Shell Preference of Hermit Crab Species in a Coastal Mudflat

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Introduction

Predation is one of the top concerns for organisms in a marine environment. The evolutionary adaptations and practices of many species are geared towards protection against threats that can come from anywhere around them; the way each species expends energy in forms of protection is called the optimal defense hypothesis. One example of this is shell selection by marine hermit crabs. Hermit crabs are known to consider at least two factors when choosing their new shells: shell thickness and interior size (Ragagnin et al. 2016). While terrestrial hermit crabs favor airier interiors with room to grow, marine hermit crabs in particular tend to chose shells that are thicker and heavier because of their increased defense capacity, despite their limitations for growth (Alcaraz, Chávez-Solís, & Kruesi, 2015). In studies, marine hermit crabs have been shown to preferentially order various species of gastropod shells based on defensive characteristics (Alcaraz, Chávez-Solís, & Kruesi, 2015). This is indicative that there may be other characteristics besides thickness and interior size that bias hermit crab towards a certain type of shell, even if that shell is not abundant in the environment.

Research Questions

- Do hermit carbs, specifically Clibanarius tricolor, choose shells that are representative of the available shells in the Triton Flats system, with respect to shell size and aperture?
- Are hermit crabs in the Triton Flats system more likely to be found in areas with higher grass or macroalgae cover, both or neither?
- Does grass or macroalgae cover correlate to gastropod or hermit crab shell size in the Triton Flats system?

Methods

In order to characterize the shell preference of mud flat-dwelling hermit crabs, it is necessary to obtain a relatively high number of samples of these species. Triton Flats was chosen because it is a mudflat research site near Layton, FL, characterized by a rocky, coral-dominant substrate populated sparsely by seagrass and macroalgae, mainly *Thalassia testudinum* and *Halimeda opuntia* respectively. In triton flats we found a shallow stop that met the criteria and laid a 20 meter transect. On that transect we laid down a 1x1 meter quadrant alternating sides each time we moved it (for example, the 1st, 3rd, and 5th, etc. quadrats are placed on the right-hand side of the transect, while the 2nd, 4th, and 6th, etc. are placed on the left-hand side). In each of these quadrants we recorded the percent of seagrass and algae and we collected all the shells we could find. After we finished collecting we went back to the lab and recorded each shells aperture, length, and if there was anything in the shell. After we recorded all the data we let the shells back in the water.

Results

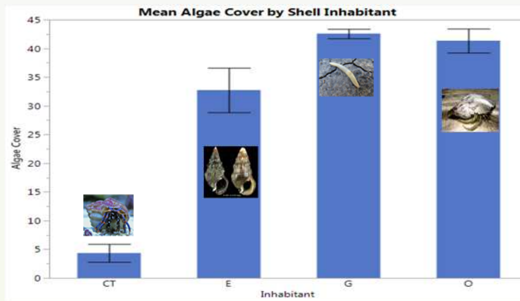


Figure 1: Mean algae percent cover by quadrat. Sites containing *Clibanarius tricolor* exhibited significantly lower algal cover ($p < 0.0001$). Error bars represent Standard Error.

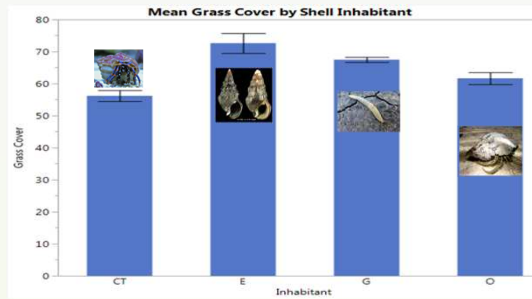
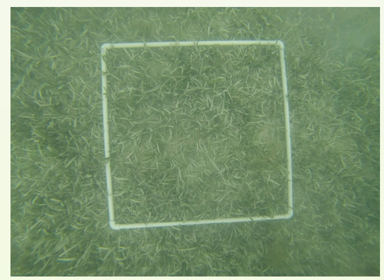


Figure 2: Mean seagrass percent cover by quadrat. Sites containing *Clibanarius tricolor* and other hermit crab species both exhibited significantly lower seagrass cover than sites containing gastropods or empty shells ($p < 0.0001$). Error bars represent Standard Error.



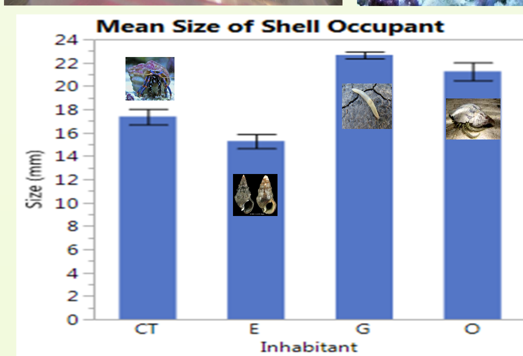


Figure 3: Mean size of shell by shell occupant. Hermit crab shells, both *Clibanarius tricolor* and otherwise had smaller shells on average than the gastropods present in the study site. Error bars represent standard Error.

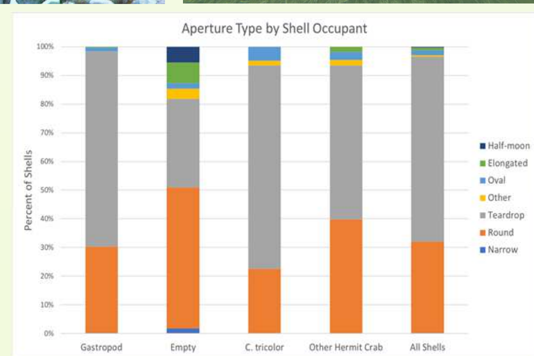


Figure 5: As gastropods represented the majority of shells found, there was no significant difference between gastropod aperture and overall aperture data ($p = 0.81$). However, both *C. tricolor* ($p = 0.01$) and other hermit crab species ($p = 0.067$) had at least marginally significant differences in aperture type from the overall dataset.

Discussion

This research was an extremely productive sampling of gastropod shells, as our average of over 18 shells per quadrat was substantial. With this data, our hypotheses regarding hermit crab shell size preference was supported, with both C. tricolor and other hermit crab species exhibiting smaller shell size than gastropods. This supports previous research that suggested that hermit crabs allocate resources to defense rather than growth. Additionally, we found that hermit crabs are indeed selective on the basis of aperture type, with C. tricolor individuals preferentially selecting shells with a teardrop-shaped aperture, and other hermit crabs preferentially selecting shells with a round aperture, as compared to the entire collection of shells we found. It was also shown that the different shell inhabitants correlated significantly with both grass and algae cover. This study concludes that hermit crabs in the Triton Flats site are indeed selective in their shell choices, as suggested by previous studies. These organisms do not merely choose to inhabit the shells that are most readily available in the environment, but seek out those with a preferred set of attributes, including size and aperture shape. Further research could discern the selectiveness of these crabs as it relates to shell shape, surface features, or other key shell characteristics.

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References

Arce, E. & G. Alcaraz, 2012. Shell preference in a hermit crab: comparison between paired shell choice trials and a multiple alternatives experiment. Marine Biology 159: 853–862.

Alcaraz, G., Chávez-Solís, C., & Kruesi, K. (2015). Mismatch between body growth and shell preference in hermit crabs is explained by protection from predators. *Hydrobiologia*, 743(1), 151-156. doi:10.1007/s10750-014-2029-8

Contreras-Garduño, J., J. L. Osorno & C. Macias-Garcia, 2009. Weight difference threshold during shell selection relates to growth rate in the semi-terrestrial hermit crab *Coenobita compressus*. Behaviour 146: 1601–1614.

Ragagnin M, Sant'anna B, Gorman D, De Castro C, Tschiptschin A, Turra A. What makes a good home for hermits? Assessing gastropod shell density and relative strength. *Marine Biology Research* [serial online]. May 2016;12(4):379-388. Available from: Academic Search Premier, Ipswich, MA. Accessed May 8, 2018.

Rodrigues A, Martinelli-Lemos J. Gastropod shell utilisation pattern by the hermit crab Clibanarius symmetricus (Anomura: Diogenidae) in an Equatorial Amazon estuary. Journal Of Natural History [serial online]. November 2016;50(41/42):2657-2671. Available from: Academic Search Premier, Ipswich, MA. Accessed May 8, 2018.