THE EFFECTS OF NUTRIENT ENHANCEMENT ON NEAR-SHORE *THALASSIA TESTUDINUM* COMMUNITIES

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Abstract. The effect of nutrient enhancement on near-shore *Thalassia* communities was investigated. Herbivory patterns may be explained either by phenotypic differences in leaf nutrition between near shore and off shore locations or by the higher epiphyte load on near-shore grasses. Results suggest that the higher epiphyte cover on near-shore leaves had the most significant effect on herbivore preference for these leaves. It did not appear that phenotypic differences in leaf nutrition affected herbivory, although these differences may not have been detected by herbivores in the treatments where epiphytes were removed. It is possible that herbivory is a function of an interaction between epiphyte load and leaf phentype. Future study could examine other mechanisms for increased herbivory in near-shore locations such as water depth and disturbance patterns.

INTRODUCTION

Many studies in marine ecology have focused on the effects of nutrient enhancement on the species composition of near shore macro-flora communities. However, relatively little is known about how nutrient levels affect herbivory by macro-fauna and how the interaction between herbivory and nutrient enhancement may influence macro-floral distribution patterns in marine environments (McGlathery 1995). Increased nutrient levels from freshwater runoff and anthropogenic sources such as sewage disposal systems are thought to be responsible for the decline in *Thalassia testudinum* abundance in near shore locations. Tomasko and Lapointe (1991) suggest that nutrient enhancement supports increased epiphyte growth on *Thalassia* blades, and this results in shading and consequently slower growth.*Thalassia* is then out-competed by macro-algae species that have rapid nutrient uptake and higher growth potentials in the eutrophic near shore locations (McGlathery 1995).

McGlathery (1995) found that herbivory rates were also strongly correlated to nutrient enhancement, and suggested that herbivory may exert as important an influence on *Thalassia* distribution as competition with macro-algae. Two mechanisms may explain increased herbivory on leaves in high nutrient near-shore locations. Herbivory may be most related to epiphyte load if herbivores preferentially select leaves with higher epiphyte cover. It is also possible that herbivory is related to leaf phenotype in onshore locations. McGlathery (1995) found that leaf nitrogen levels were highest in leaves from fertilized treatments and naturally eutrophic locations. Fish may preferentially select on-shore leaves because they have higher leaf nitrogen and are consequently more nutritious.

Near-shore locations (5-10 m from shore) at Discovery Bay, Jamaica were found to have higher nutrient levels than areas closer to the reef crest (50-60 m from shore). The goal of this study was to compare herbivory and epiphyte load between on-shore and off-shore locations and to distinguish between the effects of epiphyte load and leaf phenotype on leaf damage by herbivorous fish.

METHODS

Research was conducted on 22-23 January, 1996 in Discovery Bay, Jamaica. Two beds of *Thalassia* at a depth of 1-2 m were chosen for manipulations: a high nutrient area located at the mouth of the lagoon, and a low nutrient area located 15 m short of the reef crest, to the East of the canoe cut. We haphazardly collected 72 ungrazed *Thalassia* blades from both sites and visually indexed the epiphyte load into three categories (low, medium, high) on 24 leaves from each site. To determine whether patterns in epiphyte load on experimental leaves were similar to patterns found in nature, we quantified the epiphyte load on 24 *Thalassia* blades that were haphazardly collected without regard to grazing. Chi-square tests were used to determine differences in epiphyte load between in-shore lagoon and off-shore reef locations for both experimental and *in situ* leaves.

To distinguish between the effects of epiphyte load and leaf phenotype on herbivory, collected leaves from both sites were divided into unscraped and scraped treatments. A razor blade was used to remove all epiphytes from the scraped treatments. In all four

treatments *Thalassia* blades were cut from the base to a length of 15 cm. Each treatment contained six sets of six leaves attached to clothes pins. Clothes pins were attached to bolts and placed in a *Thalassia* bed 30 m from the dock at a depth of 1-2 m. Treatments were collected after 7 hours, and the percentage of the total area removed from grazing was estimated using a ruler. These data were arcsin transformed, and T-tests were used to compare herbivory between scraped and unscraped leaves, and between unscraped leaves from lagoon and reef locations.

RESULTS

There were significantly more epiphytes on the *Thalassia* growing near the lagoon than near the reef crest for both the experimental and *in situ* blades (df = 2, $X^2 = 7.77$; df = 2, $X^2 = 14.81$). On average, 78% of the turtle grasses near the lagoon had high epiphytes, whereas only 25% of the grasses near the crest were considered to have high epiphyte loads (Figure 1).

No herbivory occured on the scraped treatment for either site, while leaves from the unscraped treatments were consistently eaten (df = 71, t = -11.39. $P < 0.0001$). Within the unscraped treatments, herbivores seemed to preferentially eat the lagoon grasses over the reef grasses (df = 70, t = -1.82, P = 0.07; Figure 2).

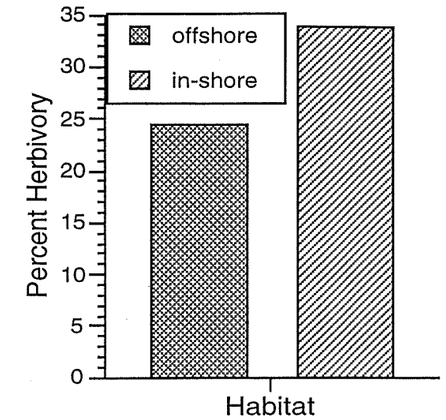

Figure 2. Pecent of unscraped offshore and in-shore *Thalassia* grazed by herbivores in Discovery Bay, Jamaica.

DISCUSSION

Thalassia blades collected from near the lagoon seemed to be preferentially chosen by fish over leaves collected from over the reef. The higher nutrient levels demonstrated in the lagoon could lead to several

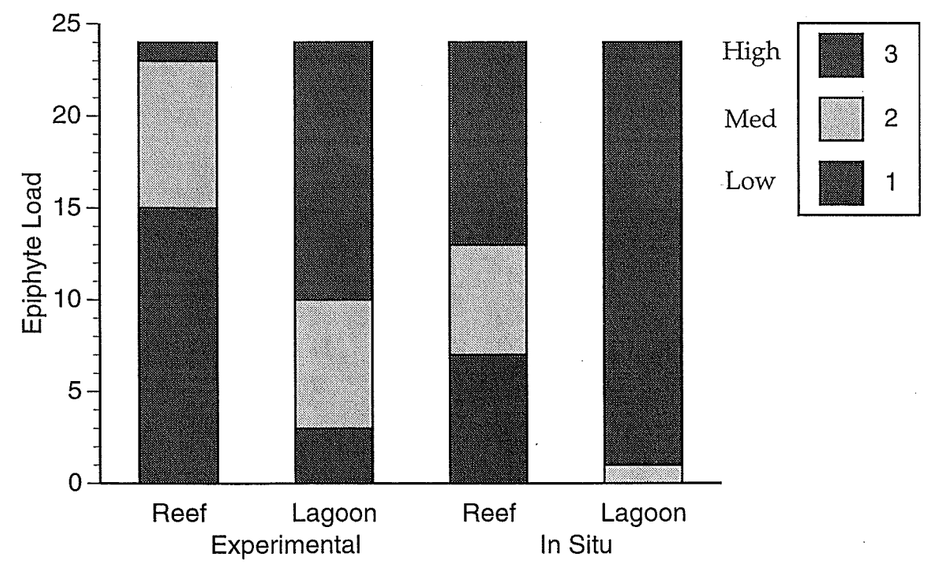

Figure 1. Epiphyte load on experimental and *in situ Thallasia* blades in the reef and lagoon area of Discovery Bay, Jamaica.

factors that would increase herbivory: higher nitrogen content in the blades, higher epiphyte growth, higher nitrogen content in the epiphytes, and a lower blade turnover time. It is difficult to separate whether the herbivory preference is due to a higher epiphyte load or to possible phenotypic variation within *Thalassia*.

Our data suggests that epiphyte load is important in fish preference, but sheds no light on possible phenotypic differences in *Thalassia* between the two sites. It is possible that although nitrogen levels in the leaves can vary according to the aquatic nutrient levels, this seems to have little effect on fish preference. Past studies also seem to indicate no change in chemical defenses from high to low nitrogen sites. This would suggest little variation of fish preference due to phenotypic changes caused directly by higher nutrient levels; but still, differences in growth rate for *Thalassia* could occur between habitats due to increased shading caused by higher epiphyte loads in the high nutrient waters.

Thalassia distribution may be controlled by the interaction between nutrient and herbivore effects, as the bottom-up effects of nutrient levels influences the preference of fish predators. Predicting that *Thalassia* would incur highest predation in high nutrient waters is consistent with past studies that indicate that *Thalassia* is outcompeted and shaded by macroalgea in high nutrient waters. This could have broad implications for the abundance and distribution of *Thalassia* in our increasingly eutrophic costal waters.

LITERATURE CITED

McGlathery 1995.

Tomasko, D.A. and B.E. Lapointe. 1991. Productivity and biomass of *Thalassia testudinum* as related to water column nutrient availability and epiphyte levels: field observations and experimental studies. Mar. Ecol. Prog. Ser. **75**: 9-17.