2014 MONITORING REPORT

FOR

CITY OF GULF BREEZE DEADMAN'S ISLAND RESTORATION PROJECT

ESTUARY HABITAT RESTORATION PROGRAM

GULF BREEZE, SANTA ROSA COUNTY, FLORIDA

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2014

Contents

1.0 Executive Summary

Status of erosion control structures, breakwater conditions and vegetation.

During the year of 2014, the project endured more erosion than the previous years. The pre-oil spill oyster reef breakwater has now 80% loss of wave attenuation as compared to 65% loss from 2013. This particular reef was placed to attenuate the strong impact of the 12 mile fetch and the strong underwater current coming from the northeast direction of Pensacola Bay. The oyster reef die-off is believed to have been caused by the compounded domino effect from the impact of the oil spill, on the oyster reef ecosystem.

Although oysters are unable to process PAH uptake, this impact most likely affected the primary productivity within the water column that supplies a food source for the oysters and other marine organisms in the bay. The reef has not recovered and continued to breakdown is a non- functional as a wave break. Funding is being sought to remove and replace this oyster shell breakwater. The northwest barren area which does not contain a breakwater, and is also currently awaiting funding, subjected to wave action from a four mile fetch. Monitoring events were very short this year, and the project was not managed full time, due to funding. There were no hurricanes for 2014. Since there wasn't project manager funding to provide ongoing maintenance or monitoring, it is unclear how many storms surges or high tide events or the speed of the twelve mile fetch. This fetch continued to impact the shoreline, which caused extreme erosion and shifting of the placed sand. The sand shifted throughout 2014 and completely smothered the seagrass project from 2013. The dunes project are continually building in areas where the dune fences were closer to shore to catch any sand. The areas farthest from the shoreline did not accumulate sand due to lack of wave and wind action transporting sand upland. There was only one planting event performed in 2014 using grant funding from other agencies.

The 2011 and 2012 breakwaters funded by the Estuary act are stable and have functioned as a successful ecological habitat for oysters and fish and also have succeeded in stabilizing the shoreline directly behind the structures. Although the breakwaters show 70% coverage in oysters, there are still no market-sized oysters to test per guidelines. This year shows good settlement/recruitment of oysters.

2.0 Description of Project

Deadman's Island is a remarkable coastal place. It is one of the few areas that have a variety of ecological habitats in one, including historical, cultural resources. The area has five shipwrecks dated back to the 1500's through 1800's and an unmarked cemetery from Yellow Fever Quarantine victims. During the 1500's Deadman's Island was used as ships careenage area by the Spanish and the British, where large schooners were pulled on marine railways for cleaning and repair. Remnants of this railway, ships, and ballast rock, are present today. In 1816, the US bought the area for many purposes, including a Yellow Fever Quarantine station.

Due to the bridge construction, dredging, the twelve mile fetch impact and seawalls; Deadman's Island has experienced accelerated erosion documented since the 1940's. This erosion has unearthed and exposed many historic structures including an unmarked cemetery; the 10,000-year-old Juncus sp. saltmarsh and killed 100-year-old marine oak trees through saltwater intrusion. In 2003, Hurricane Dennis exposed several coffins and human remains. In an effort, to stop the erosion and prevent further exposure of human remains, 850 feet of oyster breakwater (Reefblks) were placed in the within the 1450 linear feet, permitted footprint.

The oysters flourished on the Reefblk and created an effective breakwater. The oyster coverage went from 95% pre-oil spill to 1% coverage 2011. Due to the oil spill delays, additional breakwater was not placed in 2010, attributable to funding being suspended or withdrawn by grant providers. The delays resulted in further erosion of the area. In 2011 and 2012, 400 feet of the new breakwater called Ecosystem was placed in other areas of the footprint, only 200-250 feet were left to complete the entire breakwater. Not anticipating a complete die-off, in 2012, the Reefblk began to lose the shells in the bags, making the 850 feet of reefblk breakwater non- functional. This non-functional reef has caused 16,000 yds3 of newly placed sand from summer of 2012 to shift and slowly erode. As the barriers containing the sand wear and breakdown; the sand lost from the project area. The new project proposal will remove, dispose of and replace 850 feet nonfunctional breakwater, which died off in 2011, shortly after the Deep Water Horizon(DWH) oil spill of 2010. In addition, 200 feet of breakwater, located in a barren area, is needed to finish the permitted 1450' footprint of the State land lease. Ten

thousand cubic yards of sand will be moved from the existing dredged spoil area located on Deadman's Island. This sand is placed in the areas where the sand has shifted and eroded, due to the non-functional breakwater and the lack of breakwater.

Figure 1: History: Distressed Shoreline of 2007

The purpose of the project is to protect an existing salt marsh habitat while increasing the biological productivity of the Gulf Breeze aquatic area. An incidental benefit of this project is to provide protection to numerous cultural resources artifacts identified at the site. The loss of the salt marsh in this area is the result of increased erosion due to wave energy. The project would create approximately 1.5 acres of emergent salt marsh for shoreline protection and an additional 0.046 acres of coastal dune. Approximately 300 reef structures have been placed along approximately 1,240 linear feet of shoreline. The structures protect the area by reducing the amount of wave energy that reaches the shoreline. Approximately 16,000 cubic yards of sandy material have been placed to protect and cover historic resources and create a small peninsula which adjoins the land. The peninsula was stabilized with native vegetation and contains a bare, un-vegetated center for bird habitat. The restoration area is separated by a dune fence, to reduce anthropogenic stressors on the project, mainly from people and pets. In summary, the project would increase productivity and diversity of flora and fauna indigenous to the Florida areas, as well as protect and stabilize the existing shoreline.

Project Goals.

1. Complete the remaining breakwater
2. Protect exposed cultural resource site by covering them with sand
3. Control erosion and stabilize the shoreline with sandbags and geofabric
4. Create a nearshore wetland using a local sand source
5. Protect, conserve, and restore seagrass beds

6. Create sand dunes by constructing them on the nearshore island
7. Increase the overall biological productivity of the Gulf Breeze aquatic and shoreline area

2.1 Description of Field Sampling Work

Monitoring results- 2014 Summary-

a) Water Quality- success criteria: No significant change. It was difficult to pinpoint any water quality change because of the increase sewage spills in Pensacola Bay, which also included a major flood event in April 2014. The residential flood waters in Gulf Breeze were discharged into the adjacent bayous of Hoffman, Woodland, and Gilmore Bayou. Gilmore Bayou was the closest discharge site to Deadman's Island.

b) Benthic monitoring- success criteria: No significant change – the sediment behind the breakwaters, toward the shoreline, show a fine build-up of sand and a darker hydric soil. Polychaetes were present.

c) Oyster Spat Settlement, recruitment, growth rates, predation, and health inspection- success criteria: out of 300 units only 52 units were thoroughly measured this year. There was a significance in change (increase) of the 2013 results
The success criteria were met

d) Seagrass monitoring- success criteria: not met. The success criteria were not met due to smothering from sand shifting of the transported sand

e) shoreline vegetation monitoring- success criteria: There was a significance in the change (decrease) in the 2013 results due to erosion from the failure of the pre-oil spill breakwater
The success criteria were not met

f) finfish surveys- success criteria: Random sampling of 100 out of 300 units, was performed, and there was a significance in the change (increase) with the same numbered unit from the 2013 results
The success criteria were met

g) Sand accretion and shoreline erosion- success criteria: There was a significance in the change (decrease) in the 2013 results of sand accretion behind the breakwater. There was shoreline erosion observed, but not in the same reference points or footprint as before the sand placement in 2012: success criteria were met in 2014

2.1.1 Oyster Growth:

Success Criteria: The success criteria was met. There was more oyster growth on the ERA funded Ecosystems breakwater than Reefblks.

As of 2013, there were no oysters or spat found on the original Reefblk reefs. There was 90% coverage of oyster spat found in the Ecosystems as expected. The boom of oyster growth and settlement this year shows the male to female ratio possibly coming into balance with the impact of the 2010 oil spill effect. Fish production was 77% more than 2013. This result is expected on a new reef as the male to female ratio of the oysters become balanced (males are dominant in the first year on a new reef). Increased fish population also kept the predator ratios low, therefore, more spat survived in the 2013, fall and 2014 spring spawning. Salinity levels were ideal to maintain healthy spat and kept oyster predation low.

2.1.2 Species abundance:

On the entire reef, which includes the Reefblk and the Ecosystems, the oyster drill population decreased. The predators of drills, the stone crabs, sheepshead, gray trout, spadefish, and mangrove snapper, has increased 78% on 100 units. Oyster spat on the 100 units of the entire reef was approximately 84%.

2.1.3 Benthic:

Success Criteria: The success criteria was neutral. There was no changes in the benthic.

Present/absent Benthic- 10% of polychaetes were found within the substrate. This result was expected and was the same as 2013.

2.1.4 Wetland creation:

Success Criteria was not met in 2014.

This site is a functioning wetland system in sections of the transported sand. There were no hurricanes or major storms to further impact the shoreline. The bogs created for wetland vegetation show thriving wetland vegetation despite the additional sand which shifted and smothered some wetland vegetation. The pvc poles shown in the sand is the original location of the barrier placement of the sand for wetland creation. Except for the poles, the barrier system was removed completely in 2014 by volunteer events.

Figure 2: Remnants of the wetland creation before shifting of the sand caused by the failed oyster reef breakwater.

3.0 Erosion Control Status—

Background: The Phase 1 breakwaters, the Reefblks, were oyster dependent breakwaters. The oysters in the Phase 1 rebar breakwaters died off in 2011, and 2012 lost almost all shell in the vertical bags, deeming the breakwater as non-functional. This die-off made the use of live oyster dependent reef, questionable. A new type of breakwater was designed not depend on living oyster growth but will promote oyster growth and increase fish habitat yet be structurally sound for offshore wave attenuation. The 2011 Phase 2 breakwaters placed were two types, Ecodiscs Lilypads and Ecodisc Table Tops, made by Reefmaker and the prototype was created by students of Little Flower Elementary School by adding fossilized and recycled oyster shells. The difference between the two is the Lilly pads were stacked closer together with about a 4 inch gap between tiers. Each Lillypads has about six discs. Monitoring is difficult with the Lillypads because of the four inch gap. It is more difficult to

Figure 3: Barrier System and maintenance. The submerged and floating barrier was removed in 2014, leaving only the reference poles showing where the sand was placed in the previous years. Notice the light shallow sand in front of the barrier and the deeper water behind the barrier.

count the marine organisms between a 4 inch by 1 foot wide and also needs the assistance of flashlights for counting. The Ecodisc Table Tops are also circular; however, they have three partitions on each disc, about 9 inches high. These partitions deflect the wave action more, and the spacing provides easier viewing and counting. However, the species abundance monitoring data shows smaller juveniles preferred the smaller gap of the Lillypads for habitat over the larger spaced Table Tops breakwater. Both designs showed functional wave attenuation. However, the table tops showed better wave attenuation than the Lillypads. In addition to the top design, various breakwaters have two types of footing. One footing model has a pad that deploys over the Pearson piling which rests on the sub-tidal floor. The other footing is without the pad, and only the piling is exposed. All units are secured by separate collars underneath the tiers.

4.0 Shoreline Vegetation Survival, Mortality, and Coverage

Figure 4: 2014 Shoreline along the isthmus

Shoreline Vegetation Monitoring: Monitoring two weeks after placement, quarterly for the first year and after every major storm.

4.1 Shoreline Vegetation Measurements:

1. Survival/mortality percent coverage increase/decrease (Functional)
2. Measurement method- percent coverage (Functional)
3. Species composition-identify the species of seagrass within the sampled area and determine percent contribution of each species to the cover.

Timeline: First two weeks after planting, monthly for three months and twice a year thereafter for the next five years.

Species' composition –Vegetation was a consisted of *Spartina patens* and *Spartina alternaflora* over 92% of the entire site.

4.2 Results

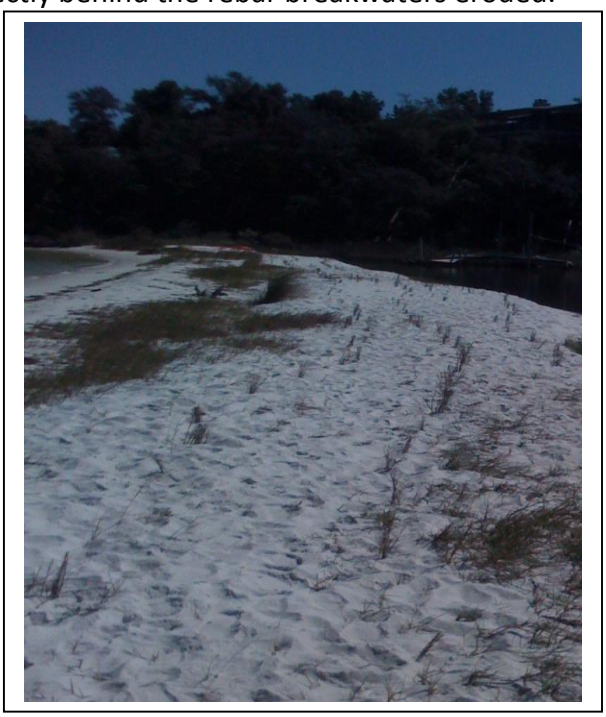
Survival/mortality percent coverage increase/decrease- The plants are growing rapidly and becoming 70% more dense throughout the project site. Several plantings occurred on the shoreline throughout the summer. When the barriers were removed the plants washed away due to lack of breakwater.

The shoreline vegetation behind west end breakwaters is stabilized. The new vegetation located on the west and north end has not shown stabilization due to heavy wave action and lack of protection. The west location of the newly placed sand fill does not contain breakwaters to protect the shoreline grasses. The breakwaters facing north are failing in many ways and have washed away 80% of the shoreline plants along the north side. Plants not subjected to the breakwater have stabilized. It is anticipated upon funding to complete the project as designed. The shoreline vegetation will have less wave action to for the roots to tolerate, and the plant can use its energy toward growth instead of trying to take root in ongoing wave action.

4.3 Shoreline Erosion Conclusion

In 2014, the plants were buried under the sand or washed out due to storms. In 2014, the vegetation that were not subjected to wave action have recovered 100% and are becoming dense clumps. Even though the storms completely covered the plants in the previous year, exposing only small sprigs of green leaves; it seems as long as there is a small exposure to sunlight for photosynthesis, the vegetation can recover or grow when buried underneath the sand.

The submerged rebar breakwater is not effective anymore. The shoreline and vegetation directly behind the rebar breakwaters eroded.



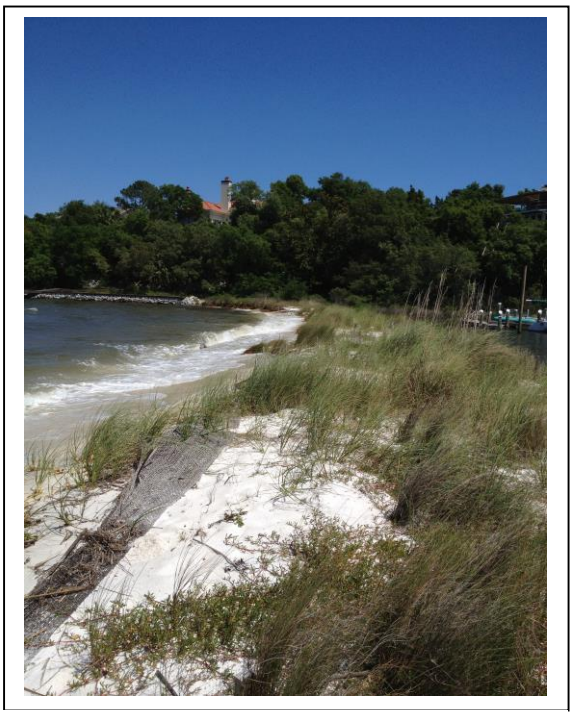


Figure 5: 2008 Isthmus planting on the north end of Deadman's Island (left) and same site in 2013

5.0 Analytical Testing Results—No laboratory testing were conducted in 2014 due to the size of the oysters not being market size for testing. Basic parameters such as salinity are routinely monitored. The salinity in Pensacola Bay was much lower than previous years. Low salinity could be due to our April 2014 rain storm which caused flooding throughout Escambia and Santa Rosa County. Gulf Breeze diverted residential flood waters directly into the bay. Due to the flooding, the number of sewage spills increased in Escambia County, which also affected the water quality of the bays and estuaries.

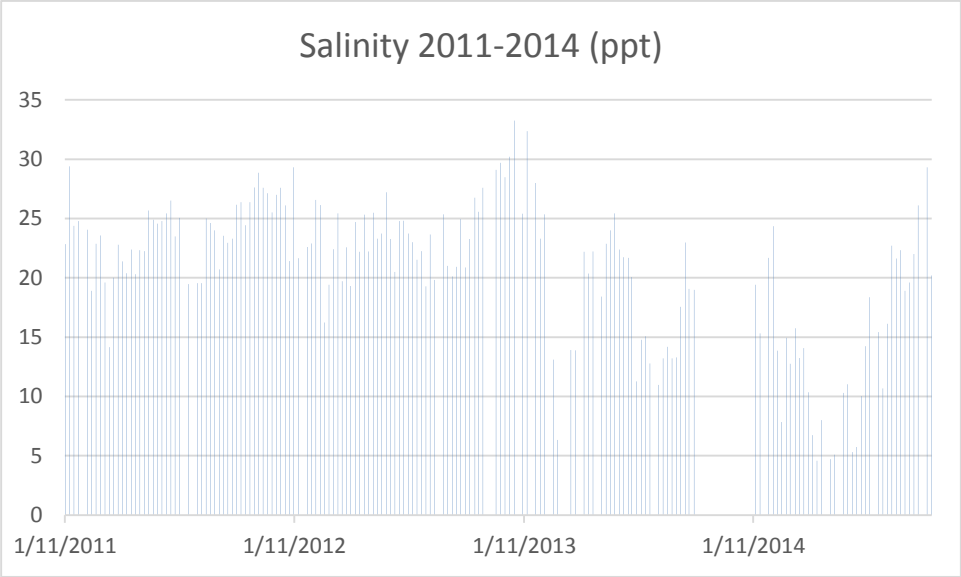


Figure 6: Salinity chart for 2011 thru 2014. 2014 shows an average of 20.83 ppt and a range of 4.57-33.26 ppt

6.0 Cost Summary— The 2014 funding significantly decreased along with volunteer events and monitoring. There was no project management funding, statistical analysis or maintenance.

The project manager volunteered time to coordinate two volunteer events and maintain small jobs.

Funding was stretched for random unit monitoring ($2000), video monitoring (no editing) ($1000), bathymetric surveys ($3600), mapping ($2000) and reports.

This does not include costs of supplies, equipment or additional surveys. Project manager fee is $50,000, but there was not enough funding in 2013 and 2014 to cover the fee for ECS due to fiscal year (ending in October). The monitoring budget needed to be stretched additional years to cover additional grant requirements. Tasks such as, monthly GIS surveys, monitoring data input, analysis and final report dates being due the latter part of December, first of the year. Monitoring expenses were used for tasks completed after the fiscal year, typically used for project management. Project manager fee includes day to day paperwork of all other projects and grants relating the Deadman's Island restoration project. Including grant proposal writing,

field operations, technician and monitoring, project design and implementation, small job clean up and maintenance, data processing, spreadsheets and data analysis, mapping, GIS, applicable training, volunteer coordination, small boat repair, maintenance and equipment maintenance. Conferences permit modifications, finances and clerical, report writing, picture processing, project implementation, school field trips and student project coordinator and quality assurance. Although the monitoring methods were reduced and altered this year, videos and pictures were taken to in case a comparison or review of data was needed to understand results. Although photos and videos are not the ideal methods to document data due to the visibility, focusing and lighting. Time needed to review; edit, map, data input and processing for future reports or any discrepancies in the previous monitoring methods was not funded this fiscal year.

7.0 Summary and Conclusions— Despite the shoreline erosion and sand shifting, 2014 was an another productive year for oysters and fish productivity. On random days, there were several bird species spotted, least tern, brown pelican, great heron, night heron, and seagull. The oyster coverage increased on random Ecosystems units. The units are still stabilizing the shoreline, and the units are anchored securely. The shoreline continues to erode, but the vegetation planted elsewhere is flourishing. Although observed throughout the year, the bird population of least terns and pelicans is unknown. The dune vegetation has stabilized and is trapping sand building up seven dunes out of the 15 dunes created. The lack of the breakwater on the north continues to threaten the shoreline and newly transported sand of 2012, but the shoreline in the other areas directly behind the ecosystem breakwaters, appear to be stabilized.

8.0 Oyster Spat Settlement, Recruitment, Growth Rates, Predation, and Health

8.1 Oyster Spat Settlement Monitoring:

Sampling will look for the absence/ presence-percent cover- size-species-disease (Functional) two weeks after placement, each oyster spawning, then quarterly, (every three months) for the first year. After the first year, monitor every year for the next five years (2011-2016).

Monitoring results showed 90% spat settlement on the East breakwaters. No disease present. Dermo could not be tested due to the size not being large enough for studies.

8.1.1 Oyster Recruitment Measurement Method:

Sampling will examine percent coverage at random stations, evaluation of spat settlement measured at the time of placement and two weeks after placement, and then quarterly (every three months) for the first year. After the first year, sample twice a year every year for the next five years.

This measurement was by percent coverage. Any purple tinted and oyster shaped shell would be considered new and counted as spat. Monitoring results showed 80% spat settlement on the East breakwaters. No disease present. Dermo could not be tested due to the size not being large enough for studies.

8.1.2 Oyster Growth Rates:

A cash stock of oysters will be marked and measured, and other stations will be used by the quantitative underwater ecological surveying techniques. Sampling will occur twice a year for a period of five years.

Oyster Growth Rates: There were no cash stocks to measure and compare to from the phase one reef, due to the die-off. However, 80% new spat growth was found on the Ecosystems.

8.1.3 Oyster Predation:

Evaluation will be done throughout random stations- using the point count method of the quantitative underwater ecological surveying techniques. Sampling will occur twice a year for a period of five years.

Random sampling of the units showed zero oyster drills.

Oyster Predation: Oyster drills, sheepshead, and crabs

Success Criteria: The number of predators on the ecosystem will be less than or equal to the number of live oysters.
The success criteria were met in 2014 – Oyster drills were not present most likely due to the low salinity in 2014.

8.1.4 Oyster Health:

Evaluation will be done throughout random stations- using the point set method of the quantitative underwater ecological surveying techniques. Sampling will occur twice a year for a period of five years.

There were no market size (<3") oysters to test for tissue or disease. Visually, the oysters show no signs of algae or sunken shells. What is present is healthy.

8.1.5 Oyster settlement-

The spring season showed spat and although, not market size for testing there was an 80% increase in oysters 2-3 inches.

9.0 Submerged Seagrass Survival, Mortality, and Coverage

The seagrass patches were smothered by huge amounts of shifting sands.

10.0 Shoreline Vegetation Survival, Mortality, and Coverage

Shoreline Vegetation (SV) Monitoring: Monitoring two weeks after placement, quarterly for the first year and after every major storm.

10.1 SV Measurements:

1. Survival/mortality percent coverage increase/decrease (Functional)
2. Measurement method- percent coverage (Functional)
3. Species composition-identify the species of seagrass within the sampled area and determine percent contribution of each species to the cover.

Timeline: First two weeks after planting, monthly for three months and twice a year thereafter for the next five years.

Species' composition –Vegetation was a combination of Spartina patens and Spartina alternaflora 62% coverage over the entire site.

10.2 SC Measurements:

1. *Survival/mortality percent coverage increase/decrease- plants washed away at the West Endpoint within three days after each planting.*
   When barriers were present, the plants along the shoreline lasted up to two weeks.

The breakwaters facing north are failing in many ways and have washed away 90% of the shoreline plants along the north side. The remaining plants have seemed to stabilize. It is anticipated upon complete funding and placement of the breakwater; the shoreline vegetation will have less wave action to tolerate.

11.0 Fish Surveys

Fin Fish Surveys: Evaluation will be done throughout the monitoring event as fish are seen on each unit- using the visual the visual census method of the quantitative underwater ecological surveying techniques.

Mangrove snapper, sheepshead, pinfish, spadefish, toadfish and blennies.

11.2 Tabletop unit vs. Lilypad unit Ecosystems

The “Table Top” Ecosystems show an increase in species' abundance, however; the 8” spacing between the table tops units are larger than 3” spacing of the “Lilypads”. This spacing difference would make counting easier because more species can be seen due to more surface area for habitat than with the smaller spaced units. There may be more species within the unit, but it is difficult to tell even with flashlights. The “lilypads” the closer spacing showed more juvenile fish, which were difficult to count because of spacing. The larger spacing showed more blennies, toadfish, and crabs. Underneath each breakwater type was mangrove snapper, spadefish, and sheepshead.

11.3 Tiers vs species abundance

The tiers support an interesting ecosystem hierarchy among fish. Tier 1,2,3 have juvenile fish, and the lower tiers have, the larger fish. The deeper in the water column the tiers are, the bigger fish. The stacked units stand in a shallow 4-5 feet depth. 2014 was the first-year black mussels were seen on the reef.

12.0 Sand Accretion and Erosion

Monitor the decrease or increase in sand accumulation. Monitoring will occur after every hurricane or large storm. Erosion device measured quarterly for the first year and after storms. After first year, monitor twice yearly every year for the next five years.

12.1 Measurements:

Fixed location stakes with measurements were deployed along the shoreline- measured at the time of placement and two weeks after placement, monthly for three months and twice a year; hereafter for the next five years.
The fixed stakes are gone, and there is still currently a professional bathymetric survey and GPS mapping performed each year.

12.2 Number of high water events/ significant storms and duration of each

There were no storms impacting the area of 2014. Highwater events were not observed on monitoring days.

13.0 Anthropogenic Stressors

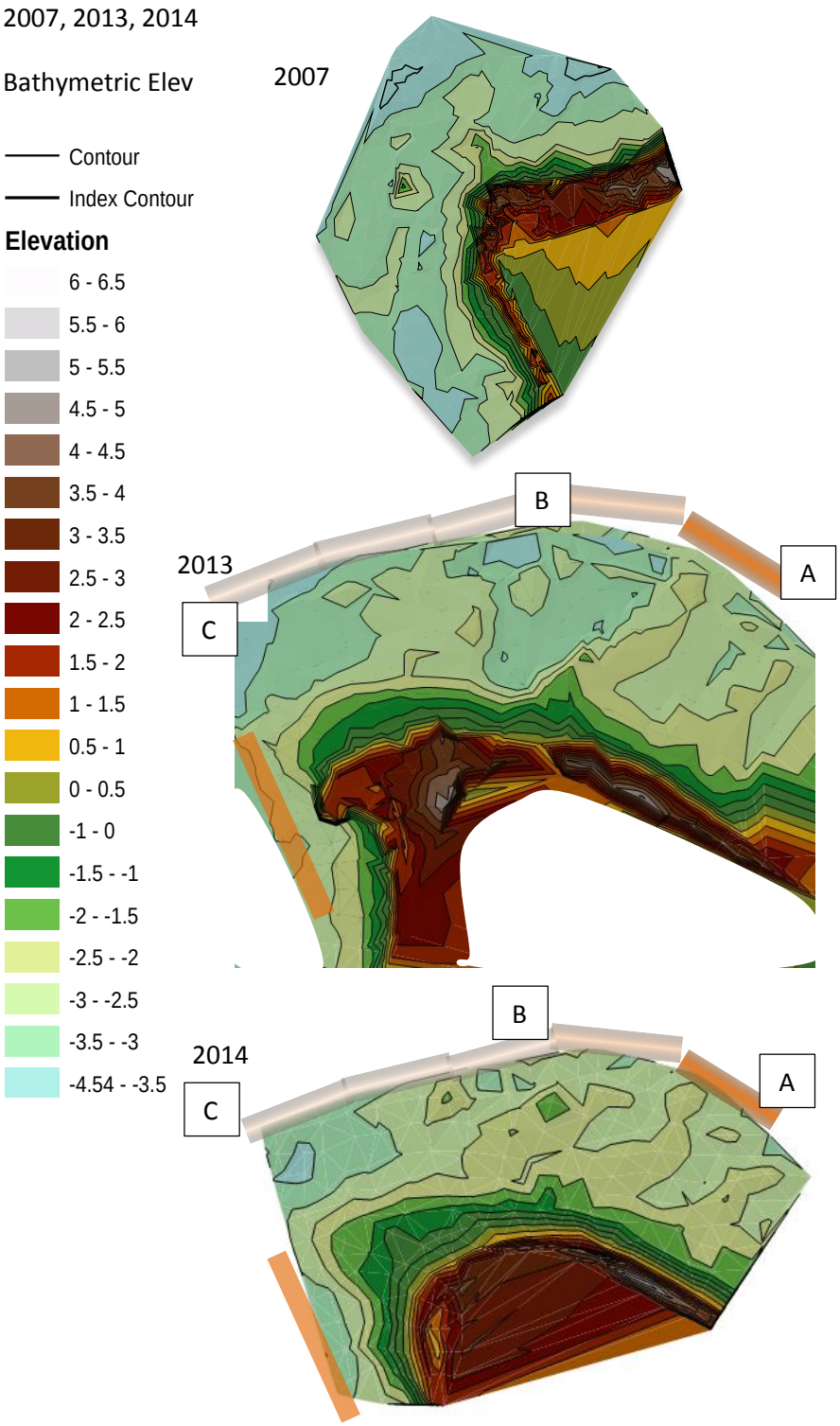
Upon completion of the 16,000 yd.^{3} of sand being transported in the wetland created, people seem to think a new section of the beach was placed for their recreational purposes. The major damage was from a lack of breakwater and constant erosion. In 2014, fences were removed, and residents still allowed pets to frequent the area. There were not has many birds nesting this year, more likely due to the anthropogenic stressors.

Figure 7: Least Tern signage to help protect the nesting of the least terns

14.0 Bathymetric Survey

A professional surveyor took a bathymetric survey with elevation points. The survey was performed mid-October each year. The points were then compared to the 2007 bathymetric baseline survey. Points from 2007, 2013, 2014 were mapped. The elevations and contours were color coded to show areas that have accreted sand and became more shallow and areas which have scoured and eroded and increased in depth.

As shown in the legend, the darker blue shade represents the deeper elevation, and a lighter green shade represents, the more shallow elevation. On land, elevation colors range from yellow/orange/red to brown, gray and white and land elevation increased.



The baseline of 2007 funded by US Fish and Wildlife (left) was before the breakwater was placed around Deadman's Island. The areas was subjected to an underwater current until the breakwater was placed. Once the breakwater was placed the bathymetric survey boundary were expanded to get a better idea of the bigger picture of the sediment transport. The survey from 2009-2011 showed an increase in accretion directly behind the breakwater. It wasn't until 2013 aerials, the rebar breakwater was observed as breaking down and not being able attenuate the 12 mile fetch from the North East. The phase 1 oyster reef breakwater did not recover from the 2010/2011 die-off. At this time, the sand was already placed due to funding deadlines.

The 2011 (A) east side breakwaters were a pilot design to not accrete sand and maintain the constant depth. If you notice in 2013, on the (A) sections there are deeper pockets of the blue shading, indicating a deeper elevation of 3.5 to 4.0 feet. The 2014 (A) section does not show as many blue or deeper elevations. These results were not expected for Section A. Section B and C are accreting more sand and the elevation and depth.

14.1 Sand shifting

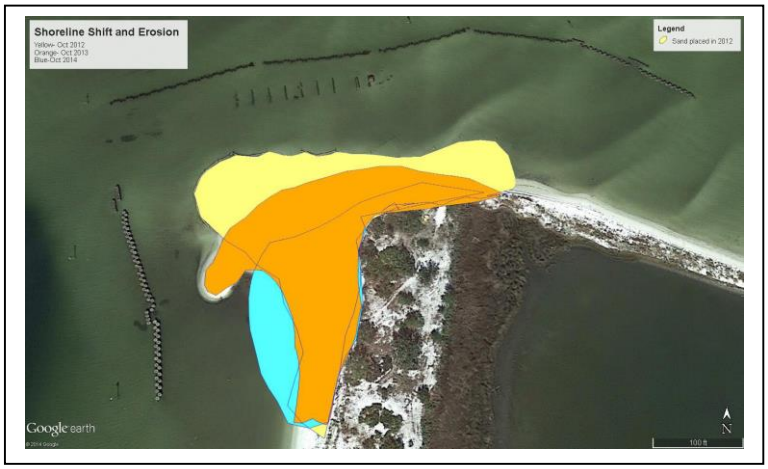
Upon placement of the 16,000 cubic yards of sand, a barrier system, the shoreline change and also barrier system was monitored. The barrier system was removed, and the shoreline change is documented.

The yellow polygon is the outline of 2012 the 16,000 cubic yards and spans (1.62 acres) of sand placement. Currently the barrier is removed and the poles remain for erosion GIS reference. The northern oyster breakwater reef did not recover as anticipated from the oyster die-off beginning during the oil spill event of 2010 to 2011.

2013 received 30-102 feet of shoreline erosion/shifting in one year. Judging by the direction of the current, most of the erosion occurred from the northern breakwater failing. The small “peninsula tail” being extend to the south west is most likely due to barren area with no breakwater and the water “pushing and shifting the sand south, when the winds came from the north west. The Ecosystems breakwater provided protection from the westerly winds and the shoreline began to accrete and become stabilized. The year of 2013 is when the barrier was starting to give way despite the efforts of maintaining the barrier as a wave attenuator until the vegetation became established. Once the barriers were completely removed in 2014, erosion accelerated and a 39% from the previous year left only 0.7 acres. The 2013 acreage was 1.14 acres and suffered a loss of 30%.

The 2013 shift changes, orange polygon, appears to have allowed the sediment to settle in the barrier footprint but moved a majority of the sand south and eventually south west. The vegetation and plantings organized from volunteer events could not develop an established root system and stabilize the evolving shoreline. The wetland bogs created to establish wetland vegetation and deeper root system before the wave reached them 15 feet away was not able to establish the root system fast enough.

The 2014 shifting , light blue polygon, caused the pensinsula to wash our an merge with the southwestern section and become protected behind the Ecosystem reef. The northwestern section which has not washed out is in the vicinity of the coffin areas. The concern is one more year of erosion, may wash out and expose the coffins again.



The comparison of the 2012, 2013, and 2014 shows the importance of complete breakwater protection. The northern breakwater was the first priority when determining where partial funding could be used the most. This failure and these results show the dire emergency to obtain funds to complete the breakwater. If the project is funded completely as designed with no interruption in funding, the project would not evolve and constantly need permit modifications and the project would sustainable.

15.0 Gulf Sturgeon

There was no funding to manage the Gulf Sturgeon projects and receivers.

16.0 Project Conclusion (see Appendix for polygon figures)

Wetlands created (2014)	.71 acres
Wetlands Protected (Gilmore Bayou)	10 acres
Total bird habitat Protected	20 acres
Oyster reef Footprint 1420 feet	0.65 acres
Oyster reef perimeter	2880 ft^2
2009-2010 Vertical Oyster reef Fish Habitat Volume (Shell inside bag)	24.06 ft^3/unit (not functional)
2009-2010 Vertical Oyster reef Fish Habitat Surface Area (oysters outside the bags and inside the unit) 33" Unit height 60 "x 6"	98.25 ft^2/ unit 23580 ft^2/ entire reef
2011-2014 Ecosystems Fish Habitat Volume	44- 48ft^3 / 4 tier unit 52- 57 ft^3 / 5 tier unit
2011-2014 Ecosystems oyster coverage surface area	30.65 ft^2 per disc 122.6 ft^2 per 4 tier disc 153.25ft^2 per 5 tier disc
Water columns	5 acres
Dune habitat restored	2 acres
Fill Sand remains	.71 acres
Total Project completed	10 acres protected (entire perimeter of Deadman's Island
Project Goal	16 acres protected (entire perimeter of Deadman's Island
Community Resilience- Hurricane protection	45 acres includes homes and property

17.0 Project Future needs

The completion of the entire breakwater footprint is needed to complete the project. The barren 200 feet of the breakwater and the replacement of the no maintenance, oyster reef, fish habitat wave attenuators. It is more cost effective as far as maintenance, for the replacement of the pre-oil spill timeframe, rebar units than repair what is already present. Once the entire footprint is complete, a few more plantings of the shoreline will be needed and then the project will be self-sustaining, will require no more maintenance and will be finished.

1.2 million dollars is needed to replace the failed rebar breakwater and the absent breakwater with the above mean high water ecosystems, remove PVC barrier posts, and replace the sand lost from this incident. If funding can be awarded all at once, then the project will not have time to evolve into other problems and the project will be low maintenance and successful restoration project.

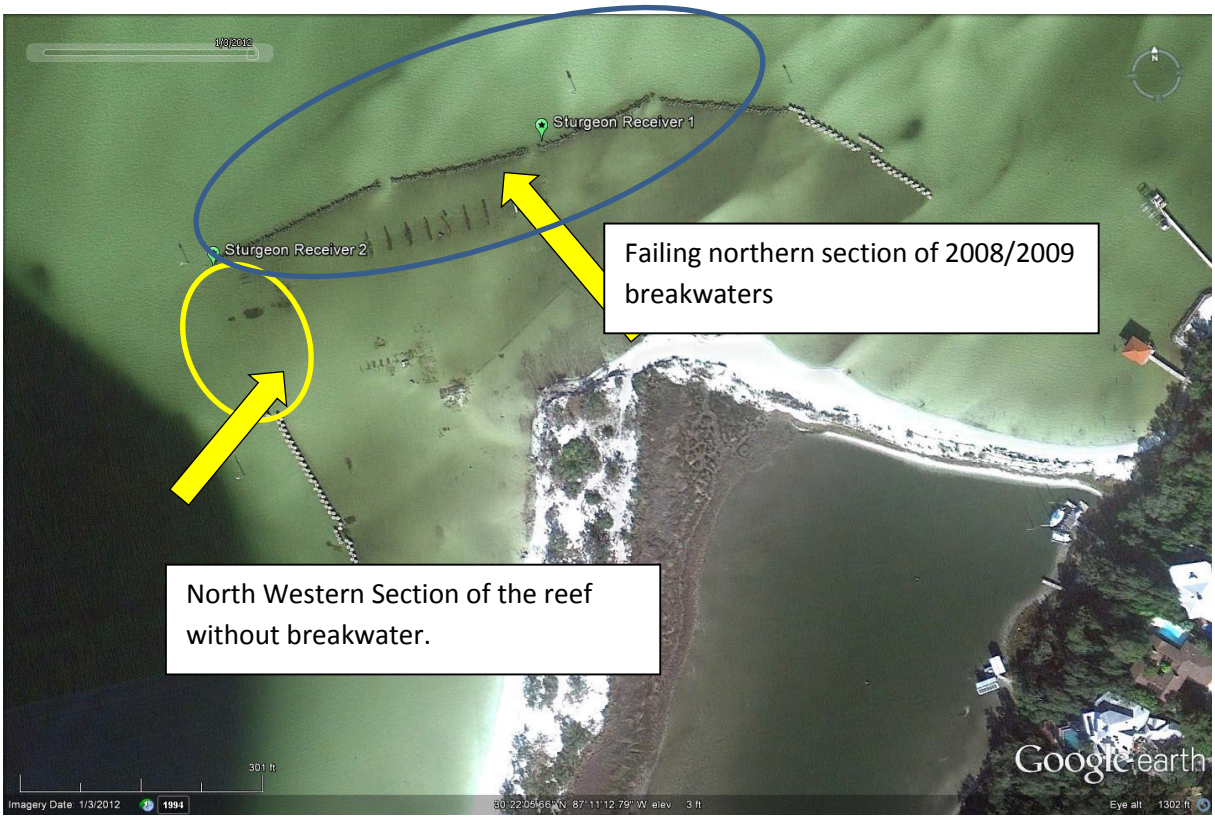


Figure 17-Project future needs, removal and replacement of northern breakwaters (blue circle) and barren western area (yellow circles) with Ecosystem.

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