Sedge Island Marine Conservation Zone Biological Study

Save Barnegat Bay Student Grant Program

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Abstract

The Sedge Island Marine Conservation Zone (SIMCZ) in Ocean County, New Jersey provides a protected habitat for a number of estuarine species in the Barnegat Bay. For ten nonconsecutive days in June, July, and August of 2019, students affiliated with Save Barnegat Bay surveyed species both inside the SIMCZ in order to understand the biodiversity. Collected species were counted and measured; the study also analyzed three substrate types- submerged aquatic vegetation (SAV) beds, macroalgae, and bare bottom - in order to determine species diversity in different habitats. The Simpson's Biodiversity Index for the habitats both inside and outside ranged from 0.752 to 0.855. It was found that the bare bottom habitat outside the conservation zone had the highest biodiversity, while bare bottom habitat inside the zone had the lowest.

Introduction

The Sedge Island Marine Conservation Zone (SIMCZ) is the only designated marine conservation zone in the state of New Jersey, located off the south end of Island Beach State Park in Berkeley Township (Figure 1). The zone was established in order to protect the natural habitat and promote species growth; commercialized fishing is prohibited, and personal watercraft use is limited. The zone is less susceptible to meteorological events, as well as wind and wave action, due to the marsh areas that separate the zone from the ocean. The location of the zone combined with its protection status may provide a safe habitat for individuals to grow and for populations to sustain themselves (Hogan, LaVallee, and Perdon, 2018). Habitats studied both inside and outside of the zone include submerged aquatic vegetation (SAV) beds, macroalgae, and bare bottom. SAV beds can provide the diverse species within the zone a shelter, acting as a nursery; macroalgae habitats provide resources for species bare bottom habitats provide migration routes (Hogan, et. al., 2018).

Five focus species studied in this research are Blue Crab (*Callinectes sapidus)*, Black-Fingered Mud Crab (*Panopeus herbstii)*, Shore Shrimp (*Palaemonetes vulgaris)*, Sand Shrimp (*Crangon septemspinosa)*, and Four Spined Stickleback (*Apeltes quadracus)*. It is important to monitor biodiversity in and around the zone in order to ensure the success of the SIMCZ; the purpose of this study was to maintain a long term data set that compares biodiversity inside and outside of the zone across three different bottom habitats.

Methodology

Study Sites:

Sites both inside and outside of the SIMCZ in Barnegat Bay, New Jersey were sampled (Figure 1). Three different substrate types were chosen: SAV, macroalgae, and bare bottom. Sampling occurred on ten non consecutive dates throughout June, July, and August of 2019.

Sampling Protocol:

- One 1m metal encapsulation cylinder was used to isolate the study area upon selecting site. The cylinder was dropped twice at each site (Figure 7).
- Dip nets were used to collect species, which were then identified and their lengths measured (Figures 8a-b).
- Collection ceased after five consecutive empty scoops (Figure 9).
- Conductivity, water temperature, and salinity were measured at each site using a YSI-85 meter. Air temperature and wind speed were measured using a Kestrel weather meter and thermometer.

Statistical Analysis:

Species diversity was quantified using a Simpson's Diversity Index (equation below). Using Microsoft Excel, a t-Test (of unequal variances) was conducted for each recurring species to compare average sizes inside and outside the zone. An alpha of 0.05 was used to indicate significance.

Results

The highest biodiversity was found in habitats outside of the Sedge Island Marine Conservation Zone compared to habitats inside the zone, on average. Outside the zone, the bare bottom habitat was the most diverse, with a score of 0.8552. In comparison, the lowest diversity was found in the bare bottom habitat inside the zone, scoring 0.7517. SAV bed habitats and macroalgae habitats had very similar scores both inside and outside the zone. Inside the zone, SAV scored 0.7958 and macroalgae scored 0.8002. Outside the zone, SAV scored 0.7645 and macroalgae scored 0.7567. The sizes of species collected were analyzed in addition to diversity. On average, fin fish like Four-Spined Stickleback were found to be larger outside the zone.

According to t-tests conducted for the five focus species, only Sand Shrimp (*Crangon septemspinosa)* are significantly different inside the zone than they are outside the zone. The rest of the t-tests returned p-values above 0.05.

Discussion

The data suggests that the organisms collected and measured outside of the conservation zone were slightly more diverse than the organisms collected inside the zone. However, the conservation zone is still essential in acting as a nursery for many organisms. The nursery, being a safe spot for smaller organisms to subside, allows them to grow and gain nutrients without consequence for the wildlife itself. The conservation zone decreases the amount of boats and jet skis going through the fragile zone and tearing up the protective SAV beds (Wilson, et. al., 1990). The SAV beds are especially important to organisms such as pipefish, which were found in abundance inside the conservation zone. The destruction of these fragile environments, SAV, micro-algae, and bare leads to stunted growth of the organisms that rely very heavily on the shelter and food they should have access to (Calizza, et. al., 2017). The diversity is most likely more significant outside of the zone due to the difference between where the zones are located. The zone on the outside has nutrients coming in directly from the ocean, whereas the conservation zone is more closed off.

The results from the Simpson's Biodiversity Index suggest that the bare bottom habitat outside the conservation zone had the highest biodiversity, while the bare habitat inside had the lowest. These habitats may statistically be the outliers because of the consistently smaller sample size. In the bare habitat, any species can greatly change the biodiversity measurement because there were not as many species collected as there were in macroalgae and SAV habitats.

Conclusion

The SIMCZ plays a major role in the growth of species, as it acts as a nursery for young. This long-term data set will help in efforts to understand the use of a conservation zone, as well as promote conservation within the zone itself.

Acknowledgements

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References

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Hogan, R., LaVallee, K., Perdon, A. (2018, August 17). Sedge Island Marine Conservation Zone Biological Survey [Scholarly project].

Wilson, Kim A., et al. "Predation Rates on Juvenile Blue Crabs in Estuarine Nursery Habitats: Evidence for the Importance of Macroalgae (Ulva Lactuca)." Marine Ecology Progress Series, vol. 58, no. 3, 1990, pp. 243–251. JSTOR, www.jstor.org/stable/24842199.

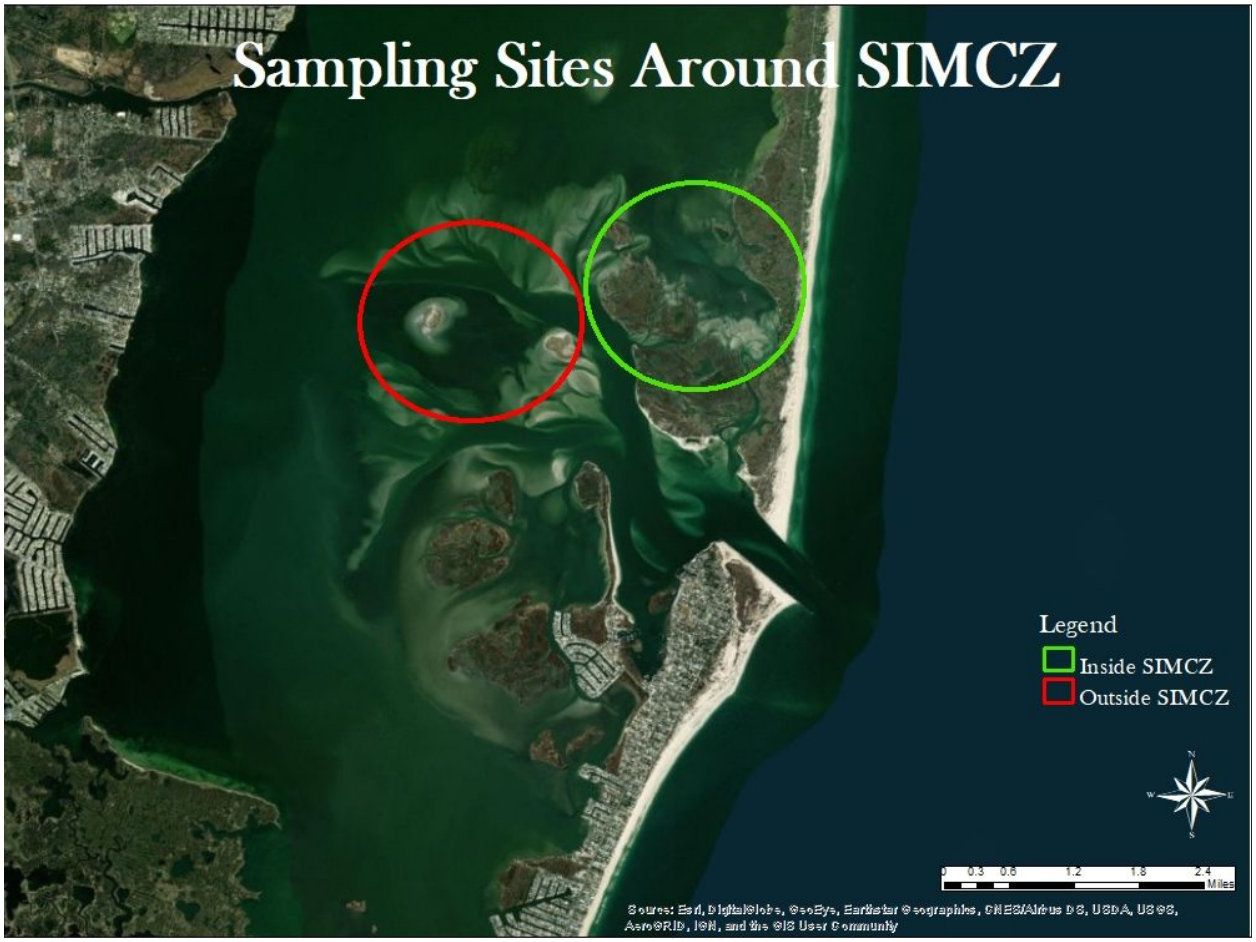

Figure 1: A map of the sites sampled from both inside and outside the SIMCZ. Over 10 non consecutive days in the summer of 2019, 30 sites within the zone and 30 sites outside of the zone were sampled from (Kowalski, 2019).

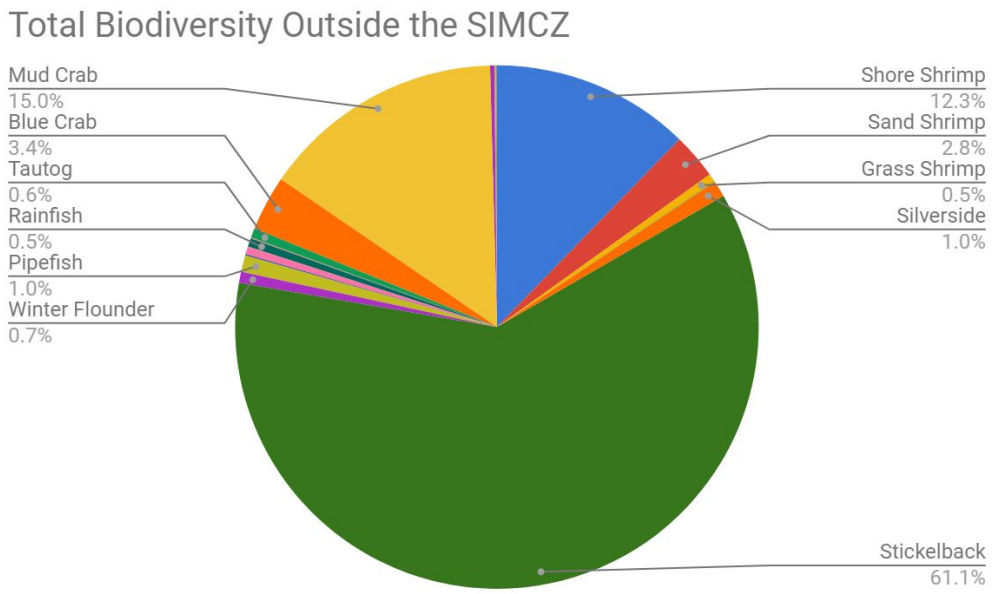

Figure 2a

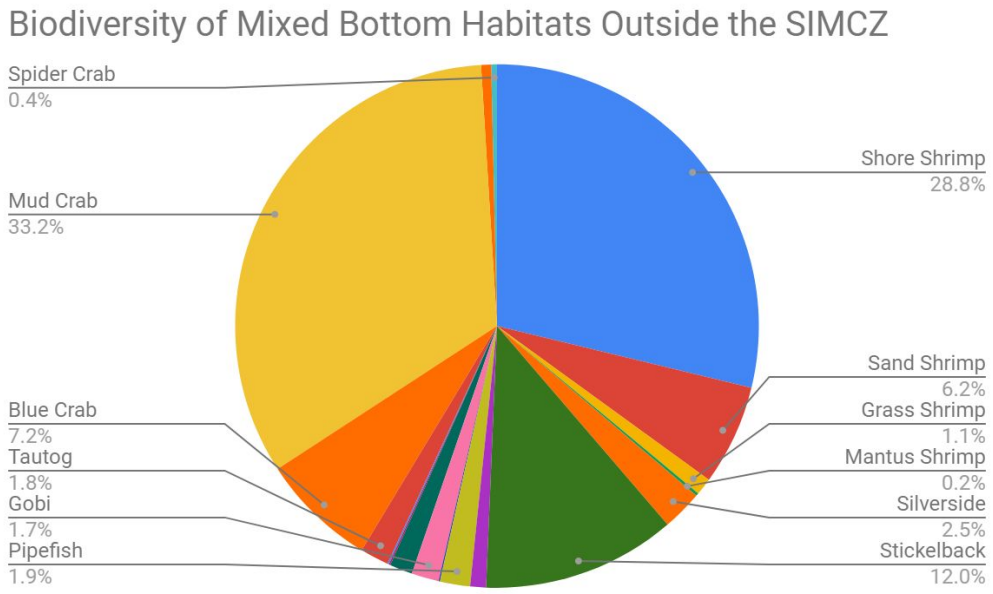

Figure 2b

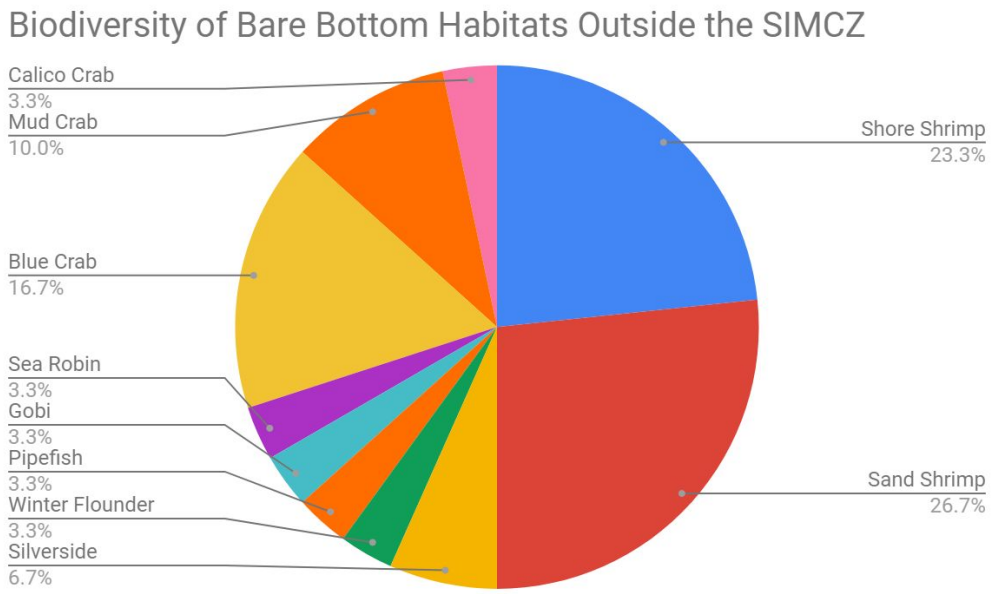

Figure 2c

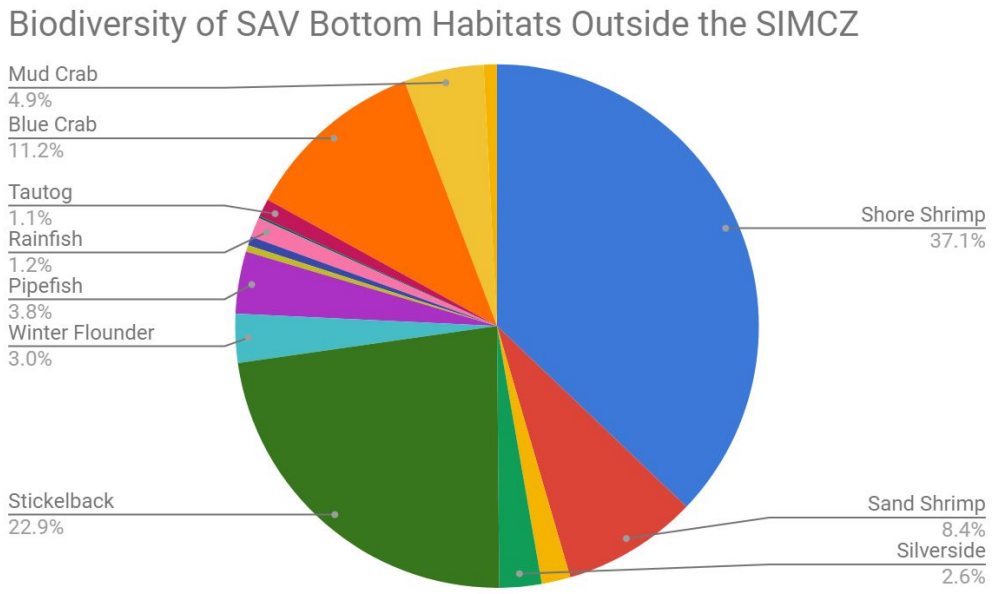

Figure 2d

Figures 2a-d: Total biodiversity was found to be higher on average outside the conservation zone, with the most outside diversity found in bare bottom habitat (0.8552), and the lowest in macroalgae habitat (0.7567).

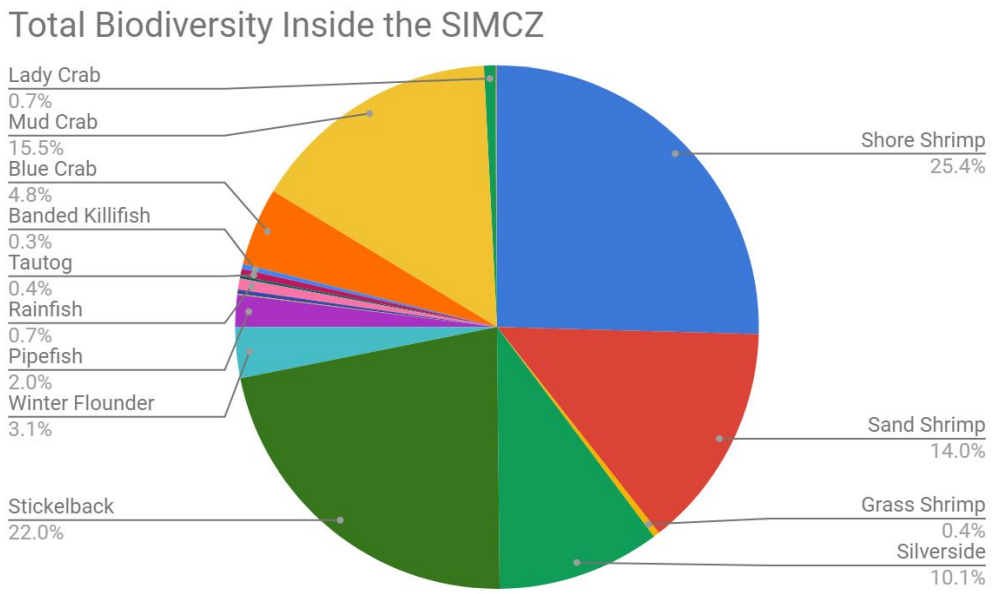

Figure 3a

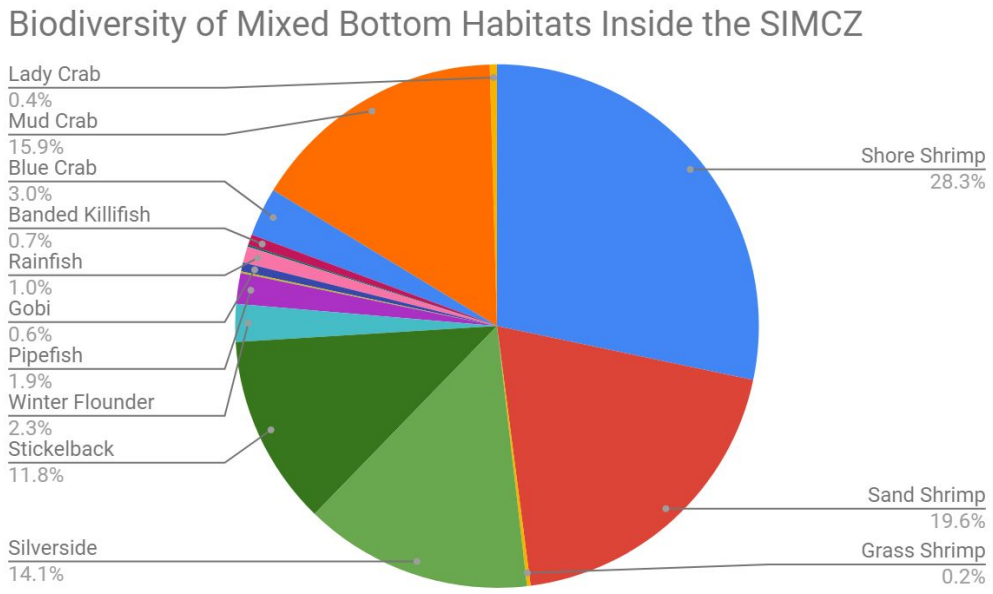

Figure 3b

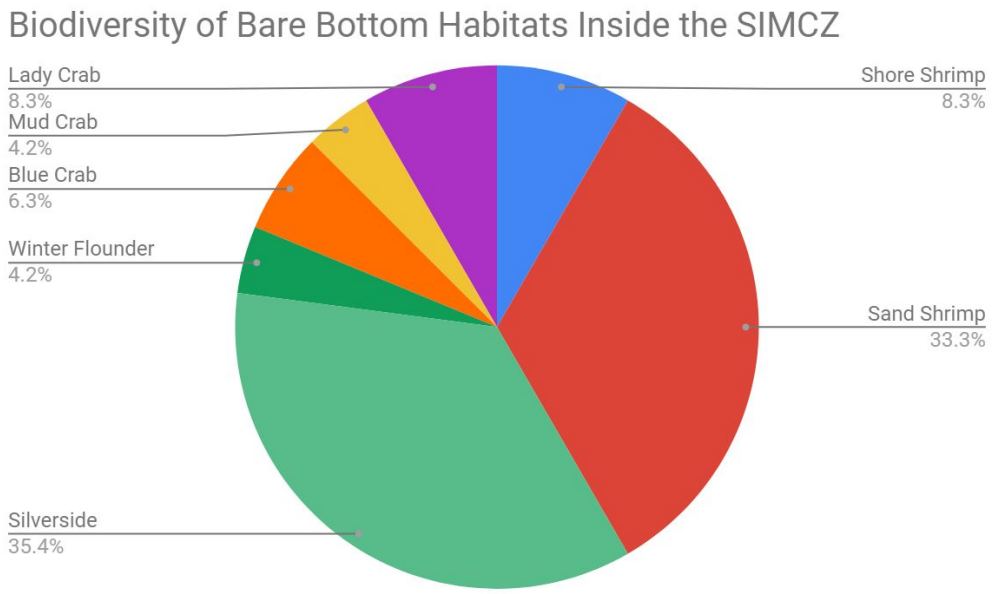

Figure 3c

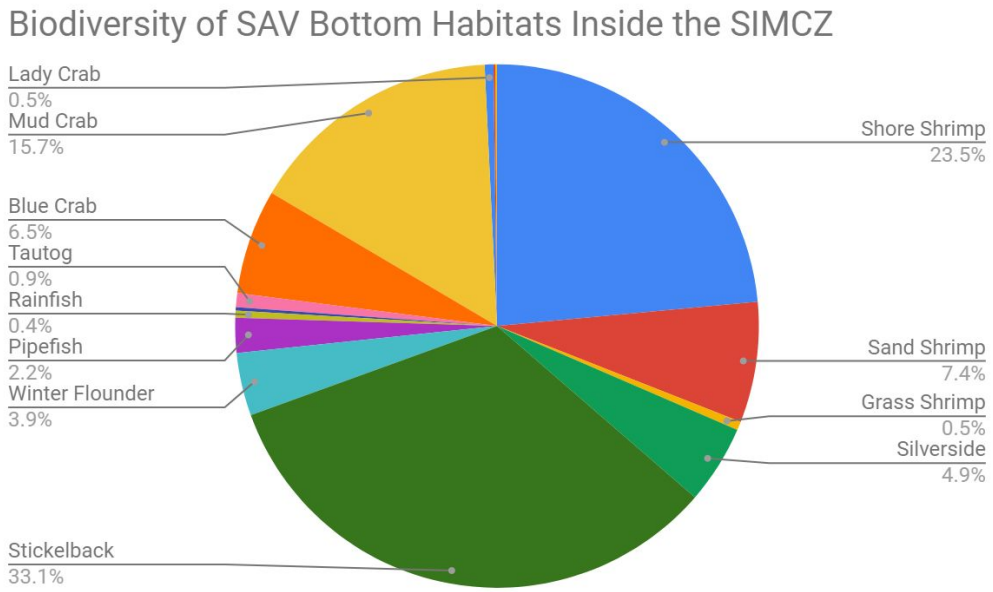

Figure 3d

Figures 3a-d: Total biodiversity was found to be lower on average inside the conservation zone, with the most inside diversity found in the macroalgae habitat (0.8002), and the lowest in the bare (0.7517).

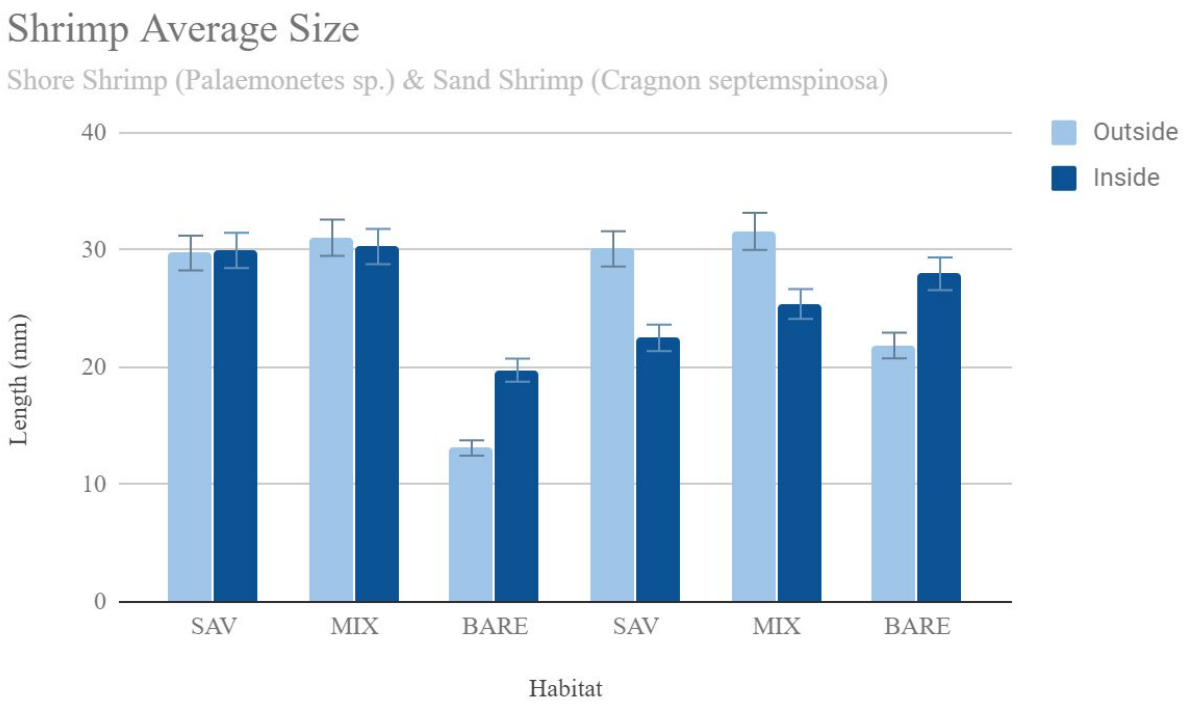

Figure 4: Size comparisons of shore shrimp (*Palaemonetes vulgaris.*) and sand shrimp (*Crangon septemspinosa*). respectively, found inside and outside of the conservation zone. When analyzed using a t-Test Assuming Unequal Variances, Sand Shrimp yielded p-values of less than 0.05.

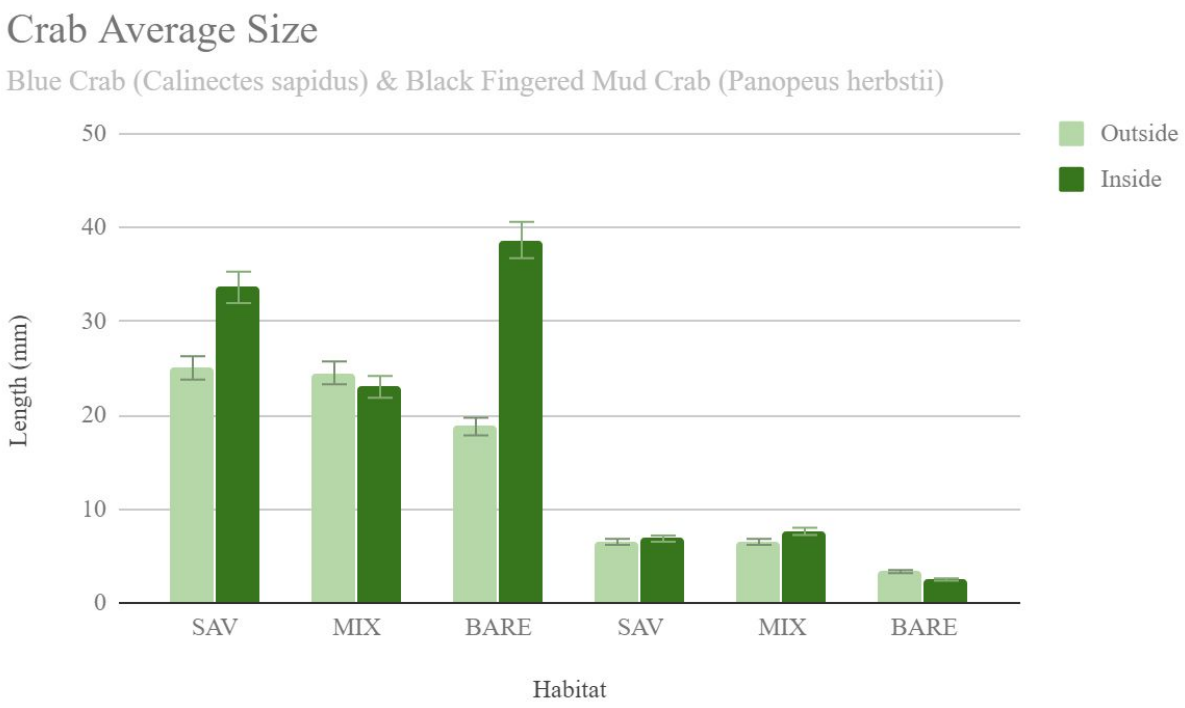

Figure 5: Size comparisons of Blue Crab (*Callinectes sapidus*) and Black-Fingered Mud Crab (*Panopeus herbstii*), respectively, found inside and outside of the conservation zone.

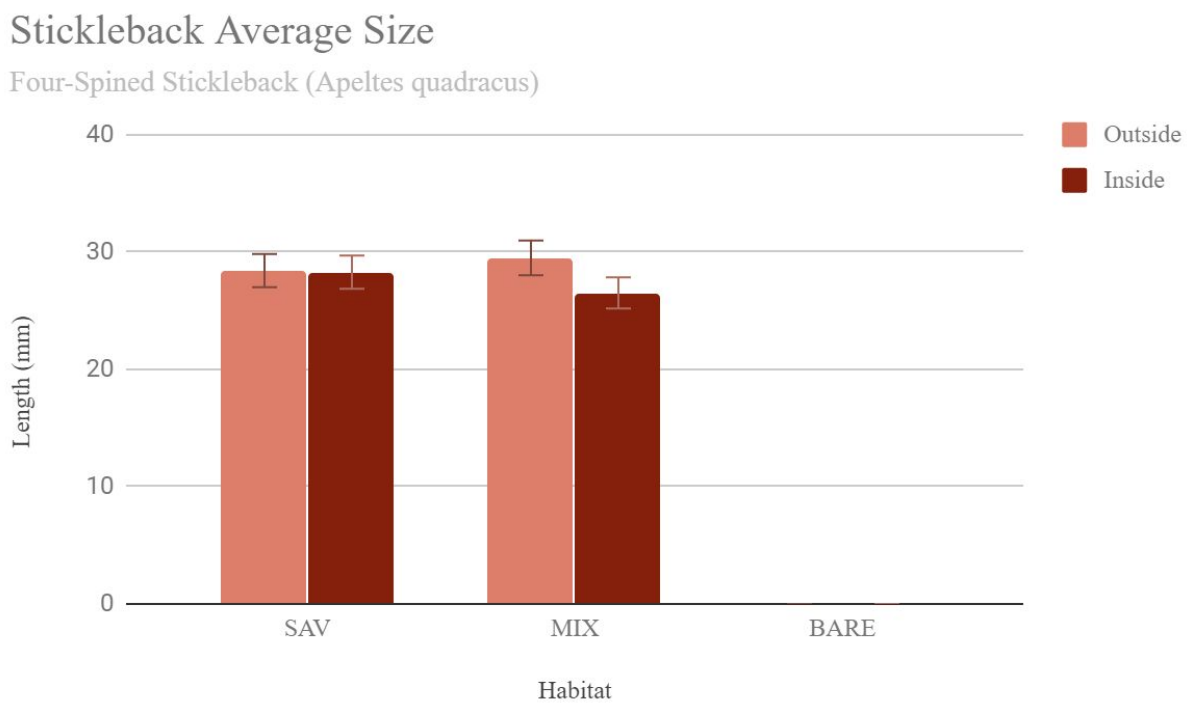

Figure 6: Size comparisons of the most common fish species, Four-Spined Stickleback (*Apeltes quadracus*), found inside and outside of the conservation zone.

Figure 7: A 1m metal encapsulation cylinder was used to isolate the study area twice at each site.

Figure 8a

Figure 8b

Figures 8a-b: Dip nets were used to collect species which were sorted through, identified, and their lengths measured.

Figure 9: Throughout the sampling, plastic bins and wood sticks were used to sort through the dense vegetation.