Effects of blade height and epiphyte load on herbivory of *Thalassia testudinum*

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Abstract: Parrotfish are herbivores that graze in marine turtle grass (*Thalassia testudinum*) beds. We hypothesized that these fish have evolved an optimal grazing strategy in order to maximize their energy gain per unit time. We predicted that parrotfish would graze preferentially on *T. testudinum* blades covered with energy rich epiphytes to maximize their energy intake. We also predicted fish would minimize search time by preferentially grazing on blades taller than average bed height, as they are more visible and their quality can be easily assessed. Parrotfish grazing was estimated by measuring herbivory on *T. testudinum* blades with differing epiphyte loads (present or absent) at two different heights (average bed height and 5 cm above bed height). Herbivory increased with increased height, but was more strongly correlatated with a higher epiphyte load. These results suggest that maximizing energy intake may be more important to optimal grazing than minimizing search time, as the fish may spend 12 hours grazing daily.

Key Words: grazers, parrotfish, turtle grass

INTRODUCTION

Turtle grass beds (*Thalassia testudinum*) are productive marine communities found on sandy substrates to a depth of 8 m (Phillips 1978). Turtle grass blades often accumulate epiphytes, including calcareous red algae, diatoms, and filamentous algae (Ogden 1976). These epiphytes provide a rich nutrient source for parrotfish (family Scaridae), and other herbivores grazing on *T. testudinum* (J. J. Gilbert, *pers. comm*).

Parrotfish are visually oriented grazers thought to select epiphyte covered blades in order to maximize their feeding efficiency (J. J. Gilbert, *pers. comm.*). Therefore, we predicted that to maximize energy gain per unit time, parrot fish would preferentially graze on more nutritious, epiphyte laden blades. Furthermore, as suggested by Douzinas et al. (1998), we hypothesized that blade height would affect the amount of herbivory on the grass. Emergent blades would be preferred as they stand out from other blades in the bed, and thus their epiphyte load can be quickly assessed, reducing search time. Finally, we examined the relative importance of maximizing energy gain (epiphyte load) vs. minimizing time spent foraging (blade height).

METHODS

On 27 February 1999 we measured turtle grass herbivory in Discovery Bay, Jamaica, using a factorial experimental design with two height levels (average and 5 cm above average) and two epiphyte load levels (present and absent). We collected 100 ungrazed *Thalassia testudinum* blades with high epiphyte loads and 100 ungrazed blades with low epiphyte loads, all from the seagrass bed within 100 m of the dock. All blades were cut to 10 cm in length. For the non-epiphyte treatments we rubbed and rinsed each blade with a low epiphyte load in freshwater to remove any epiphytes.

The experiment consisted of four treatments: 5 cm above the bed with epiphytes, 5 cm above the bed without epiphytes, average bed height with epiphytes, and average bed height without epiphytes. For each treatment we performed 10 replicates in 5 sites (2 per site). Each individual replicate consisted of 5 blades secured on a clothespin (so that it could float in the water column) and anchored with a bolt. All 5 sites were located in a *T. testudinum* bed 20 m from the reef crest, as parrotfish herbivory is supposed to be strongest within 50 m of the crest (Berg et al. 1998). After 6 hours, we collected the blades and estimated herbivory on each blade as percent foliage loss. The five herbivory estimates on each

clothespin were averaged to find the herbivory for that replicate.

We compared mean percent herbivory between height and epiphyte-load treatments using Wilcoxon non-parametric tests. A Tukey-test was used for pairwise comparisons between the four treatments.

RESULTS

Herbivory was significantly higher on blades with high epiphyte loads than those without epiphytes regardless of height (Fig. 1;Wilcoxon Ranked Test; X^2=25.62, df=1, P=0.0001).

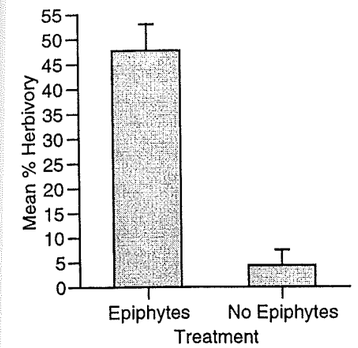

Fig. 1. Percent herbivory (mean ± SE) on turtle grass (*Thalassia testudinum*) blades with and without epiphytes, across all heights, at Discovery Bay, Jamaica.

There was also significantly higher herbivory on blades 5 cm higher than the average blade height regardless of the epiphyte load (Fig. 2; Wilcoxon Ranked Test; X^2=4.21, df=1, P=0.04). Of these two factors, epiphyte load had a stronger effect than height on the amount of herbivory (Standard Least Squares, epiphyte load: r^2=0.56; height: r^2=0.07). Herbivory was greatest on *T. testudinum* with high epiphyte loads and located 5 cm above the grass bed (mean = 59.1%), followed by the grass with a high epiphyte load which was located at mean bed height (36.3%). The epiphyte free *T. testudinum* located 5 cm above the bed height had still lower herbivory (8.7%), and finally the epiphyte free grass located at mean bed height had the least herbivory (0.10 %) (Fig. 3).

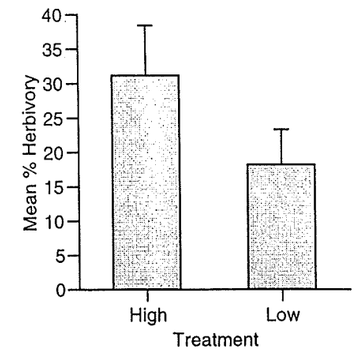

Fig. 2. Percent herbivory (mean ± SE) on turtle grass (*Thalassia testudinum*) within the natural grass mat (low) and 5 cm above (high), across all epiphyte loads at Discovery Bay, Jamaica.

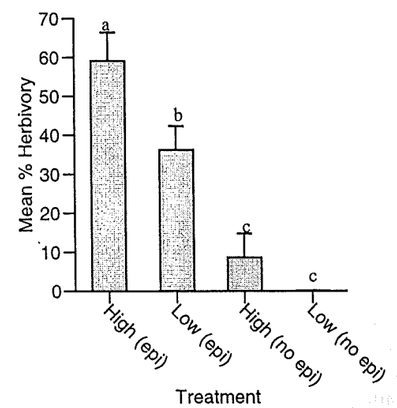

Fig. 3. Percent herbivory (mean ± SE) on four treatments of turtle grass (*Thalassia testudinum*) at Discovery Bay, Jamaica Different letters indicate significant differences (P<0.05).

DISCUSSION

We found that parrotfish preferentially grazed on blades with epiphytes. For a given grazing effort, the energy return is higher on these blades than blades without epiphytes, so they should be preferred by fish which forage optimally. Additionally, among epiphyte laden blades, the taller blades were preferred by grazers. Since parrotfish select blades visually (J. J. Gilbert, *pers. comm.*), the easily seen tall blades are expected to be most heavily grazed. Emergent blades would be less apt to be passed over because they stand out from the rest of the bed.

These data suggest that the parrotfish may be foraging optimally, by minimizing search time and foraging preferentially on those blades offering the highest energy return. The grazing levels on the two epiphyte-free treatments further support this possibility, since fish almost never graze on the blades providing low return if they have to search for them in the bed, but they will graze occasionally above the bed.

This continuum of choice suggests that the energy return of the epiphytes is the factor which most strongly determines grazing choices, but that reducing search time is also important. If parrotfish are actively foraging for most of the day, they would be expected to put a higher premium on a high energy return than slightly decreasing their search time. Therefore, while the fish appear to be opportunsitic grazers of emergent blades, they seem to allocate most of their foraging effort in searching for high energy, epiphyte-laden blades.

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