

## FISH HERBIVORY ON TWO GROWTH FORMS OF MARINE PLANTS

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*Abstract:* A number of complex interacting factors determine marine vegetation morphology. For instance, fish may eat foliose and low-profile forms at different rates, exerting a selection pressure upon these forms. However, debate exists in the literature as to whether the low-profile form benefits the plant by reducing herbivory. Through an *in situ* manipulation of *Thalassia testudinum* blades, we compared the herbivory on prostrate (a proxy for low-profile forms) and vertical (a proxy for foliose forms) blades. We found that herbivorous fish consumed vertical blades ten times more often than prostrate blades. This suggests that prostrate forms are less desirable to fish herbivores and may be a growth strategy to decrease herbivory. Further research could focus on costs of low-profile growth that may offset the herbivory benefit.

*Key words:* algae, foliose growth form, herbivory defense, low-profile growth form, *Thalassia testudinum*

### INTRODUCTION

Plant morphology is the result of various ecological pressures, such as maximizing photosynthesis and minimizing herbivory. In marine algae, both foliose and low-profile forms exist, and these different growth forms relate to differences in herbivory (Lewis et al. 1987). Prostrate (low-profile) growth forms may be more difficult for herbivores to eat than vertical (foliose) ones because it is mechanically harder to bite a leaf growing against a hard substrate than one with more surface area available in the water column (Lewis et al. 1987, Loren and Tanner 1989). Alternatively, Littler and Littler (1980) suggest that low-profile forms may be more easily accessible to herbivores. This suggestion would lead to higher herbivory rates in prostrate growth forms than vertical growth forms. To resolve these opposing theories, we measured herbivory rates on prostrate and vertical growth forms by using experimentally manipulated *Thalassia testudinum* leaves.

### METHODS

We measured herbivory rates on vertical and prostrate *T. testudinum* leaves at Discovery Bay Marine Laboratory, Jamaica. We compared

herbivory by using a paired design. Three prostrate leaves and three vertical leaves were attached to a ceramic tile (15.1 × 15.1 cm). Prostrate leaves were held with clothespins on each end and one wrap of 15-lb test fishing line to hold down the leaf center, and vertical leaves were each held in place with a clothespin on one end; this was repeated on 24 tiles. We used approximately 23 cm × 2.5 cm leaf tip sections of *T. testudinum* with roughly equal epiphyte loads. Tiles were randomly divided into three groups of eight tiles and placed in three sites. Each site was a sandy patch surrounded by *T. testudinum*, and all tiles were placed on the edge of the patch. Tiles were left out from 1010 to 1645 on 25 February 2004.

We calculated herbivory as percent of the grass blade missing after sampling. Average percent herbivory for vertical blades and for prostrate blades was calculated for each tile. We arcsine-transformed these data to correct for non-normality and compared transformed average percent herbivory between vertical and prostrate blades using a paired t-test. We determined spatial variation in herbivory rates using a nested one-way ANOVA with site and plate nested within site as effects.

## RESULTS

There was evidence of herbivory on both leaf orientation treatments. Per-tile mean vertical blade herbivory ranged from 0 - 78%, while per-tile mean prostrate blade herbivory ranged from 0 - 35%. Most herbivory resulted from scallop-shaped parrotfish bites. Herbivory was over ten times greater on vertical blades than on prostrate blades (paired  $t = 5.49$ ,  $df = 23$ ,  $P < 0.0001$ ; Fig. 1). Herbivory varied significantly within sites (between plates;  $F_{21,71} = 6.3$ ,  $P < 0.0001$ ) and between sites ( $F_{2,71} = 18.85$ ,  $P < 0.0001$ ).

## DISCUSSION

While fish were able to feed upon both forms, they preferred vertical grass blades to prostrate ones. This result supports findings by Lewis et al. (1987). As *T. testudinum* was used for both treatments, other factors that might affect herbivory on different macroalgae - such as differential nutrient content or calcification -

could be excluded. A low-profile form must therefore be more difficult to feed upon, possibly due to a more difficult feeding position or biting angle for fish. It is also possible that fish search for vertical blades when feeding on turtle grass, which could also explain their preference for vertical blades.

Our results suggest that patterns of herbivory are dependant on herbivore behavior, as there was spatial variation in herbivory rates. Though we did not examine in detail how herbivory rates varied across the back reef, we found significant variation across large (between sites) and small (within sites) spatial scales. Herbivory is patchy throughout the turtle grass habitat, which might be expected from schooling herbivores such as parrotfish. The mechanism for foraging patterns of herbivores could be examined in further detail.

Our results demonstrate that a low-profile form is beneficial to the plant as it decreases herbivory. As both low-profile and foliose forms are found in nature, this suggests a cost-benefit tradeoff to the prostrate form. The decrease in exposed surface area in a low-profile alga may decrease photosynthetic rates or nutrient uptake; alternatively, it may decrease mechanical wave stress and damage. Further studies could examine such potential costs and benefits of a low-profile growth form, as many ecological factors, biotic and abiotic, influence growth form.

## LITERATURE CITED

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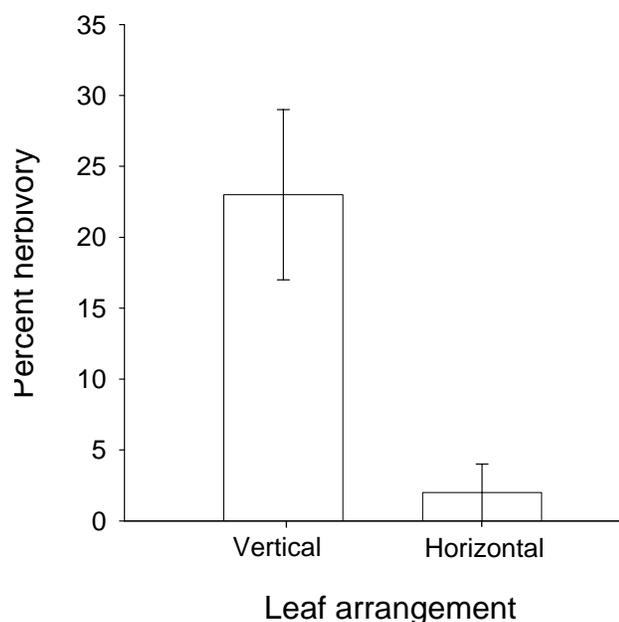


Figure 1. Mean percent herbivory ( $\pm$  SE) on vertical and horizontal blades of *T. testudinum*.

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