The Role of Grazing by Fish and Sea Urchins in Structuring Seagrass Beds in Bocas del Toro, Panamá

El Papel del Pastoreo por los Peces y los Erizos Marinos en Estructurar las Praderas Marinas en Bocas del Toro, Panamá

Le Role du Broutage des Poissons et des Oursins de Mer sur la Dynamique des Herbiers Marins de Bocas del Toro, Panama

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EXTENDED ABSTRACT

Introduction

Syringodium filiforme and *Thalassia* testudinum coexist in some seagrass beds in Bahía Almirante, Panamá, but other beds are occupied exclusively by *T. testudinum.* This may be due to grazing, but the comparative importance of different grazers is less clear. While Tribble (1981) observed that fish grazed roughly six times as much seagrass as sea urchins in Guna Yala, Panamá, and Hay (1984) asserts that fish are more important grazers than urchins in Caribbean seagrass beds, Bocas del Toro's fish populations have been over-exploited (Seemann et al. 2014, Cramer et al. 2017), which may have shifted the balance between functional groups. Hydrography across Bahía Almirante is also highly variable and may influence *S. filiforme* survival. Aronson et al. (2014), divides the bay into three regions based on runoff and water quality (See Figure 1). Sector A has the most exposure to runoff from the Changuinola Flood Plain and the most degraded water quality. Sector B has the most oceanic exposure, but still somewhat degraded water quality due to pollution from Bocas Town on Isla Colón. Sector C has the least oceanic influence, but also the least degraded water quality due to having the lowest exposure to both floodplain runoff and pollution from Bocas Town. To assess the comparative impact of fish vs.

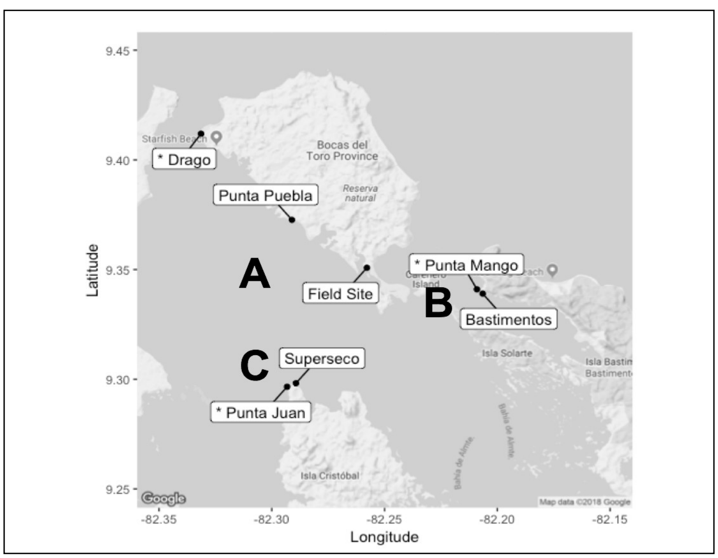

Figure 1. Location of sampling sites and hydrographic zones in Bahía Almirante. *S. filiforme* is present at sites with a * symbol.

urchin grazing and whether either explains the absence of *S. filiforme* from certain seagrass beds, grazing assays were conducted in beds with and without *Syringodium* across all three hydrographic sectors.

Methods

A total of seven experimental sites were selected and names and hydrographic zones can be seen in figure 1. Habitat complexity was assessed by taking three parallel 20m transects at each site and sampling seagrass shoot density and the height of a randomly selected blade for each applicable species on either side of the transect line at 0m, 5m, 10m, 15m, and 20m for a total of 30 samples per site. Heights were multiplied by density for each species and added together to calculate complexity. Daytime fish abundance and nighttime urchin abundance was surveyed along these transects throughout the experiment according to the methods of Lee et al. (2015).

Grazing assays consisted of interspersed blades of *T. testudinum* and *S. filiforme*. Night-deployed assays measured sea urchin grazing and day-deployed assays measured fish grazing (Robblee and Zieman 1984, Klinger and Lawrence 2009). Upon recovery *T. testudinum* blades with bite marks or *S. filiforme* blades that lost more than 1cm of length were considered grazed. Mass could not be used to calculate seagrass consumption, because *S. filiforme* re-absorbs water while deployed and length of consumed *T. testudinum* could not be measured, because grazer bites tended to remove pieces of the blade without reducing its length. Only assays that experienced non-zero amounts of grazing were used to calculate fish and urchin preferences and grazing rates and grazing rates were normalized to length of time deployed.

Results

On assays that were grazed, a higher percentage of *S. fiilforme* blades were grazed than *T. testudinum* blades. Higher percentages of both species were also grazed during the day than at night. Grazing on deployed blades as well as length of *S. filiforme* removed during the day was highest at Drago, which had the highest habitat complexity. Fish were observed to directly consume seagrass blades only infrequently. Urchins in the genus *Echinometra* were more abundant at sites without *S. filiforme* than in sites with *S. filiforme* in sectors B and C, but absent from all experimental sites in sector A.

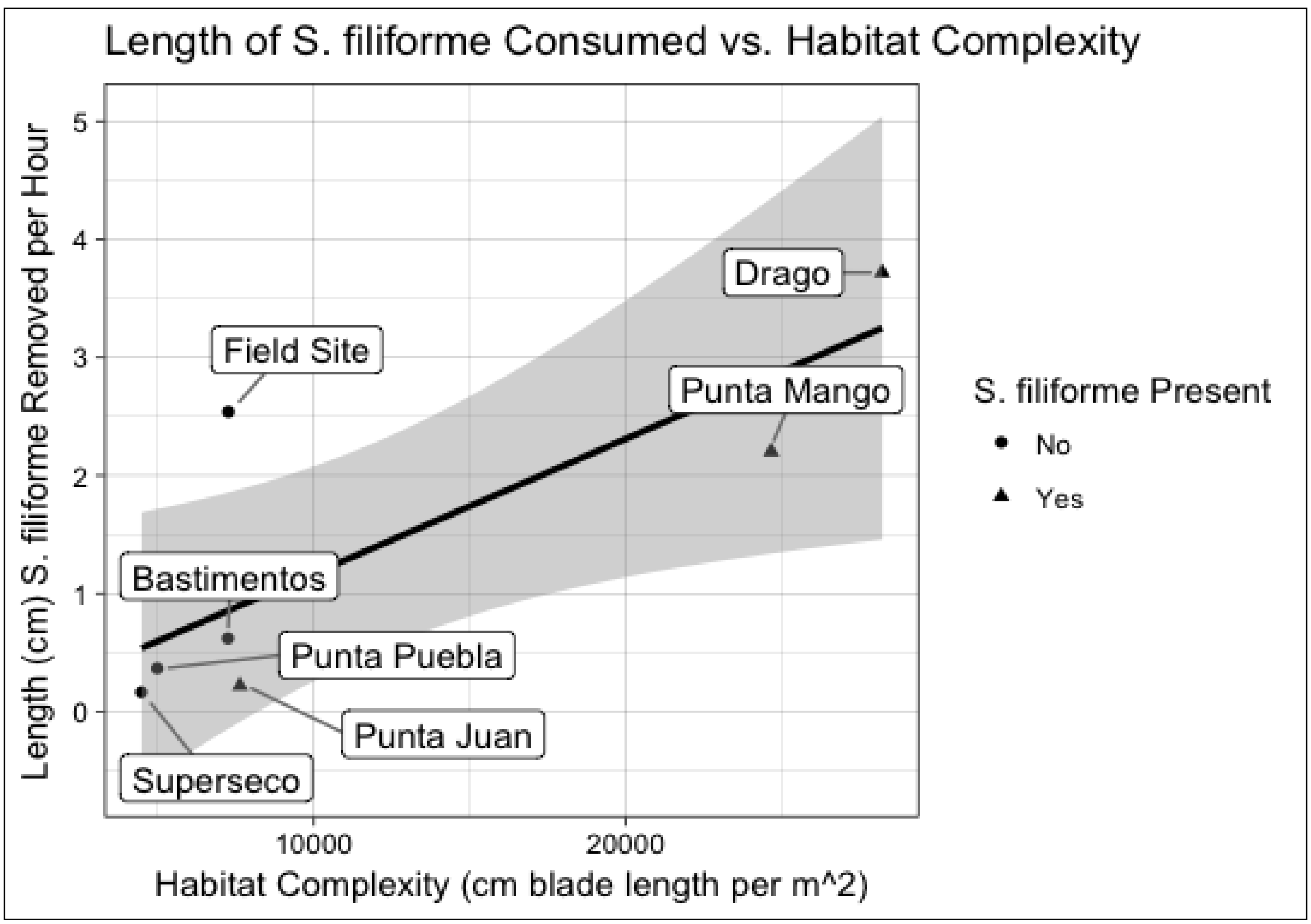

Figure 2. A positive correlation (r^2 = 0.65) was observed between site habitat complexity and length of *S. filiforme* removed per hour.

Conclusions

The results of this study agree with the conclusions of previous work that herbivores prefer *S. filiforme* to *T. testudinum* (Tribble 1981) and that fish graze more seagrass than urchins (Tribble 1981, Hay 1984) but does not conclusively establish that grazing excludes *S. filiforme* from certain beds in Bocas del Toro, because mean length of *S. filiforme* removed per hour was highest at Drago, where *S. filiforme* is present. There appears to be a positive relationship between amount of *S. filiforme* removed and habitat complexity of a given site ($R^2 = 0.65$), which suggests that most of the grazing on deployed blades was done by small grazers that rely on the seagrass canopy for shelter rather than by large grazers whose feeding reduces canopy height (Macía and Robinson 2005) (Figure 2). This, unfortunately, seems to suggest that grazing assays using clipped seagrass blades may not be the ideal way to measure the ecological impact of grazing, because they may be preferentially visited by small herbivores, which are more evenly distributed through the bed (Randall 1965), but have a lower top-down effect on seagrass communities (Randall 1965, Scott et al. 2018). Degree of top-down control on seagrass communities may be more accurately assessed through transplant or exclosure experiments.

KEYWORDS: Seagrass, herbivore, urchin

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