The effects of herbivory by *Sesarma reticulatum* on salt marsh vegetation and food preference

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Introduction

The purple marsh crab *Sesarma reticulatum* is a nocturnal, herbivorous crab that inhabits salt marshes. This species has been the focus of recent studies focusing on salt marsh die-off. In the absence of their primary predators, it is hypothesized that *Sesarma* populations are increasing (Altieri et al., 2012). In a study by Holdredge et al. (2008), *Sesarma* were tethered in either vegetated or bare ground locations. The *Sesarma* in vegetated areas fell prey to predators, while those in bare locations survived. *Sesarma* inhabit burrows in the middle to low levels of salt marshes (Coverdale et al., 2012). The burrows extend to the same depth as the roots system of salt marsh plants allowing *Sesarma* to feed while escaping predation above ground (Bertness et al., 2009). The main focus of this study was the crabs' feeding behaviors and food preferences as these are still unknown. Past studies have observed consumption of the salt marsh grasses *Spartina alterniflora* and *Spartina patens*, and most die back has been in *S. alterniflora* areas. But specifics on the dynamics of their herbivory on marsh plants have not been studied. My research asked several questions: a) do the crabs prefer one grass type over another, b) what are their nocturnal activity patterns and feeding rates, and c) what is their distribution on high marsh habitats?

Figure 1: Laboratory Set up: Bottom Left *Spartina patens*, Upper Right *Spartina alternaflora*

Methods and Materials

Three different approaches were used to assess feeding dynamics: lab trials, exclusion cage field studies, and burrow density observations. Eight *S. reticulatum* were collected from Banca Salt Marsh, in Branford, CT for lab trials. The crabs were individually placed in aquaria with two types of salt marsh plants, *Spartina alterniflora* and *Spartina patens*, in opposite corners (Figure 1). The combs of grasses were counted before and after a two and four week time period to calculate individual consumption rate and determine food preference.

Field studies were conducted during the day and night. Night studies consisted of deploying an array of cameras overnight to record natural feeding behaviors (Figure 2). I also assessed feeding preference using a field manipulation experiment. Three experimental treatments were deployed: full cage, a cage control, and a non-caged vegetation control (Figure 3). The cages completely enclosed the clump of plants to prevent any predation (predator exclusion). The cages extended into the ground to prevent underground herbivory. The cage control had holes large enough for *Sesarma* to enter and tested any cage effects. The third treatment had no cage to mimic the natural environment. Lastly burrows were counted in different regions of the marsh to calculate burrow density and herbivory pressures.

Figure 2: Camera array in dieback areas: Left: camcorder Right: GoPro

Figure 3: Exclusion cages: full, partial and bare

Results

Two time periods were observed for the laboratory trials: 4 weeks and 2 weeks. An equal variance t-test was performed showing a marginally significant difference in food preference for both the two week (p=0.077) and four week (p=0.083) time periods, with greater consumption on *S. alterniflora.*

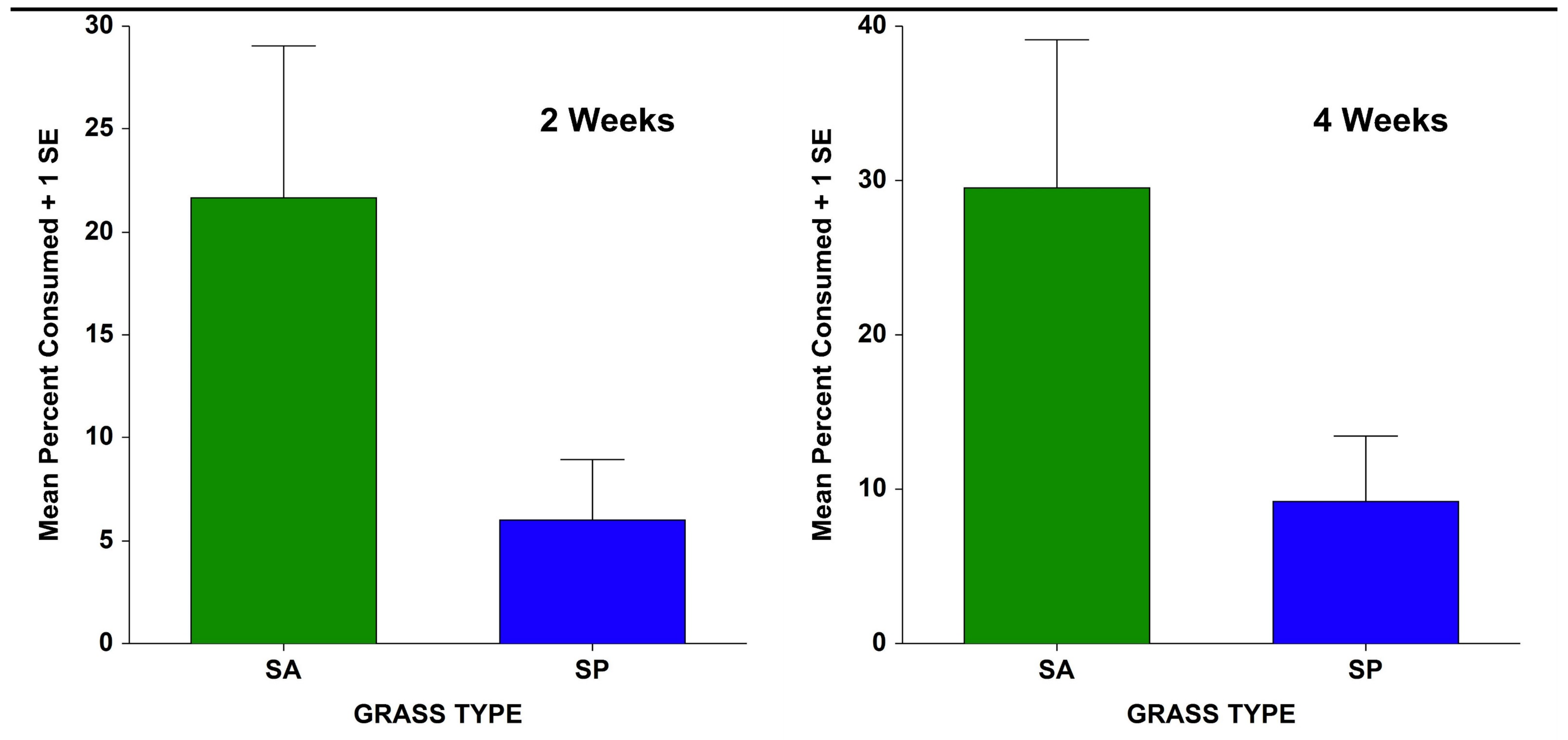

Figure 4: Lab Trials: Right- 2 weeks, Left- 4 weeks

An ANOVA was performed for the caging experiment. There were significant differences among cage treatments (p = 0.00671; greater hebivory on uncaged plants) and plant type consumption (p = 0.000899). Like the the lab trials, the field studies show a preference of *S alterniflora* over *S patens*.

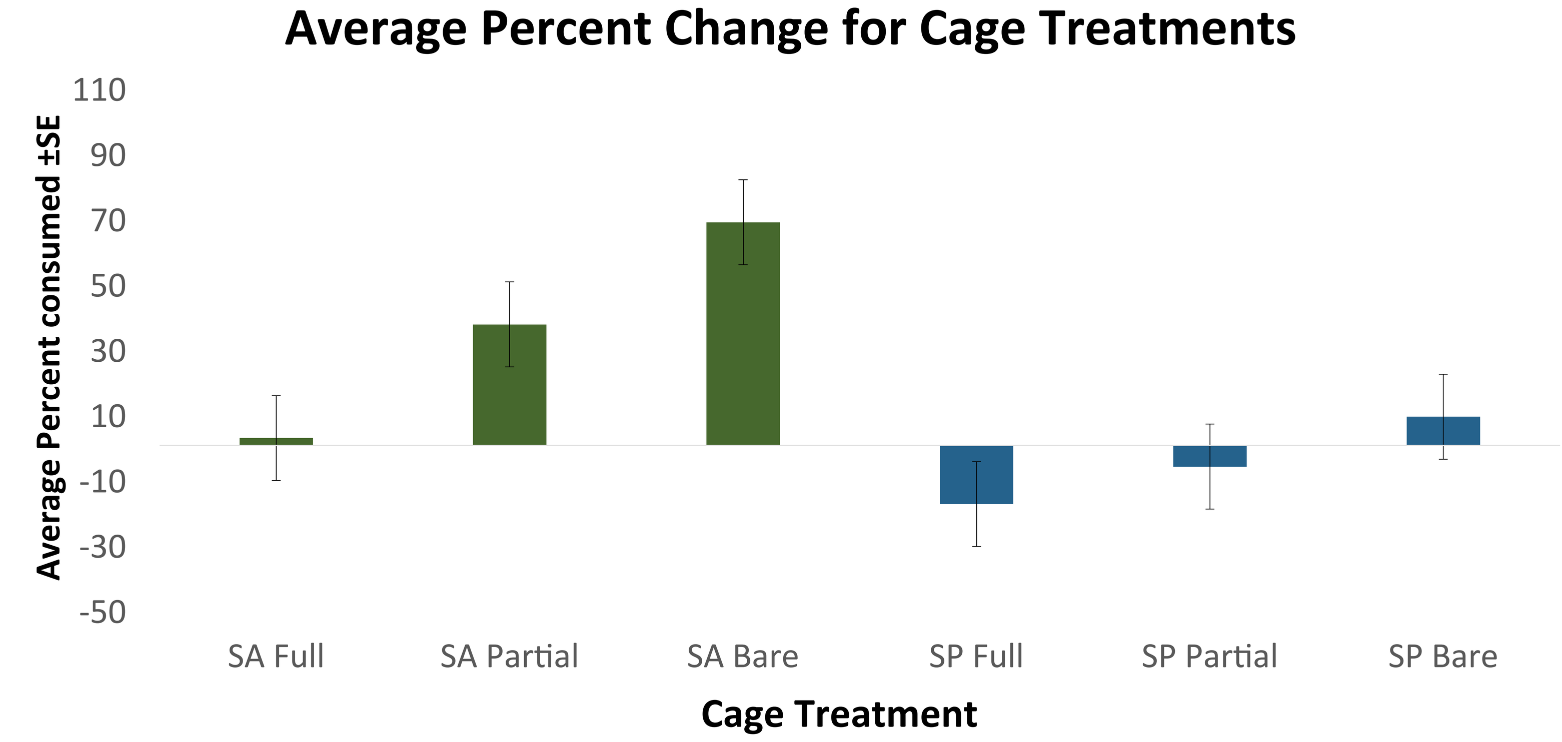

Figure 5: Cage Treatments

To determine if there were differences in crab burrow density among different dieback regions, 5 regions were surveyed which were divided into three separate area and sampled with five replicate quadrats. A nested ANOVA was performed to test for significance among the regions as well as for spatial variation within each region. There was a statistically significant difference in burrow density among regions, p=0.00365, but burrow density did not vary within regions, p=0.538. The 30 hours of night video collected indicated that *Sesarma* make slow, deliberate movements, cut vegetation and pull the clippings into the burrow. The rate at which they did this was surprisingly slow, suggested that herbivory rates are slow overall.

Discussion

The lab trials and field experiments suggest that *Sesarma* has a preference for *S. alterniflora* over *S. patens*. This agrees well with previous studies that indicate dieback to occur in primarily low marsh habitats dominated by this plant. However, there are increasing areas of S. patens that are also being denuded and this may represent a shift due to changing marsh conditions such as increased tidal level. The preference may also be due to food quality. The burrow densities varied by location on the marsh, usually highest near creeks, suggesting differences in herbivory pressure. Some future studies based on these results would be to recreate the lab trails with larger sample sizes and testing the food preference of other salt marsh flora. Since *Sesarma* are invading upper levels of the marsh, there may be a preference for other flora.

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