2012 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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2012

ECS

CITY OF GULF BREEZE FLORIDA 1961

Contents

1.0 Executive Summary

Status of erosion control structures, breakwater conditions and vegetation.

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In 2012, the oyster breakwater showed stability through storms and tides and ecosystem growth. The tides were exceptionally high throughout 2012. Oyster growth started improving on the new ecosystem breakwaters but not the pre oil spill breakwater (Reefblks). The Reefblk began to fail due to lack of oysters cementing the shells, and the constant high wave action caused the shells to wear down in the bags and through the mesh. This reduced the height of the breakwater tremendously. Monitoring events occurred in February, June, July and October. There were no laboratory testing performed due to lack of market sized oysters. Market size oysters are needed for testing protocol. In May 2012, 16,000 cubic yards of sand were placed in the designated permit area. This new area was surrounded by a barrier system to stay in place until the sand settled and was stabilized. Stabilization occurs by settling and by planting wetland vegetation. Elevation stakes and pvc piping was placed in order to monitor sand shifting, erosion and accretion.

The Ecosystems placed on the west and east side have sustained themselves through many strong winds and storms, provided immediate fish habitat and have allowed oyster spat to settle. During the first two seasons, the East breakwater showed less spat. This lack of settlement is most likely due to new reef deployment occurring between spat season. It is anticipated by year three or four, the oyster reef system, will flourish with 90% oyster coverage, within its respective water column of the tiered units. The northern reef (not funded by the ACOE) has lost the oysters holding the reef together and rebar frame is all that remains. This lack of breakwater threatens the northern section of the newly placed sand in December 2012. No analytical laboratory samples were taken due to the lack of oysters.

Vegetation: After several storms of 2012, the vegetation 10 feet above the shoreline was stressed and appeared to have died off initially, but has recovered and is starting to spread. The shoreline with breakwater protection in front has not lost any plants. The shoreline threatened by lack of wave attenuators needs to periodically, have vegetation planted and protected by the barrier system.

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 historic cultural resources. The area as 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 bridge construction, dredging, 12 mile fetch impact and seawalls. Deadman' s Island has experience accelerated erosion documented since the 1940's. This erosion has unearthed and exposed many historic structures including an unmarked cemetery, threatened a 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 the1450 footprint. The oysters flourished and created an effective breakwater. Comparing pre-oil spill monitoring data and 2011 monitoring data –oyster coverage went from 95% to 1% coverage. Due to the oil spill delays, additional breakwater was not placed in 2010. The delays cost additional erosion to the area. In 2011 and 2012, 400 feet new breakwater called Ecosystem was placed in other areas of the footprint, only 200-250 feet were left to complete the breakwater. Not anticipating a complete die off, 2012 the Reefblk began to lose the shells in the bags and made the 850feet 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 breakdown; the sand is lost. This project will remove, dispose and replace 850 feet nonfunctional breakwater, which died off in 2011. Shortly after the DWH oil spill of 2010 and add the additional 200 feet of breakwater to finish the permitted 1450’ footprint of the State land lease. Five thousand cubic yards of sand will be moved from the existing spoil area, to be placed in the areas where the sand has shifted and eroded, due to the non-functional breakwater and the lack of breakwater.

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 generally the result of increased erosion due to wave energy. The project would create approximately 1.04 acres of emergent salt marsh for shoreline protection and an additional 0.046 acres of coastal dune. Approximately 300 reef structures will be placed along approximately 1,240 linear feet of shoreline. The structures will 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 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 island 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. Install Gulf sturgeon monitoring equipment
8. Increase the overall biological productivity of the Gulf Breeze aquatic and shoreline area

2.1 Description of Field Sampling Work

Monitoring results- 2012 Summary-

a) Water Quality- success criteria: due to the unexpected oyster crash. The success criteria was neutral.

b) Benthic monitoring- success criteria: due to the unexpected oyster crash. The success criteria was neutral.

c) Oyster Spat Settlement, recruitment, growth rates, predation, and health inspection- success criteria: due to the unexpected oyster crash. The success criteria was neutral.

d) seagrass monitoring- success criteria: not applicable

e) shoreline vegetation monitoring- success criteria: success criteria was met

f) fin fish surveys- success criteria: success criteria was met

g) sand accretion and shoreline erosion- success criteria: success criteria was met

2.1.1 Oyster Growth:

Success Criteria: Due to unexpected oyster crash. The success criteria was not met.

There were no oysters or spat found on the original Reefblk reefs. There was 11% found on the Ecosystems. This lack of oysters has been trending in the entire Pensacola bay since early 2011. The bay harvest areas are sparse; the amount of larvae traveling with the current and settles on the oyster shells is also reduced. This 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 keep the predator ratios low, therefore more spat survive after the first year of deployment. Oyster settlement and abundance on the Ecosystems is expected to increase to 65% or more in 2013 (four spat seasons).

2.1.2 Species abundance:

On the entire reef, which includes the Reefblk and the Ecosystems, the oyster drill population has reduced to 25%, the Stone crabs, sheepshead, gray trout, spadefish and mangrove snapper has increased 60%. Oyster spat on the entire reef was approximately 4%.
Other species found on the reef was coral (*Astrangia danae*), tube worms and other polychaetes and unusually small horseshoe crabs and a scallop was found in the sand next to the Ecosystems. An abundance of fish eggs were attached to the old oyster shells, which have fallen off the bags onto the sediment during 2010 and 2011.

2.1.3 Benthic:

Success Criteria: The success criteria was neutral. There was no changes in the benthic community due to the Pensacola Bay oyster crash.

Present/absent Benthic- 10% of polychaetes were found within the substrate. This was expected.

2.1.4 Wetland creation:

Success Criteria was met.

The storms of 2012, did cause shifting of the 16000 cubic yards of sand which was placed in May 2012. Along the shoreline only, about 30% of plant vegetation washed out. Planting occurred throughout the year. This was anticipated due to high tides; therefore, several plantings occurred throughout 2012.

The barrier system, when intact was sufficient to keep the sand in place while settlement occurred. It would be declared as a successful project and can be determined as transferable method, with very high maintenance, in a sediment management plan. The sand around the west end shoreline, within the barrier shifted constantly. According to GIS and surveys the sand shifted and stayed within the barrier system. It was only after sections of the barrier system became ripped and torn, the barrier system began to fail.

Anchoring: Due to the lack of the breakwater in one section, the barrier needed to be secured by wood piling instead of PVC pilings, which when this project is completed, all pilings will be removed. Maintenance was constant on the barrier system due to storms and high tides. The barriers were ripped in many places. Barrier sections, as they deteriorate, need to be replaced each year for the duration of time when all the breakwaters are in place. There is only enough barrier left for year 2013.

It is anticipated, due to the observed increase in the fish population and decrease in oyster drills, the oyster reef ecosystem will show at least 60% coverage in the year 2013. The reduction of predators, which occurred after the oyster die off in late 2010 and early 2011, and the possible balance of the male to female ratio through the spat seasons should increase the spawning and spat counts.

3.0 Erosion Control Status—

The Phase 1 breakwaters the Reefblks were oyster dependent breakwaters. The oysters in the phase 1 rebar breakwaters died off in 2011 and in 2012 lost almost all shell in the vertical bags, deeming the breakwater as non-functional. The 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 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. Although it is too early to tell, observations demonstrate the unit with a Pad on the bottoms tends to accrete sand, where the units on the bottom without a pad, tending to scour or leave the levels constant with neither scouring nor accretion. The annual professional survey should be a good long term indicator of the coastal processes occurring.

Figure 1- Two type of verticals wave attenuators placed at Deadman's Island

4.0 Shoreline Vegetation Survival, Mortality and Coverage

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 were a combination of Spartina patens and Spartina alternaflora 92% coverage over the entire site.

4.2 Results

Survival/mortality percent coverage increase/decrease- plants washed away at the West End point within three days after each planting.

When barriers were present, the plants along the shoreline lasted up to two weeks.

The emergent grasses planted in June, July and August, were ten feet past the shoreline were very successful in establishment. The storms impacted the grasses by washing sand over the grass. However; the grass immediately recovered. It is expected the grass patches will increase in density in 2013.

The shoreline vegetation behind breakwaters seems to have stabilized. The sand shifting has covered the protected plants, but the plants seem to have 70% recovery. The 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 70% of the shoreline plants along the north side. The remaining plants have seem to stabilize. It is anticipated upon complete funding and placement of the breakwater, the shoreline vegetation will have less wave action to tolerate and can place the plant's energy toward growth only.

4.3 Shoreline Erosion Conclusion

The storm events did cause some damage to the shoreline, however; reviewing the tide data historically, there were several high tides which were above normal. The 2012 moon phases caused extremely high tides which created, unpredictable rogue surges. Rogue surges created the most damage to the entire area of Deadman's Island. Overall, 64% of the vegetation recovered from storm impact and being buried. The plants, as long as there is a small exposure to sunlight for photosynthesis, can recover or grow when buried underneath the sand.

The breakwaters which were above high tide, protected the area more than the submerged breakwater which acted as fringing reef which caused waves to break on the reef, and create more momentum for sand shifting.

Issac Sept 2012 Rogue surges Nov 2012

Figure 2- after picture of the vegetation after Issac (Sept 2012)and and after picture of a rogue surge (not declared a storm) in Nov 2012. The roque surge caused more scouring and removed more plants than tropical storm Issac. In addition, more sand was deposited and buried a majority of the vegetation

5.0 Analytical Testing Results—No laboratory testing were conducted in 2012 due to oyster die off

6.0 Cost Summary— Labor for biological monitoring, data processing, maintenance of the breakwaters, shoreline stabilization, barriers of total of 827 man hours and a total cost are $12468.16. This does not include costs of supplies, equipment or surveys. Project manager man hours are 1920+ of a total cost of $50, 256.00. Project manager includes day to day paperwork of all other projects and grants relating the Deadman's Island restoration project. , 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 and maintenance, equipment maintenance. Conferences, permit modifications, finances and clerical, report writing, picture processing, project implementation, school field trips and student project coordinator and quality assurance.

7.0 Summary and Conclusions— Water Quality Monitoring: Water quality will be testing the ability of a 1200 ft. long virgin living oyster reef ability to change ambient water quality. Sampling parameters include Biological Oxygen Demand, Chlorophyll a, Total Suspended Solids, Color, Turbidity, Fecal Coliforms, Total Coliforms, Enterococcus, Nitrates, Nitrites and Total Phosphorus. Two water quality samples will be taken during each sampling event.

The ideal sampling method would be behind a functional reef which provides a quiescent environment of zero to low wave action. Since the original 840 ft rebar breakwater is failing and the other breakwater although are attenuating waves, does not provide an enclosed system, these tests are not cost effective because they are not effective in determining water quality unless in a closed off system. These tests should be performed in the third year when the breakwater footprint is entirely completed, and the sand has become established with a microbial environment which is ideal for the benthic community.
Water quality parameters such as salinity, temperature, turbidity (Secchi disk) are documented throughout the year and will be sufficient in a high circulation and high flow semi open system. These parameters are crucial in evaluating the survival of the oyster reef and the presence of any predators a which prefer high or low levels of salinity.

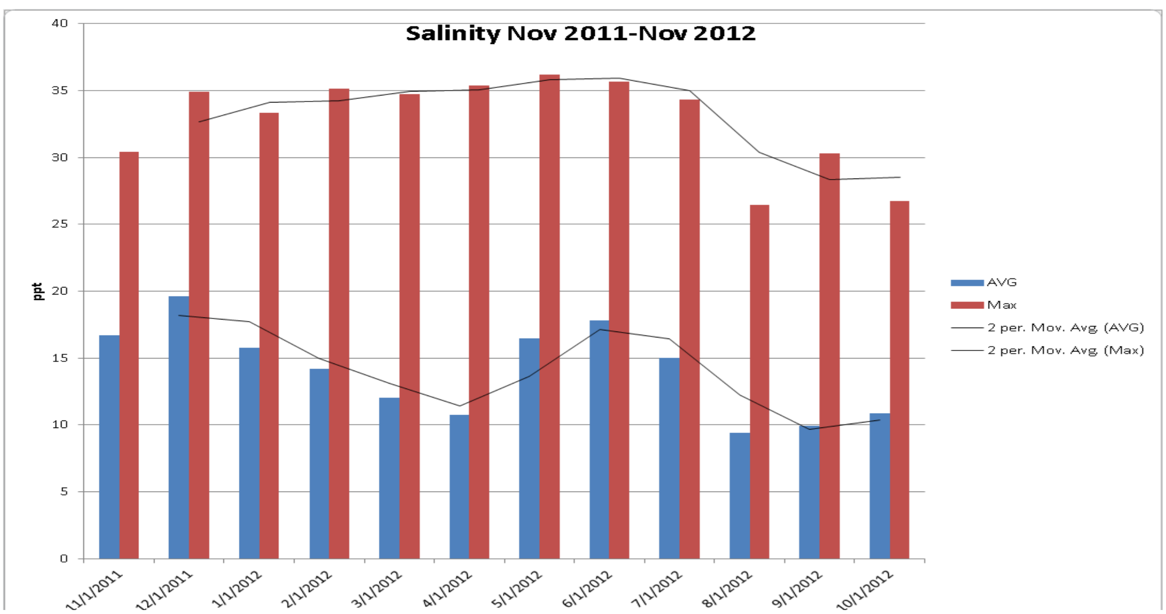


Figure 3- Salinity chart for Nov 2011 thru Nov 2012 showing a range between 10-36 ppt

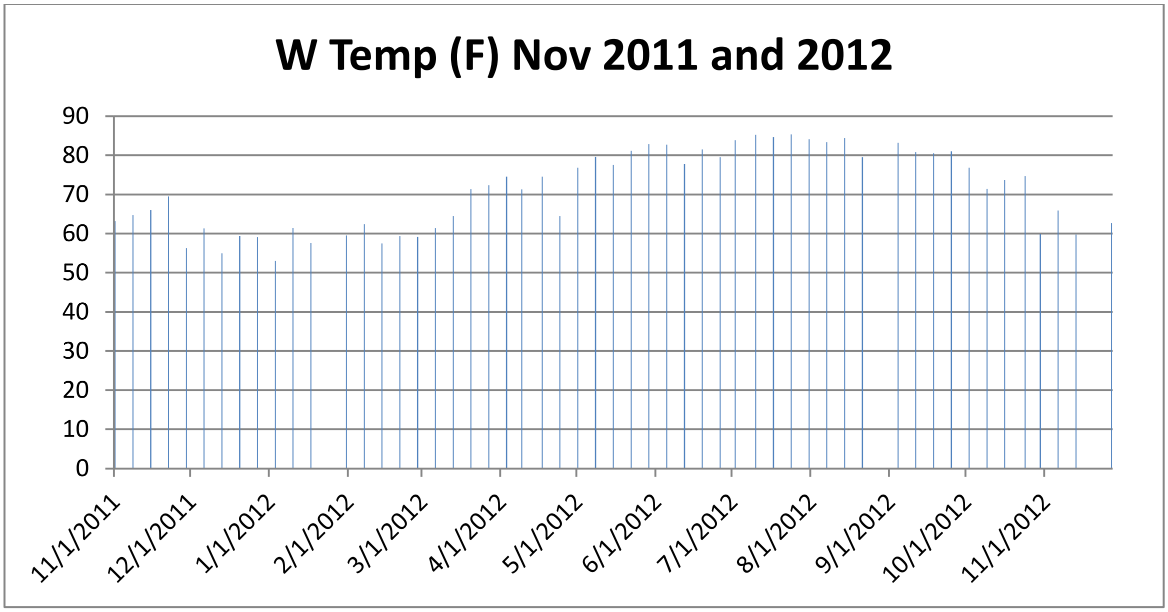


Figure 4- Temperature trends from Nov 2011 thru Nov 2012 showing a range from 5- to 88 F

The chart above shows the temperature trends of 2012, spawning events coincide with at least a 10° temperature change. February 2012 September 2012 and November 2012 all show a change in temperature over 10°F. This temperature change is known to induce spawning.

7.1 Conclusion:

Salinity is the most important perimeter to trend to understand whether the oysters will have a healthy year. Salinity influences the health of the oyster and also its predators. Higher salinity accommodates a majority of the predators of the oysters. Oysters grow in spawn an intermediate salinity such as 25 parts per thousand. For the year 2012, the average salinity was ideal for healthy oysters, although it times the maximum level of salinity would reach 35 parts per thousand, yet this is still in the range of healthy oyster growth.

Looking at the higher numbers of Max salinity in 2012, also supports the predators of the oysters. Therefore; although oyster growth was occurring, there was competition by the predators of the reef.

7.1.1 Benthic

Benthos Monitoring: Sediment will be characterized by analyzing for grain and percent organics. Petite Ponars will be used to sample at designated stations for benthic macro invertebrates in areas where structures will be placed. Each station will have three separate replicate samples that will be individually sampled as opposed to composite samples. This will give the most statistically valid number of benthos and diversity. Samples will be submitted for statistical analysis using the Shannon Weaver Diversity Index. Two samples will be taken twice a year for a period of five years.

7.1.2 Ponars:

Three Ponars were taken and placed in a jar with Rose Bengal to colorize any benthic organisms.The ponars were not particularly effective, and they were heavy so about ½ cup of sediment was taken – One year of data is not feasible for the Shannon Weaver index – When compared with the 2008 data, the same species were present

7.1.3 Grain Size: Taken through a test sieve –Average of 1.37 phi

A ponar is a singularly poor method to obtain shallow water samples in sandy soil if trying to determine diversity. The microbial environment is disturbed, and the possibility of excluding some organism due to loss through the ponar, is high.   It is recommended to use sediment placement trays. Sediment placement trays were placed in the water at three locations. These placement trays are to build an artificial sediment community which can be removed without disturbing or impacting the microbial community.

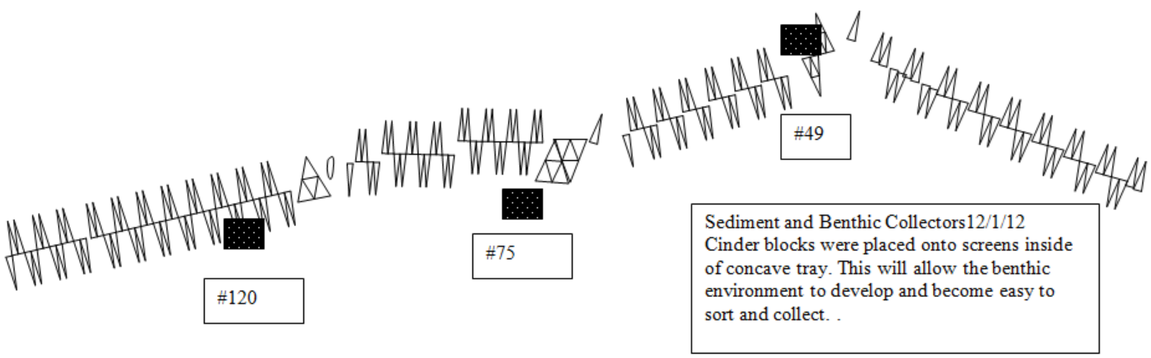


Figure 5- Three sites for the sediment and benthic community collectors. Each collector is placed behind the breakwaters for protection

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

Figure 6-Spat and oyster settlement on the western reefs of Deadman's island

8.1 Oyster Spat Settlement Monitoring :

Sampling will look for 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, sample twice a year every year for the next five years.

> *Monitoring results showed no settlement on the new Eastern Reefs but there was a small percentage of established settlement on the older Western reefs. Therefore, there is a possibility older oysters were present on the westside established reefs which contributed to more spat settlement.*

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, then quarterly (every three months) for the first year. After the first year, sample twice a year every year for the next five years.

Monitoring results showed no settlement on the new Eastern Reefs, but there was a small percentage of established settlement on the older Western reefs. Therefore there is a possibility older oysters were present on the westside established reefs which contributed to more spat settlement.

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, new spat growth was found on the Ecosystems. The random oyster spat size was 0.25 inch to 1 inch in length.

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.

Predators – oyster drills were much less in 2012 yet still abundant in 2012, the predators for oysters drills are starting to return to the reef from the ecosystem die off in 2011. The Sheepshead, which are predators to oyster drills, showed an increase in juveniles and were more abundant this year than last. Crushed oyster drill shells were found all over the reefs and sub tidal bottom. The presence of crushed shells, showed the oyster drill population were beginning to be controlled by Sheepshead and stone crabs, unlike the previous year where there was a lack of.

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 not met in 2012

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.

In the pre monitoring assessment in the Spring and fall spat season in 2012 showed the fall of 2012 has a 60% increase in spat than the spring of 2012. The was a 20% die off of the fall spat within two weeks. The Pensacola Bay is still trying to cover from the impact of the oil spill activities, which included the dredging of East Bay by poachers for live oysters. The oyster population was slowly dying off during in 2010 according to fishers testimonies, and in order to maintain their harvest quota, East Bay was dredged. It is unsure how much of the population was dredged, but the lack of spat on the reefs, can cause speculation the impact was greater than normal harvesting methods with tongs. This dredging activity impacted the spawning. Once the oysters begin to recruit, the male to female ratio must be established due to the oyster spat which do spawn are predominantly male, and after a few years the ratio is in balanced. It was anticipated 2012 would contain a recovery in spat settlement, however, a brief observation in the fall season shows the recovery may be balanced in 2013.

8.1.5 Oyster settlement-

The fall season showed no oyster present. When spat was found, it was normally dead due to predation of oyster drills and crabs. This is expected the first two seasons until the male to female ratio of oysters becomes balanced where the spawning and settlement rate increase and out number the predator population.

9.0 Submerged Seagrass Survival, Mortality and Coverage

Currently, the area seagrass patches have been mapped by GPS and the expansion project will begin in 2013.

Shoreline Vegetation Survival, Mortality and Coverage

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

9.1 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 were a combination of Spartina patens and Spartina alternaflora 92% coverage over the entire site.

9.2 Measurements:

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

The emergent grasses planted in June, July and August, were ten feet past the shoreline were very successful in establishment. Storms impacted the grasses by washing sand over the grass. However,; the grass immediately recovered. It is expected the grass patches will increase in density in 2013.

The shoreline vegetation behind breakwaters seems to have stabilized. The sand shifting has covered the protected plants, but the plants seem to have 70% recovery. The vegetation located on the west and north end has not shown stabilization due to heavy wave action and no protection. The west location of the newly placed fill does not contain breakwaters to protect the shoreline grasses. The breakwaters facing north are failing in many ways and have washed away 70% of the shoreline plants along the north side. The remaining plants have seem to stabilize. It is anticipated upon complete funding and placement of the breakwater, the shoreline vegetation will have less wave action to tolerate and can place the plant's energy toward growth only.

10.0 Fish Surveys

Fin Fish Surveys: Evaluation will be done throughout random stations- using the visual the visual census method of the quantitative underwater ecological surveying techniques

After placement of the wave attenuators – two weeks 2% spat (1/2 inch size) – immediate fish presence (most likely from the adjacent reefs) showed on all reefs. Pinfish are the first species to appear on the reef within the first two weeks. One month later, all species as adults were present. Most juveniles species, such as mangrove snapper, did not appear for another season.

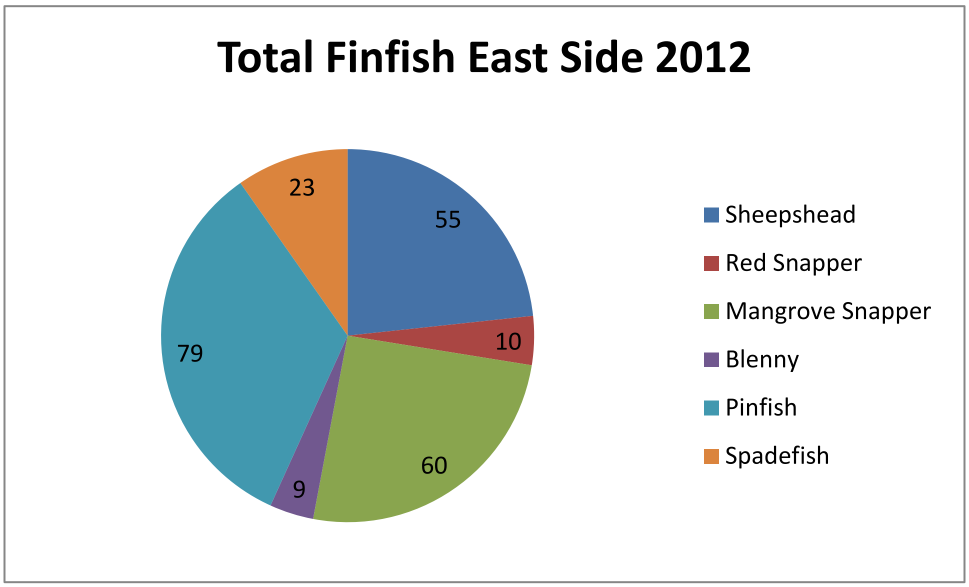


Figure 7-Total number of finfish for the east side breakwaters

10.1 Competition and Species present:

This reef was deployed late July 2011 after spring spat season-
Dates of monitoring July 2012

Table 1- The total abundance of species for both breakwaters of the east and west section of the project

Species	Common	East	West
Urosalpinx cinerea	Oyster Drills (OD)	1277	4300
Urosalpinx cinerea	Egg Casing (EC)	38	30
Crassostrea virginica	Live Oyster (LO)	43.01	402
Crassostrea virginica	Dead Oyster (DO)	368	1265
Archosargus probatocephalus	Sheepshead	55	128
Lutjanus campechanus	Red Snapper	10	41
Lutjanus griseus	Mangrove Snapper	60	0
Zooanthis sp.	Zooanthids	13	25
Hypsoblennius hentzi	Blenny (Feather)	9	177
Balanus sp	Acorn Barnacles	157	504
Cerianthus spp.	Tunicates	18	168
Callinectes sapidus	Blue crab juv	11	130
Menippe mercenaria	Stone crab	4.01	50
Pagurus longicarpus	Hermit Crab	49	336
Lagodon rhomboides	Pinfish	79	448
Chaetodipterus faber	Atlantic Spadefish	23	12
Astrangia danae	Coral	1	21
Crassostrea virginica	Live Spat	0	6690
Crassostrea virginica	Dead spat	0	10807
Opsanus beta	Toadfish	0	7
Brevoortia patronus	Menhaden juv	0	57
Sabellidae spp	Feather duster worm	0	21
Cerianthus spp	Anemone	3	111
Haemulon album	Grunt	0	1
	Total	2220.02	25731
	Land Side	695.02	8447.34
	Bay Side (North Side)	747	8169
	East Side	196	2445
	West Side	505	7233

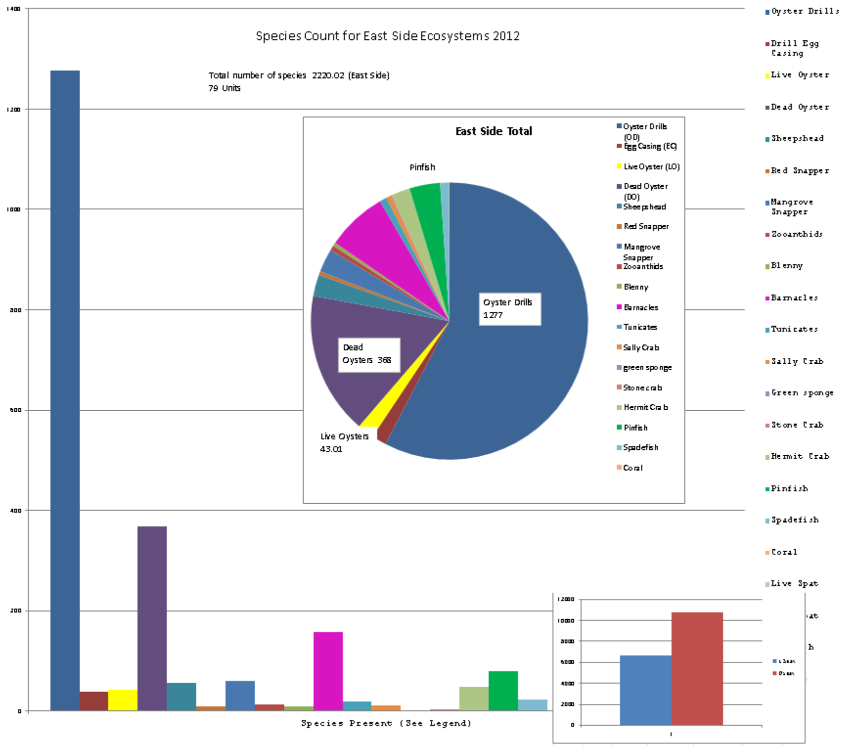


Figure 8- Species count for the entire east side reef

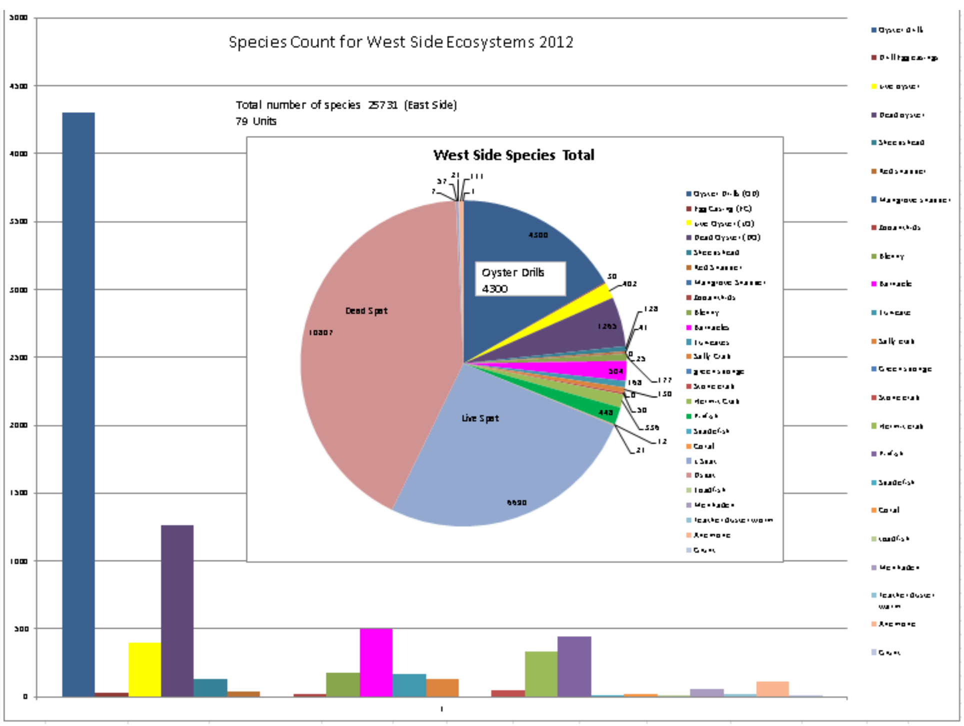


Figure 9- Species count for the entire west side reef

Table 2- Total reef, live oyster and fish species abundance in relation to all tiers of each unit, all directions of north, south (Land), east, west and the two different structure designs.

	#units	Total All Species abundance	Live Oyster Relative Abundance	Fish relative abundance	Shannon Weiner Diversity Index	Simpson's Diversity Index
Tier 1	62	111	0	71	1.04437692	0.53833171
Tier 2	62	185	3	111	1.16156894	0.59352085
Tier 3	62	690	18	438	1.06182216	0.61406365
Tier 4	62	467	13	59	1.129841	0.69497569
Tier 5	62	376	8	76	0.93666305	0.58145499
Tier 6	62	122	0	51	1.0575529	0.76209186
Land	62	736	20	736	1.70784715	0.68301339
North	62	816	10	816	1.43075945	0.58030494
East	62	165	1	165	1.35476194	0.57184035
West	62	514	12	514	1.29067669	0.61304147
Table Tops Ecodiscs	36	2027	38	974	1.64909462	-1.7145199
Lillypads Ecodiscs	26	1392	41	1392	1.70979866	0.17563693

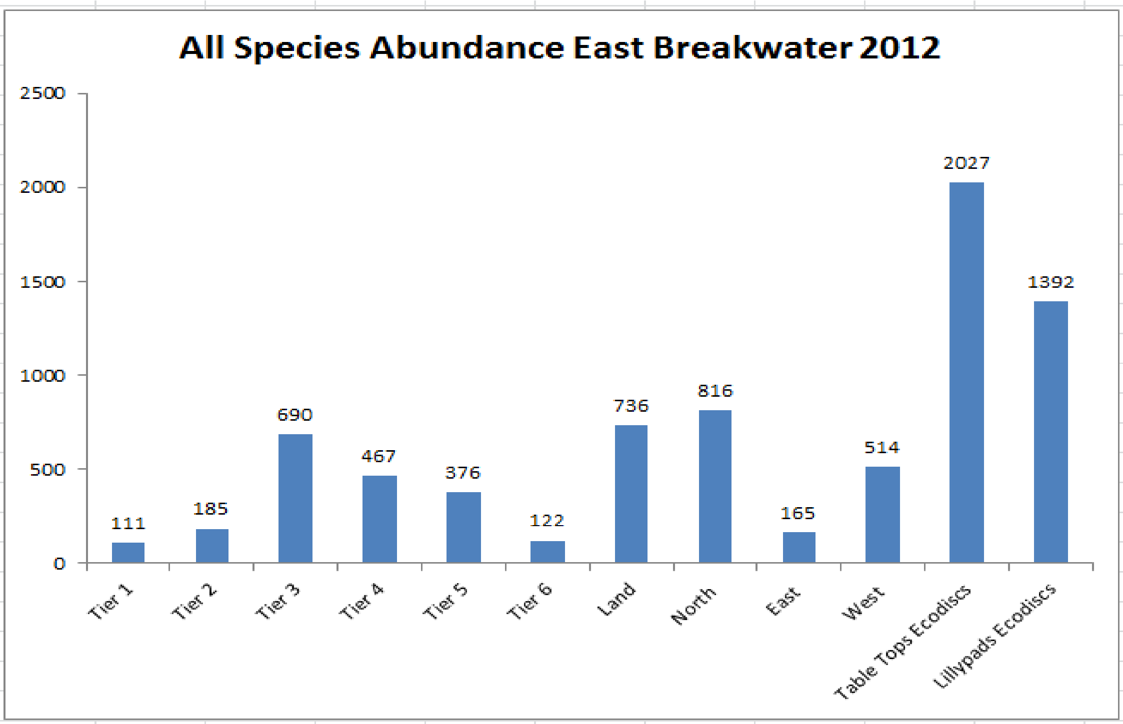


Figure 10- Graph showing total reef species abundance in relation to all tiers of each unit, all directions of north, south (Land), east, west and the two different structure designs.

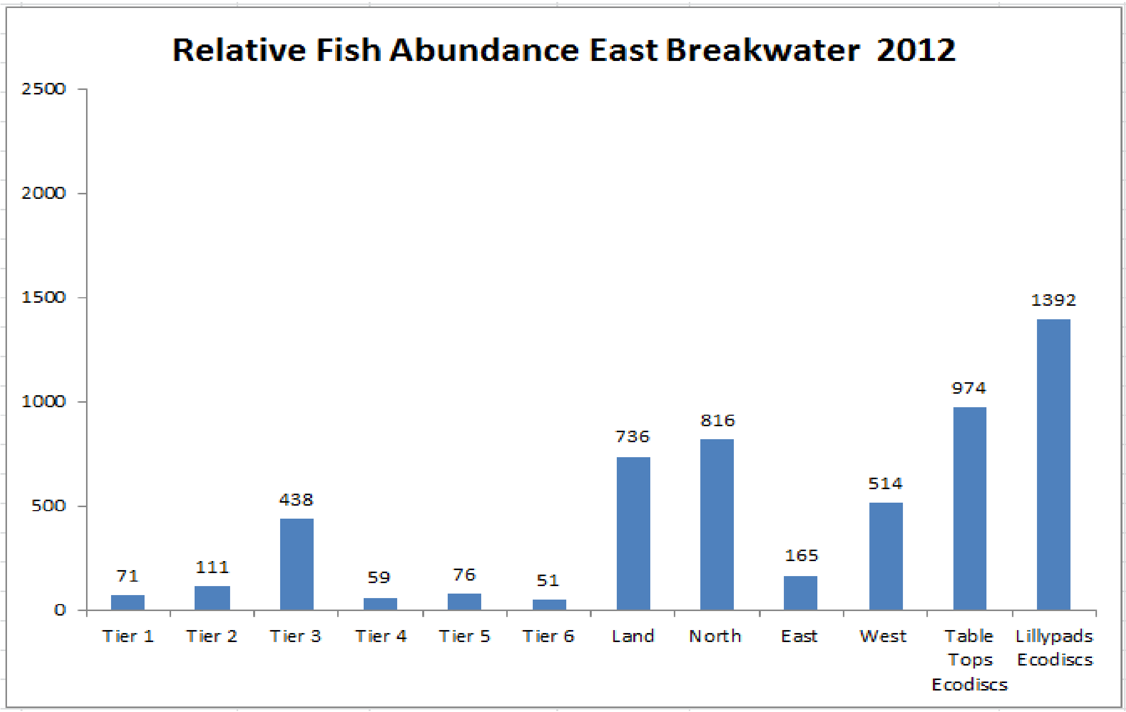


Figure 11-Graph showing relatives fish abundance in relation to all tiers of each unit, all directions of north, south (Land), east, west and the two different structure designs.

11.0 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 first year and after storms. After first year, monitor twice yearly every year for the next five years.

11.1 Measurements:

- permanent stakes with measurements- 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.

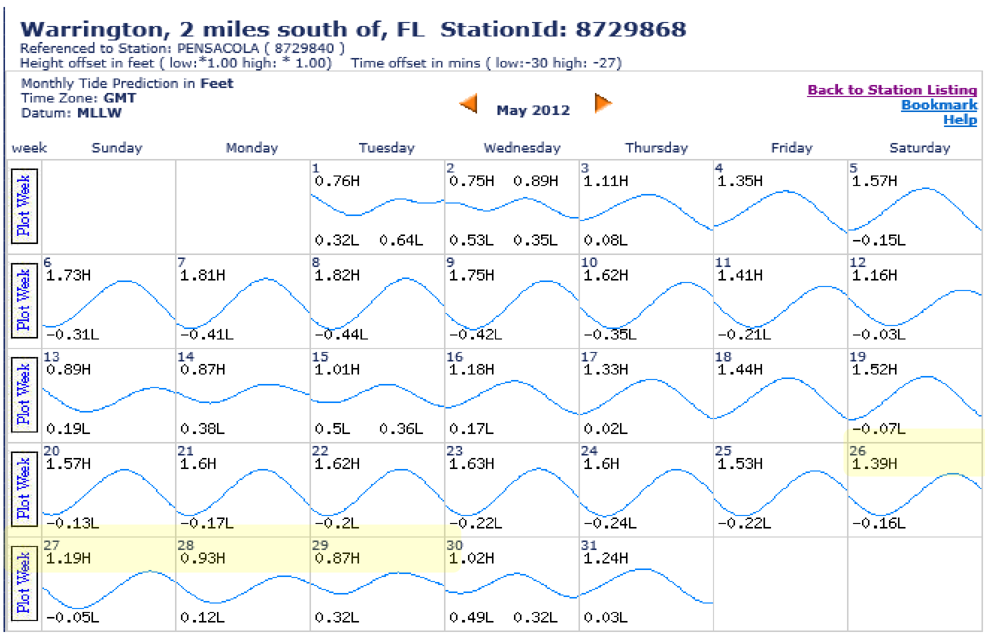
It was difficult to measure the the permanent stakes due to the shift in currents during various times of the year. There would be time the stakes would be covered and other times the stakes would be exposed. The erosion stakes are however, good reference point for GPS mapping. It is recommended the erosion stakes remain and be monitored for the duration of the project.

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

There were three significant storms but not all show high water damage. The areas which were subjected to the lowest range high tides caused the most damage. Since the width of the breakwater path are sufficiently long, and installed with the crest elevation close to the mean tide level, the structures will actually cause the wave to break, on top of the structures. This type of breaking is through depth induced breaking. When the water level rises, the underwater structures cause a wave break. When a wave breaks in a coastal environment, the wave break is putting mass into the water column, so it creates a local increase or super elevation of the water level at the shoreline. The process is trying to move the shoreline back, which is what has been observed on the northern end of the new sand peninsula.   If the structures were higher, there would not be an issue of offshore wave break and sand being pushed further onshore. As the Reefblk oysters shells in the bags wear down and become smaller and fall out of the mesh bags, the breakwater height decreases. Storms will continue to decrease the height and wear the shells. The sand, which accreted behind the breakwater, will also decrease as the wave action increases, especially during storms which do not have an increase in tide height. Tropical storm Debbie had the lowest high tide range 0.8- 1.39 ft (high tide only) level during impact and caused the most damage to the barriers and pushed sand on the shoreline on the entire north end of Deadman's Island; not just the newly placed sand. Although below mean high tide reefs are good from a habitat standpoint, it is not the best choice for off shore wave breaking purposes.

The coastal process was validated by the observation of tropical storm Issac. Overall water level is higher, but what happens on a sandy shoreline when the water level comes up when it comes on the sand in the system, the sand is seeking a new shoreline position.   This shifting in shoreline position causes over washed deposits during storm events as seen in figures.

Storms of 2012



Warrington, 2 miles south of, FL StationId: 8729868
Referenced to Station: PENSACOLA (8729840)
Height offset in feet (low:*1.00 high: * 1.00)   Time offset in mins (low:-30 high: -27)

Monthly Tide Prediction in **Feet**
Time Zone: **GMT**
Datum: **MLLW**

May 2012

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week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Plot Week			1 0.76H 0.32L 0.64L	2 0.75H 0.89H 0.53L 0.35L	3 1.11H 0.08L	4 1.35H	5 1.57H -0.15L
Plot Week	6 1.73H -0.31L	7 1.81H -0.41L	8 1.82H -0.44L	9 1.75H -0.42L	10 1.62H -0.35L	11 1.41H -0.21L	12 1.16H -0.03L
Plot Week	13 0.89H 0.19L	14 0.87H 0.38L	15 1.01H 0.5L 0.36L	16 1.18H 0.17L	17 1.33H 0.02L	18 1.44H	19 1.52H -0.07L
Plot Week	20 1.57H -0.13L	21 1.6H -0.17L	22 1.62H -0.2L	23 1.63H -0.22L	24 1.6H -0.24L	25 1.53H -0.22L	26 1.39H -0.16L
Plot Week	27 1.19H -0.05L	28 0.93H 0.12L	29 0.87H 0.32L	30 1.02H 0.49L 0.32L	31 1.24H 0.03L		

Figure 12-Tide Chart 2012 tropical storm Alberto May 19 to May 22, 2012, 60 mph. Although the tides levels were high (1.62 ft) during the time frame, it was not the highest range of the month. Tuesday May 8, was the highest tide at 1.82 ft.

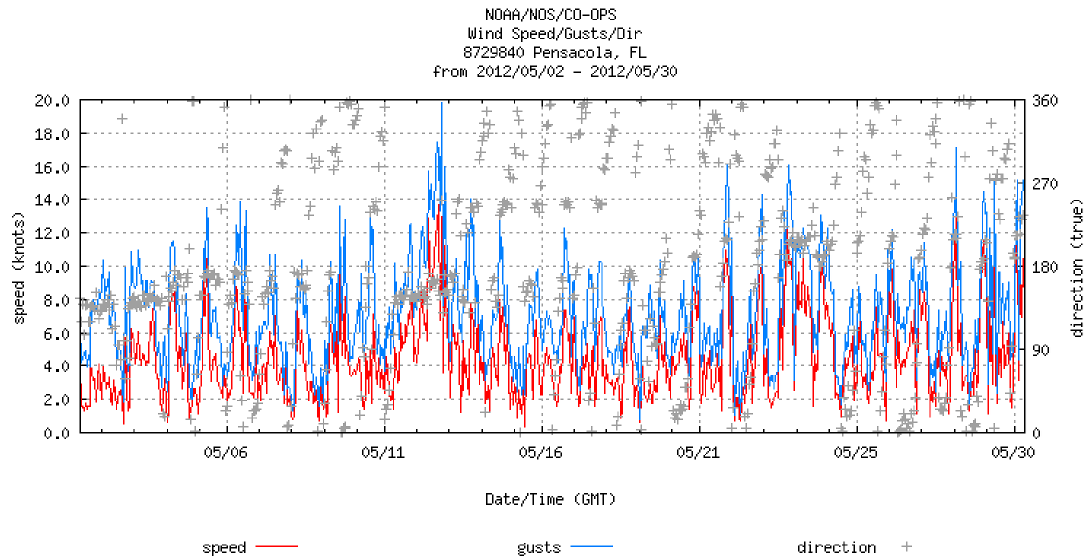


Figure 13-Wind Chart 2012 tropical storm Alberto May 19 to May 22, 2012, 16 kts. The wind gust were high during the projected time of tropical storm Alberto (16 knots). Six days before the storm the gust were the strongest at 20 knts. Strong winds continued 10 more days, leading into tropical storm Debbie.

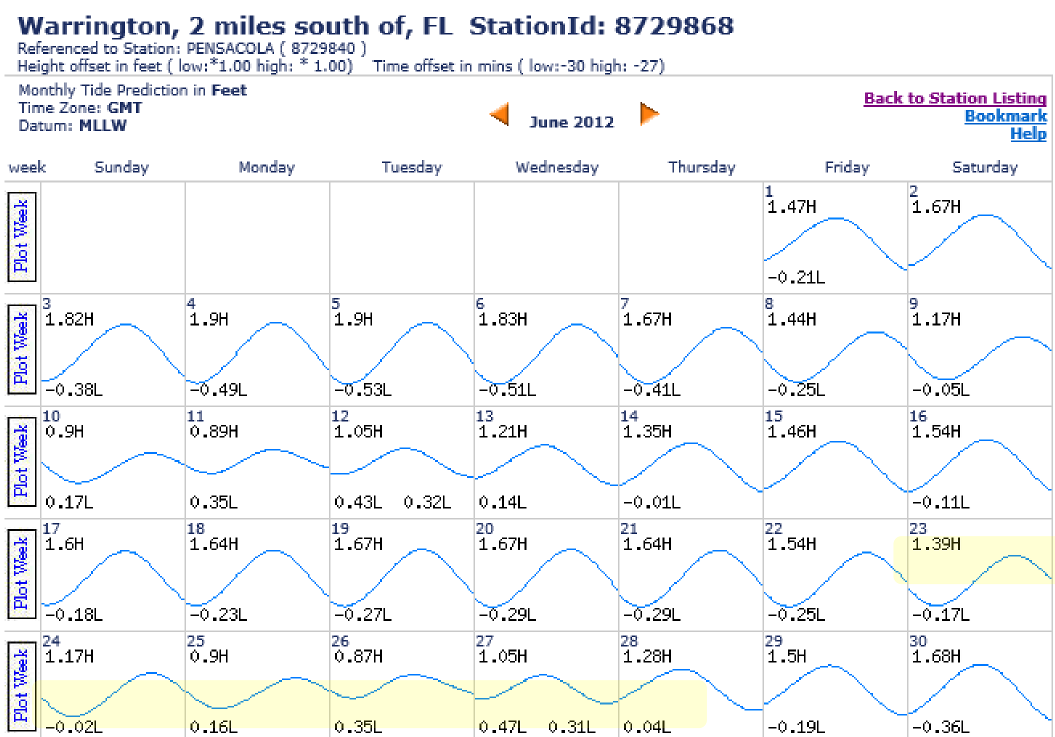


Figure 14- Tide Chart 2012 tropical storm Debbie June 23 to June 27, 65 mph. Debbie produced more damage due to lower tides (0.8- 1.39 ft) impacting the shorelines.

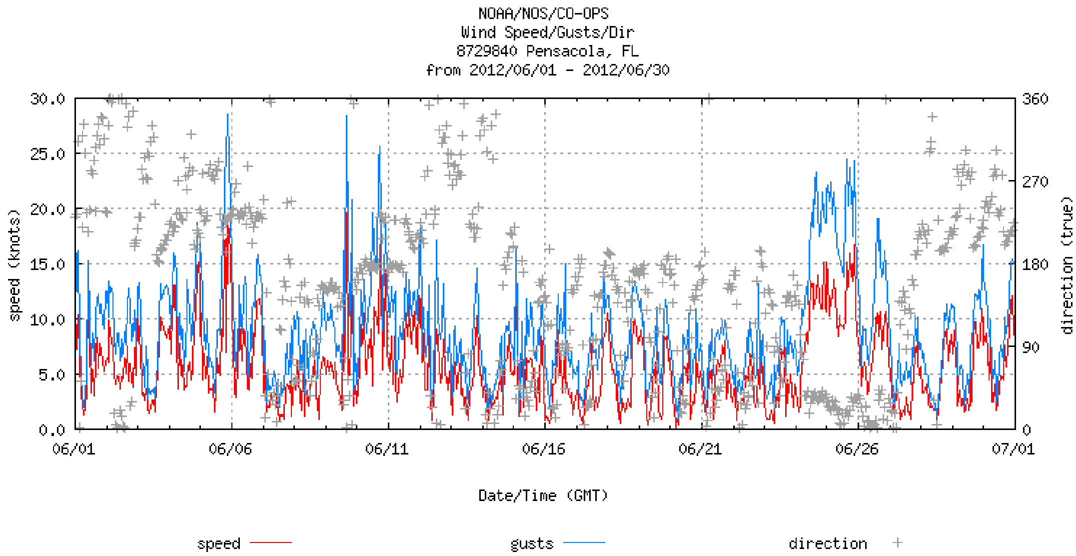
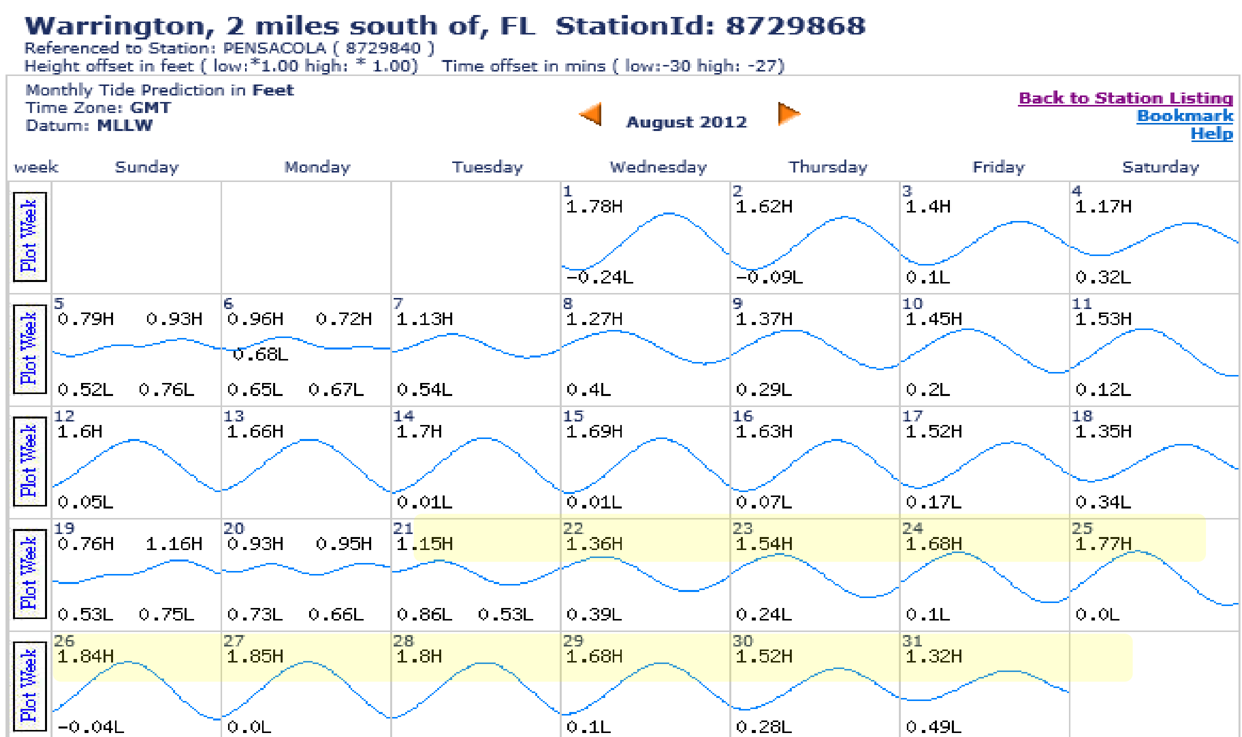


Figure 15- Wind chart for 2012 tropical storm Debbie June 23 to June 27, 2012, 16 kts and gusts up to 24 kts. The wind gust were high during the projected time of tropical storm Debbie (23 knots), continued with high gusts and speeds for three days.



Warrington, 2 miles south of, FL StationId: 8729868

Referenced to Station: PENSACOLA (8729840)

Height offset in feet (low:*1.00 high: * 1.00) Time offset in mins (low:-30 high: -27)

Monthly Tide Prediction in **Feet**
Time Zone: **GMT**
Datum: **MLLW**

August 2012

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week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Plot Week				1 1.78H -0.24L	2 1.62H -0.09L	3 1.4H 0.1L	4 1.17H 0.32L
Plot Week	5 0.79H 0.93H 0.52L 0.76L	6 0.96H 0.72H 0.68L 0.65L 0.67L	7 1.13H 0.54L	8 1.27H 0.4L	9 1.37H 0.29L	10 1.45H 0.2L	11 1.53H 0.12L
Plot Week	12 1.6H 0.05L	13 1.66H	14 1.7H 0.01L	15 1.69H 0.01L	16 1.63H 0.07L	17 1.52H 0.17L	18 1.35H 0.34L
Plot Week	19 0.76H 1.16H 0.53L 0.75L	20 0.93H 0.95H 0.73L 0.66L	21 1.15H 0.86L 0.53L	22 1.36H 0.39L	23 1.54H 0.24L	24 1.68H 0.1L	25 1.77H 0.0L
Plot Week	26 1.84H -0.04L	27 1.85H 0.0L	28 1.8H	29 1.68H 0.1L	30 1.52H 0.28L	31 1.32H 0.49L	

Figure 16-August 21, 2012 tropical storm Isaac, August 21 to September 1, 80 mph – High tide range from 1.15 to 1.68

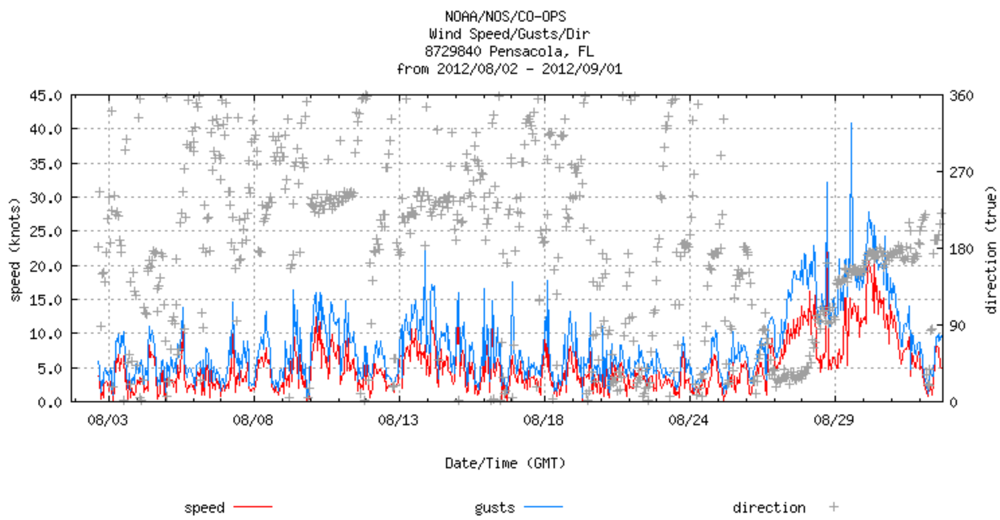


Figure 17-Wind chart for 2012 tropical storm Issac August 21 to September 1, 2012, 20 kts and gusts up to 40 kts. The wind gust were low during the projected time of tropical storm Issac (>10 kts), continued with high gusts and speeds for seven days at max of 40 kts before dissipating.

11.3 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. Campfires were created; the area was littered with fireworks during Fourth of July, and dogs roam the area and holes were dug throughout the Sandy creation. To alleviate and compromise with the general public, a dune fence was placed around the restoration project and approximately 50 feet of Sandy area was left between the previous remnants of Deadman's Island and the fence. In addition, aesthetic and elevation appropriate vegetation was placed along the fence line and signs were placed requesting no admittance into the area. In 2013, FWC will give the project bird nesting signage. It is anticipated the fence and the signage will deter the general public from entering the ongoing restoration project. This is measured by simply observing the footprints found within the area. Since the fence has been erected, a majority of the disturbance has stopped. There has only been a few footsteps, possibly only one resident and their pet to enter the area on a daily basis.

Figure 18-Two types of Ecodisc design- "Table Tops" (left) show a concrete pad stabilizing the units and the "Lillypads" with the piling exposed and secured by a collar underneath.

Figure 19 (Below) -Method of monitoring is a dual Hooka regulator system attach to SCUBA tanks.

12 Bathymetric Survey

A bathymetric survey was taken by a professional surveyor with elevation points. The points were then compared to the 2007 bathymetric baseline survey. This comparison was performed by hand and excel input. Points from 2007, 2011 and 2012 which were close together on the map were put in placed an excel spreadsheet and also color coded on the map.

Results: The method of analysis has not been perfected. Previous methods employed the use of small depth markers behind the rebar breakwaters at an increment of 1 meter. To determine the amount of accretion at a distance of 3 meters from the south side of the breakwater. This is still a good method for this type of breakwaters. The downside to this method is scale. The scale encompasses over five acres; this method would be questionable after 6 meters due to the correction factor of reference points.

It is more cost effective in labor and quality assurance to hire a licensed surveyor to perform a bathymetric survey. The idea is to compare each bathymetric survey with the elevations numbers from the previous years, which is hoped to give an idea of accretion, subsidence or erosion rates over various years.

The analysis method involves highlighting each point and comparing the point data; to the previous years within a spreadsheet. It was found the data analysis was very time consuming and not as successful as hoped. However, ; the survey data is very important to have in this project. The method of analysis will have to be modified, hopefully, for the next report.

Suggestions:

It is suggested to use, with the appropriate software, the data files which can be manipulated in to mapping programs and manipulated for better comparison using spatial analyst. At the moment, this grant does not have the software, which should cost about $1550 with training.

12.1 Sand shifting

Upon placement of the 16,000 cubic yards of sand, a barrier system, the shoreline change and also barrier system was monitored for three months. The barrier system needs constant maintenance, and the shoreline change is documented when a significant change is observed.

Figure 20-The barrier system (Green markers) was placed in May 2012. These markers are fixed reference points of anchoring for the barrier. The August 2012 after TS Issac points (blue points) show sand shifting and eroding back towards the peninsula. The March 20

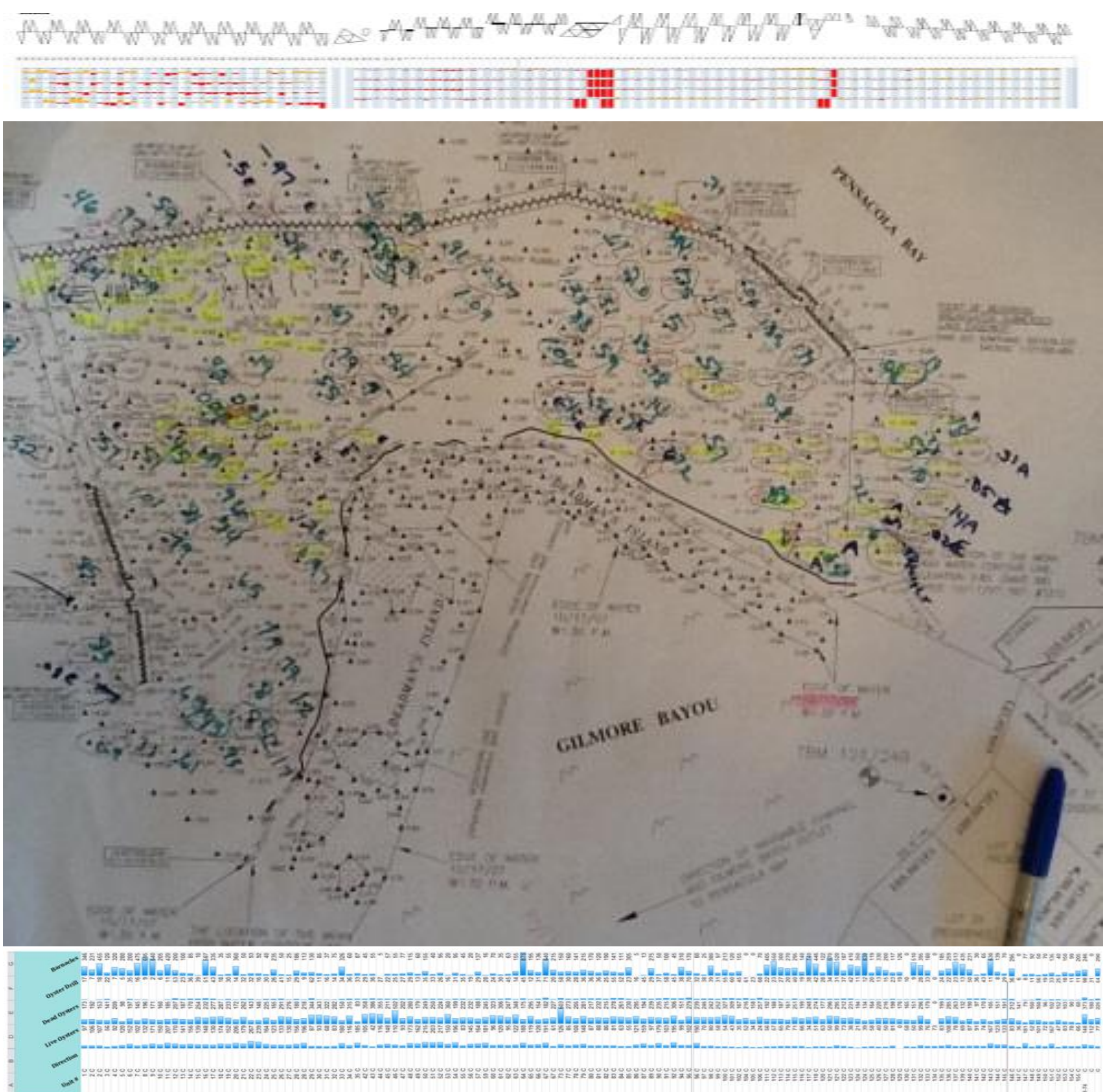


Figure 21- Bathymetric survey of the sub tidal floor in front and behind the wave attenuators of the Deadman's Island restoration project.

13 Gulf Sturgeon

Sturgeon receivers which detect VR transmitters were placed in three locations of the breakwater to monitor the present of the protected Gulf Sturgeon. There were 157 tags total and the sturgeons' presence at the reef varied. Data is compared each year to determine the migration patterns of the Gulf Sturgeon.

Figure 22-Sturgeon receiver sites fixed for transmitter detection- three sites- Site 1 represents shallow sand bar (265), site 2 represents (266)both shallow sandbar and near deeper cove, and site 3 represent near deeper cove (267),

157 Tags total
Receiver 1(265)- 134
Receiver 2(266)-142
Receiver 3 (267)-155

Table 3-Number of sturgeon transmitters detected according to origin of tagged event

River	Sum of tags detected	Sum of Tagged Sturgeon
Blackwater	49	77
Choctawhatchee	19	135
Escambia	42	52
Yellow	58	69
Grand Total	**168**	**333**

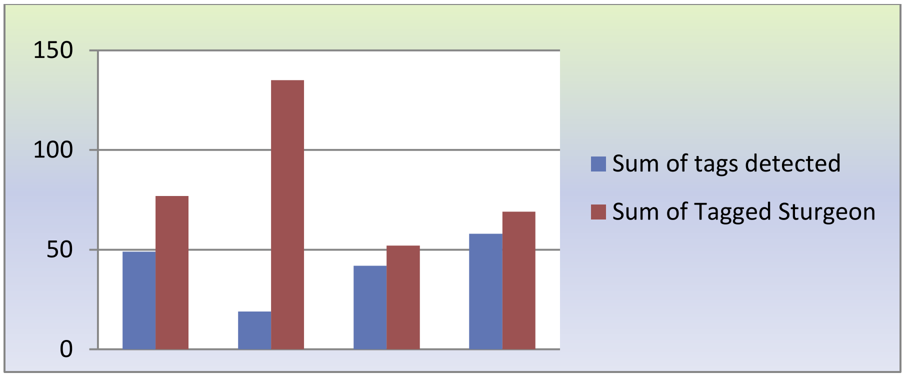


Figure 23-The number of transmitters detected vs the number of sturgeon transmitters detected

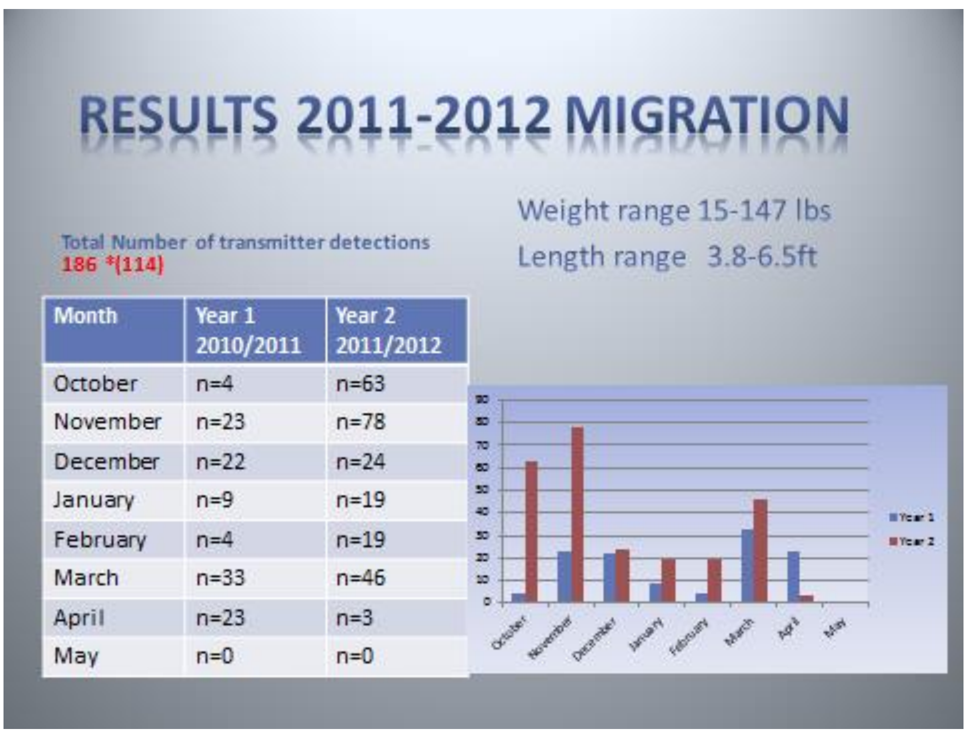
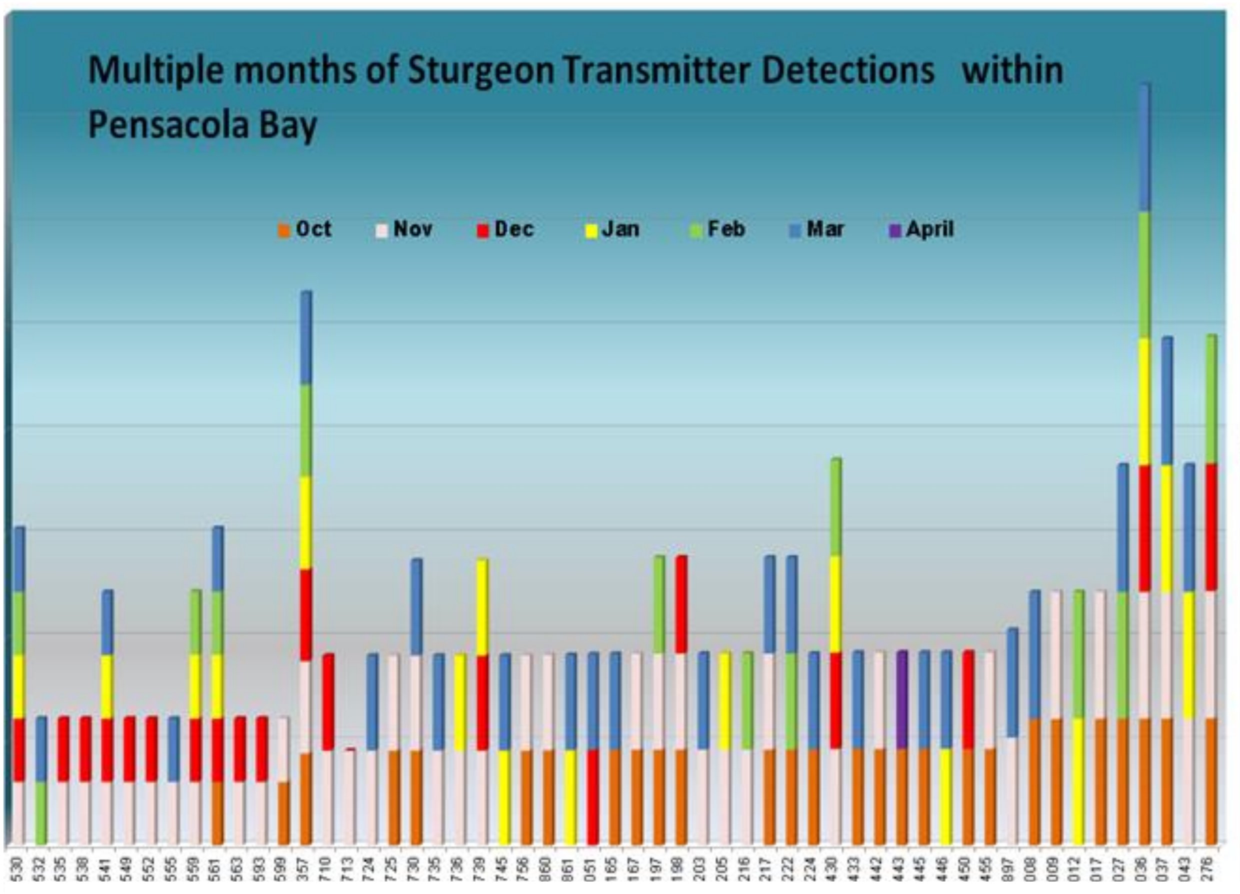


Figure 24-The two year comparison of the number of tags detected by month



•

Figure 25-The presence of tagged sturgeon throughout the month of migration in Pensacola Bay

Challenges to address

- Assessing Gulf sturgeon population status is difficult due to a combination of:
- untagged juveniles
- life history characteristics
  (skip spawning where individuals do not return to spawn each year)
- behavior (gear avoidance)
- and variations in sampling programs (effort and location) that all contribute to uncertainty in current population estimates.

Pre-Digestion Grain Size Distribution

Onshore Grab Sample
Sample: SRB-008
Total Sample Mass: 44.008 grams

Sieve Size (phi)	Sieve Midpt (phi)	Weight (grams)	Freq Weight %	Cumulative Weight %
-2.00	-2.125	0.000	0.000	0.000
-1.75	-1.875	0.000	0.000	0.000
-1.50	-1.625	0.000	0.000	0.000
-1.25	-1.375	0.000	0.000	0.000
-1.00	-1.125	0.000	0.000	0.000
-0.75	-0.875	0.002	0.005	0.005
-0.50	-0.625	0.000	0.000	0.005
-0.25	-0.375	0.000	0.000	0.005
0.00	-0.125	0.005	0.011	0.016
0.25	0.125	0.016	0.036	0.052
0.50	0.375	0.015	0.034	0.086
0.75	0.625	0.100	0.227	0.314
1.00	0.875	1.342	3.049	3.363
1.25	1.125	6.266	14.238	17.601
1.50	1.375	19.351	43.972	61.573
1.75	1.625	13.468	30.604	92.176
2.00	1.875	2.895	6.578	98.755
2.25	2.125	0.444	1.009	99.764
2.50	2.375	0.081	0.184	99.948
2.75	2.625	0.014	0.032	99.980
3.00	2.875	0.002	0.005	99.984
3.25	3.125	0.003	0.007	99.991
3.50	3.375	0.001	0.002	99.993
3.75	3.625	0.001	0.002	99.995
4.00	3.875	0.001	0.002	99.998
5.00	4.500	0.001	0.002	100.000

Statistical Results			
Mean:	1.4410	phi	(0.3683 mm)
Standard Dev:	0.2463	phi-units	(0.843 mm)
Skewness:	0.0516	dimensionless	
Kurtosis:	5.6594	dimensionless	
5th Moment:	7.4009	dimensionless	
6th Moment:	207.9846	dimensionless	
RARD *	0.1710	dimensionless	
Median	1.3092	phi	(0.4035 mm)

* RARD = reciprocal absolute relative dispersion (see below)

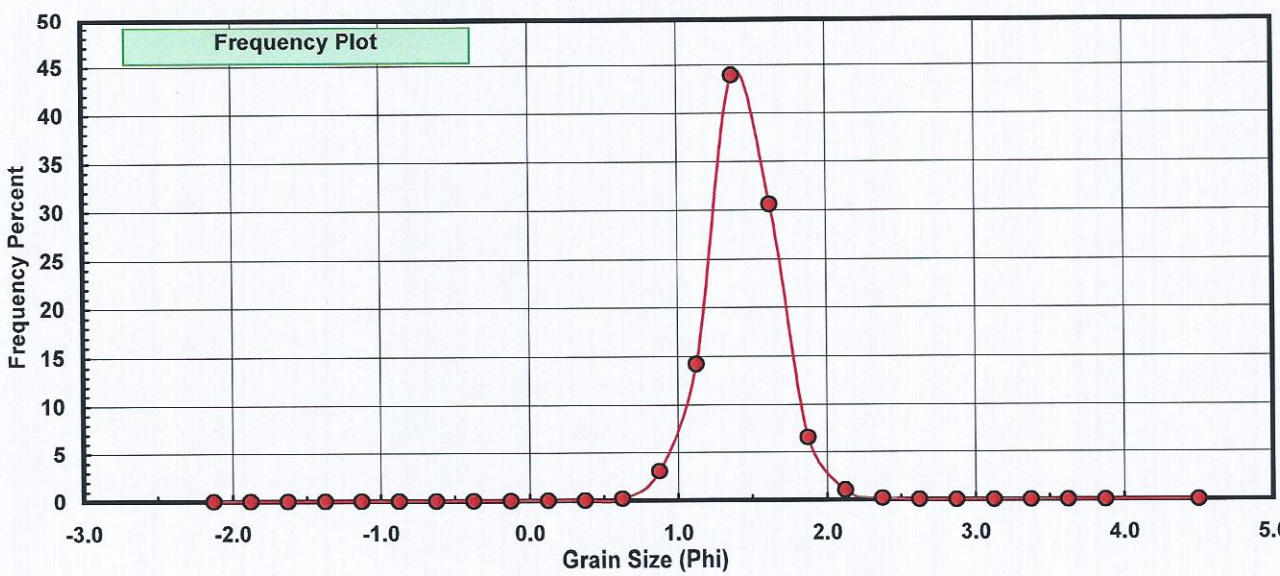
Statistical Explanation

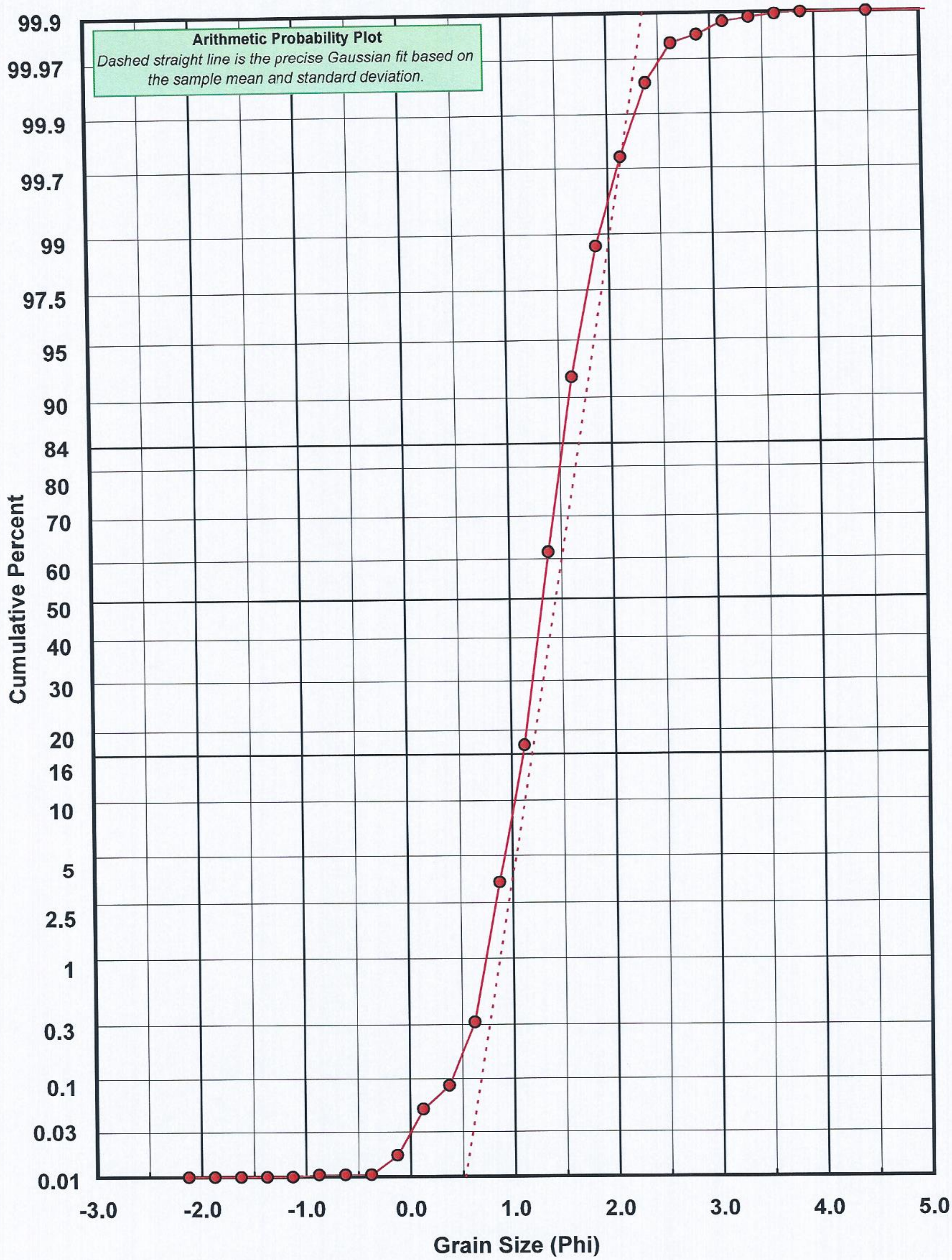
Calculations based on the Method of Moments
Skewness: 3rd Stand. Moment; Exact Gaussian = 0.0
Kurtosis: 4th Stand. Moment; Exact Gaussian = 3.0

For Further Explanation, See Calculation Sheets

Millimeter data calculated by mm = 2^(-phi)

Reciprocal Absolute Relative Dispersion (RARD) Scale	
< 0.5	Excellent homogeneity (e.g., beaches)
0.5 to 1.0	Good homogeneity
1.0 to 1.33	Fair homogeneity
> 1.33	Poor homogeneity (e.g., glacial)





Arithmetic Probability Plot
Dashed straight line is the precise Gaussian fit based on the sample mean and standard deviation.
99.9
99.97
99.9
99.7
99
97.5
95
90
84
80
70
60
50
40
30
20
16
10
5
2.5
1
0.3
0.1
0.03
0.01
Cumulative Percent
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Grain Size (Phi)

Pre-Digestion Grain Size Distribution

Onshore Grab Sample
Sample: SRB-009
Total Sample Mass: 37.893 grams

Sieve Size (phi)	Sieve Midpt (phi)	Weight (grams)	Freq Weight %	Cumulative Weight %
-2.00	-2.125	0.000	0.000	0.000
-1.75	-1.875	0.000	0.000	0.000
-1.50	-1.625	0.000	0.000	0.000
-1.25	-1.375	0.000	0.000	0.000
-1.00	-1.125	0.000	0.000	0.000
-0.75	-0.875	0.000	0.000	0.000
-0.50	-0.625	0.003	0.008	0.008
-0.25	-0.375	0.004	0.011	0.018
0.00	-0.125	0.009	0.024	0.042
0.25	0.125	0.042	0.111	0.153
0.50	0.375	0.263	0.694	0.847
0.75	0.625	1.088	2.871	3.718
1.00	0.875	8.303	21.912	25.630
1.25	1.125	12.303	32.468	58.098
1.50	1.375	10.112	26.686	84.783
1.75	1.625	3.845	10.147	94.930
2.00	1.875	1.278	3.373	98.303
2.25	2.125	0.405	1.069	99.372
2.50	2.375	0.147	0.388	99.760
2.75	2.625	0.060	0.158	99.918
3.00	2.875	0.018	0.048	99.966
3.25	3.125	0.005	0.013	99.979
3.50	3.375	0.002	0.005	99.984
3.75	3.625	0.001	0.003	99.987
4.00	3.875	0.001	0.003	99.989
5.00	4.500	0.004	0.011	100.000

Statistical Results			
Mean:	1.2113	phi	(0.4319 mm)
Standard Dev:	0.3275	phi-units	(0.7969 mm)
Skewness:	0.6997	dimensionless	
Kurtosis:	5.8216	dimensionless	
5th Moment:	20.9081	dimensionless	
6th Moment:	177.9414	dimensionless	
RARD *	0.2704	dimensionless	
Median	1.0626	phi	(0.4788 mm)

* RARD = reciprocal absolute relative dispersion (see below)

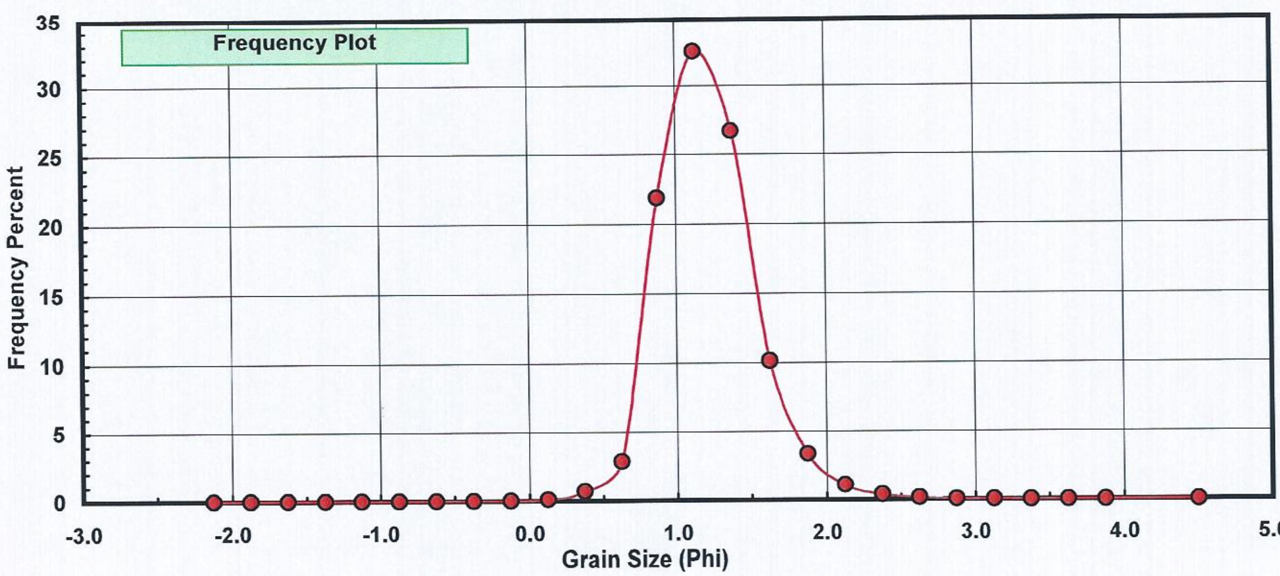
Statistical Explanation

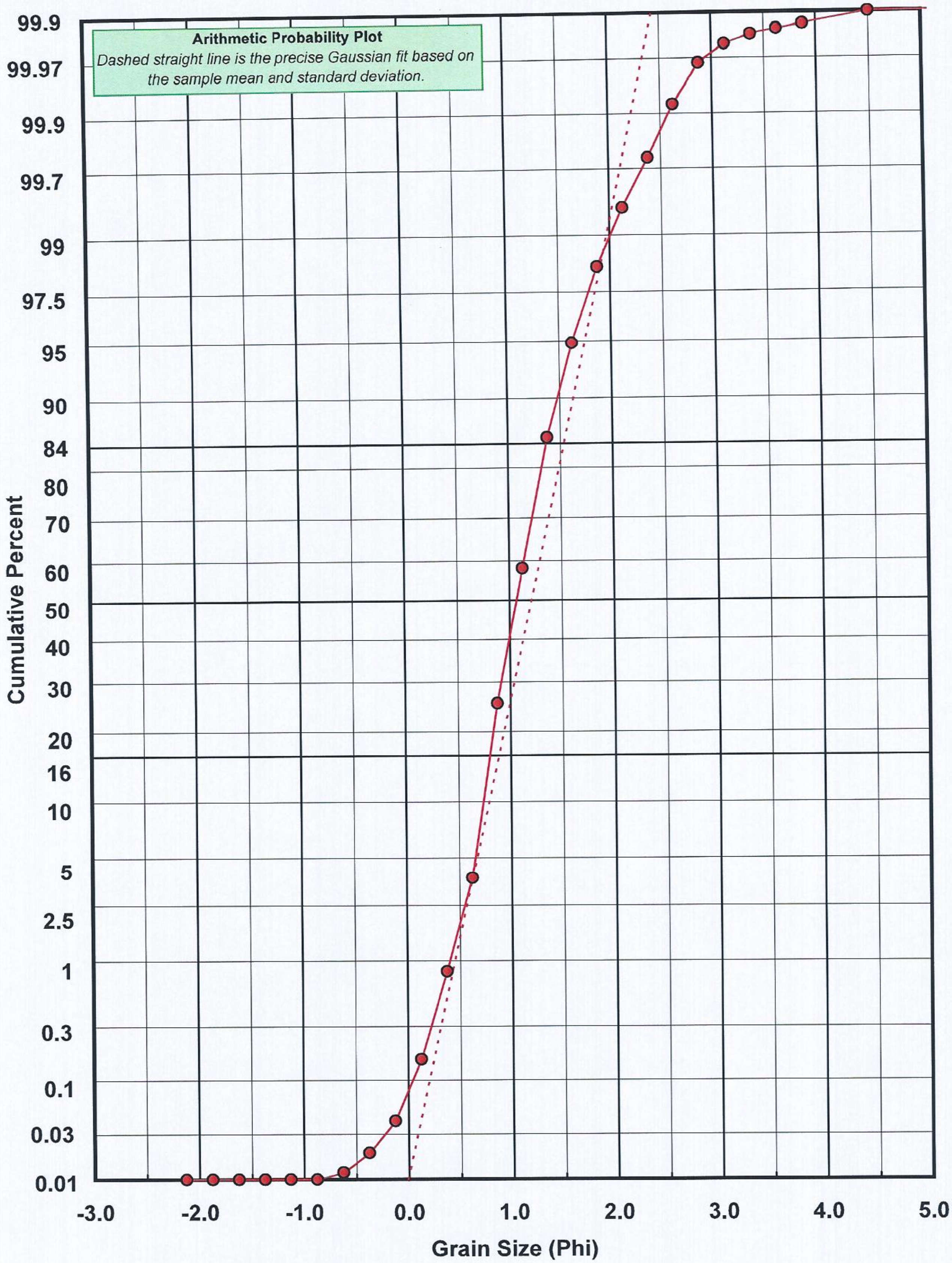
Calculations based on the Method of Moments
Skewness: 3rd Stand. Moment; Exact Gaussian = 0.0
Kurtosis: 4th Stand. Moment; Exact Gaussian = 3.0

For Further Explanation, See Calculation Sheets

Millimeter data calculated by mm = 2^(-phi)

Reciprocal Absolute Relative Dispersion (RARD) Scale	
< 0.5	Excellent homogeneity (e.g., beaches)
0.5 to 1.0	Good homogeneity
1.0 to 1.33	Fair homogeneity
> 1.33	Poor homogeneity (e.g., glacial)





Arithmetic Probability Plot
Dashed straight line is the precise Gaussian fit based on the sample mean and standard deviation.
99.9
99.97
99.9
99.7
99
97.5
95
90
84
80
70
60
50
40
30
20
16
10
5
2.5
1
0.3
0.1
0.03
0.01
Cumulative Percent
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Grain Size (Phi)

Pre-Digestion Grain Size Distribution

Onshore Grab Sample
Sample: SRB-010
Total Sample Mass: 41.910 grams

Sieve Size (phi)	Sieve Midpt (phi)	Weight (grams)	Freq Weight %	Cumulative Weight %
-2.00	-2.125	0.000	0.000	0.000
-1.75	-1.875	0.000	0.000	0.000
-1.50	-1.625	0.000	0.000	0.000
-1.25	-1.375	0.000	0.000	0.000
-1.00	-1.125	0.000	0.000	0.000
-0.75	-0.875	0.000	0.000	0.000
-0.50	-0.625	0.000	0.000	0.000
-0.25	-0.375	0.000	0.000	0.000
0.00	-0.125	0.000	0.000	0.000
0.25	0.125	0.007	0.017	0.017
0.50	0.375	0.024	0.057	0.074
0.75	0.625	0.101	0.241	0.315
1.00	0.875	0.770	1.837	2.152
1.25	1.125	4.781	11.408	13.560
1.50	1.375	17.619	42.040	55.600
1.75	1.625	14.460	34.503	90.103
2.00	1.875	3.446	8.222	98.325
2.25	2.125	0.559	1.334	99.659
2.50	2.375	0.108	0.258	99.916
2.75	2.625	0.025	0.060	99.976
3.00	2.875	0.004	0.010	99.986
3.25	3.125	0.001	0.002	99.988
3.50	3.375	0.001	0.002	99.990
3.75	3.625	0.001	0.002	99.993
4.00	3.875	0.001	0.002	99.995
5.00	4.500	0.002	0.005	100.000

Statistical Results			
Mean:	1.4759	phi	(0.3595 mm)
Standard Dev:	0.2437	phi-units	(0.8446 mm)
Skewness:	0.2270	dimensionless	
Kurtosis:	5.8999	dimensionless	
5th Moment:	19.9577	dimensionless	
6th Moment:	263.0202	dimensionless	
RARD *	0.1651	dimensionless	
Median	1.3417	phi	(0.3946 mm)
* RARD = reciprocal absolute relative dispersion (see below)			

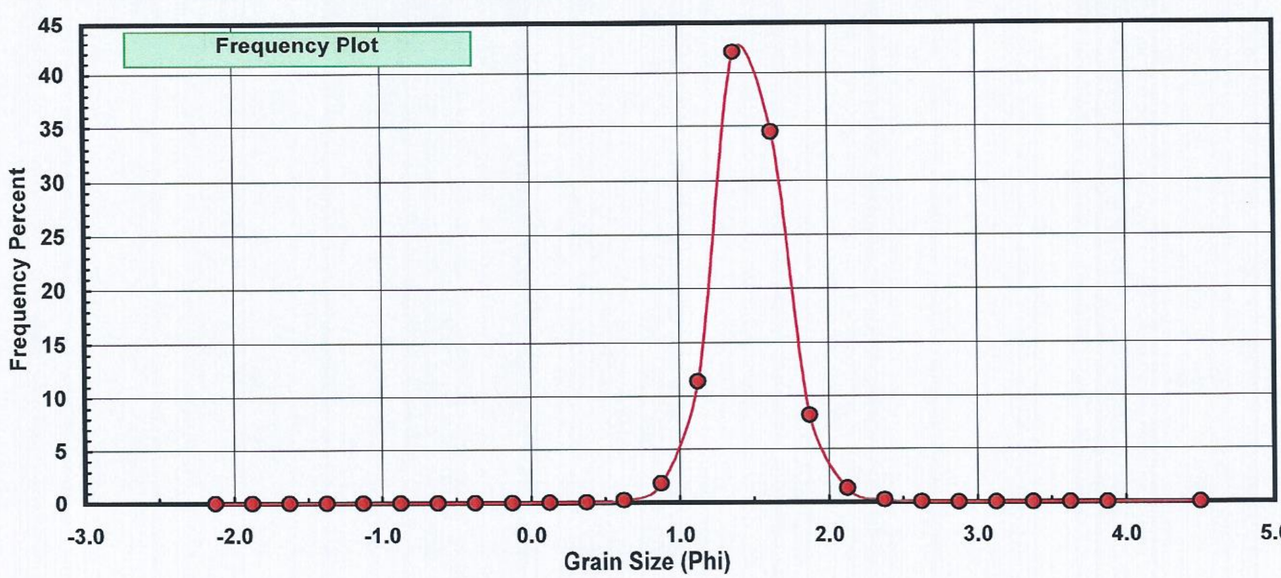
Statistical Explanation

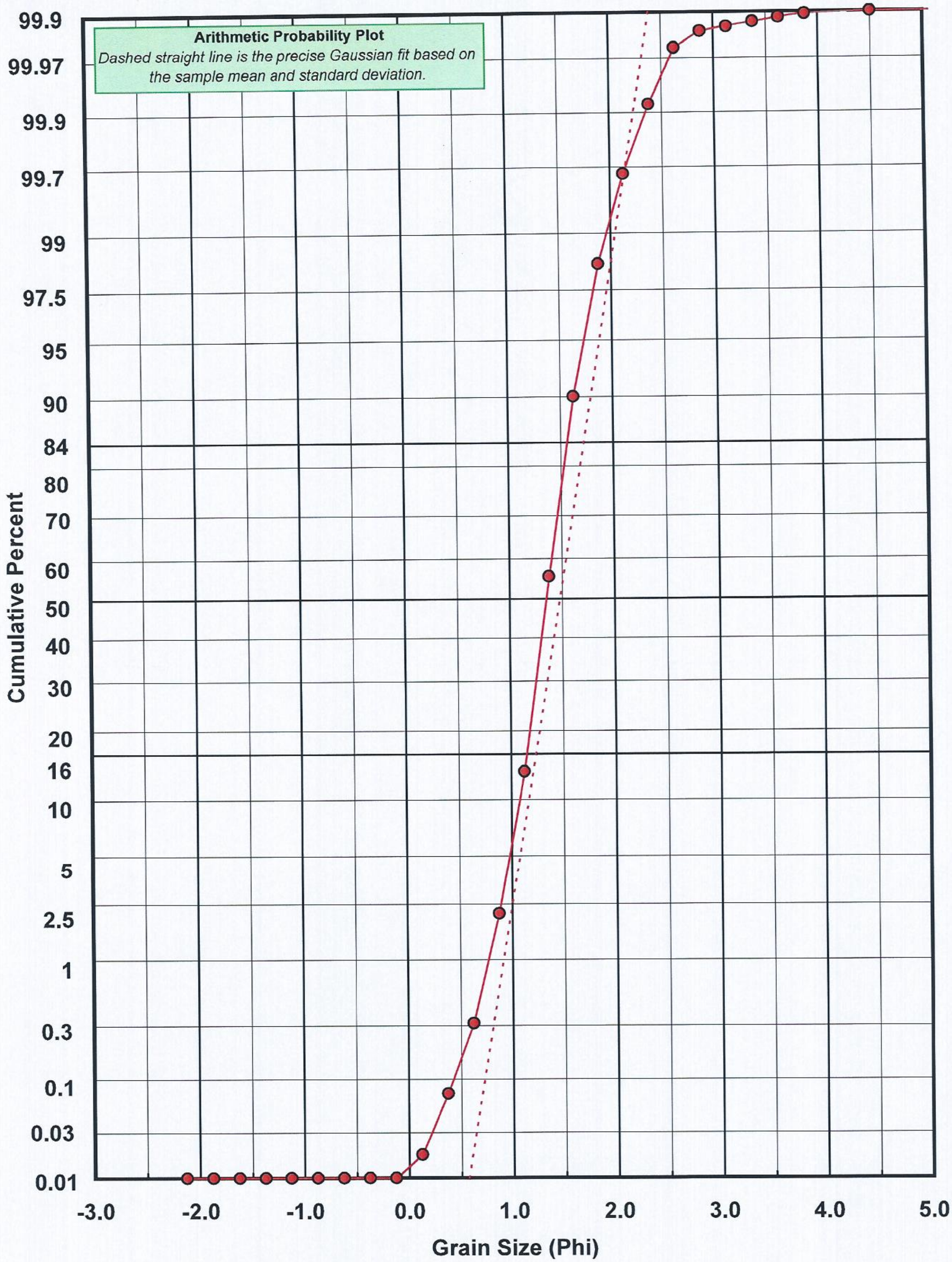
Calculations based on the Method of Moments
Skewness: 3rd Stand. Moment; Exact Gaussian = 0.0
Kurtosis: 4th Stand. Moment; Exact Gaussian = 3.0

For Further Explanation, See Calculation Sheets

Millimeter data calculated by mm = 2^(-phi)

Reciprocal Absolute Relative Dispersion (RARD) Scale	
< 0.5	Excellent homogeneity (e.g., beaches)
0.5 to 1.0	Good homogeneity
1.0 to 1.33	Fair homogeneity
> 1.33	Poor homogeneity (e.g., glacial)





Arithmetic Probability Plot
Dashed straight line is the precise Gaussian fit based on the sample mean and standard deviation.
99.9
99.97
99.9
99.7
99
97.5
95
90
84
80
70
60
50
40
30
20
16
10
5
2.5
1
0.3
0.1
0.03
0.01
Cumulative Percent
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
Grain Size (Phi)