A Comparative Analysis into Ecologies of *Crassostrea virginica* Population Health in the Chesapeake Bay and Gulf of Mexico

Leila Avery, Environmental Studies, Social Sciences Concentration, Dr. Aimée Thomas, Nikki Bass, Sofia Giordano

Introduction

Today, our shorelines are being met with constant threats of sea level rise, land subsidence, wave erosion, increased intensity of natural disasters, and increasing water temperature and salinity. It seems like we are in a race against climate change as Louisiana loses an equivalent amount of land to a football field every 90 minutes which is about 25,000 acres of land a year. In the Chesapeake Bay watershed, we are met with many of the same issues losing about 10,942 acres of land each year. I have had the amazing opportunity to partner with the Coalition to Restore Coastal Louisiana (CRCL) and the Chesapeake Bay Foundation (CBF) in collecting data in the field analyzing the productivity of planted oyster reefs. I specifically wanted to highlight the impact of protecting the sacred grounds of BIPOC communities of the Nansemond Indian Nation located in Norfolk, VA and the Pointe-au-Chien Indian Tribe located in Montegut, LA. For the Nansemond Indian Nation, their community reef has brought back TEK (Traditional Educational Knowledge) practices back to tribal land providing food, material to make jewelry and tools, as well as improve local water quality. For the Pointe-au-Chien community, reefs protect against wave erosion caused by local fisherman and protect sacred ancestral mounds.

My goal was to see increased spat attachment, vertical and horizontal growth, reintroduction of invertebrates and sea grasses, cluster formation, improved water quality, and land retention. I greatly considered the type of substrate that is present at both of these sites and which type of planting method would work best.

Methods

Data collected at reef locations has followed the guidelines of established planted oyster reefs in OSRP (Oyster Shell Recycling Programs). Analysis include oysters dead and alive, shell size, spat attachment, invertebrates present dead and alive, and any other observations taken at the time of monitoring. Early conversations with the Nansemond Indian Nation included how we wanted the community reef to be built. The substrate of the Chesapeake Bay ranges from very soft silt to mixed shell and rocks. In the Nansemond River, substrate is very soft marshland and fine silt that is on the river bed. When exploring the best options to plant shell, we determined concrete oyster balls would not be a great option as the ball would sink over time resulting in any living oysters to suffocate. Oyster cages were also not the most efficient option as cages would get stuck in the mud. We settled on using marine grade mesh bagging to bag spat-set-shell to build the community reef and incorporating suspended oyster cages with spat-set-shell on community docs and local riverfront properties of the Nansemond River. In Bayou Pointe-au-Chien , parameters are similar to the Nansemond River with soft and muddy substrate. The biggest differences of these reefs have to do with region. The CBF plants spat-on-shell reefs to see more productivity in oyster growth, this is largely due to the winter months of the Chesapeake watershed. Once water temperature is below 40 degrees fahrenheit, oysters stop productivity and are forced into maintaining themselves-almost like a hibernation. In the Gulf of Mexico, organizations do not have to plant shell with established spat because of the year long spawning periods due to a higher water temperature and availability of free floating eggs in the water column. Something I also had to consider was the desalinifying of the Nansemond River. Parts of the Chesapeake Bay including the Nansemond River that are usually salty ranging from 20-25 ppt have been reading at 12 ppt or lower causing concern for oyster retention. The *Crassostrea virginica* species of oyster if known for their dynamic adaptability to different regions, truly hardy little animals. Another CBF reef can be found in a neighboring tributary in the Lafayette River. This reef in particular has great productivity and is exceeding parameters set for its three year monitoring data, planted one year before the Nansemond community reef. Providing us with assurement with oyster retention.

Figure 1 to the left, oyster cluster with spat attachment found on the banks of the Nansemond River

Figure 2 to the right, oyster cluster found during reef monitoring in Bayou Pointe-au-Chien

Results

In 2019, the construction of the first Pointe-au-Chien community reef was completed with a total of 200 tons of recycled oyster shells placed back into the water protecting the communities sacred mounds that are fighting the battle against sea level rise. Shell was bagged in marine grade mesh bagging allowing small invertebrates to move freely in and out of bags. The average level of salinity found at this reef was 1.85 ppt from the year 2020-2021. Invertebrates found during monitoring trips include and are not limited to blue crabs, mussels, shore crabs, eels, barnacles, hermit crabs, anemones, red worms, oyster shell boring worms, shrimp, crawfish, apple snail eggs, and bristle worms. Some statistics I would like to highlight is that we had a 7% decrease of live oysters in data 2021 compared to 2020. we need to take into consideration of Hurricane Ida and the destruction it had on Louisiana marshland. CRCL found all planted reef data and oyster retention dropped after the hurricane hit. With that being said, spat attachment increased by 15% between 2020-2021 showing promise these oysters can be resilient in this location. The Nansemond community reef was built in late 2020 approximately 400 ft with spat-on-shell filled marine grade mesh bagging. All invertebrates listed above have been found in the Nansemond reef including seahorses, with a special mention of native sturgeon returning to this part of the Chesapeake Bay. The Nansemond community reef had around 20 inches of vertical growth proving to be one of the most active and successfully planted reefs I have observed in my time conducting research.

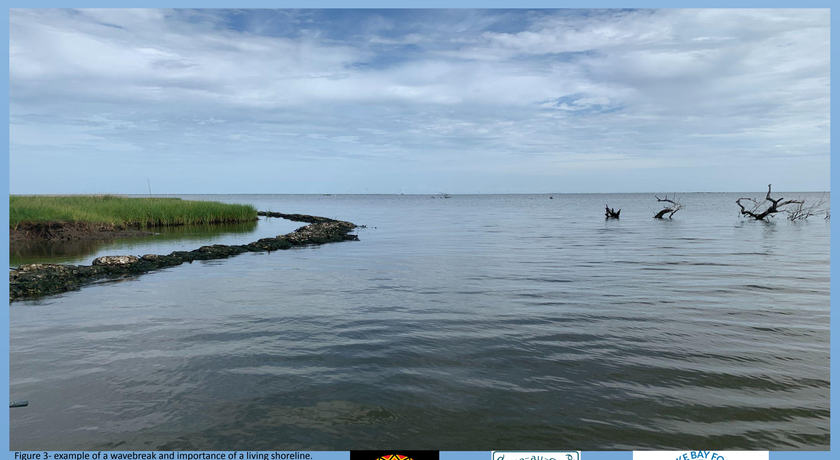

Figure 3- example of a wavebreak and importance of a living shoreline.

Discussion

I believe living shorelines can directly tell the health of a local ecosystem. In the Nansemond community we saw the return of native plants, animals, and fishes. In Pointe-au-Chien we have seen a dramatic decrease in erosion where reefs have been planted although not much vertical growth has occurred, I hypothesize many environmental have impacted the productivity of oyster recruitment. One observation I have made for both reefs is that the amount of shell submerged in substrate is wasteful. The muddy substrate allows for shell to sink into the mud which is not growing any oysters. I believe if we set one or two bag layers of sandbags directly on top of the substrate, we could have even more recruitment as shell would not be submerged in substrate, providing more surface area for spat attachment. Restorative organizations like CBF and CRCL can tap into local glass recycling options for sandbags so we can mitigate dredging for sand in other areas. We also need to be more aware of the introduction of microplastics in the environment. Our "marine-grade" mesh bagging is non-biodegradable plastic mesh bags that introduce microplastics in the new habitat. At this time there are not biodegradable options that will withstand the weight of planted reefs. These living shorelines bring back native habitat and considerably improve water quality. The Chesapeake Bay has had terrible bouts of contaminated water since the early 2000's. When I was growing up in the watershed we were not allowed to swim in bay water because of contaminants. I am happy to see today many condemned areas of the bay that have been treated with oyster reefs are now safe to swim in. The importance of these habitats have not been highlighted enough, we are in a race against time as we lose precious marshlands and tributaries that are essential to our basins and watersheds.

Figure 4 Oyster clusters found outside of planted reef area.

Acknowledgements

I would like to thank all the people that have guided me and influenced my research over the years starting with the Chesapeake Bay Foundation. I thank my friends at CRCL for welcoming me with open arms and sharing their data with me. My mentor, teammate, and colleague Sofia Giordano. My amazing professor and academic advisor Dr. Aimée Thomas. My best friend and partner in crime, Robert Coates. My beloved cousin Nikki Bass for inspiring me to begin my journey in research and most of all my parents, brother, and sister for their constant love and support.