Diel variation in herbivory on *Thalassia testudinium*

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Abstract: Turtle grass (*Thalassia testudinium*) in Discovery Bay, Jamaica, is eaten by three main herbivores: the green sea turtle, sea urchins, and parrotfish (*Scarus* spp.). Parrotfish activity varies over 24 hours: fish school in the sea grass beds during the day and leave them to hide at night. Furthermore, since the number of fish per school increases during the late afternoon, we predicted there should be diel changes in herbivory. The number of blades experiencing herbivory did not differ over time, which could be due to parrotfish preferentially feeding on blades which have already been bitten. However, the greater percent herbivory and greater total area of herbivory occurred in the late afternoon and early morning, and the least in the late morning/early afternoon and night. These findings suggests that there is a strong correlation between parrotfish activity and herbivory on turtle grass.

Key Words: Parrotfish, turtle grass, herbivory

INTRODUCTION

Turtle grass (*Thalassia testudinium*) is one of the dominant sea grass species in Discovery Bay, Jamaica. Robblee and Zieman (1984) found that the composition of fish species in turtle grass beds changed between day and night; the diurnal fishes were mostly herbivores, and the nocturnal fishes were all predators. Parrotfish (*Scarus* spp.), which are diurnal herbivorous fish, are one of three herbivore groups, including the green sea turtle and sea urchins, that feed on this sea grass. Schools of parrotfish spend the majority of the day in turtle grass beds, leaving them at night to hide. As fish often school to feed, and there are more fish per school in the afternoon between 1330 and 1630 (Glennon and Hubbard 1995), we hypothesized that there would be diel changes in herbivory. We predicted that the most herbivory on turtle grass would occur in the late afternoon (1430-1830), the least at night (1830-2230). Furthermore, we predicted that there would be more herbivory in the morning (600-1000) than the early afternoon (1000-1400), since it is unlikely that herbivorous fish feed at night and thus would need to replenish their energy reserves in the morning.

METHODS

Our experiment was conducted on 27 February 1999 at the Discovery Bay Marine Lab, Jamaica. Fifty *T. testudinium* blades were collected four hours prior to each placement (except *T. testudinium* for the 0600 placement, which was collected the night before), cut to 15 cm long, and attached to clothespins in groups of 5. Blades had no previous herbivory and had approximately the same epiphyte load. Two clothespins were tied to a bolt, and 5 bolts were laid out at each time. A buoy was tied to the central bolt, and the other four were placed within a meter of this one. Trials occurred for 4 hrs at 0600, 1000, 1430, and 1830. At the end of the trial, the grass was collected and percent herbivory for each blade was assessed. We estimated the average area of one blade to determine the area affected by the herbivory. Herbivory data was natural log transformed before analysis.

RESULTS

All replicates experienced some herbivory. The bites were small semi-circles on the leaf margins, concentrated at the tip of the blade, characteristic of parrotfish.

There was not a significant difference over time in the mean percent of blades affected by herbivory (Mean: 15%; X^2=2.89, df=3, P=0.41). However, mean percent of leaf tissue eaten by herbivores varied significantly with time (ANOVA on log transformed proportions: F=10.63, df=3, P=0.0014; Fig. 1).

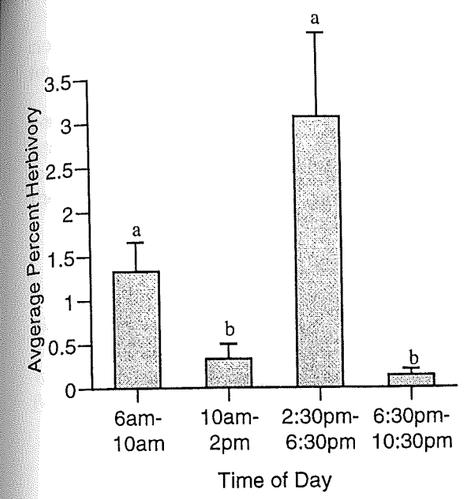

Figure 1. Mean (± 1 SE) percent tissue loss to herbivory on *Thalassia testudinum* sea grass at different times of day at Discovery Bay, Jamaica. There was a significant difference over time (p=0.0014; n=5 at each time point). Significantly different values are indicated by different letters.

The morning (0600-1000) and late evening (1430-1830) trials had the highest percent herbivory, while early afternoon (1000-1400) and evening (1830-2230) had the least (data was grouped, morning with late evening and early afternoon with early evening; X^2=12.75, df=1, P=0.0004). Also, mean total area of herbivory (cm^2 removed for ten blades) was significantly different over time (ANOVA on log transformed data: F=6.68, df=3, P=0.0078). The mean total area of herbivory was highest in the late afternoon sample (1.06 ± 0.23 cm^2), followed by the morning sample (0.65 ± 0.20 cm^2), then the early afternoon (0.15 ±0.07 cm^2), and the evening trial (0.06 ± 0.41 cm^2).

DISCUSSION

The fact that the mean number of blades showing signs of herbivory did not differ throughout the day may suggest that one fish ate multiple times on a single blade when herbivory was high. Alternatively, it may be that a bite on a blade attracts other fish to that particular blade. Perhaps a bitten blade signifies that it has a high epiphyte load and therefore, a high energy return. Also, damaged tissue may produce a chemical cue attracting other fish to previously bitten blades.

As predicted, parrotfish tend to eat more in the early morning and late afternoon than at other periods during the day. Although herbivory during the night was not quantified since the evening treatment was set out while there was still some light (1830), the small percentage of herbivory from 1830 to 2230 and the large percentage of herbivory from 0600-1000 suggests that there is likely no herbivory on sea grass blades at night. Furthermore, these diel changes in herbivory suggest that there is a strong correlation between herbivory and parrotfish activity in sea grass beds at different times of day.

LITERATURE CITED

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