DIURNAL AND NOCTURNAL HERBIVORY ON *THALASSIA TESTUDINUM* NEAR AND FAR FROM A PATCH REEF

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Abstract. Turtle grass, *Thalassia testudinum*, is an important food source for many reef-dwelling animals, including sea urchins and various species of parrotfish Most herbivorous fish in Jamaica are diurnal, but there are both diurnal and nocturnal urchins. We hypothesized that fish herbivory would be greater during the day and urchin herbivory would not vary between day and night. Because fish use reef crevices as protection from predators, we hypothesized that fish herbivory would be greater close to a patch reef compared to an open location 10 m from the reef. Because most urchins do not rely on reefs for protection, we also hypothesized that urchin herbivory would not vary between sites close and far from the same patch reef. We found that fish fed more during the day whereas urchins seemed to feed more during the night. Fish herbivory damage was higher far from the reef, but urchin herbivory damage did not change with distance from reef.

INTRODUCTION

Thalassia testudinum beds support a large number of fish and invertebrate grazers (primarily sea urchins). Herbivorous fish species, such as parrotfishes, feed actively during the day and rest at night (Randall 1968). In contrast, we expected that urchins would vary in their diel feeding patterns. Therefore, we hypothesized that fish herbivory, would be greater during the day and that urchin herbivory would not vary between day and night.

Fish hide in reefs to escape predators. If the threat from predators is high, herbivorous fish might selectively forage close to shelter. Therefore, we hypothesized that the amount of fish herbivory would be greater close to a reef compared to a more exposed location. Besides *Diadema antillarum*, urchins do not typically use reef crevices to avoid predation, so predation pressure should not limit their foraging to the area near a reef. Therefore, we hypothesized that urchin herbivory would not vary between sites close and far from a patch reef.

METHODS

We conducted our study on 21-22 February 1995 in the west back reef of Discovery Bay, Jamaica, at two sites about 40 m offshore from the marine laboratory. The first site contained a patch reef about 3 m in diameter at a depth of 3 m. The second site, 10 fin strokes (about 10 m) south of the first, had a sandy bottom at a depth of 2.5 m.

We collected 240 *Thalassia* blades with no herbivory damage from the lagoon immediately west of the laboratory's boat dock. Each blade was trimmed to approximately 18 cm. For both the night and day herbivory experiments, we put six blades in each of 20 clothes pins and tied two of these clothes pins to each of 10 metal bolts. Five of these bolts were placed about 1 m apart in the sand along the edge of the reef at site 1, and five bolts were placed about 1 m apart on the sandy bottom at site 2.

To assess nighttime herbivory, we placed the samples in the water at 11:30 PM and collected them the following morning at 5:30 AM (before sunrise). To assess daytime herbivory, we placed the samples at 11:30 AM and collected them at 5:30 PM (before sunset). Brady visually estimated the percent herbivory damage on each blade, and we assessed the type of herbivory damage (fish or urchin) based on the shape of the bite marks.

For statistical analysis, proportions were arcsine transformed to meet the assumption of normality.

RESULTS

We found that there were significantly more leaves with fish herbivory damage during the day compared to the night ($G=196.667$, $df=1$, $P<0.0001$). We found a weakly significant trend of more urchin damage in the night compared to the day ($G=3.424$, $df=1$, $P=.064$). Overall, we found 113 fish-damaged leaves in the day treatment, and 9 fish-damaged leaves in the night treatment. There was only 1 urchin-damaged leaf in the day and 7 in the night (Fig. 1).

Daytime fish herbivory was significantly higher far from the patch reef than close to the patch reef ($t=-6.411$, $df=112$, $P<0.0001$). There was no significant difference in amount of nighttime fish herbivory between the two sites ($P=0.729$) There was no significant difference in amount of nighttime urchin herbivory damage between the two sites ($P=1.00$). Only one leaf had daytime urchin herbivory damage. There was also no significant difference in total herbivory damage during day and night between the two sites ($P=0.118$).

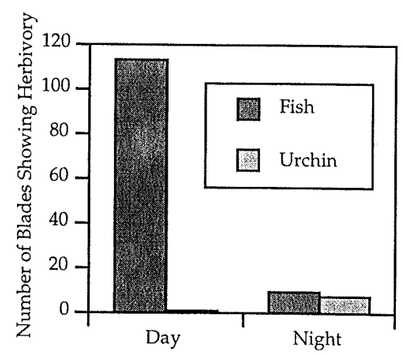

FIG. 1. Number of leaves showing fish or urchin damage in day and night treatments.

DISCUSSION

As hypothesized, fish fed on *Thalassia* more during the day than night, as most herbivorous fish forage during the day and rest at night. Although urchin herbivory appeared to be higher at night, daytime urchin herbivory might be higher than our results suggest. Up to 100% of exposed leaf area was consumed during the day, so we assessed type of herbivory based only on the visible bite marks. All visible bite marks on the most heavily damaged leaves were from fish, so potential urchin herbivory on areas later consumed by fish was not apparent.

Our finding that there was more fish herbivory farther from the reef suggests that fish are not limited to foraging close to shelter. Reefs offer shelter from predatory fish, so herbivorous fish might selectively forage close to reefs when predatory fish are abundant. Fish trapping in Jamaica has drastically reduced predatory fish abundance, lowering the predatory threat to herbivorous fish. *Thalassia* may be more abundant further from the reef, so fish foraging efficiency may be higher in beds further from the reef. The lower predation may allow the herbivorous fish to selectively forage in high quality areas further from shelter.

Our results also suggest that urchin foraging is not limited to areas close to the reef. *Tripneustes ventricosus* (the most common urchin in the back reef of Discovery Bay) and *Lytechinus variegatus* are present in *Thalassia* beds far from reefs throughout the day and night. Again, if foraging efficiency is higher further from reefs, urchins might selectively forage further from reefs. Our limited sample size ($n = 7$ blades with urchin herbivory damage), however, limits our ability to draw any strong conclusions about urchin foraging behavior.

Fish grazing intensity, estimated by the total number of leaves with fish herbivory damage was greater than urchin grazing intensity. Following the 1983 epidemic that killed 93% of the Caribbean *Diadema* population, fish grazing increased three to fourfold (Carpenter 1988). The decreased competition from *Diadema* and decreased

predation due to fish trapping probably allowed herbivorous fish populations to explode, making fish the dominant grazers in *Thalassia* beds in Discovery Bay.

To better address whether fish and urchins feed preferentially near to or far from reefs, future studies should distribute replicates among multiple patch reefs. Since we used only one patch reef, our results might not reflect more general trends in fish and urchin feeding behavior.

LITERATURE CITED

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