A COMPARISON OF HERBIVORY RATES ON TURTLEGRASS, *THALASSIA TESTUDINUM*, AT TWO CARIBBEAN SITES

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Abstract: Herbivory is believed to be a factor controlling seagrass distribution and abundance, but the type of herbivory, identity of the herbivores, and the consequent pattern of herbivory may vary among seagrass beds. The marine angiosperm *Thalassia testudinum*, or turtlegrass, is ubiquitous in the Caribbean, and is consumed primarily by fish and sea urchins. I predicted that *Thalassia* would experience higher herbivory in beds at Little Cayman Island than in beds at Discovery Bay, Jamaica, where fish and sea urchin populations are depressed. Instead, I found almost no evidence of herbivory on experimentally-placed *Thalassia* blades in beds at Little Cayman Island. I explore several mechanisms behind this unexpected result, including altered food webs, differences in bed configuration, and idiosyncratic characteristics of *Thalassia* subpopulations.

Key Words: Little Cayman Island, Discovery Bay, Jamaica, Scaridae, Diadema

INTRODUCTION

Tropical coral reef plants may experience the highest herbivory rates of any plant community on earth (Bolser and Hay 1996), and herbivory is thought to influence the productivity, abundance, spatial distribution, and chemical composition of algae and seagrasses (Randall 1965, Ogden *et al.* 1973, Ogden 1976, Hay *et al.* 1983, Bolser and Hay 1996, Valentine and Heck 1999). The angiosperm turtlegrass, *Thalassia testudinum*, dominates shallow-water seagrass beds throughout the Caribbean and feeds a number of marine species (Randall 1965, Ogden 1976). Chief among these herbivores are the sea urchin *Diadema antillarum*, a nocturnal feeder, and fishes of the Scaridae (parrotfish) family, which feed diurnally (Ogden *et al.* 1973, Ogden 1976, Hay *et al.* 1983). *Diadema* and most of the Scarids make regular forays from the reef to inshore seagrass beds, *Diadema* traveling up to 10 m (Ogden 1976) and Scarids traveling up to 500 m to feed (Valentine and Heck 1999). These forays may result in *Thalassia*-free "halos" surrounding coral outcrops, although which type of herbivore is responsible for the halo appears to be site-specific (Randall 1965, Ogden 1976, Valentine and Heck 1999).

Extensive herbivory has been reported on the *Thalassia* beds in Discovery Bay, Jamaica. For example, Berry *et al.* (1994) observed bite marks on 39% of

experimentally-placed *Thalassia* blades after just three hours, and Calvi *et al.* (2000) reported instances of 100% area loss of experimental blades over a 24-hour period. In Discovery Bay, Scarids appear to be the primary herbivores, followed by *Diadema* (Dums *et al.* 1997, Rutar *et al.* 1997, Berg *et al.* 1998). The reefs surrounding Little Cayman Island are undisturbed relative to those of Jamaica, where hurricane damage, overfishing, and disease have depleted fish, *Diadema*, and coral populations (Hughes 1994). Because herbivore habitat and populations are more intact at Little Cayman, I predicted that rates of herbivory on *Thalassia* blades at Little Cayman Island would be higher than those found previously at Discovery Bay. Furthermore, since herbivorous fish may be more abundant near coral head shelters, I predicted that there would be higher herbivory on *Thalassia* near the coral than on *Thalassia* near the shore.

METHODS

On the afternoon of 25 February, 2007 I collected undamaged *Thalassia* blades from the back reef and lagoon (landward of the reef crest) outside the Little Cayman Research Center, Little Cayman Island. I collected the blades haphazardly from two 120-m transects paralleling the shore – one in the *Thalassia* bed, approximately 20 m seaward, and the other within 6 m of the coral, where *Thalassia* appeared less dense. I selected 36 blades from each transect, choosing blades of similar width and with similar epibiont communities, and trimmed all to 8.25 cm long. I randomly grouped the *Thalassia* from each transect into 12 clusters of three blades each, and secured them together using clothespins weighted with steel bolts and flagged with buoys. On the evening of 25 February, 2007 I placed these blades in the fore-reef in a nested design. I chose six sites along the original two transects: three sites 20 m from shore in the *Thalassia* bed paired with three sites 4-6 m from the coral. Each site received four clusters of *Thalassia*, two clusters from the bed and two clusters from the region near the coral, placed approximately 80 cm from one another on the sandy substrate.

I checked the sites on the morning of 26 February, 2007, and noted the loss of one cluster and the entanglement of the buoys and clusters at three sites. Because the tangled string and buoys might deter herbivores, I untangled them and moved them slightly farther apart.

On 27 February, 2007 I collected all clusters 39 hours after placing them on the fore-reef.

RESULTS

Apart from a single Scarid bite mark, no leaf showed any sign of herbivory.

DISCUSSION

Despite extensive herbivore damage to *Thalassia* on the fore-reef of Little Cayman Island (personal observation), I found no evidence of short-term herbivory anywhere on the reef. My field methods differed only in minor details from those of previous short-term studies at Discovery Bay, Jamaica (Berry *et al.* 1994, Dums *et al.* 1997 Berg *et al.* 1998, Calvi *et al.* 2000). Contrary to my predictions, grazing pressure both near shore and near coral in the seagrass beds surrounding Little Cayman Island may be much lower than in Discovery Bay.

Differences in the populations of fish and sea urchins between Little Cayman Island and Discovery Bay may account for my finding. While *Diadema* density at Discovery Bay may be quite high (approximately one individual per square meter) (Dallison *et al.* 1999), I saw very few *Diadema* over the three days of the study. A lower level of fish herbivory at Little Cayman Island is more difficult to explain, but could be attributable to the nature of the overfishing afflicting Jamaica. Fishermen in Jamaica probably target larger fish, releasing small species (such as *Sparisoma radians*, the smallest Scarid and a species that uniquely lives in and mostly eats *Thalassia*) (Ogden 1976) from predation pressure, thus allowing them to expand their ranges and/or population sizes. However, in 1992, *Scarus taeniopterus* and *Sparisoma viride*, larger Scarid species, were the most abundant Scarids in the fore-reef of Discovery Bay (Bizzarro *et al.* 1992). Taking the prevalence of these large species into account, an alternative explanation for my finding could be that the depletion of living coral in Discovery Bay may have forced the Scarids there to graze in seagrass beds more frequently than they would otherwise. Future studies that document which Scarid species consume *Thalassia* at Discovery Bay would reveal which of these scenarios is correct.

The orientation of a seagrass bed in relation to the reef may also determine the extent to which the seagrass is consumed. While the beds at Little Cayman Island are in swaths that parallel the beach and reef crest, the bed studied at Discovery Bay is roughly square, bordered on one side by mangroves and on another by coral (Calvi *et al.* 2000). Fish and sea urchins may be more likely to enter the Discovery Bay seagrass bed because of the protection afforded by nearby mangrove roots and coral. *Thalassia* beds more similar to those at Little

Cayman do apparently occur in Jamaica, outside Discovery Bay (Macia and Robinson 2005); by comparing these beds to those at Little Cayman, researchers could start to disentangle the effects of seagrass bed layout and fish and urchin communities on herbivory.

Other features of seagrass beds that could influence herbivory include *Thalassia* density, the epibiont load of *Thalassia*, and *Thalassia* palatability. If *Thalassia* density were much higher in the beds at Little Cayman Island, an equivalent amount of total daily herbivory would be dispersed among more blades and would therefore be more difficult to observe. If epibiont density were lower in the Little Cayman *Thalassia* beds, they may be less nutritious for Scarid herbivores who prefer epibionts on the *Thalassia* they eat (Berry *et al.* 1994). Finally, future studies could test for differences in *Thalassia* toughness, chemical defenses, and other factors that may render it less palatable on Little Cayman Island than at Discovery Bay.

In contrast to my results, recent observational studies of the seagrass beds at Little Cayman Island suggest that patterns of herbivory may be similar to those of Discovery Bay. At Little Cayman, the number of bite marks on *Thalassia* leaves per unit area does not change with distance from the reef (Marlow *et al.* 2007); similarly, there is no distance effect on the amount of leaf material removed from experimental blades at Discovery Bay (Berg *et al.* 1998). It is possible that the tangled *Thalassia* clusters in this study frightened herbivores away, but given the consistent lack of herbivory across sites, it seems unlikely that the deterred herbivores would have eaten enough leaf material to equal the rates of herbivory at Discovery Bay. Further studies within *Thalassia* beds at Little Cayman Island may help explain the striking difference in levels of short-term herbivory between these two Caribbean locations.

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