DIEL ZOOPLANKTON VARIATION IN A CARIBBEAN BACK-REEF

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Abstract: Many zooplankton populations exhibit diel vertical migration (DVM), a behavioral adaptation where zooplankton minimize exposure to predators by ascending into the water column at night to feed and retreating to the benthos during the day. We predicted zooplankton on a Caribbean back-reef would exhibit DVM. Thus, we predicted that abundance in the upper water column would be greater during the night, and that this trend would be especially strong for larger zooplankton which are subject to more intense visual predation. After sampling in the afternoon and evening we found more zooplankton during the night than day; additionally we found that large copepods, decapod larvae, and polychaete larvae were more abundant at night. Thus, these data supported both predictions.

Key Words: zooplankton, diel vertical migration, copepods

INTRODUCTION

Many marine organisms are either entirely planktonic, or have evolved a complex life cycle which includes a planktonic larval stage. These planktonic organisms are susceptible to intense predation and have therefore evolved behavioral mechanisms to reduce predation pressure while feeding. Such a mechanism is diel vertical migration (DVM), in which these organisms rise into the water column to feed at night and seek refuge in the benthos from visual predators during the day.

We hypothesized that zooplankton on the back-reef of Discovery Bay, Jamaica would exhibit DVM. Therefore, we predicted that zooplankton abundance would be greater at night than during the day. Additionally, because larger zooplankton may be more susceptible to diurnal visual predation, we predicted that among and within taxa this trend would be specially pronounced for large individuals.

METHODS

We collected zooplankton on 25 February 2006 along a 20 meter transect approximately 20 meters south of the reef crest in the west back-reef of Discovery Bay, Jamaica. We collected four day samples from 1400 – 1500 and four night samples from 2200 – 2300 by swimming approximately 0.5 m/s along the transect with a completely submerged (~.5 m below water surface and ~.5 m above substrate) 153 μm mesh net (26 cm diameter). The volume of water filtered for each sample was about 1.06 m^3. We immediately preserved collected samples in the field in 10% formalin sea water and counted and measured all zooplankton in each sample under dissecting microscopes within 24 hours. To examine differences between night and day in overall zooplankton abundance, as well as within size classes of abundant taxa, we used one-way ANOVA on log (x + 1) transformed data.

RESULTS

In total, we sorted 482 zooplankton (Table 1). These numbers are much lower than in previous years (Hunter et al. 2005, Iwamoto et al. 2003). However, visual surveys of the area revealed few zooplankton, so we do not believe this change is a result of sampling error.

In general, there were more zooplankton in the night samples (97 ± 22 organisms/m^3) than in the day samples (24 ± 6 organsims/m^3; $F_{1, 6} = 13.60$, $p = 0.01$). Copepods made up 82% of the day samples and 21% of the night samples. Night samples were primarily composed of polychaete larvae (40%), decapod larvae (19%) and isopods (11%).

We found differences in abundances between day and night samples for the three most abundant taxa that we identified. There were more large copepods (> 1mm) at night than during the day ($F_{1, 6} = 23.67$, $p = 0.0028$), but there were no differences between night and day for other copepod size classes (Fig. 1a) or for copepods overall ($p > 0.5$). There were many more decapods overall at night ($F_{1, 6} = 92.92$, $p < 0.0001$). Only a few decapods in the smallest size class were found during the day (Fig. 1b). There were also more polychaete larvae overall at night ($F_{1, 6} = 100.82$, $p < 0.0001$). Only a few polychaetes in the smallest size class were found during the day (Fig. 1c).

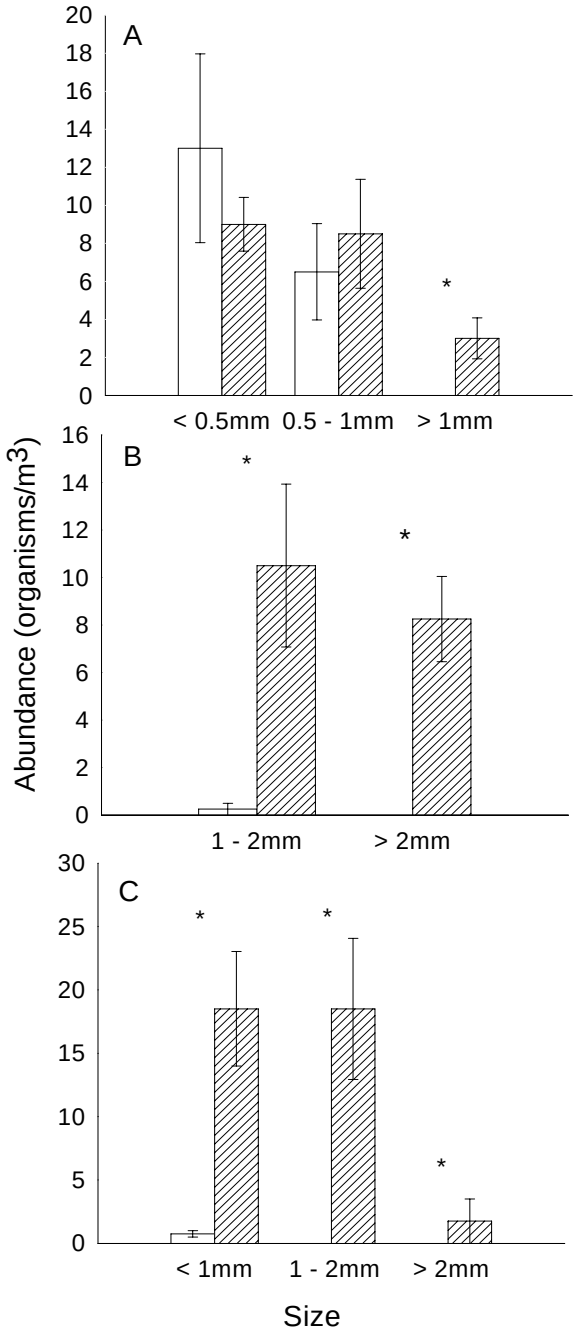

Figure 1. Abundance (mean ± SE) of copepods (A), decapod larvae (B), and polychaete larvae (C) in samples collected during the day (light bars) and at night (shaded bars) at Discovery Bay, Jamaica. Individuals in each taxa were divided according to size class. Asterisks indicate significant differences ($p < 0.05$).

Table 1. Total number of zooplankton in samples collected during the day and at night.

Taxa	Day	Night
Copepods (< 0.05mm)	52	36
Copepods (0.5 - 1mm)	26	34
Copepods (> 1mm)	0	12
Decapods (1 - 2mm)	1	42
Decapods (> 2mm)	0	33
Amphipods (< 1mm)	2	1
Amphipods (1-2mm)	1	9
Amphipods (> 2mm)	0	4
Isopods (< 1mm)	5	12
Isopods (1 - 2mm)	1	26
Isopods (> 2mm)	1	5
Mysids (2 - 4mm)	0	0
Mysids (4 - 6mm)	0	2
Fish larvae (< 2mm)	0	3
Fish larvae (2 - 4mm)	0	3
Fish larvae (> 4mm)	0	1
Polychaete larvae (< 1mm)	3	74
Polychaete larvae (1 -2mm)	0	74
Polychaete larvae (> 2mm)	0	7
Cumacean Shrimp	2	4
Other (Gastropods, Ostracods)	1	5
Total	95	387

DISCUSSION

Many zooplankton in Discovery Bay undergo a diel vertical migration, with larger size classes showing the greatest disparity between day-time and night-time abundances. The increased prevalence of large zooplankton at night is consistent with higher daytime predation as a selective pressure for DVM, with large zooplankton likely being more vulnerable to visual predators.

Zooplankton abundances, particularly copepods, were far lower than in previous studies that used similar methodology (Hunter et al. 2005, Iwamoto et al. 2003). Copepods made up 94% of night samples in 2003, 63% in 2005, but only 21% in our study. This may be the result of a continuing decline over time in copepod abundance and dominance. However, rough weather on the day we collected data is also a possible cause of decreased copepod and overall zooplankton numbers. The weather may have directly affected zooplankton; additionally, it may have had indirect effects, as it forced us to sample further from the reef crest than in past years, over a substrate of patch reef and sand.

LITERATURE CITED

Hunter, S.A., C.C. Carey, R.W. Trierweiler, S.J. Martinson and the 2005 FSP class. Diel zooplankton activity in the back reef at Discovery Bay, Jamaica. Dartmouth Studies in Tropical Ecology, p. 190-193.

Iwamoto, K.A., J.T. Lennon, K.S. Simon and 2003 FSP class. Zooplankton diel variation on a Caribbean back-reef. Dartmouth Studies in Tropical Ecology, p. 191-193.