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ESCAMBIA BAY & PENSACOLA BAY SUBTIDAL OYSTER REEF MAPPING & ASSESSMENT



Located in Escambia Bay & Pensacola Bay Escambia County Florida

Prepared for Pensacola and Perdido Bays Estuary Program

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Hydrographic Surveying & Mapping • Environmental Services • Geographic Information Systems

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INTRODUCTION

Over the past century, there has been an estimated 85% global loss of native oyster reef habitats due to habitat degradation, over-harvesting, reduced water quality, disease, boat wakes, and other factors (Beck 2011). According to Beck et al. (2011 a significant data gap has been identified as result of a lack of current data on the extent and condition of oyster habitats; data which is essential for monitoring oyster population health and key in guiding restoration and resource management efforts. The decline in oyster habitats and lack of accurate population data extends to many of Florida's estuaries and bay systems in the Gulf of Mexico, including the Pensacoloa Bay System (PBS).

Escambia Bay is an intertidal and subtidal body of water located in Escambia County, FL. It is situated just north and proximal to Pensacola Bay in th PBS. Over the last few decades and following the Deepwater Horizon oil spill, oyster production has significantly declined. It is unclear whether or not any of the reefs within the PBS contain live oysters, and if so in what quantities and sizes. To help reach the long-term goal of conserving, restoring, and managing oyster habitats in the PBS, Escambia County, The Pensacola and Perdido Bays and Estuary Program, in coordination with the state and community stakeholders, and The Nature Conservancy (TNC) created a bay-scale recovery plan: the *Oyster Fisheries and Habitat Management Plan for the Pensacola Bay System* (Birch 2021). The plan provides guidance for recovery goals to help ensure that oysters thrive as a habitat and a fishery throughout the PBS.

An essential element of the plan is an oyster habitat suitability model (HSM), which helps identify the best places for oyster reef restoration. Escambia County, contracted MREC Environmental LLC (MREC) in April of 2021 to conduct a mapping and condition analysis of oyster reefs in the PBS, utilizing funding appropriated by the State of Florida legislature for the Pensacola and Perdido Bays Estuary Program in Escambia County, as well as funding granted by the RESTORE Act Direct Component funding granted by the Deepwater Horizon compensation funds. Mapping the remnant and restored oyster reefs establishes a comprehensive baseline of the oyster resources in the PBS and provides the foundation of information necessary to develop comprehensive oyster habitat restoration and management objectives. The collection of marine organisms, including all oyster sampling performed by MREC for this study was conducted under the Florida Fish and Wildlife Conservation Commission, FWC Special Activities License #SAL-20-2243A-SR.

MATERIALS AND METHODS

The hydrographic survey, quadrant oyster sampling as well as the analysis and processing of all data for this subtidal mapping and assessment report has been completed by a MREC Environmental crew lead by senior oyster biologist Gabe Johnson. Aerial GIS maps were created by Suzanne Beasley, senior GIS analyst at Custom Mapping Services.

The water bottom/oyster resource assessment was conducted in Escambia Bay, an intertidal and subtital body of water just north of Pensacola Bay, in Escambia County, FL. The bay, measuring just over 20.1k acres in area, was subsampled into 30 individual study areas. The areas were previously identified as oyster bearing either by Florida Fish and Wildlife Commission (FWC) or local watermen, or were found via satellite imagery as possible oyster reefs or oyster bearing substrates.

Survey Platform

A 30ft. custom aluminum, outboard motor propelled research vessel with a \sim 1.5 ft. draft, was used to collect data and survey the study area. Bathymetric, side scan-sonar, and navigation data

as well as water quality, and square meter oyster samples were all collected from this vessel. Navigation data was performed using a Trimble MPS865 marine GNSS receiver, with dual Trimble GA 830 antennas, and operated using both Hypack® software running and Chesapeake Technology Inc.'s Sonar Wiz 7 software running on a DELL Rugged computer and a Panasonic Toughbook computer.



<u>Bathymetric Data</u>

Aboard the research vessel, an Odom CV-100 single-beam sounder was used to collect bathymetric data along survey track lines spaced ~ 100 ft. apart. The instrument was mounted on a rigid pole on the side of the vessel, deployed 2ft. below the water surface, and properly calibrated. Top of water elevations were calculated using the Mean Lower Low Water (MLLW) reading of the NOAA tide gauge station at Lora Point, Escambia Bay, FL Station ID: 8729816. Single-beam bathymetry was derived from chirp profiles collected. This data was used to create a bathymetric model that provided contour coverage of the area through interpolation.

Water Quality Data

Using a YSI Pro 2030 handheld meter, salinity, and water temperature data was collected at the top of the water column (approximately 18 inches below the surface). Salinity, water temperature, and dissolved oxygen (DO) was collected near the water bottom (approximately 6" above the substrate).

<u>Side Scan Sonar Imagery</u>

Acoustic backscatter data was collected using Edgetech 4125 side scan-sonar systems, towed alongside the vessel \sim 3 ft. below the surface. Track lines were spaced 200ft. apart, and the side



scan swath was 150 ft. to each side of the track. Post collection processing of the data was completed using Chesapeake Technology Inc.'s "Sonar Wiz 7," software.

Backscatter intensity, as recorded with side scan sonar, is an acoustic measure of variations in the physical properties of the sea floor. Side scan-sonar imagery was processed such that high backscatter (relatively strong acoustic returns) is represented by white, and low backscatter

(relatively weak acoustic returns) is represented by black. In Escambia Bay, backscatter variability is generally caused by shell material on the seafloor. Due to the low incidence angles associated with towed systems, topographic highs and lows can be interpreted based on acoustic shadows. Poling, as well as oyster dredge samples, and square meter dive samples were all used as a means of ground truthing the sonar results. ArcGIS 10.2.2 was used for mapping the imagery collected within the survey area.

Poling Data/Ground Truthing

Field investigations to ground truth the bottom type characteristics observed in the side scan sonar observations were conducted during the survey. Point of Interest (POI) poling spot checks were run across the study area. The boat was guided along these transects at speeds no greater than 4.0 knots, while an investigator stood on the side of the vessel and systematically poled the water bottom using an aluminum sounding pole. The water bottoms were probed noting water bottom features.

Water Bottom Substrate Classifications

Water bottoms were classified according to the following charachterizations: Soft mud/sand - where the bottom is dominantly soft, slushy mud which would not support small pieces of cultch material; moderately firm mud/sand - where the bottom would support small pieces of cultch material; sand - where the bottom is dominantly compact sandy substrate; buried shell - where shells are buried under soft sediment; exposed shell - where the bottom is dominantly loose or scattered oyster shell material or hard substrate such as clam shells, limestone or concrete aggregate; reef - where the bottom is dominantly clustered or aggregated oyster shells or hard substrates like clam shells, limestone or concrete aggregate.



Oyster Square Meter Quadrant Samples

Three (3) square meter samples per sample set were collected by a scuba diver in each survey location where reef and/or shell observations were recorded. The number of sample sets were determined by acerage and spacing of found oyster reef complexes. As previously stated all marine organisms collected during this quadrant sampling were collected under FWC Special Acivities License# SAL-20-2243A-SR. The scuba diver placed a square meter aluminum frame over the shell material on the water bottom for each sample. All surface materials (6" depth) within the frame were removed from the bottom, placed into a metal basket and brought to the boat. The materials were photographed, labeled and placed into plastic bags for later analysis. Once back to the research lab the live oysters and oyster boxes were measured, counted and observations were made on their conditions. The square meter quadrat (SQM) oyster samples were collected to determine overall oyster mortalities on the reefs in the survey area, spatial distribution of any oysters in the area, and an estimation of the quantities of oysters, shells, or other shellfish in the area. The live oysters were totaled for the three main size categories: Spat

(1-25 mm), Seed (26-75 mm), and Market (76 mm+), and using an estimated mortality discounting method (180 oysters/sack, spat by 90%, and seed by 50% for potential crop), the total sacks per acre were calculated for each toss/sample according to the following formula:

$$\frac{Sacks}{Acre} = (\left(\frac{Market}{m2}\right) + 0.1\left(\frac{Spat}{m2}\right) + 0.5\left(\frac{Seed}{m2}\right)) * \frac{4047m2}{acres} * \frac{1sack}{180 oysters}$$

<u>RESULTS</u>

Study Overview

The Escambia Bay assessment covered a total of 4,050.7 acres in 30 study areas. Forty percent of the study areas contained exposed shell, and only 30% of the study areas contained exposed reef (9 of 30 areas) (Figure 1 and Table A), resulting in 190.3 acres of reef and 45.7 acres of exposed shell (Table B). The present reef is found within the depth ranges of 6.00ft-10.0ft. The reef and shell areas were often surrounded by soft/mud sand and/or moderately firm mud/sand. Of the exposed shell, 78% was found in the eastern portion of the bay, and of the reef, 96% was found in the eastern portion of the bay. Live oysters were found in 5 of the 9 areas where samples were performed. Individual sample data can be found in Appendix A.



Figure 1. The 30 study areas in Escambia Bay, including found reef and sample site locations.

Area	Sample Area 1			Sample Area 2			
	Location Coordinates		Date sampled	Location Coordinates		Date sampled	
E2	N 30°27.472' W 87°06.586'		7/19/2021				
E3	N 30°27.991'	W 87°06.072'	7/19/2021				
E6	N 30°28.678	W 87°06.337	7/19/2021				
E7	N 30°28.920'	W 87°06.898'	7/21/2021				
E8	N 30°29.986'	W 87°06.509'	7/21/2021				
E9	N 30°29.771'	W 87°07.070'	7/27/2021	N 30°29.779'	W 87°06.823'	7/28/2021	
E15	N 30°30.119'	W 87°06.258'	7/21/2021	N 30°30.324'	W 87°06.526'	7/28/2021	
E16	N 30°30.369'	W 87°06.878'	7/27/2021	N 30°30.435'	W 87°06.797'	7/28/2021	
E17	N 30°31.034'	W 87°06.679'	7/27/2021				
E18	N 30°30.997'	W 87°07.100'	7/27/2021				
E19	N 30°30.825'	W 87°07.532'	7/27/2021	N 30°30.573'	W 87°07.409'	7/27/2021	
E21	N 30°32.448'	W 87°08.808'	7/27/2021	N 30°32.448'	W 87°08.810'	7/27/2021	
E25	N 30°29.511'	W 87°08.499'	7/28/2021				
E27	N 30°29.009'	W 87°08.825'	7/28/2021				
E28	N 30°29.023'	W 87°09.441'	7/28/2021				
E29	N 30°28.547'	W 87 08.713'	7/28/2021				
E30	N 30°28.365'	W 87°09.143'	7/28/2021				
Table A. Dive sample locations and dates. Those highlighted in yellow had live and/or dead oysters in sample.							

	Oyster Bearing Substrates (Acres)			Density	Mortality	Total Sacks
Area	Exposed Shell	Reef	Total	(Sacks/Acre)	(Total)	(180 oys/sack)
E3	0.9	29.7	30.6	29.2	10%	894
E7	6.7	51.1	57.8	0.0	100%	0
E8	13.4	50.8	64.2	246.5	16%	15827
E9	1.5	26.7	28.2	6.7	0%	190
E15	3.6	5.7	9.3	0.0	100%	0
E16	2.8	10.5	13.3	0.0	0%	0
E17	6.9	8.4	15.3	40.5	24%	619
E27	6.4	6.5	12.9	0.0	100%	0
E28	3.5	0.9	4.4	7.5	88%	33
Total	45.7	190.3	236			17564
	1	I	Mean	36.7		
Table P. A groups of shall and react in the study areas where overar samples were performed, as well as density						

Table B. Acreage of shell and reef in the study areas where oyster samples were performed, as well as density of live oysters, total mortality, and estimated sacks for the entire study area.

Water quality data (Table C) at the bottom was collected across 21 of 30 sites. Water bottoms at the collection areas averaged at 9.2 ft in depth, data was collected at the top of the water column (approximately 18 inches below the surface) and near the water bottom (approximately 6" above the substrate). The average dissolved oxygen in these areas near the water bottom were 5.31 mg/L. Surface salinity was on average 3.2 ppt with average bottom salinity at 4.5 ppt. Surface temperature averaged 30.2°C, while bottom temperature averaged 30.1°C. Bathymetry for all 30 study areas are shown in Figure 2.

A #20	Surface	Bottom	Surface	Bottom temp	DO2	Depth		
Alea	Salinity (ppt)	salinity (ppt)	Temp (°C)	(°C)	(mg/L)	(ft.)		
E2	6.2	6.8	30.9	30.6	5.21	11.6		
E3	6	7	30.8	30.3	5.95	8.2		
E7	5	6.2	30.6	30.3	6.87	11.1		
E8	4.2	5.7	31	30.5	5.99	9.4		
E10	2.3	4.7	29.5	29.4	5.81	10.9		
E11	2.5	4.2	30.1	29.8	5.07	9		
E12	1.4	3.3	29.5	29.4	4.21	9.3		
E13	1.1	2.5	28.9	29.8	5.28	9.4		
E15	5.3	7.6	31	30.9	4.02	9.7		
E16	4.3	5.8	31.2	30.4	6.57	8.8		
E17	4.5	6	31.3	30.8	5.7	8.5		
E18	4.4	4.8	30.8	30.5	6.02	9		
E19	3.1	5.1	30.4	30.4	6.27	9		
E20	1.1	2	29.5	29.4	4.52	13.5		
E21	1.5	3.4	30.2	30.4	2.9	8.1		
E22	1.7	1.7	30.5	30.6	6.81	6.7		
E23	0.8	3.3	29	29.2	2.27	7.9		
E26	2.1	2.5	29.7	29.7	5.57	6.9		
E27	3.1	4	29.8	29.8	5.56	8.7		
E28	3.9	3.9	29.8	29.8	5.4	7.9		
E30	3.2	3.7	29.7	29.6	5.55	9.8		
Mean	3.2	4.5	30.2	30.1	5.31	9.2		
Table C. Water quality analysis at 21 of the 30 study areas.								





<u>Area E1</u>

Area E1, consisted of 29.1 acres total in study with water depth ranges between 3.0ft – 6.0ft. The different bottom types present within the study area included 1.8 acres of moderately firm mud/sand, and 27.3 acres of sand. There was no reef found within the study area. Bottom type composition, sidescan imagery, and bathymetry are shown in Figures 3, 4, and 5, respectively.





Figure 4. Sidescan imagery of area E1.



Figure 5. Bathymetry of area E1.

Area E2

Area E2 consisted of 194.9 acres total in study with water depth ranges between 6.5ft – 13.0ft. The different bottom types present within the study area included 48.5 acres of soft mud/sand, 2.10 acres of buried shell, 89.4 acres of moderately firm mud/sand, 0.20 acres of exposed oyster shell, and 54.6 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 5.21 mg/L. Surface salinity was 6.2 ppt, while bottom salinity was 6.8 ppt. Surface temperature was 30.9°C, while bottom temperature was 30.6°C. Bottom type composition and bathymetry are shown in Figures 6, 7, and 8, respectively.





Figure 7. Sidescan imagery of area E2.



Figure 8. Bathymetry of area E2.

<u>Area E3</u>

Area E3 consisted of 165.4 acres total in study with water depth ranges between 3.0ft - 11.5ft. The different bottom types present within the study area included 21.9 acres of soft mud/sand, 1.20 acres of buried shell, 46.0 acres of moderately firm mud/sand, 0.90 acres of exposed oyster shell, 65.7 acres of sand, and 29.7 acres of reef. Reef was relatively at level with surrounding soft/mud sand with a vertical relief of about 0in.-6in. The reef consisted of limestone and fragmented cultch material which held both live and dead spat. All shells obtained were gray in color. Reef organisms found in samples included barnacles, oyster drills, hermit crabs, mud crabs, and mussels. Dissolved oxygen reading was 5.95 mg/L. Surface salinity was 6.0 ppt, while bottom salinity was 7.0 ppt. Surface temperature was 30.8°C, while bottom temperature was 30.3°C. Bottom type composition and bathymetry are shown in Figures 9, 10, and 11, respectively.







Figure 11. Bathymetry of area E3.

<u>Area E4</u>

Area E4 consisted of 29.1 acres total in study with water depth ranges between 10.5ft – 11.0ft. The different bottom types present within the study area included 9.3 acres of soft mud/sand, and 19.8 acres of moderately firm mud/sand. There was no reef found within the study area. Bottom type composition, sidescan imagery, and bathymetry are shown in Figures 12, 13, and 14, respectively.





Figure 13. Sidescan imagery of area E4.



Figure 14. Bathymetry of area E4.

<u>Area E5</u>

Area E5 consisted of 29.1 acres total in study with water depth ranges between 9.5ft – 10.5ft. The different bottom types present within the study area included 12.1 acres of soft mud/sand, and 17.0 acres of moderately firm mud/sand. There was no reef found within the study area. Bottom substrate type, sidescan imagery, and bathymetry are shown in Figures 15, 16, and 17 respectively.





Figure 16. Sidescan imagery of area E5.



Figure 17. Bathymetry of area E5.

<u>Area E6</u>

Area E6 consisted of 29.1 acres total in study with water depth ranges between 8.0ft – 9.5ft. The different bottom types present within the study area included 10.6 acres of soft mud/sand, 0.40 acres of buried shell, and 18.1 acres of moderately firm mud/sand. There was no reef found within the study area. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 18, 19 and 20, respectively.





Figure 19. Sidescan imagery of area E6.



Figure 20. Bathymetry of area E6.

Area E7

Area E7 consisted of 227.3 acres total in study with water depth ranges between 6.5ft - 11.0ft. The different bottom types present within the study area included 109.2 acres of soft mud/sand, 13.5 acres of buried shell, 46.4 acres of moderately firm mud/sand, 6.70 acres of exposed oyster shell, and 51.1 acres of reef. Reef was surrounded by soft/mud sand and moderately firm mud/sand with a vertical relief of up to a foot or higher. The reef consisted of fragmented cultch material which held old dead spat, seed, and sack. All shells obtained were gray in color. Reef organisms found in samples included oyster drills. Dissolved oxygen reading was 6.87 mg/L. Surface salinity was 5.0 ppt, while bottom salinity was 6.2 ppt. Surface temperature was 30.6°C, while bottom temperature was 30.3°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 21, 22, and 23, respectively.







Figure 23. Bathymetry of area E7.

<u>Area E8</u>

Area E8 consisted of 300.1 acres total in study with water depth ranges between 6.0ft - 10.5ft. The different bottom types present within the study area included 100.1 acres of soft mud/sand, 25.6 acres of buried shell, 110.2 acres of moderately firm mud/sand, 13.4 acres of exposed oyster shell, and 50.8 acres of reef. Reef was surrounded by soft/mud sand and moderately firm mud/sand with a vertical relief of up to a foot or higher. The reef consisted of limestone and fragmented cultch material which held both live and old dead spat, seed, and sack. Shells obtained in sample one were 40% brown and 60% gray in color. Samples two and three shells were 10% brown and 90% gray. Reef organisms found in samples included barnacles, oyster drills, and mussels. Dissolved oxygen reading was 5.99 mg/L. Surface salinity was 4.2 ppt, while bottom salinity was 5.7 ppt. Surface temperature was 31.0°C, while bottom temperature was 30.5°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 24, 25, and 26, respectively.







Figure 26. Bathymetry of area E8.
<u>Area E9</u>

Area E9 consisted of 97.9 acres total in study with water depth ranges between 6.5ft - 11.5ft. The different bottom types present within the study area included 50.4 acres of soft mud/sand, 5.70 acres of buried shell, 13.9 acres of moderately firm mud/sand, 1.50 acres of exposed oyster shell, and 26.7 acres of reef. Reef was surrounded by soft/mud sand and moderately firm mud/sand with a vertical relief of up to a foot or higher. The reef consisted of fragmented cultch material which held live spat. Shells obtained in sample one were 5% brown-green, 10% brown, and 85% gray. Samples two and three shells were 10% brown and 90% gray. Reef organisms found in samples included barnacles, oyster drills, and mussels. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 27, 28, and 29, respectively.







Figure 29. Bathymetry for area E9.

<u>Area E10</u>

Area E10 consisted of 29.1 acres total in study with water depth ranges between 8.5ft – 10.5ft. The different bottom types present within the study area included 22.6 acres of soft mud/sand, and 6.50 acres of moderately firm mud/sand. There was no reef found within the study area. Dissolved oxygen reading was 5.81 mg/L. Surface salinity was 2.3 ppt, while bottom salinity was 4.7 ppt. Surface temperature was 29.5°C, while bottom temperature was 29.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 30, 31, and 32, respectively.





Figure 31. Sidescan imagery of area E10.



Figure 32. Bathymetry of area E10.

<u>Area E11</u>

Area E11 consisted of 29.1 acres total in study with water depth ranges between 8.0ft – 10.0ft. The different bottom types present within the study area included 22.4 acres of soft mud/sand, 0.60 acres of buried shell, and 6.10 acres of moderately firm mud/sand. There was no reef found within the study area. Dissolved oxygen reading was 5.07 mg/L. Surface salinity was 2.5 ppt, while bottom salinity was 4.2 ppt. Surface temperature was 30.1°C, while bottom temperature was 29.8°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 33, 34, and 35, respectively.





Figure 34. Sidescan imagery of area E11



Figure 35. Bathymetry of area E11.

Area E12

Area E12 consisted of 29.1 acres total in study with water depth ranges between 7.5ft – 9.5ft. The different bottom types present within the study area included 18.0 acres of soft mud/sand, 2.40 acres of buried shell, and 8.70 acres of moderately firm mud/sand. There was no reef found within the study area. Dissolved oxygen reading was 4.21 mg/L. Surface salinity was 1.4 ppt, while bottom salinity was 3.3 ppt. Surface temperature was 29.5°C, while bottom temperature was 29.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 36, 37, and 38, respectively.





Figure 37. Sidescan imagery of area E12.



Figure 38. Bathymetry of area E12.

<u>Area E13</u>

Area E13 consisted of 28.3 acres total in study with water depth ranges between 8.0ft – 8.5ft. The different bottom types present within the study area included 24.7 acres of soft mud/sand, 1.30 acres of buried shell, and 2.30 acres of moderately firm mud/sand. There was no reef found within the study area. Dissolved oxygen reading was 5.28 mg/L. Surface salinity was 1.1 ppt, while bottom salinity was 2.5 ppt. Surface temperature was 28.9°C, while bottom temperature was 29.8°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 39, 40, and 41, respectively.







Figure 41. Bathymetry of area E13.

Area E14

Area E14 consisted of 26.9 acres total in study with water depth ranges between 2.0ft – 4.5ft. The different bottom types present within the study area included 0.50 acres of moderately firm mud/sand, and 26.4 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 4.02mg/L. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 42, 43, and 44, respectively.





Figure 43. Sidescan imagery of area E14.



Figure 44. Bathymetry of area E14.

Area E15

Area E15 consisted of 74.1 acres total in study with water depth ranges between 6.0ft - 9.5ft. The different bottom types present within the study area included 34.7 acres of soft mud/sand, 6.00 acres of buried shell, 24.1 acres of moderately firm mud/sand, 3.60 acres of exposed oyster shell, and 5.70 acres of reef. Reef was relatively at level with surrounding soft/mud sand and moderately firm mud/sand with a vertical relief of about 0in.-6in. The reef consisted of fragmented cultch material which held old dead seed and sack. All shells obtained were gray in color. No reef organisms were found in the samples collected. Dissolved oxygen reading was 4.02mg/L. Surface salinity was 5.3 ppt, while bottom salinity was 7.6 ppt. Surface temperature was 31.0°C, while bottom temperature was 30.9°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 45, 46, and 47, respectively.







Figure 47. Bathymetry of area E15.

<u>Area E16</u>

Area E16 consisted of 243.9 acres total in study with water depth ranges between 6.5ft – 9.0ft. The different bottom types present within the study area included 140.7 acres of soft mud/sand, 11.2 acres of buried shell, 78.7 acres of moderately firm mud/sand, 2.80 acres of exposed oyster shell, and 10.5 acres of reef. Reef was relatively at level with surrounding soft/mud sand with a vertical relief of about 0in.-6in. The reef consisted of fragmented cultch material which showed no live or dead spat, seed, or sack. All shells obtained were gray in color. Reef organisms found in samples included barnacles and mussels. Dissolved oxygen reading was 6.57 mg/L. Surface salinity was 4.3 ppt, while bottom salinity was 5.8 ppt. Surface temperature was 31.2°C, while bottom temperature was 30.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 48, 49, and 50, respectively.







Area E17

Area E17 consisted of 93.6 acres total in study with water depth ranges between 6.5ft - 8.5ft. The different bottom types present within the study area included 41.9 acres of soft mud/sand, 10.6 acres of buried shell, 25.8 acres of moderately firm mud/sand, 6.90 acres of exposed oyster shell, and 8.40 acres of reef. Reef was relatively at level with surrounding soft/mud sand with a vertical relief of about 0in.-6in. The reef consisted of limestone and fragmented cultch material which held live spat, seed, and sack, as well as old dead spat and seed. Shells obtained in sample one were 5% brown and 95% gray. All shells found in samples two and three were gray. Reef organisms found in samples included barnacles and mussels. Dissolved oxygen reading was 5.7 mg/L. Surface salinity was 4.5 ppt, while bottom salinity was 6.0 ppt. Surface temperature was 31.3°C, while bottom temperature was 30.8°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 51, 52, and 53, respectively.







Figure 53. Bathymetry of area E17.

<u>Area E18</u>

Area E18 consisted of 29.1 acres total in study with water depth ranges between 7.0ft – 8.5ft. The different bottom types present within the study area included 17.1 acres of soft mud/sand, 1.30 acres of buried shell, 8.70 acres of moderately firm mud/sand, and 2.00 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 6.02 mg/L. Surface salinity was 4.4 ppt, while bottom salinity was 4.8 ppt. Surface temperature was 30.8°C, while bottom temperature was 30.5°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 54, 55, and 56, respectively.





Figure 55. Sidescan imagery of area E18.



Figure 56. Bathymetry of area E18.

<u>Area E19</u>

Area E19 consisted of 161.7acres total in study with water depth ranges between 6.5ft – 8.5ft. The different bottom types present within the study area included 66.0 acres of soft mud/sand, 2.30 acres of buried shell, 68.5 acres of moderately firm mud/sand, and 24.9 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 6.27 mg/L. Surface salinity was 3.1 ppt, while bottom salinity was 5.1 ppt. Surface temperature and bottom temperature were both 30.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 57, 58, and 59, respectively.





Figure 58. Sidescan imagery of area E19.



Figure 59. Bathymetry of area E19.

<u>Area E20</u>

Area E20 consisted of 1,008.5 acres total in study with water depth ranges between 3.0ft – 16.0ft. The different bottom types present within the study area included 537.4 acres of soft mud/sand, 110.8 acres of buried shell, 168.9 acres of moderately firm mud/sand, and 201.4 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 4.52 mg/L. Surface salinity was 1.1 ppt, while bottom salinity was 2.0 ppt. Surface temperature was 29.5°C, while bottom temperature was 29.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 60, 61, and 62, respectively.





Figure 61. Sidescan imagery of area E20.



Figure 62. Bathymetry of area E20.
<u>Area E21</u>

Area E21 consisted of 326.9 acres total in study with water depth ranges between 3.5ft – 9.0ft. The different bottom types present within the study area included 147.9 acres of soft mud/sand, 9.70 acres of buried shell, 10.6 acres of moderately firm mud/sand, and 158.8 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 2.9 mg/L. Surface salinity was 1.5 ppt, while bottom salinity was 3.4 ppt. Surface temperature was 30.2°C, while bottom temperature was 30.4°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 63, 64, and 65, respectively.







Figure 64. Sidescan imagery of area E21.



Figure 65. Bathymetry of area E21.

<u>Area E22</u>

Area E22 consisted of 28.4 acres total in study with water depth ranges between 3.0ft – 6.0ft. The different bottom types present within the study area included 14.8 acres of soft mud/sand, 0.40 acres of buried shell, 4.90 acres of moderately firm mud/sand, and 8.30 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 6.81 mg/L. Surface and bottom salinities were both 1.7 ppt. Surface temperature was 30.5°C, while bottom temperature was 30.6°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 66, 67, and 68, respectively.







Figure 67. Sidescan imagery of area E22.



Figure 68. Bathymetry of area E22.

Area E23

Area E23 consisted of 69.3 acres total in study with water depth ranges between 7.0ft – 14.0ft. The different bottom types present within the study area included 56.6 acres of soft mud/sand, 4.10 acres of buried shell, 5.00 acres of moderately firm mud/sand, and 3.60 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 2.27 mg/L. Surface salinity was 0.8 ppt, while bottom salinity was 3.3 ppt. Surface temperature was 29.0°C, while bottom temperature was 29.2°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 69, 70, and 71, respectively.





Figure 70. Sidescan imagery of area E23.



Figure 71. Bathymetry of area E23.

Area E24

Area E24 consisted of 29.1 acres total in study with water depth ranges between 5.5ft – 7.5ft. The different bottom types present within the study area included 13.5 acres of soft mud/sand, 2.30 acres of buried shell, 12.3 acres of moderately firm mud/sand, and 1.00 acre of sand. There was no reef found within the study area. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 72, 73, and 74, respectively.





Figure 73. Sidescan imagery of area E24.



Figure 74. Bathymetry of area E24.

<u>Area E25</u>

Area E25 consisted of 129.7 acres total in study with water depth ranges between 4.0ft – 9.0ft. The different bottom types present within the study area included 23.7 acres of soft mud/sand, 7.90 acres of buried shell, 10.9 acres of moderately firm mud/sand, 2.60 acres of exposed oyster shell, and 84.6 acres of sand. There was no reef found within the study area. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 75, 76, and 77, respectively.







Figure 76. Sidescan imagery of area E25.



Figure 77. Bathymetry of area E25.

Area E26

Area E26 consisted of 19.4 acres total in study with water depth ranges between 2.0ft – 8.5ft. The different bottom types present within the study area included 6.20 acres of soft mud/sand, 3.70 acres of buried shell, 4.90 acres of moderately firm mud/sand, and 4.60 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 5.57 mg/L. Surface salinity was 2.1 ppt, while bottom salinity was 2.5 ppt. Surface and bottom temperatures were both 29.7°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 78, 79, and 80, respectively.







Area E27

Area E27 consisted of 274.0 acres total in study with water depth ranges between 6.5ft - 11.0ft. The different bottom types present within the study area included 128.8 acres of soft mud/sand, 13.3 acres of buried shell, 119.0 acres of moderately firm mud/sand, 6.40 acres of exposed oyster shell, and 6.50 acres of reef. Reef was relatively at level with surrounding soft mud/sand with a vertical relief of about 0in.-6in. The reef consisted of fragmented cultch material which held old dead seed and sack. All shells obtained were gray in color. Reef organisms found in samples included barnacles. Dissolved oxygen reading was 5.56 mg/L. Surface salinity was 3.1 ppt, while bottom salinity was 4.0 ppt. Surface and bottom temperatures were both 29.8°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 81, 82, and 83, respectively.





Figure 82. Sidescan imagery of area E27. The blue square indicates sample location.



Figure 83. Bathymetry of area E27.

<u>Area E28</u>

Area E28 consisted of 144.8 acres total in study with water depth ranges between 4.0ft - 9.0ft. The different bottom types present within the study area included 106.9 acres of soft mud/sand, 24.8 acres of buried shell, 3.50 acres of exposed oyster shell, 9.10 acres of sand, and 0.90 acres of reef. Reef was relatively at level with surrounding soft/mud sand with a vertical relief of about 0in.-6in. The reef consisted of fragmented cultch material which held live spat and seed, as well as recent and old dead spat, seed, and sack. Shells obtained in sample one and two were all gray, while sample three held 5% brown and 95% gray shells. Reef organisms found in samples included barnacles, mud crabs, and mussels. Dissolved oxygen reading was 5.4 mg/L. Surface and bottom salinities were both 3.9 ppt. Surface and bottom temperatures were both 29.8°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 84, 85, and 86, respectively.





Figure 85. Sidescan imagery of area E28. The blue square indicates sample location.



Figure 86. Bathymetry of area E28.

<u>Area E29</u>

Area E29 consisted of 55.1 acres total in study with water depth ranges between 9.5ft – 12.5ft. The different bottom types present within the study area included 52.1 acres of soft mud/sand, 2.80 acres of buried shell, and 0.20 acres of exposed oyster shell. There was no reef found within the study area. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 87, 88, and, 89, respectively.





Figure 88. Sidescan imagery of area E29.



Figure 89. Bathymetry of area E29.

<u>Area E30</u>

Area E30 consisted of 118.6 acres total in study with water depth ranges between 6.0ft – 11.5ft. The different bottom types present within the study area included 30.1 acres of soft mud/sand, 8.40 acres of buried shell, 4.20 acres of exposed oyster shell, and 75.9 acres of sand. There was no reef found within the study area. Dissolved oxygen reading was 5.55 mg/L. Surface salinity was 3.2 ppt, while bottom salinity was 3.7 ppt. Surface temperature was 29.7°C, while bottom temperature was 29.6°C. Water bottom types, sidescan imagery, and bathymetry are shown in Figures 90, 91, and 92, respectively.





Figure 91. Sidescan imagery of area E30.



Figure 92. Bathymetry of area E30.

DISCUSSION

In the Escambia Bay portion of the PBS, approximately 30% of the study areas based on previous oyster reef sightings from FWC and other watermen were found to have reef structure of some kind. Overall standing stock densities, when found, were extremely low, and dominantly spat sized oysters. Water quality was fairly consistent throughout Escambia Bay, with salinity seemingly the dominant factor for live oyster presence.

<u>Substrata</u>

Most of the study areas based on historical oyster sightings confirmed that at least sometime in the past, oyster bearing substrates were present. Of the 30 areas, 83% contained at least some portion of buried shell. Areas E1, E4, E5, E10, and E14 were the only areas to contain no reef, exposed shell, nor buried shell. In the eastern portion, the reefal structure ran predominantly north to south, with a large, connected structure in area E3, and many proximate and interconnected structures from E7 to E17. The southwestern portion had only a small portion of exposed reef in E27 and 28, but there were other areas of exposed shell in the surrounding areas, despite lack of actual reefal structure, but this section makes up less than 22% of the exposed shell, and less than 4% of the reef in the entire bay. Additionally, the presence of mud or soft sand substrates adjacent to the reef structures is fairly common in oyster reefs, and doesn't seem to be a restricting factor for overall oyster reef health.

Every other study area contained at least some portion of moderately firm or sandy substrate. The areas running approximately down the middle of the bay, from E10 to E13, western portions of E16 and E19, the central portion of E20, E23, and E29 contained the highest proportions of soft bottom mud/sand bottoms relative to firm and better bottom types. This is most likely due to the hydrodynamics of bay and material deposition from the Escambia river.

<u>Reef Quality</u>

Of the reef areas sampled, the vast majority of the reef structure was comprised of fragmented oyster cultch material, with some small portions of limestone in the samples from E3, E8, and E17. The dominantly grey color, with small portions of brown, or green brown, is typical of oyster reefs. All of the samples, including the one sample without any live oysters or old boxes (E16) were found to contain other invertebrates, including barnacles, mud crabs, mussels, and oyster drills. Drills were present in the areas with the highest density of reef (E3, E7, E8, and E9), which indicates enough live oysters to support some amount of predation. The presence and quality of reef structure, as well as accompanied invertebrate biome does not seem to be a restricting factor for overall oyster reef health.

<u>Standing Stock</u>

The standing stock of live oysters in Escambia Bay was found to be quite low despite the amount of oyster bearing material present in the bay. In fact, out of all 27 samples taken, only 9 sack sized, 47 seed sized, and 126 spat sized oysters were found, with the vast majority of all of those oysters being found in E8. Recent mortality was only found in samples E3, E8, and E28, while old boxes, indicative of past mortality were found in all of the samples except E9 and E16. In fact, the samples from E16 contained no live oysters nor oyster boxes, despite the exposed reef present in the southeastern portion of the study area.

The highest stock density, by far, was found in area E8. With a calculated potentioal of 246.5 sacks/acre, E8 sits in the geographic center of the north south reef strip on the eastern portion of the bay. Surprisingly, though, the next highest stock densities, 40.5 and 29.2 sacks per acre, were found at the northern most and southern most, E17 and E3, respectively, sections of the eastern bay.

It is also critical to understand that the potential stock densities mentioned are derived from calculations based on sacks of 180 oysters per sack, over a 3 year period, where spat and seed sized oysters are discounted at 90% and 50% mortality, respectively, for the remaining 2 years. As mentioned before, there were only 9 actual sack sized oysters present in the entire bay. The presence of spat oysters, as well as presence of old boxes of sack size, does indicate that there is a reproducing population of oysters, albeit small, present in the bay, and the low numbers of spat in general indicate there is some pressure being exerted on the oyster population restricting settlement and/or growth to seed and sack size.

Water Quality

Water quality in Escambia Bay remained fairly consistent throughout the entirety of the bay, with some minor variations. Temperature varied only 2°C, with a range of 29°C to 31°C throughout the entirety of the bay. This temperature is well within the limits of normal oyster habitats. Likewise dissolved oxygen measurements varied little, between 4.21 mg/L and 6.87 mg/L, with the exception of area E21 which measured 2.9 mg/L. Dissolved oxygen levels are likewise within the limits of normal oyster habitats.

Salinity measurements throughout Escambia Bay weres slightly more varied, but still within a relatively narrow range for brackish water environments. The lowest salinity reading (0.8 ppt), at the surface of area E23, was the most proximate to the mouth of the Escambia river, while the highest measurement (7.4 ppt) was at the bottom of E15, along the eastern portion of the bay. In all areas surface salinity was found to be lower than than the bottom salinity measurements, which is not unusual in areas of moderate freshwater influx, which tends to flow along the surface as it moves.

There does appear to be an effect of salinity on oyster population health and location in Escambia Bay. Figure 92 shows the portion of the bay that was found to have salinity measurements over 5.0 ppt both at the bottom and at the surface. Even this moderate salinity regime seems to have significant impact on the overall oyster population structure throughout the bay. Oyster populations struggle in salinities under 5 ppt (Starke 2011). In fact, despite populations existing in salinity ranges from 5 - 40 ppt (USDA 2018), a various articles in literature indicate ideal conditions area somwhere in the middle: 14 - 34 ppt (Baggett 2014), 12 - 20 ppt (Starke 2011), 15 - 25 ppt (Mann 2004). As can be seen throughout the entire bay, overall low salinity is a likely restriction on overall oyster population health in the area.



Figure 93. Green area indicates bottom salinity over 5 ppt. Yellow areas indicate both bottom and surface salinities over 5 ppt.

Future efforts for oyster repopulation in Escambia Bay should focus on the eastern portion where reefal habitats are still present in higher abundance, and a small population of oysters are currently residing. There is likely some hydrodynamic function of the bay causing freshwater influx to remain in the western portion, creating a salinity regime that demarcates the eastern portion as the only viable area for growth, albeit minimally in the current low salinity regimes. More in depth hydrographic surveys would be key in understanding if this regime fluctuates temporally or even consistently. This data may be key in understanding where the highest salinities in the bay are dominant. Likely restoration areas should include areas devoid of reefal structures but with better salinity conditions, proximal to existing reefal areas in order to maximize larval settlement and continued growth.

It should be noted that unless the current salinity regime can be modified, restoration efforts will likely be hampered by consistent freshwater influx. Future surveys as part of the Habitat Suitability Model (HMS) should consider the possibility of either restoration of natural meandering freshwater flow upstream (i.e. reduction of streamlined freshwater flow due to development along riparian zones), or increased saltwater influx (i.e. additional channel cuts in the PBS system) if prioritization of restoring healthy oyster reefs.

Submitted by:

Habuel Johnson

Gabriel Johnson OLDEB Certified Biologist MREC Environmental, LLC

Appendix A - Sample Data



SQUARE METER QUADRANT SAMPLE								
Study Area: E	3		Sample No: 2					
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Ba Pensacola Ba Escambia Co 8.2	y ay System unty	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/19/2021 30°27.991' 87°06.072'				
SQM #2 Bas	ket Photo			Th				
Picture Date:	//19/2021		Escantaza Bay Anga Kas 19 July 21 2					
SQM #2 Tal Picture Date	ble Photo : 7/19/2021							
SQM #2 Oys Picture Date	ster Photo : 7/19/2021	•	Escambita Bay Area Es 19 July 21 2					
SQM #2 Bo Picture Date	ox Photo : 7/19/2021		Escambia Bay Area E3 19 July 21					
SQUARE METER QUADRANT SAMPLE								
--	--	---	--	--	--	--	--	--
Study Area: E	3	Sample No: 3						
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Bay System Escambia County 8.2	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/19/2021 30°27.991' 87°06.072'					
SQM #3 Bas Picture Date: SQM #3 Tal Picture Date:	ket Photo 7/19/2021	<image/>						

	SQUARE METER QUADRANT SAMPLE							
Stı	ıdy Area:	E3			S	Sample No:	1	
Oys Loc Cou	ter Area: ation: ınty:	Pensacola B Escambia B Escambia	ay System ay			Sample Date:	7/19/2021	
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality	
	0 0-4	7			20.00%	0.00%	0.00%	
at	1 5-9	24		1	71.43%	0.00%	4.00%	
Sp	2 10-14	2		_	5.71%	0.00%	0.00%	
	3 15-19							
	4 20-24 5 25-29		1		2.86%	100.00%	100.00%	
	6 <u>30-34</u>		1		2.00 /0	100.00 %	100.00 %	
	7 35-39							
	8 40-44							
ed	9 45-49							
Se	10 50-54							
	11 55-59							
	12 60-64							
	13 65-69							
	14 70-74							
	15 75-79							
	17 85-89							
	18 90-94							
	19 95-99							
ъ	20 100-104							
Sa	21 105-109							
	22 110-114							
	23 115-119							
	24 120-124							
	25 125-129							
	Totals	33	1	1	100.00%	2 94%	5 71%	
	100015		OVETER			2:3470	5.7178	
			UTSTER S	DIZE DISTRIE	SUTION			
							Live	
	3	5					Recent Dead	
	3						■Old Dead	
	2	25						
	2	20						
	:	15						
		10						
		5		-		Old Dead		
		0				Recent Dead		
		0 - 24 mm S	pat 25-74 mm	Seed		ve		
				>	7 4 11111 JdCK			
1								

	SQUARE METER QUADRANT SAMPLE							
Stı	ıdy Area:	E3			S	Sample No:	2	
Oys Loc Cou	iter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System ay			Sample Date:	7/19/2021	
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality	
	0 0-4	1			12.50%	0.00%	0.00%	
Ħ	1 5-9	5			62.50%	0.00%	0.00%	
Spa	2 10-14		1		12.50%	100.00%	100.00%	
	3 15-19							
	4 20-24							
	5 25-29							
	6 30-34							
	7 35-39	-	-		40.50%		100.000/	
5	8 40-44			1	12.50%		100.00%	
ee	9 45-49							
ပ	10 50-54							
	11 55-59				+			
	12 00-04							
	14 70-74							
	15 75-79							
	16 80-84							
	17 85-89							
	18 90-94							
	19 95-99							
Sack	20 100-104							
	21 105-109							
	22 110-114							
	23 115-119							
	24 120-124							
	25 125-129							
	26 >130							
	Totals	6	1	1	100.00%	14.29%	25.00%	
			OYSTER S	IZE DISTRIE	UTION			
							Live	
		5					Recent Dead	
		4					Old Dead	
		3						
		2						
						_		
				-		Old Dead		
		0 - 24				Recent Dead		
		mm	25-74	1				
		Spat	mm Seed		>74 mm			
			Seed		JOLK			
1								



Study Area: E3

Acres in Study Area: 165.4 Acres with Oysters: 30.6

Oyster Area: Location:

Area: Pensacola Bay System n: Escambia Bay Escambia

Sample Date: 7/19/2021

C	ULTCH/MATERIALS	PRESENT	
Material	Sample 1	Sample 2	Sample 3
Crush Concrete	0	0	0
Limestone	Х	Х	Х
Oyster Shell Cultch	Х	Х	Х
Oyster Shell Fragments	Х	Х	Х
Oyster Shell Rubble	Х	Х	Х
Oyster Clusters	0	0	0
Oyster Singles	Х	Х	0
Broken Oyster Shells	0	0	0
Clam Shells	Х	Х	Х
Marsh Debris	0	0	0
H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	3	1	3
Hermit Crabs	0	1	0
Mud Crabs	1	0	0
Mussels	0	2	2
Rangia	0	0	0
Material	Total Count		
Oyster Drills	7		
Hermit Crabs	1		
Mud Crabs	1		
Mussels	4		
Rangia	0		

Sample 1					
Shell Color	%				
Brown-Green	0				
Brown	0				
Black	0				
Gray	100				



OYSTER SHELL COLOR

Sample 2				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Gray	100			



Sample 3					
Shell Color	%				
Brown-Green	0				
Brown	0				
Black	0				
Gray	100				



			OYST	ER DENSI	TIES			
Study Area	: E3					Acres with C	es in Study: Dyster Reef:	165.4 30.6
Oyster Area: Location: County:	Pensacola Ba Escambia Ba Escambia	ay System y					Sample Date:	7/19/2021
	0	ysters in Sam	ole		S	Sacks Per Acr	9	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	lities	Total
-	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	33	0	0	742	74	0	0	74
2	6	0	0	135	13	0	0	13
3	0	0	0	0	0	0	0	0
TOTAL	39	0	0	877	88	0	0	88
	12.0	0.0	0.0	202.2	20.2	0.0	0.0	20.0
AVERAGE	13.0	0.0	0.0	292.2	29.2	0.0	0.0	29.2
		E	STIMATED P	OTENTIAL ST		P		
Average Sad	cks Per Acre		No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
2	9	х	30	0.6	=	89	94	
from s meter s	quare amples		determined fro scan son	om poling/side ar survey				
		5	SQUARE MET		MORTALITIE	5		
								1
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		33	1	1		3%		6%
2		6	1	1		14%		25%
3	1	0	0	0		0%		0%
	-	-		-				-
Total		39	2	2		Recent Mortality		Total Mortality
Average		13.0	0.7	0.7		5.7%		10%

SQUARE METER QUADRANT SAMPLE							
Study Area: E	7	Sample No: 1					
Location: Oyster Area: Parish/County: Depth (ft):	Pensacola Bay System Escambia Bay Escambia County 11.1	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/21/2021 30°28.920 87°06.898				
SQM #1 Bas Picture Date:	ket Photo 7/21/2021	ESCAMBIN BAY AREA E? JUIY '21					
SQM #1 Tal Picture Date.	ble Photo · 7/21/2021						
SQM #1 Bo Picture Date:	DX Photo 7/21/2021	ESCA Già Đày AREA E 7 July 21 1					
	•						

SQUARE METER QUADRANT SAMPLE								
Study Area: E	7	Sample No: 2						
Location: Oyster Area: Parish/County: Depth (ft):	Pensacola Bay System Escambia Bay Escambia County 11.1	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/21/2021 30°28.920 87°06.898					
SQM #2 Bas Picture Date: SQM #2 Tal Picture Date	Sket Photo 7/21/2021	Escawiora sav Area e 7 Joing 21						
SOM #2 Ov	tor Photo							
Picture Date	<u>: 7/21/2021</u>	ESCANDIA BAY AREA E7 July '21 Constant of the second secon						

SQUARE METER QUADRANT SAMPLE							
Study Area: E	7	Sample No: 3					
Location: Oyster Area: Parish/County: Depth (ft):	Pensacola Bay System Escambia Bay Escambia County 11.1	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/21/2021 30°28.920 87°06.898				
SQM #3 Bas Picture Date: SQM #3 Tal Picture Date. SQM #3 Oys Picture Date.	Ster Photo T/21/2021 De Photo T/21/2021 Ster Photo T/21/2021 Ster Photo T/21/2021	<image/>					
SQM #3 Oys Picture Date	ster Photo : 7/21/2021	ESCATORA BAY AREA E7 JUN 21 JUN 21	•				

	SQUARE METER QUADRANT SAMPLE							
Stı	ıdy Area:	E7			S	Sample No:	1	
Oys Loc Cou	ster Area: ation: ınty:	Pensacola B East Bay Escambia	ay System			Sample Date:	7/22/2021	
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality	
	0 0-4							
at	1 5-9				_			
Sp	2 10-14			2	40.00%		100.00%	
	3 15-19 4 20-24			2	40.00%		100.00%	
	5 25-29			1	20.0070		100.0070	
	6 30-34			1	20.00%		100.00%	
	7 35-39							
	8 40-44							
ed	9 45-49							
Se	10 50-54							
	11 55-59							
	12 60-64			1	20.00%		100.00%	
	13 65-69				-			
	14 /0-/4							
	15 75-79							
	17 85-89							
	18 90-94							
	19 95-99							
ч	20 100-104							
Sa	21 105-109							
	22 110-114							
	23 115-119							
	24 120-124							
	25 125-129							
	26 >130	0	0	E	100.00%	0.00%	100 00%	
	Totals	0		3	100.00%	0.00%	100.00%	
	2.	3	1-				 Live Recent Dead Old Dead 	
	1	2 .5 1 0.5 0 - 24 mm S	pat 25-74 mm	Seed >	Li 74 mm Sack	Old Dead Recent Dead ve		

	SQUARE METER QUADRANT SAMPLE							
Stı	ıdy Area:	E7			S	Sample No:	2	
Oys Loca Cou	iter Area: ation: inty:	Pensacola B East Bay Escambia	ay System			Sample Date:	7/22/2021	
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality	
	0 0-4							
at	1 5-9							
Sp	2 10-14 3 15-19							
	4 20-24							
	5 25-29							
	6 30-34							
	7 35-39							
5	8 40-44							
ee	9 45-49							
ပ	10 50-54							
	12 60-64			1	50.00%		100.00%	
	13 65-69							
	14 70-74			1	50.00%		100.00%	
	15 75-79							
	16 80-84							
	17 85-89							
	18 90-94							
×	20 100-104							
Sac	21 105-109							
•••	22 110-114							
	23 115-119							
	24 120-124							
	25 125-129							
	26 >130	0	0	2	400.00%	0.00%	400.00%	
	TOLAIS	0			100.00%	0.00%	100.00%	
	1.8	2 8					LiveRecent	
	1	6					Dead	
	1.	4					■Old Dead	
	1.	2		_				
		1		_				
	0			_				
	0	.0		_				
	0	.6						
	0	.4						
	0	0.2				Old Dead		
		0			- /	Recent Dead		
		0 - 24	75 7	1		ve		
		Spat	25-74 mm	T	>74 mm			
1			Seed		Sack			



Study Area: E7

Acres in Study Area: 227.3 Acres with Oysters: 57.8

Oyster Area: Location: County:

ea: Pensacola Bay System East Bay

East Bay Escambia Sample Date: 7/22/2021

Sample 3

%

0

0

0

100

Shell Color

Brown-Green

Brown

Black

Gray

CULTCH/MATERIALS PRESENT

Material	Sample 1	Sample 2	Sample 3
Crush Concrete	0	0	0
Limestone	0	0	0
Oyster Shell Cultch	Х	Х	Х
Oyster Shell Fragments	Х	Х	Х
Oyster Shell Rubble	Х	Х	Х
Oyster Clusters	Х	0	Х
Oyster Singles	Х	Х	Х
Broken Oyster Shells	0	0	0
Clam Shells	Х	Х	Х
Marsh Debris	0	0	0
H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	0	0	0
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample
Oyster Drills	1	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	0	0	0
Rangia	0	0	0
Material	Total Count		_
Oyster Drills	1		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	0		
Rangia	0		

Sample 1					
Shell Color	%				
Brown-Green	0				
Brown	0				
Black	0				
Gray	100				





OYSTER DENSITIES

Stu	dy	Area:	E7

Acres in Study: 227.3

Acres with Oyster Reef: 57.8

Oyster Area: Location: County:	Pensacol East Bay Escambia	a Bay System					Sample Date	: 7/22/2021
	0	sters in Sam	ole		S	Sacks Per Acr	е	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	lities	Total
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0
AVERAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		E	STIMATED P	OTENTIAL ST	ANDING CRC)P		
Average Sacks	Per Acre	Y	No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
u from squa meter sam	are iples	X	determined fro scan son	7.8 om poling/side ar survey	=		J	
		S	SQUARE MET		MORTALITIE	S		
							-	-
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		0	0	5		0%		100%
2		0	0	2		0%		100%
3		0	0	2		0%		100%
	-			-			-	-
Total		0	0	0		Recent		Total
iotai		0	0	9		Mortality		Mortality
Average	1	0.0	0.0	3.0		0.0%		100%

SQUARE METER QUADRANT SAMPLE

Study Area: E	8	Sample No: 1	
Location:	Escambia Bay	Collection Method:	Scuba Dive
Oyster Area:	Pensacola Bay System	Sample Date:	7/21/2021
Parish/County:	Escambia	Latitude:	30°29.986
Depth (ft):	9.4	Longitude:	87°06.509



SQUARE METER QUADRANT SAMPLE						
Study Area: E	8		Sample No: 2			
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Ba Pensacola B Escambia 9.4	ay ay System	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/21/2021 30°29.986 87°06.509		
SOM #2 Boo	kat Dhata	and the second of				
Picture Date:	7/21/2021					
			ESCAMBIA BA9 AREA EB Julig 123 2			
SQM #2 Tak	ble Photo					
Picture Date:	7/21/2021					
SQM #2 Oys Picture Date:	ter Photo 7/21/2021					
			ESCAMBIA DAY AREA EB 21 July 221 2			
SQM #2 Bo	x Photo	5		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
			REA EB 21 JULY 22 21 JULY 22			

SQUARE METER QUADRANT SAMPLE						
Study Area: E8			Sample No:	3		
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Ba Escambia 9.4	/ y System	Collection Method Sample Date: Latitude: Longitude:	: Scuba Diver 7/21/2021 30°29.986 87°06.509		
SOM #2 Back	ot Photo	· Allow		Chaile 1-		
Picture Date:	7/21/2021	1198	ESCATIBIA BAY	HIT		
SQM #3 Table Picture Date:	e Photo 7/21/2021		AREA EB July '21			
SQM #3 Oyste	er Photo					
SQM #3 Box	Photo		AREA EB 21 July 21			
Picture Date:	7/21/2021		ESCAMBIA BAY AREA ES 21 July 21	3		

		SQU	ARE METER		ANT SAMP	LE	
Stı	ıdy Area:	E8			Ş	Sample No:	1
Oys Loc Cou	ster Area: ation: ınty:	Pensacola E Escambia B Escambia	Bay System ay			Sample Date:	7/22/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4	1			2.78%	0.00%	0.00%
at	1 5-9	8			22.22%	0.00%	0.00%
Sp	2 10-14	3	_		8.33%	0.00%	0.00%
	3 15-19	5	1	1	10 449/	16 67%	29 570/
	4 20-24 5 25-29	2	1	I	19.44 <i>%</i> 5.56%	0.00%	28.37%
	6 30-34	4		1	13,89%	0.00%	20.00%
	7 35-39	1		-	2.78%	0.00%	0.00%
	8 40-44			1	2.78%		100.00%
ed	9 45-49			2	5.56%		100.00%
Se	10 50-54						
	11 55-59						
	12 60-64				0 00/		
	13 65-69	1		1	2.78%	0.00%	100.00%
	14 70-74	1			2.78%	0.00%	0.00%
	16 80-84				2.7070	0.00 /8	0.0078
	17 85-89	1			2.78%	0.00%	0.00%
	18 90-94	1			2.78%	0.00%	0.00%
	19 95-99	1			2.78%	0.00%	0.00%
сk	20 100-104						
Sa	21 105-109						
	22 110-114						
	23 115-119				-		
	24 120-124						
	25 125-129						
	Totals	29	1	6	100.00%	3.33%	19.44%
			OVSTER S				
	1	8 -				_	Live
	1	6					Recent Dead
	1	.4					■Old Dead
	-						
	L	2					
	:	10					
		8					
		0					
		6					
1		4					
		2					
1						Old Dead	
		0				Recent Dead	
1		0 - 24 mm S	pat			ive	
			25-74 mm	Seed			
				>	74 mm Sack		

	SQUARE METER QUADRANT SAMPLE								
Stu	ıdy Area:	E8			e,	Sample No:	2		
Oys Loca Cou	iter Area: ation: inty:	Pensacola E Escambia B Escambia	Bay System ay			Sample Date:	7/22/2021		
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality		
	0 0-4	2			5.56%	0.00%	0.00%		
at	1 5-9	4		1	13.89%	0.00%	20.00%		
Spi	2 10-14	3		1	11.11%	0.00%	25.00%		
	3 15-19	4			11.11%	0.00%	0.00%		
	4 20-24	8	1		25.00%	11.11%	11.11%		
	5 25-29	4	_	4	11.11%	0.00%	0.00%		
	6 30-34	4	_	1	2.78%	0.000/	100.00%		
	7 35-39	1			2.78%	0.00%	0.00%		
5	8 40-44								
ee	9 45-49	-	+	2	5 56%		100.00%		
S	10 50-54	1		2	2 78%	0.00%	0.00%		
	12 60-64	1			2.7070	0.00 %	0.0078		
	13 65-69								
	14 70-74								
	15 75-79								
	16 80-84	1		1	5.56%	0.00%	50.00%		
	17 85-89								
	18 90-94	1			2.78%	0.00%	0.00%		
	19 95-99								
÷	20 100-104								
Sa	21 105-109								
	22 110-114								
	23 115-119								
	24 120-124								
	25 125-129								
	26 >130								
	Totals	29	1	6	100.00%	3.33%	19.44%		
			OYSTER S	IZE DISTRIE	BUTION				
	2!	5 1					Live		
	2	0					Recent Dead		
		-					■Old Dead		
	1	5							
	1								
	-	.0							
		5							
		0				Old Dead			
1		0 - 24				Recent Dead			
		0 - 24 mm	25-74	1	Li	ve			
1		Spat	mm		>74 mm				
1			Seed		Sack				

	SQUARE METER QUADRANT SAMPLE								
Stı	idy Area:	E8			0,	Sample No:	3		
Oys Loc: Cou	ter Area: ation: nty:	Pensacola E Escambia B Escambia	3ay System ay			Sample Date:	7/22/2021		
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality		
	0 0-4				0.000/	0.000/			
at	1 5-9	6			9.68%	0.00%	0.00%		
Sp	2 10-14	9			14.52%	0.00%	0.00%		
	4 20-24	11			17 74%	0.00%	0.00%		
	5 25-29	14		1	24.19%	0.00%	6.67%		
	6 30-34	5		1	9.68%	0.00%	16.67%		
	7 35-39	4			6.45%	0.00%	0.00%		
	8 40-44			2	3.23%		100.00%		
ed	9 45-49								
Se	10 50-54			2	3.23%		100.00%		
	11 55-59								
	12 60-64								
	13 65-69	1			1 61%	0.00%	0.00%		
	15 75-79				1.0176	0.00%	0.0070		
	16 80-84								
	17 85-89								
	18 90-94	1			1.61%	0.00%	0.00%		
	19 95-99								
ack	20 100-104								
ŝ	21 105-109								
	22 110-114								
	23 115-119								
	24 120-124								
	26 >130								
	Totals	56	0	6	100.00%	0.00%	9.68%		
		-	OYSTER S	IZE DISTRIE	UTION				
	3	35					Live		
		30					Recent Dead		
		25					■Old Dead		
		20							
		20							
		15							
		10							
		5	-						
						/ Old Dead			
		0 24				' Recent Dead			
		0 - 24 mm	25-7	4		live			
		Spat	mm	1	>74 mm ٰ				
			See	d	Sack				

Study Area: E8

Acres in Study Area: 300.1 Acres with Oysters: 64.2

Oyster Area: Location: County:

rea: **Pensacola Bay System** Escambia Bay Escambia

Sample Date: 7/22/2021

CULTCH/MATERIALS PRESENT

Material	Sample 1	Sample 2	Sample 3
Crush Concrete	0	0	0
Limestone	Х	Х	Х
Oyster Shell Cultch	Х	Х	Х
Oyster Shell Fragments	Х	Х	Х
Oyster Shell Rubble	Х	Х	Х
Oyster Clusters	Х	Х	Х
Oyster Singles	Х	Х	Х
Broken Oyster Shells	0	0	0
Clam Shells	Х	Х	Х
Marsh Debris	0	0	0
H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

		OY	STER REEF ORGAN	NISMS - COUNT		
_						
	Materia		Sample 1	Sample 2	Sample 3	
	Oyster Dr	lls	1	1	1	
	Hermit Cra	ıbs	0	0	0	
	Mud Crat	S	0	0	1	
	Mussels		2	3	7	
	Rangia		0	0	0	
	Materia		Total Count			
	Oyster Dr	lls	3			
	Hermit Cra	ıbs	0			
	Mud Crat	S	1			
	Mussels		12			
	Rangia		0			
			OYSTER SHELL	COLOR		
Samp	le 1		Sample	2	Sample 3	
Shell Color	%		Shell Color	%	Shell Color	%
Brown-Green	0		Brown-Green	0	Brown-Green	0
Brown	40		Brown	10	Brown	10
Black	0		Black	0	Black	0
Gray	60		Gray	90	Gray	90
]	0.4471.5			
SAME	LE 1		SAMPLE	2	SAMPLE 3	
60%	% 40% 0%		0%10 90%	% 0%	0%10% 0% 90%	
Brown-Green	Brown		Brown-Green	Brown	Brown-Green Brow	vn
Black	Gray		віаск	Gray	Black Gray	/

OYSTER DENSITIES

Study Area: E8

Acres in Study: 300.1

Acres with Oyster Reef: 64.2

Oyster Area: Location: County:	Pensacola Ba Escambia Ba Escambia	ay System y					Sample Date:	7/22/2021
	O	ysters in Samp	ole		Ś	Sacks Per Acr	e	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	lities	Total
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	17	8	4	652	38	90	90	218
2	21	6	2	652	47	67	45	160
3	31	24	1	1259	70	270	22	362
TOTAL	69	38	7	2563	155	427	157	740
AVERAGE	23.0	12.7	2.3	854.2	51.7	142.4	52.5	246.5
		E	STIMATED P	OTENTIAL ST.	ANDING CRC)P		
Average Sac	ks Per Acre		No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
24	7	Х	64	4.2	=	158	327	
from s meter s	quare amples		determined fr scan son	om poling/side ar survey				
		S	QUARE MET	ER SAMPLE I	MORTALITIE	S		
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		29	1	6		3%		19%
2		29	1	6		3%		19%
3		56	0	6		0%		10%
				•				
Total		114	2	18		Recent Mortality		Total Mortality
Average		38.0	0.7	6.0		2.2%		16%

SQUARE METER QUADRANT SAMPLE

Study Area: E	59	Sample No: 1	
Location:	Pensacola Bay System	Collection Method:	Scuba Diver
Oyster Area:	Escambia Bay	Sample Date:	7/27/2021
Parish/County:	Escambia County	Latitude:	30°29.711
Depth (ft):	9.0	Longitude:	87°07.070
SQM #1 Bas	sket Photo		
Picture Date:	//2//2021		LETAN.
		AREA E9	APP C
	XIIIX	27 July 21	
			A MESS
		A LESS COMMENTED DA	North Contraction
			A RIA NOV
			A G TO AUTON
SQM #1 Tal	ble Photo		
Picture Date			
	No.		
			3
		Escensin Say	· · · ·
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
			122 100
	1 in the		T.
SOM #1 . Ov	otor Photo		
Picture Date	· 7/27/2021	Escamora Day	7
	. //2//2021	Area Eg	
	A	27 July 21	E. C. State
	· · · · · · · · · · · · · · · · · · ·		
	the state of the s		, 2 - ()
	the second second second		
	+	1. 1 × 1/2 / 1 × 1 × 1	A.t.
	the set of the	C BARRIER C	
		Contraction of the second	e T
	0	and the second s	
	Barra and		
	and the second	a sea and	, that the safe is a

SQUARE METER QUADRANT SAMPLE							
Study Area: E9 Sample No: 2							
Location: Ovster Area:	Pensacola Bay System Escambia Bay	Collection Method: Sample Date:	Scuba Diver 7/27/2021				
Parish/County:	Escambia County	Latitude:	30°29.711				
Depth (ft):	9.0	Longitude:	87°07.070				
SQM #2 Bas	sket Photo		111116				
		AREA EQ 27 John 121					
SOM #2 Ta	ble Photo						
Picture Date	: 7/27/2021						
		Ensatis 64 ens E1 27 Jun 21					
SQM #2 Oys Picture Date	ster Photo						
		Escambia Bay Area Eg	7				
		27 July 21	-				
	24						

SQUARE METER QUADRANT SAMPLE								
Study Area: E9 Sample No: 3								
Location: Oyster Area: Parish/County:	Pensacola Bay System Escambia Bay Escambia County	Collection Method: Sample Date: Latitude:	Scuba Diver 7/27/2021 30°29.711					
Depth (ft):	9.0	Longitude:	87°07.070					
SQM #3 Bas Picture Date:	sket Photo 7/27/2021	EUCAMBIA BAY AREA E9 37 Jong 121						
SQM #3 Tai Picture Date	ble Photo : 7/27/2021							
SQM #3 Oys Picture Date	ster Photo : 7/27/2021	Escambia Bay Area Eg 27 July 21	3.					



Figure 94. Water Bottom Image Area E9







Study Area: E9

Acres in Study Area:97.9 Acres with Oysters: 28.2

Oyster Area: Location:

a: **Pensacola Bay System** Escambia Bay Escambia

Sample Date: 7/27/2021

ounty:	Escambia			
	CU	LTCH/MATERIALS I	PRESENT	
	Material	Sample 1	Sample 2	Sample 3
	Crush Concrete	0	0	0
	Limestone	0	0	0
	Oyster Shell Cultch	Х	Х	Х
	Oyster Shell Fragments	Х	Х	Х
	Oyster Shell Rubble	0	Х	Х
	Oyster Clusters	0	Х	0
	Oyster Singles	Х	Х	0
	Broken Oyster Shells	0	0	0
	Clam Shells	0	0	0
	Marsh Debris	0	0	0
	H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	3	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	21	6	3
Rangia	0	0	0
Material	Total Count		
Oyster Drills	3		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	30		
Rangia	0		

Sample 1Shell Color%Brown-Green5Brown10Black0Gray85



OYSTER SHELL COLOR

Sample 2				
Shell Color	%			
Brown-Green	0			
Brown	10			
Black	0			
Gray	90			



Sample 3				
Shell Color	%			
Brown-Green	0			
Brown	10			
Black	0			
Gray	90			
	-			



OYSTER DENSITIES

Study Area: E9

Acres in Study: 97.9

Acres with Oyster Reef: 28.2

Oyster Area: Location: County:	Pensacola B Escambia Ba Escambia	ay System ay					Sample Date:	7/27/2021
	Ο	sters in Sam	ole		S	Sacks Per Acr	е	
Sample #	<24mm	25-74	>75mm All sizes Discounted for M		ounted for Morta	talities Total		
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	4	0	0	90	9	0	0	9
2	4	0	0	90	9	0	0	9
3	1	0	0	22	2	0	0	2
TOTAL	9	0	0	202	20	0	0	20
AVERAGE	3.0	0.0	0.0	67.4	6.7	0.0	0.0	6.7
		E	STIMATED PO	OTENTIAL ST	ANDING CRC	P		
Average Sacks Per Acre No. of Acre		No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area		
7		х	28	3.2	=	19	90	
from square meter samples			determined from poling/side scan sonar survey					
		S	QUARE MET	ER SAMPLE	MORTALITIES	5		
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		4	0	0		0%		0%
2		4	0	0		0%		0%
3		1	0	0		0%		0%
Total		0	0	0		Recent		Total
Total		9	U	0		Mortality		Mortality
Average		3.0	0.0	0.0		0.0%		0%

SQUARE METER QUADRANT SAMPLE						
Study Area: E	15	Sample No: 2				
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Bay System Escambia County 9.7	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/28/2021 30°30.324 87°06.526			
SQM #2 Bas Picture Date:	eket Photo 7/28/2021	Escaria Ry Area 15 28 July 2				
SQM #2 Tal Picture Date	ble Photo : 7/28/2021					
SQM #2 Bo Picture Date	Dx Photo : 7/28/2021	Escambia Bay Area 15 28 July 21				
	•		· · ·			

SQUARE METER QUADRANT SAMPLE						
Study Area: E	15	Sample No: 3				
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Bay System Escambia County 9.7	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/28/2021 30°30.324 87°06.526			
SQM #3 Bas Picture Date:	sket Photo 7/28/2021	Escambia Bay Area 15 28 July 21				
SQM #3 Tal Picture Date	ble Photo : 7/28/2021					
SQM #3 Bo Picture Date	DX Photo : 7/28/2021	Escanbia Bay Ba Area 15 28 July 21				



Figure 95. Water Bottom Image Area E15






Study Area: E15

Acres in Study Area:74.1 Acres with Oysters: 9.3

Oyster Area: Location:

Pensacola Bay System Escambia Bay

Escambia

Sample Date: 7/28/2021

County:	Escambia			
	CU	ILTCH/MATERIALS	PRESENT	
	Material	Sample 1	Sample 2	Sample 3
	Crush Concrete	0	0	0
	Limestone	0	0	0
	Oyster Shell Cultch	Х	Х	Х
	Oyster Shell Fragments	Х	Х	Х
	Oyster Shell Rubble	Х	Х	Х
	Oyster Clusters	0	0	0
	Oyster Singles	Х	0	Х
	Broken Oyster Shells	0	0	0
	Clam Shells	0	0	0
	Marsh Debris	0	0	0
	H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	0	0	0
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	0	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	0	0	0
Rangia	0	0	0
Material	Total Count		
Oyster Drills	0		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	0		
Rangia	0		

OYSTER SHELL COLOR

Sample 1				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Gray	100			
	-			



Sample 2				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Grav	100			



Sample 3				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Gray	100			



Study Area: E15

Acres in Study: 74.1

Acres with Oyster Reef: 9.3

Oyster Area: Location: County:	Pensacola B Escambia Ba Escambia	ay System ay					Sample Date	7/28/2021
	Ο	/sters in Sam	ole		5	Sacks Per Acr	'e	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	alities	Total
-	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0
AVERAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		E	STIMATED P	OTENTIAL ST	ANDING CRC)P		
Average Sac	ks Per Acre		No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
0	I	х	9	.3	=		0	
from so meter sa	quare amples		determined fro scan son	om poling/side ar survey				
		S	SQUARE MET	ER SAMPLE	MORTALITIE	S		
							-	
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		0	0	2		0%		100%
2		0	0	1		0%		100%
Total		0	0	3		Recent Mortality		Total Mortality
Average		0.0	0.0	1.5		0.0%		100%

SQUARE METER QUADRANT SAMPLE Study Area: E16 Sample No: 1 Location: Escambia Bay Collection Method: Scale

Location:Escambia BayOyster Area:Pensacola Bay SystemParish/County:Escambia CountyDepth (ft):8.8

Collection Method: Sample Date: Latitude: Longitude: Scuba Diver 7/27/2021 30°30.369' 87°06878'



Study Area: E16

Location:Escambia BayOyster Area:Pensacola Bay SystemParish/County:Escambia CountyDepth (ft):8.8

Sample No: 2

Collection Method: Sample Date: Latitude: Longitude:

Scuba Diver 7/27/2021 30°30.369' 87°06878'



SQUARE METER QUADRANT SAMPLE Study Area: E16 Sample No: 3 Location: Escambia Bay Collection Method: Scuba Diver Pensacola Bay System Oyster Area: Sample Date: 7/27/2021 Parish/County: Escambia County Latitude: 30°30.369' Depth (ft): Longitude: 8.8 87°06878' SQM #3 Basket Photo Picture Date: 7/27/2021 Escambia Ba Area E-16 27 July 21 SQM #3 Table Photo Picture Date: 7/27/2021







Study Area: E16

Acres in Study Area: 243.9 Acres with Oysters: 13.3

Oyster Area: Location:

Pensacola Bay System Escambia Bay

Sample Date: 7/27/2021

County:	Escambia			
	CU	LTCH/MATERIALS	PRESENT	
	Material	Sample 1	Sample 2	Sample 3
	Crush Concrete	0	0	0
	Limestone	0	0	0
	Oyster Shell Cultch	Х	Х	Х
	Oyster Shell Fragments	Х	Х	Х
	Oyster Shell Rubble	Х	Х	Х
	Oyster Clusters	0	0	0
	Oyster Singles	0	0	0
	Broken Oyster Shells	0	0	0
	Clam Shells	0	0	0
	Marsh Debris	0	0	0
	H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	0	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample
Oyster Drills	0	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	5	0	0
Rangia	0	0	0
Material	Total Count		-
Oyster Drills	0		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	5		
Rangia	0		

OYSTER SHELL COLOR

Sample 1				
%				
0				
0				
0				
100				



Sample 2				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Grav	100			



Sample 3				
%				
0				
0				
0				
100				



Study Area: E16

Acres in Study: 243.9

Acres with Oyster Reef: 13.3

Oyster Area: Location: County:	Pensacola E Escambia B Escambia	8ay System ay					Sample Date	: 7/27/2021
	0	ysters in Samp	ole		S	acks Per Acr	e	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	alities	Total
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0
AVERAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		E	STIMATED P	OTENTIAL ST	ANDING CRO	P		
Average Sac	ks Per Acre		No. of Acres ⊢	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
C)	Х	13	3.3	=	(0	
from s meter s	quare amples		determined fro scan son	om poling/side ar survey				
						_		
		2		ER SAMPLE	MORTALITIES	5		
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		0	0	0		0%		0%
2		0	0	0		0%		0%
3		0	0	0		0%		0%
Total		0	0	0		Recent Mortality		Total Mortality
Average		0.0	0.0	0.0		0.0%		0%

Study Area: E	17	Sample No: 1	
Location:	Escambia Bay	Collection Method:	Scuba Diver
Oyster Area:	Pensacola Bay System	Sample Date:	7/27/2021
Parish/County:	Escambia County	Latitude:	30°31.034
Depth (ft):	8.5	Longitude:	87°06.674



SQUARE METER QUADRANT SAMPLE						
Study Area: E	17		Sample No	o: 2		
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Ba Escambia Cou 8.5	/ y System unty	Collection Methor Sample Date: Latitude: Longitude:	d: Scuba Diver 7/27/2021 30°31.034 87°06.674		
SQM #2 Bas Picture Date:	ket Photo 7/27/2021		Escamora Dar Area 17 27 July 121			
SQM #2 Tal Picture Date.	ble Photo 7/27/2021		Image: Sector Se Sector Sector Se			
SQM #2 Oys Picture Date	ster Photo 7/27/2021		Escambia Bai Area 17 27 July 21 20 0000			
SQM #2 Oys Picture Date.	ster Photo 7/27/2021		Escambia Baj Area 17 27 July 21 27 July 21			

SQUARE METER QUADRANT SAMPLE						
Study Area: E	17		Sample No: 3			
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Ba Pensacola B Escambia Co 8.5	ay ay System bunty	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/27/2021 30°31.034 87°06.674		
SOM #2 Back	kat Photo		Escambia Bay			
Picture Date:	7/27/2021		Area 17 27 July:21	Ne //		
SQM #3 Tab Picture Date:	le Photo 7/27/2021					
Picture Date:	ter Photo 7/27/2021		Escambia Bai Area 17 27 July 21 3			
SQM #3 Oyst Picture Date:	ter Photo 7/27/2021		Escambia Bar Area 17 27 July 21 Bar			

	SQUARE METER QUADRANT SAMPLE						
Stı	ıdy Area:	E17			S	Sample No:	1
Oys Loc Cou	iter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System ay			Sample Date:	7/27/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4	1			14.29%	0.00%	0.00%
at	1 5-9	1			14.29%	0.00%	0.00%
Spi	2 10-14	1			14.29%	0.00%	0.00%
	3 15-19				-		
	4 20-24	2			29 570/	0.00%	0.00%
	5 25-29 6 30-34	2			20.57%	0.00%	0.00%
	7 35-39						
	8 40-44						
be	9 45-49			1	14.29%		100.00%
See	10 50-54						
	11 55-59	1			14.29%	0.00%	0.00%
	12 60-64						
	13 65-69						
	14 70-74						
	15 75-79						
	16 80-84						
	17 85-89						
	10 90-94						
×	20 100-104						
Sac	20 100-104						
0,	22 110-114						
	23 115-119						
	24 120-124						
	25 125-129						
	26 >130						
	Totals	6	0	1	100.00%	0.00%	14.29%
			OYSTER S	IZE DISTRIB	UTION		
	2	3		-			Live Recent Dead
	1	2 .5 1 0.5 0 0 - 24 mm S	pat 25-74 mm	n Seed	Li 74 mm Sack	Old Dead Recent Dead ve	

	SQUARE METER QUADRANT SAMPLE						
Stı	ıdy Area:	E17			S	ample No:	2
Oys Loc Cou	ter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System ay			Sample Date:	7/27/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4						
at	1 5-9						
Sp	2 10-14						
	3 15-19 4 20-24			1	16.67%		100.00%
	5 25-29	1			16.67%	0.00%	0.00%
	6 30-34					0.0070	0.0070
	7 35-39	1			16.67%	0.00%	0.00%
	8 40-44	1			16.67%	0.00%	0.00%
ed	9 45-49			1	16.67%		100.00%
s	10 50-54						
	11 55-59						
	12 60-64						
	13 65-69						
	14 70-74	1			16.67%	0.00%	0.00%
	16 80-84				10.0770	0.0070	0.0070
	17 85-89						
	18 90-94						
	19 95-99						
ıck	20 100-104						
Se	21 105-109						
	22 110-114		_		-		
	23 115-119						
	24 120-124						
	26 >130						
	Totals	4	0	2	100.00%	0.00%	33.33%
			OYSTER S	IZE DISTRIB	UTION		
							_1.
	:	3					Live
	2.	5					Recent Dead
		2					■Old Dead
		2					
	1.	.5					
l		1					
	0	.5					
		0		-		Old Dead Recent Dead	
		0 - 24			Liv	/6	
		mm	25-74	1			
		Spat	mm Seed		>74 mm		
			2004		JUCK		
l							

	SQUARE METER QUADRANT SAMPLE						
Stu	ıdy Area:	E17			S	Sample No:	3
Oys Loca Cou	ter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System ay			Sample Date:	7/27/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4	1			25.00%	0.00%	0.00%
pat	2 10-14				23.0070	0.0070	0.0070
S	3 15-19						
	4 20-24						
	5 25-29	1			25.00%	0.00%	0.00%
	6 30-34						
	7 35-39	1			25.00%	0.00%	0.00%
b	9 45-49				20.0070	0.0070	0.0070
See	10 50-54						
	11 55-59						
	12 60-64			1	25.00%		100.00%
	13 65-69						
	15 75-79						
	16 80-84						
	17 85-89						
	18 90-94						
×	19 95-99						
Sac	20 100-104						
05	22 110-114						
	23 115-119						
	24 120-124						
	25 125-129						
	Totals	3	0	1	100.00%	0.00%	25.00%
	lotaio		OYSTER S		UTION		20100 /0
				-			
		2					
	1	.8					Recent Dead
	-						Old Dead
	1	4					
	1	2					
		1					
	(0.8					
		0.6					
		0.4					
		0.2					
		0.2				/ Old Dead	
						Recent Dead	
		0 - 24 mm	25-7	24		ive	
		Spat	mr	1	>74 mm		
1			See	d	Sack		
1							

Study Area: E17

Acres in Study Area:93.6 Acres with Oysters: 15.3

Oyster Area: Location:

County:

: Pensacola Bay System Escambia Bay

Sample

Escambia

Sample Date: 7/27/2021

CULTCH/MATERIALS PRESENT				
Material	Sample 1	Sample 2	Sample 3	
Crush Concrete	0	0	0	
Limestone	Х	Х	Х	
Oyster Shell Cultch	Х	Х	Х	
Oyster Shell Fragments	Х	Х	Х	
Oyster Shell Rubble	Х	Х	Х	
Oyster Clusters	Х	Х	Х	
Oyster Singles	Х	Х	Х	
Broken Oyster Shells	0	0	0	
Clam Shells	Х	Х	Х	
Marsh Debris	0	0	0	
H2S Odor	0	0	0	

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	0	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	200	100	120
Rangia	0	0	0
Material	Total Count		
Oyster Drills	0		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	420		
Rangia	0		

OYSTER SHELL COLOR

Sample 1					
Shell Color	%				
Brown-Green	0				
Brown	5				
Black	0				
Gray	95				
	-				



Sample 2				
Shell Color	%			
Brown-Green	0			
Brown	0			
Black	0			
Grav	100			



Samp	Sample 3				
Shell Color	%				
Brown-Green	0				
Brown	0				
Black	0				
Gray	100				



Study Area: E17

Acres in Study: 93.6

Acres with Oyster Reef: 15.3

Oyster Area: Location: County:	Pensacola E Escambia B Escambia	3ay System ay					Sample Date	7/27/2021
	Ο	/sters in Samp	ole		S	Sacks Per Acr	e	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	alities	Total
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	1
1	3	3	0	135	7	34	0	40
2	0	3	1	90	0	34	22	56
3	1	2	0	67	2	22	0	25
TOTAL	4	8	1	292	9	90	22	121
AVERAGE	1.3	2.7	0.3	97.4	3.0	30.0	7.5	40.5
		E	STIMATED P	OTENTIAL ST	ANDING CRC	P		
Average Sac	ks Per Acre		No. of Acres H	lolding Oysters		Estimated No Sacks in S	o. of Potential Study Area	
40)	Х	15	5.3	=	6	19	
from so meter sa	quare amples		determined fro scan son	om poling/side ar survey				
		S	QUARE MET	ER SAMPLE	MORTALITIES	5		
	•					-		1
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		6	0	1		0%		14%
2		4	0	2		0%		33%
3		3	0	1		0%		25%
Total		13	0	1		Recent		Total
Total		13	0	4		Mortality		Mortality
Average		4.3	0.0	1.3		0.0%		24%

Study Area: E	27	Sample No: 2	
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Bay System Escambia County 9.0	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/28/2021 30°29.009 87°08.825
SQM #2 Bas	ket Photo		
Picture Date:	7/28/2021	Escambia Bay Area 27 28 July 21 2	
SQM #2 Tal	ble Photo		
Picture Date:			
SQM #2 Bo Picture Date:	DX Photo 7/28/2021	Escamenta Bay Anea 27 28 July 20 00000000000000000000000000000000000	

	SQUARE METER	QUADRANT SAMPLE	
Study Area: E	27	Sample No: 3	
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Bay System Escambia County 9.0	Collection Method: Sample Date: Latitude: Longitude:	Scuba Diver 7/28/2021 30°29.009 87°08.825
SQM #3 Bas Picture Date: SQM #3 Tal Picture Date	Aket Photo T/28/2021		

L



Figure 96. Water Bottom Image Area E27

	SQUARE METER QUADRANT SAMPLE						
Stu	ıdy Area:	E27			S	Sample No:	1
Oys Loca Cou	iter Area: ation: inty:	Pensacola Ba Escambia Ba Escambia	ay System y			Sample Date:	7/28/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4				_		
at	1 5-9						
Sp	2 10-14						
	4 20-24						
	5 25-29						
	6 30-34						
	7 35-39						
	8 40-44			1	25.00%		100.00%
bed	9 45-49			2	50.00%		100.00%
Se	10 50-54						
	11 55-59						
	12 60-64	-			-		
	13 65-69						
-	14 70-74						
	16 80-84						
	17 85-89						
	18 90-94			1	25.00%		100.00%
	19 95-99						
ъ	20 100-104						
Sa	21 105-109						
	22 110-114						
	23 115-119						
	24 120-124						
	25 125-129						
	26 >130	0	0	4	100.00%	0.00%	100 00%
	TOLAIS	0	0	4	100.00%	0.00%	100.00%
	2. 1	3 5 2 .5 1 0.5					 Live Recent Dead Old Dead
		0 0 - 24 mm Sp	pat 25-74 mm	n Seed	Li 74 mm Sack	Old Dead Recent Dead ve	

	SQUARE METER QUADRANT SAMPLE						
Stı	ıdy Area:	E27			S	Sample No:	2
Oys Loc Cou	ter Area: ation: inty:	Pensacola Ba Escambia Ba Escambia	ay System iy			Sample Date:	7/28/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4						
at	1 5-9						
sp	2 10-14						
	4 20-24						
	5 25-29						
	6 30-34						
	7 35-39						
σ	8 40-44						
See	9 45-49 10 50-54						
00	11 55-59						
	12 60-64			1	14.29%		100.00%
	13 65-69			4	57.14%		100.00%
	14 70-74			1	14.29%		100.00%
	15 75-79						
	16 80-84						
	18 90-94						
	19 95-99			1	14.29%		100.00%
ç	20 100-104						
Sa	21 105-109						
	22 110-114						
	23 115-119						
	25 125-129						
	26 >130						
	Totals	0	0	7	100.00%	0.00%	100.00%
			OYSTER S	IZE DISTRIB	UTION		
							Live
	6	5					
		5					Recent Dead
							Old Dead
		4					
		3		_			
		2		_			
		1					
		0		~	-	/ Old Dead Recent Dead	
		0 - 24	25-7/	1		ve	
		Spat	25-72 	т	>74 mm		
			Seed		Sack		



Study Area: E27

Acres in Study Area: 274 Acres with Oysters: 12.9

Oyster Area:

Pensacola Bay System Location: Escambia Bay

Sample Date: 7/28/2021

	JLICH/MATERIALS	PKESENI	
Material	Sample 1	Sample 2	Sample 3
Crush Concrete	0	0	0
Limestone	0	0	0
Oyster Shell Cultch	Х	Х	Х
Oyster Shell Fragments	Х	Х	Х
Oyster Shell Rubble	Х	Х	Х
Oyster Clusters	Х	0	0
Oyster Singles	Х	0	0
Broken Oyster Shells	0	0	0
Clam Shells	0	0	0
Marsh Debris	0	0	0
H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	0	0	0
Hermit Crabs	0	0	0
Mud Crabs	0	0	0
Mussels	0	0	0
Rangia	0	0	0
Material	Total Count		
Oyster Drills	0		
Hermit Crabs	0		
Mud Crabs	0		
Mussels	0		
Rangia	0		

OYSTER SHELL COLOR

Sample 1					
Shell Color	%				
Brown-Green	0				
Brown	0				
Black	0				
Gray	100				

Black

Sample 2

Shell Color	%
Brown-Green	0
Brown	0
Black	0
Gray	100







Gray

Study Area: E27

Acres in Study: 274

Acres with Oyster Reef: 12.9

Oyster Area: Location:	Pensacola Ba Escambia Ba	ay System y					Sample Date	7/28/2021
County.	Escallipia							
	O	sters in Sam	ole		Ś	Sacks Per Acr	е	
Sample #	<24mm	25-74	>75mm	All sizes	Disc	ounted for Morta	lities	Total
	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0
		-		-	-	-		-
AVERAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		E	STIMATED P	OTENTIAL ST	ANDING CRC)P		
						Estimated No	of Potential	
Average Sad	cks Per Acre		No. of Acres H	lolding Oysters		Sacks in S	Study Area	
							···· , · · · ·	
()	x	12	29	=	(r	
		X				·		
from s	auare		determined fr	om polina/side				
meter s	amnles		scan son	ar survey				
	ampiee		ocar con					
		c				2		
				ER SAMPLE	WORTALITIE	5		
0		#15.0 Output	# Recent	# Old David		Recent		Total Mandality
Sample #		# Live Oysters	Boxes	# Old Boxes		Mortality		I otal Mortality
1		0	0	4		0%		100%
2		0	0	7		0%		100%
Total		0	0	11		Recent		Total
10101		Ŭ	0			Mortality		Mortality
Average		0.0	0.0	5.5		0.0%		100%

Study Area: E28		Sample No: 1	
Location:	Escambia Bay	Collection Method:	Scuba Diver
Oyster Area:	Pensacola Bay System	Sample Date:	7/28/2021
Parish/County:	Escambia County	Latitude:	30°29.023
Depth (ft):	7.9	Longitude:	87°09.441



Study Area: E28 Sample No: 2 Location: Escambia Bay Collection Method: Scub Oyster Area: Pensacola Bay System Sample Date: 7/2 Parish/County: Escambia County Latitude: 30' Depth (ft): 7.9 Longitude: 87' SQM #2 Basket Photo Picture Date: 7/28/2021 Image: Source and the second and the s	pa Diver 28/2021 229.023 209.441
Location: Escambia Bay Collection Method: Scub Oyster Area: Pensacola Bay System Sample Date: 7/2 Parish/County: Escambia County Latitude: 30' Depth (ft): 7.9 Longitude: 87' SQM #2 Basket Photo Picture Date: 7/28/2021 SQM #2 Table Photo Picture Date: 7/28/2021 SQM #2 Table Photo Picture Date: 7/28/2021	a Diver 28/2021 °29.023 °09.441
SQM #2 Basket Photo Picture Date: 7/28/2021	A Law
SQM #2 Table Photo Picture Date: 7/28/2021	
SQM #2 Oyster Photo Picture Date: 7/28/2021 EscamBia BAY AREA E28 28 July 21	St.
SQM #2 Box Photo Picture Date: 7/28/2021	

SQUARE METER QUADRANT SAMPLE						
Study Area: E	28		Sample N	lo: 3		
Location: Oyster Area: Parish/County: Depth (ft):	Escambia Bay Pensacola Ba Escambia Co 7.9	y y System unty	Collection Metho Sample Date: Latitude: Longitude:	od: Scuba Diver 7/28/2021 30°29.023 87°09.441		
SQM #3 Basi Picture Date:	ket Photo 7/28/2021		Escambia BAY AREA E28 28 July 21			
SQM #3 Tab Picture Date:	ole Photo 7/28/2021					
SQM #3 Oys Picture Date:	ter Photo 7/28/2021	·	AREA E28 28 July 21	3		
SQM #3 Bo Picture Date:	x Photo 7/28/2021		Escale 28 Barur 201			

	SQUARE METER QUADRANT SAMPLE						
Stu	ıdy Area:	E28			S	Sample No:	1
Oys Loca Cou	iter Area: ation: inty:	Pensacola Ba Escambia Ba Escambia	ay System Iy			Sample Date:	7/29/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4	1			6.25%	0.00%	0.00%
at	1 5-9	3			18.75%	0.00%	0.00%
Sp	2 10-14						
	4 20-24						
	5 25-29						
	6 30-34						
	7 35-39						
_	8 40-44						
eec	9 45-49						
Š	10 50-54						
	12 60-64			2	12 50%		100.00%
	13 65-69				12.0070		100.00 /0
	14 70-74			2	12.50%		100.00%
	15 75-79			2	12.50%		100.00%
	16 80-84			1	6.25%		100.00%
	17 85-89			-			
	18 90-94			3	18.75%		100.00%
×	19 95-99			1	6.25%		100.00%
ac	20 100-104			I	0.23%		100.00%
05	22 110-114			1	6.25%		100.00%
	23 115-119						
	24 120-124						
	25 125-129						
	26 >130						
	Totals	4	0	12	100.00%	0.00%	75.00%
		8 7 6 5 4 3 2					 Live Recent Dead Old Dead
		1 0 0 - 24 mm Sp	pat 25-74 mm	n Seed >	Li 74 mm Sack	Old Dead Recent Dead ve	

SQUARE METER QUADRANT SAMPLE							
Stu	ıdy Area:	E28			S	ample No:	2
Oys Loca Cou	ter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System Iy			Sample Date:	7/29/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4						
at	1 5-9			1	5.00%	0.000/	100.00%
Sp	2 10-14	1			5.00%	0.00%	0.00%
	3 15-19						
	5 25-29						
	6 30-34						
	7 35-39						
	8 40-44			1	5.00%		100.00%
ed	9 45-49						
Se	10 50-54			1	5.00%		100.00%
	11 55-59						
	12 60-64						
	13 65-69			2	10.00%		100.00%
	14 70-74			2	10.00%		100.00%
	15 75-79			2	10.00%		100.00%
	10 80-84			3	15.00%		100 00%
	17 03-09			3	15.00%		100.00%
	19 95-99			2	10.00%		100.00%
×	20 100-104			_	10.0070		100.0070
Sac	21 105-109			1	5.00%		100.00%
••	22 110-114	1					
	23 115-119						
	24 120-124			1	5.00%		100.00%
	25 125-129						
	26 >130						
	Totals	1	0	19	100.00%	0.00%	95.00%
	1: 1	2 0 8 6 4 2 0 0 - 24 mm Snat	25-74			Old Dead Recent Dead	 Live Recent Dead Old Dead
		Spat	mm Seed		>74 mm Sack		

	SQUARE METER QUADRANT SAMPLE						
Stı	ıdy Area:	E28			Ş	Sample No:	3
Oys Loc Cou	iter Area: ation: inty:	Pensacola B Escambia Ba Escambia	ay System ay			Sample Date:	7/29/2021
	Shell length (mm)	Live	Recent Dead	Old Dead	% Frequency	% Recent Mortality	% Mortality
	0 0-4		1		6.67%	100.00%	100.00%
at	1 5-9						
Sp	2 10-14						
	4 20-24						
	5 25-29						
	6 30-34						
	7 35-39						
5	8 40-44	1			6.67%	0.00%	0.00%
ee	9 45-49						
S	10 50-54						
	12 60-64						
	13 65-69			1	6.67%		100.00%
	14 70-74			1	6.67%		100.00%
	15 75-79			2	13.33%		100.00%
	16 80-84			1	6.67%		100.00%
	17 85-89			2	13.33%		100.00%
	19 95-99			1	6.67%		100.00%
ъ	20 100-104			1	6.67%		100.00%
Sa	21 105-109						
	22 110-114			1	6.67%		100.00%
	23 115-119			1	6.67%		100.00%
	25 125-129			1	6.67%		100.00%
	26 >130			•			
	Totals	1	1	13	100.00%	50.00%	93.33%
			OYSTER S	IZE DISTRIE	BUTION		
	1	12 1					Live
	:	10					Recent Dead
							Old Dead
		8					
		6					
		4					
		2					
						Old Dead	
		0 - 24				Recent Dead	
		mm	25-7	4		ive	
		Spat	mm	า d	>74 mm		
			Jee	<i>ч</i>	SdCK		
1							

Study Area: E28

Acres in Study Area:144.8 Acres with Oysters: 4.4

Oyster Area: Location:

a: Pensacola Bay System Escambia Bay Escambia

Sample Date: 7/29/2021

County:	Escambia			
	CL	JLTCH/MATERIALS	PRESENT	
	rr			
	Material	Sample 1	Sample 2	Sample 3
	Crush Concrete	0	0	0
	Limestone	0	0	0
	Oyster Shell Cultch	Х	Х	Х
	Oyster Shell Fragments	Х	Х	Х
	Oyster Shell Rubble	Х	Х	Х
	Oyster Clusters	0	0	0
	Oyster Singles	Х	Х	Х
	Broken Oyster Shells	0	0	0
	Clam Shells	Х	Х	Х
	Marsh Debris	0	0	0
	H2S Odor	0	0	0

OYSTER REEF ORGANISMS - PRESENT

Species	Sample 1	Sample 2	Sample 3
Barnacles	Х	Х	Х
Brittle Stars	0	0	0
Sea Squirts	0	0	0
Slipper Shells	0	0	0
Bryozoan	0	0	0

Material	Sample 1	Sample 2	Sample 3
Oyster Drills	0	0	0
Hermit Crabs	0	0	0
Mud Crabs	1	0	0
Mussels	3	5	6
Rangia	0	0	0
Material	Total Count		
Oyster Drills	0		
Hermit Crabs	0		
Mud Crabs	1		
Mussels	14		
Rangia	0		

OYSTER SHELL COLOR

Sample 1						
Shell Color	%					
Brown-Green	0					
Brown	0					
Black	0					
Gray	100					

SAMPLE 1

Brown-Green Brown

Gray

Black

Sample 2

Shell Color	%
Brown-Green	0
Brown	0
Black	0
Gray	100



Sample 3	
%	
0	
5	
0	
95	


OYSTER DENSITIES								
Study Area: E28					Acres in Study: 144 Acres with Oyster Reef: 4.4			144.8 4.4
Oyster Area: Location: County:	Pensacola Bay System Escambia Bay Escambia				Sample Date: 7/29/2021			
	Oysters in Sample				Sacks Per Acre			
Sample #	<24mm	25-74 >75mm		All sizes	Discounted for Mortalities			Total
•	spat	seed	sack	180oys/sack	spat(10%)	seed(50%)	sack	1
				-				
1	4	0	0	90	9	0	0	9
2	1	0	0	22	2	0	0	2
3	0	1	0	22	0	11	0	11
TOTAL	5	1	0	135	11	11	0	22
AVERAGE	1.7	0.3	0.0	45.0	3.7	3.7	0.0	7.5
								•
		E	STIMATED P	OTENTIAL ST	ANDING CRC)P		
Average Sacks Per Acre		No. of Acres Holding Oysters			Estimated No. of Potential Sacks in Study Area			
7		x	4.4		=	33		
from square meter samples		determined from poling/side scan sonar survey						
		S	QUARE MET	ER SAMPLE I	MORTALITIE	S		
	•							
Sample #		# Live Oysters	# Recent Boxes	# Old Boxes		Recent Mortality		Total Mortality
1		4	0	12		0%		75%
2	I	1	0	19		0%		95%
3		1	1	13		50%		93%
	-	· ·				-		-
Tatal	0		4	4.4		Recent		Total
iotai	6	0	1	44		Mortality		Mortality
Average		2.0	0.3	14.7		16.7%		88%

GULF COAST OYSTER REEF ORGANISM FIELD GUIDE

BIVALVES

Eastern Oyster, (Crassostrea virginica)



• **Description:** the eastern oyster is often cemented to rocks or other shells, with a grey or white exterior. The interior is white with a darkly colored muscle scar. Spat only have one visible valve and are dark grey-purple in color.

• **Habitat:** these oysters are found along the Gulf of Mexico and Atlantic coasts, this ranges from Mexico all the way to Canada. The oyster larvae will attach themselves to submerged objects in order to develop into spat, and later on become juvenile

oysters. Oysters create a physical habitat for many other marine organisms by creating hard surfaces, such as oyster reefs. As filter feeders, oysters can improve water quality and clarity providing us with an important ecosystem service.







Hooked Mussel, (Ischadium recurvum)

• **Description:** the hooked mussel is brown or dark grey in color with ribs radiating from the beak/hinge outwards. The interior shell is a shiny with a purple, pink or brown color. The mussels itself is triangular in shape and hooks towards one side.

• **Habitat:** it is native to the Gulf of Mexico and north of the Chesapeake Bay. These organisms will attach themselves to submerged objects, such as forming large groups on oysters. These filter feeders can help improve water quality.



Rangia (Rangia sp.)

- **Description:** the rangia are ribbed with a brown exterior and a glossy white interior.
- **Habitat:** these bivalves are found I areas with low salinities, particularly estuarine habitats.



BRYOZOANS



TUNICATES

Encrusting Bryozoan, (Conopeum sp.)

• **Description:** encrusting bryozoans pertaining to this particular genus, have calcified walls between individuals, which are rectangular or oval in shape. They will either have a brown or orange color depending on their diet.

• **Habitat:** these organisms can be found across a broad range of salinities and occur on hard substrates, such as oyster reefs.



Sea Squirts, (Molgula manhattensis)

Description: tunicates are soft bodied marine invertebrates, this species in particular is often lees than 1 inch in size.
Habitat: these soft bodied invertebrates are native to the Gulf of Mexico. They are restricted to higher salinities and grow on hard substrates.

BARNACLES



Barnacle, (Amphibalanus sp.)

• **Description:** barnacles are sessile crustaceans with plated calcium carbonate domes.

• **Habitat:** they can be found in marine environments on hard substrates.

CRUSTACEANS

Striped Hermit Crab (Clibanarius Vittatus)

• **Description:** hermit crabs are invertebrates with soft abdomen and use salvaged empty shells to support and protect their body.



• Habitat: these organisms inhabit a wide range of habitats from land to shallow waters.



Flat-back mud crab (Eurypanopeus depressus)

Description: this small crab is o bigger than half an inch in width. The carapace is a molted dark brown and it has unequal claw sizes with a white tip. Spines can be found on the edge of the carapace.
Habitat: these organisms often inhabit oyster reefs.

Oyster shell mud crab (Panopeus simpsoni)

• **Description:** this crab is similar to flat-back mud crab but can be larger in size. There is a large tooth on their top claw, which is moveable.



• Habitat: these organisms often inhabit oyster reefs.

OPHIURIDA



Brittle Star (Ophiothrix fragilis)

• **Description:** brittle stars have 5-6 long, slender arms which radiate from a central disk. Unlike starfish, brittle stars use their arms for locomotion.

• **Habitat:** These organisms can be found in all the world's oceans, as well as intertidal zones. Salinity may vary from tropical ocean waters, to brackish waters.

MOLLUSCA

Oyster Drills (Urosalpinx cinerea)

- **Description:** as the name indicates, this snail drills a hole in the oyster shell in order to access the soft tissue inside which they feed on.
- **Habitat:** this snail is endemic to the Atlantic. They can be found in shallow areas and depths of up to 25ft.



Slipper Shells (Crepidula fornicate)

- **Description:** this marine snail can be found in oval or egg-shaped shells that look as though they are cut in half.
- **Habitat:** these organisms can be found in a wide variety of habitats, such as, intertidal zones, marshes and beaches.



Glossary of Acronyms

- DO Dissolved Oxygen
- FWC Florida Fish and Wildlife Conservation Commission
- FDEP Florida Department of Environmental Protection
- GIS Geographic Information System
- HSM Habitat Suitability Model
- MREC Marine Research Ecological Consulting Environmental, LLC
- NOAA National Oceanic and Atmospheric Administration
- NRDA Natural Resource Damage Assessment
- OIMMP Oyster Integrated Mapping and Monitoring Program
- PBS Pensacola Bay System
- POI Points of Interest
- PPBEP Pensacola and Perdido Bays Estuary Program

RESTORE – Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States

- SQM Square Meter Quadrant
- TNC The Nature Conservancy
- USDA United States Department of Agriculture

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