1.54
	Night	2.18	2.00

night. One explanation for this result is that *T. ventricosus* may not move more than 8 m a day (Tertschnig 1989), and the patches we sampled were not close to the interface between rocky and turtle grass habitats. *T. ventricosus* distribution on rocky habitats was less aggregated at night than it was during the day, which is inconsistent with their observed migration patterns. Further study is needed to better understand the nocturnal migration and resulting dispersion patterns of *T. ventricosus*.

Our results showed that *Lytechinus variegatus* was close to randomly dispersed in turtle grass habitats during the day, which suggests that they may not experience the food limitation that we posit causes the overdispersion pattern in *T. ventricosus*. We found that *L. variegatus* was somewhat more aggregated in turtle grass at night, which might be the result of predation pressures or mating behavior. Lastly, we found that *L. variegatus* was slightly aggregated in rocky habitat at both day and night, but this result may be unreliable given the extremely low densities of this species in rocky habitats.

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