2023 NRDA Cat Point Living Shoreline Project Report

Contents

Introduction

The Cat Point Living Shoreline (CPLS) project is a *Deepwater Horizon* Phase III early restoration project. As a result of the 2010 *Deepwater Horizon* oil spill and associated response activities, benthic secondary productivity and salt marsh habitats along Florida's Panhandle suffered adverse impacts. This project seeks to foster reef and salt marsh habitat development, which will help compensate the public for spill-related injuries and losses to benthic secondary productivity and salt marsh habitat. Monitoring will be conducted within a five-year period to ensure project designs were correctly implemented and to evaluate project effectiveness. Performance criteria will be used to determine project success. Monitoring data and adaptive management principles will be used to evaluate the need for corrective actions and to correct deficiencies as funding allows. This monitoring plan will be implemented by the Florida Department of Environmental Protection (FDEP). The monitoring will be performed by the Central Panhandle Aquatic Preserves (CPAP) which is part of FDEP's Office of Resilience and Coastal Protection (ORCP). The monitoring plan and activities conducted may be modified over time based on management needs for the CPLS Project.

Project Overview

The Cat Point Living Shoreline project employs living shoreline techniques that utilize natural breakwater material to reduce shoreline erosion, provide habitat, and protect recovering salt marshes at Cat Point, Florida. The living shoreline breakwaters were constructed in 2019-2020 at the Apalachicola National Estuarine Research Reserve (ANERR) in Eastpoint, Florida, in Franklin County (Figure 1). The specific breakwater elevation and design was selected to maximize shoreline protection and meet state regulatory requirements. The living shoreline techniques were employed along approximately 0.3 miles of shoreline. This area has been the location of previous successful living shoreline projects that contribute to shoreline protection.

Saltmarsh cordgrass (*Spartina alterniflora* – recently classified as *Sporobolus alterniflorus* by Peterson et al. 2014), saltmeadow cordgrass (*Spartina patens*), and sea oats (*Uniola paniculata*) were planted in suitable locations landward of the breakwaters in late spring 2020. Because of wash-out events and plant die-offs, additional saltmarsh cordgrass planting occurred in early 2021 and 2022.

Restoration Objectives and Performance Criteria

<u>Objectives:</u>

1. Construction of reefs that meet project design criteria, support benthic secondary productivity, reduce wave energy affecting the shoreline, and are sustained for the expected life of the project.
2. Creation of salt marsh habitat that meets project design criteria and achieves the designed percent cover by native saltmarsh vegetation.
3. Reduction of shoreline erosion.

Performance Criteria:

1. At year five, the reef area is equal to or greater than constructed area and the elevation is within 10% of constructed height.
    - **In Progress**
2. At year two, the density of oysters and bivalves should be a minimum of 50% cover of the breakwater surface area.
    - **Achieved:** In 2021, year one average percent coverage was 56.3%
3. A minimum of 80% of plantings must be viable at the end of the first growing season.
    - **Not Achieved:** Average survival was 69.98%.
4. At year one, percent cover is at least 80% of original planted cover. At year five, percent cover is equal to or greater than 75% within the project area.
    - Year One: **Not Achieved** – Percent cover of original planted cover is 69.91%.
    - Year Five: **In Progress**
5. At year five, the shoreline position (mean high water line) has not moved landward from its original position prior to construction of the breakwater.
    - **In Progress**
6. At year five, the marsh spatial extent is equal to or greater than one acre.
    - **In Progress** – currently at 0.79 acres

Figure 1. Location of the Cat Point Living Shoreline project in Franklin County, FL.

Monitoring Schedule:

The monitoring schedule is listed in Table 1. Because of large losses of saltmarsh cordgrass during the initial plantings, there is an offset in what is considered Year 0, Year 1, etc. For the breakwater construction and monitoring, Year 0 of monitoring began in 2020 when they were initially constructed. As such, 2020 is Year 0, 2021 is Year 1, and so on in that order. For the vegetation monitoring, Year 0 began in 2021 as almost all initial marsh plantings were gone. New planting began in 2021, so this is considered Year 0 for replanting areas (RPs) planted in 2021. However, half of the RPs were planted in 2022; therefore Year 0 for these RPs begins in 2022. Analysis of marsh plant data was analyzed in a manner account for these staggered planting dates to ensure the most accurate representation of overall plant growth and survival. Table 1 only shows the actual years that monitoring needs to be performed, however the initial planning for the project involved describing the timeframe as Year 0, Year 1, etc., so we have retained that schedule as well.

Table 1. Planned monitoring schedule for CPLS. *Performed prior to amendment of projects.

Monitoring Parameters	Monitoring Timeframe						
	Pre-Const. Monitoring	Const. Monitoring	Post-Construction Monitoring				
	2017	"As Built" Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025
Verifying amount of breakwater material placed		X*					
Verifying quantity of plants placed in marsh creation		X*					
Breakwater Height/Elevation and Area				X			X
Bivalve Composition, Density, Size Distribution			X	X	X	X	X
Infauna and Epifauna Composition, Density, and Biomass			X	X	X	X	X
Survival of Plantings		X*		X	X		
Vegetation Species Composition, Percent Cover, and Height		X*	X	X	X	X	X
Shoreline Position and Elevation	X			X			X
Marsh Spatial Extent/Complexity		X*		X			X
Water Quality			X	X	X	X	X

Pre-Construction Monitoring and Construction of Breakwaters:

<u>Pre-Construction Monitoring:</u>

Pre-construction monitoring was performed by Taylor Engineering Inc. in 2017. The monitoring included determining shoreline position and elevation, existing saltmarsh habitats, and zones for future saltmarsh restoration (Figures 2-6). The mean high-water line (MHWL) was determined to be 0.65ft as referenced to the North American Vertical Datum of 1988 (NAVD 88). Geospatial data of the shoreline position was given to CPAP in order to compare changes over time. The final plan for the breakwater construction is shown in Figure 7.

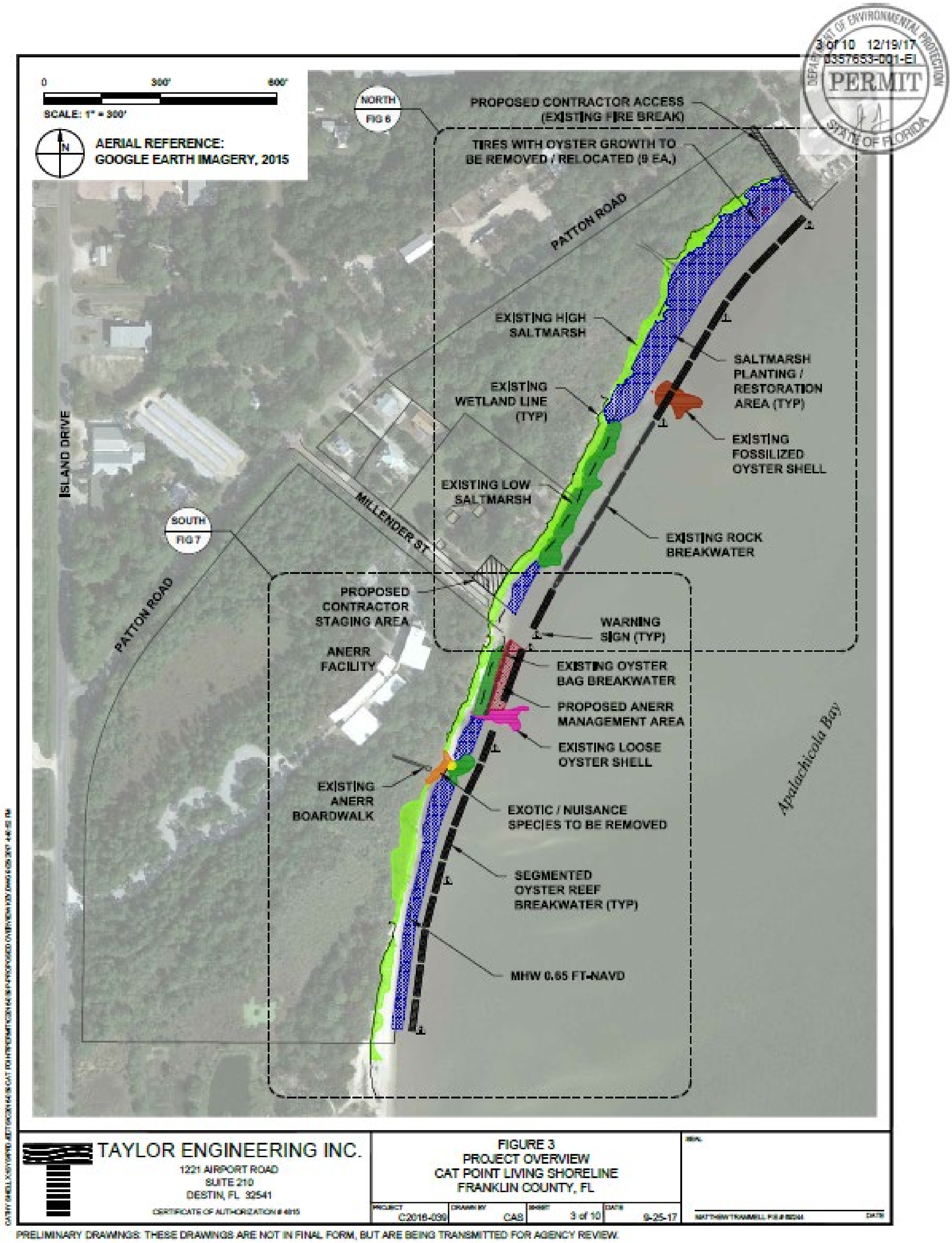


Figure 2. Overview of the pre-construction survey of the entire shoreline. Includes existing marsh areas, proposed areas for future marsh restoration, the mean high-water line, and proposed breakwater locations (Note: the two breakwaters surrounding the existing loose oyster shell were not constructed).

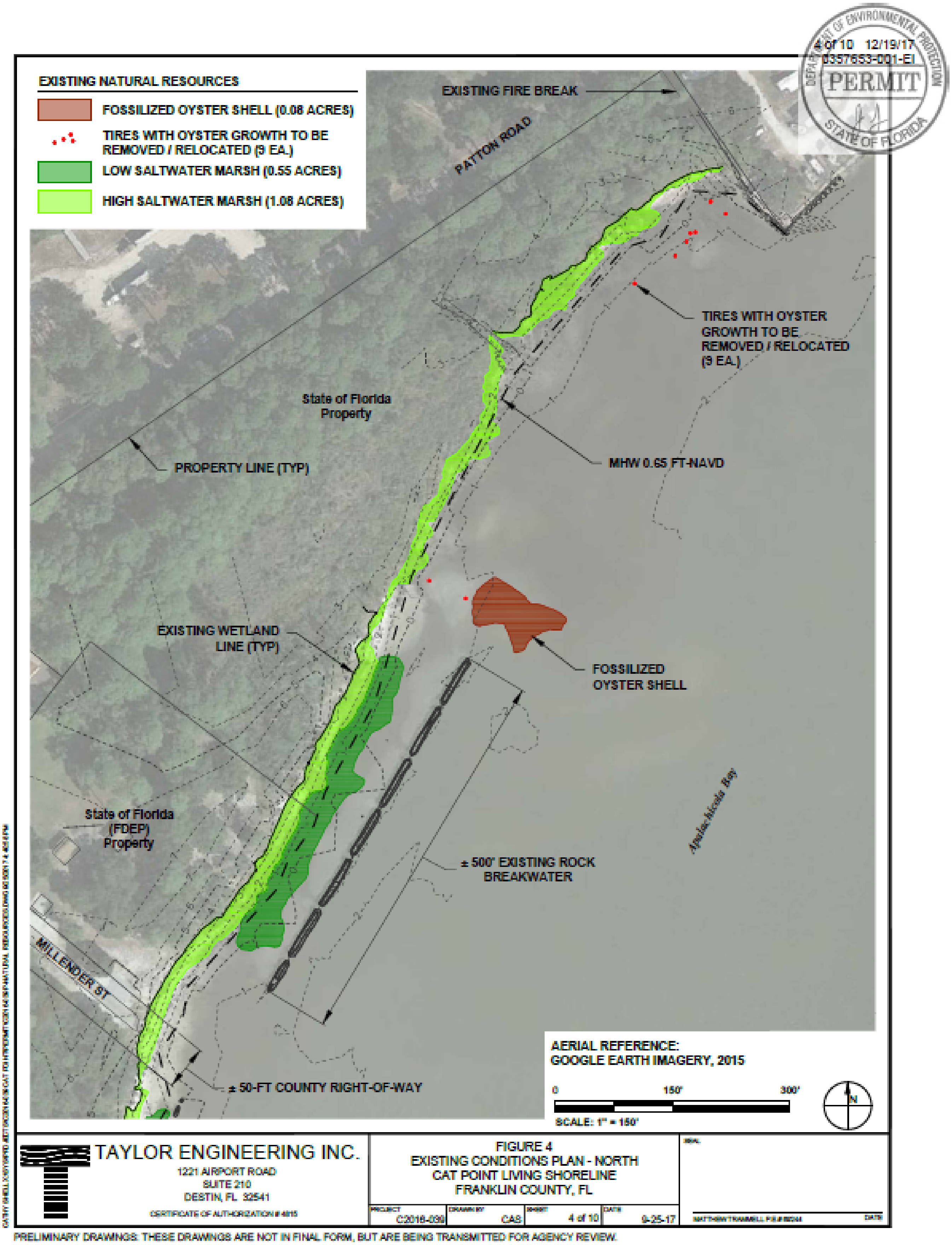


Figure 3. Overview of the pre-construction survey of the north end of the shoreline, including existing natural resources, elevations, and the mean high-water line.

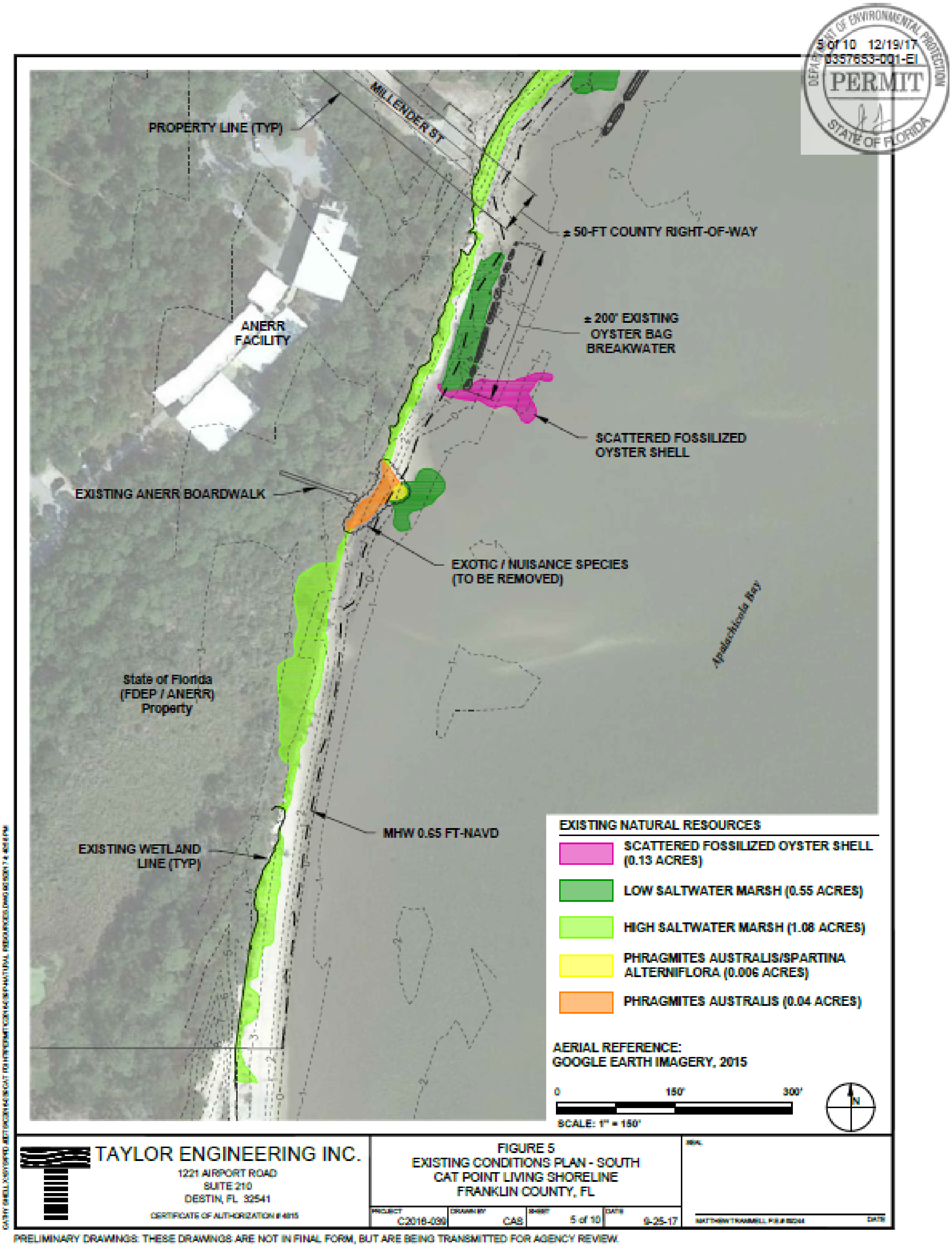


Figure 4. Overview of the pre-construction survey of the south end of the shoreline, including existing natural resources, elevations, and the mean high-water line.

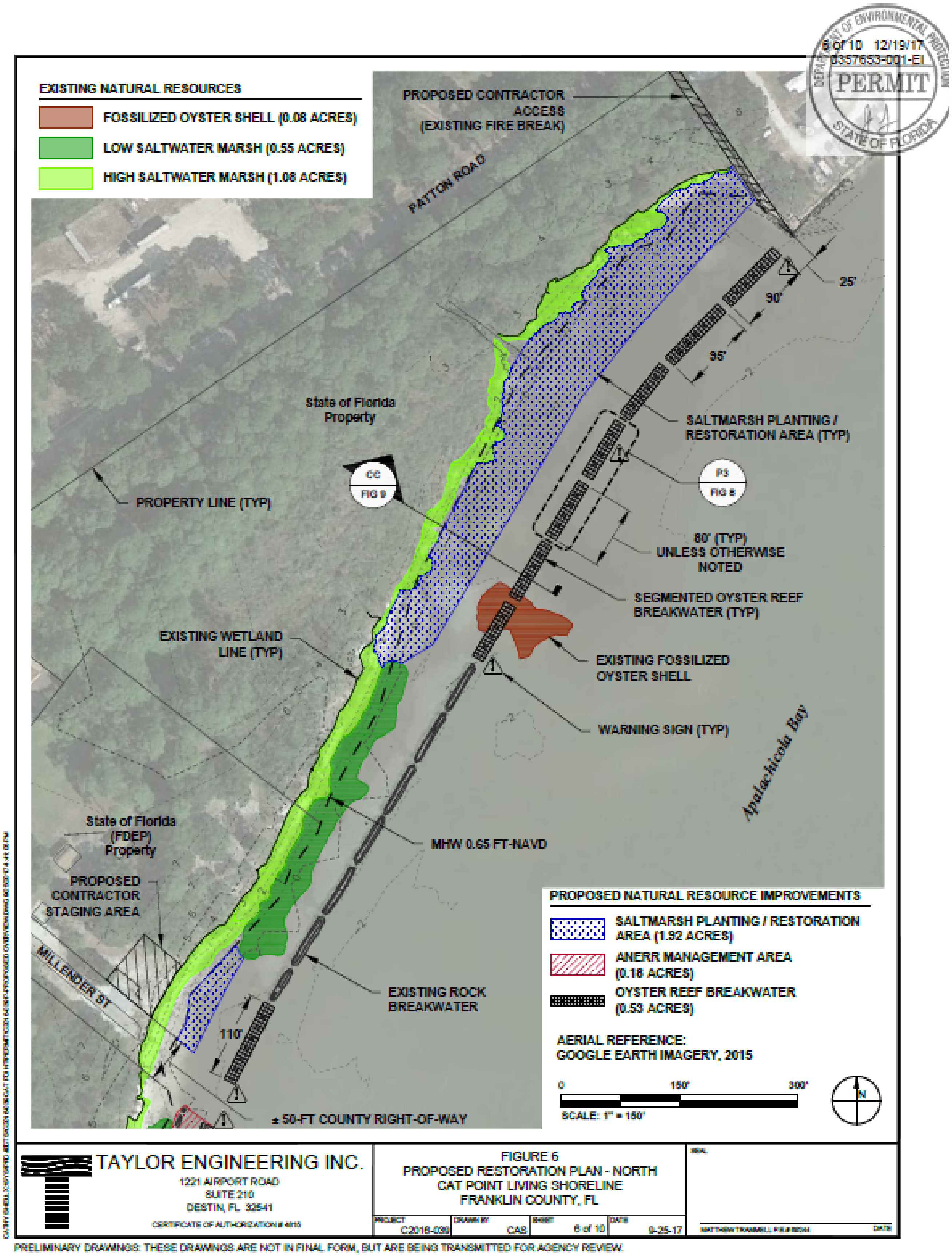


Figure 5. Overview of the pre-construction survey of the north end of the shoreline, including existing natural resources, elevations, proposed breakwaters, the mean high-water line, and proposed natural resource improvements.

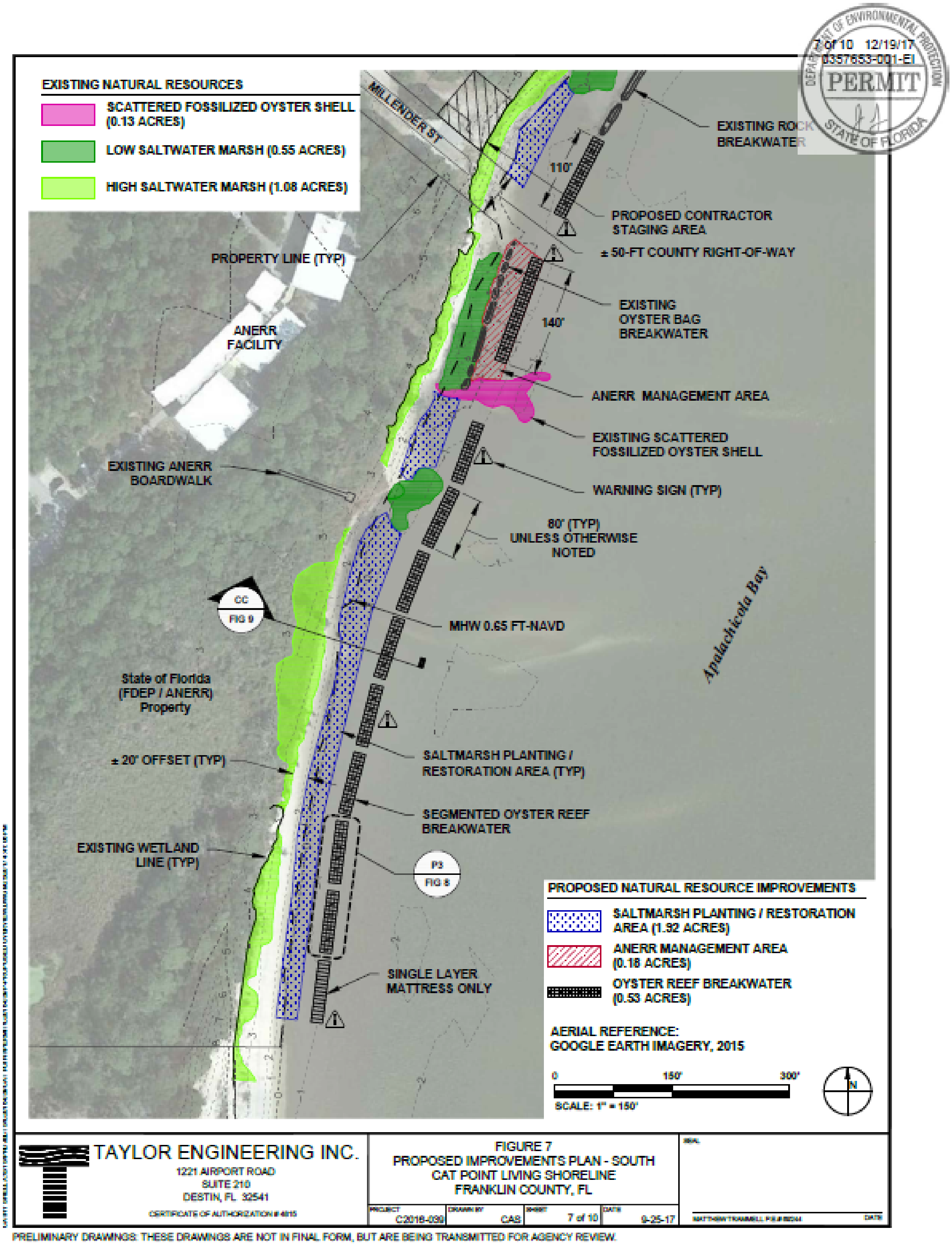


Figure 6. Overview of the pre-construction survey of the south end of the shoreline, including existing natural resources, elevations, proposed breakwaters (Note: the two breakwaters surrounding the existing scattered fossilized oyster shell were not constructed), the mean high-water line, and proposed natural resource improvements.

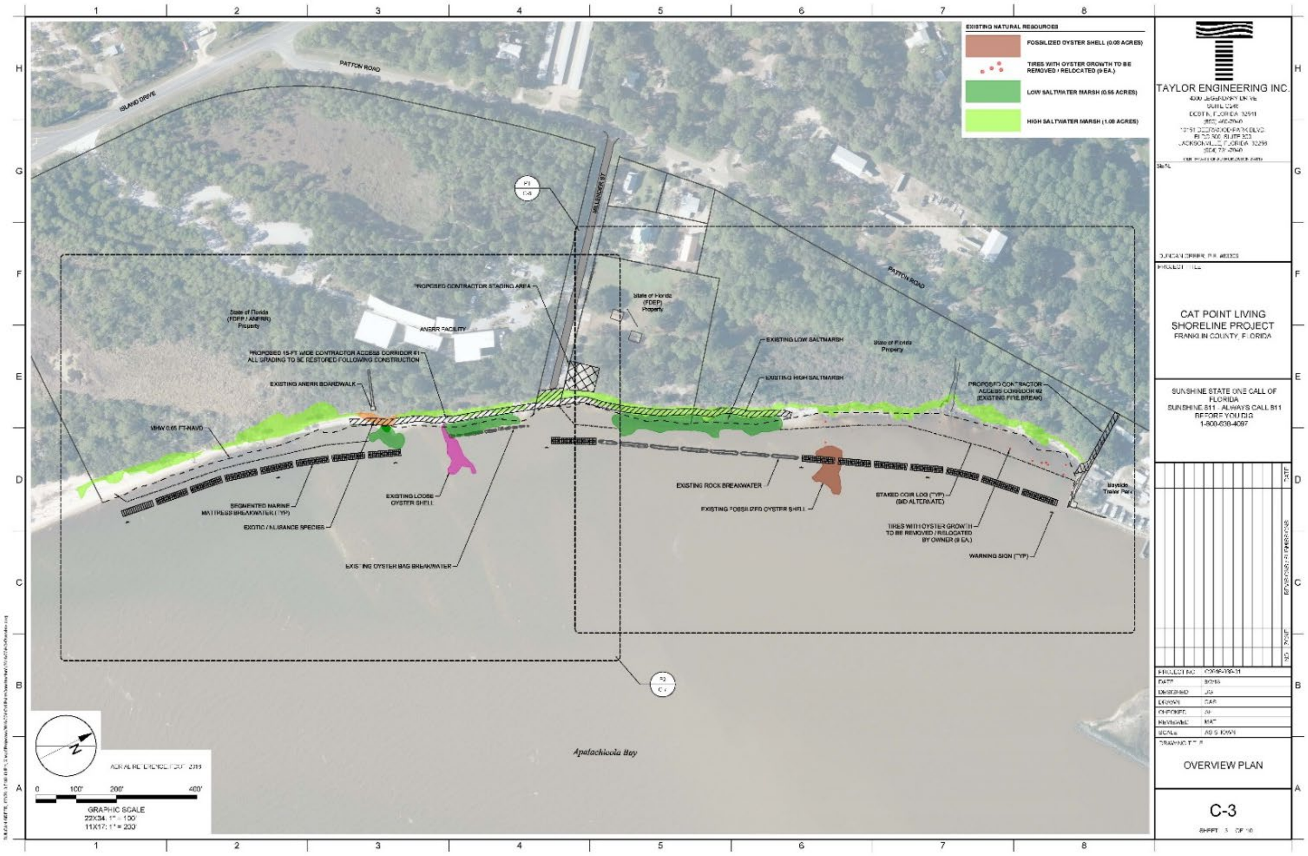


Figure 7. The final plan for the construction of the breakwaters

<u>Breakwater Construction:</u>

Breakwater construction began in October 2019 and was completed in March 2020. During the construction period, CPAP staff completed daily monitoring reports documenting conditions, construction staff, equipment present, work performed, and any possible environmental concerns (threatened/endangered species, spills, debris, turbidity monitoring, etc.). Sixteen breakwaters were constructed, encompassing an area of 0.43 acres. Originally, breakwaters were to be composed of two layers of marine mattresses that reached a height of two feet above the sediment. However, additional fill was needed in order to reach the desired height, so a middle layer of mattresses was added. These layers are composed of several marine mattresses placed next to one another. The bottom mattress layer is typically 80’ L x 14.9’ W x 0.79’ H, the middle is typically 74.5’ L x 6.5’ W x 0.625’ H, and the top is typically 72.4’ L x 4.9’ W x 0.833’ H. Each breakwater is 10 feet apart from the next as measured from the bottom layers. All three layers are filled with granite which is contained within a high-density polyethylene mesh (Figure 8).

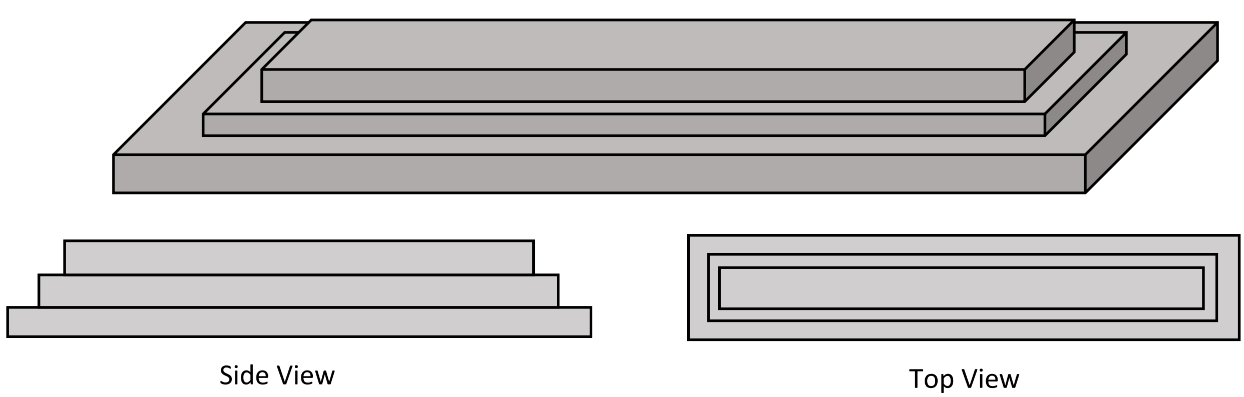


Figure 8. Diagrams of the breakwaters constructed on the living shoreline.

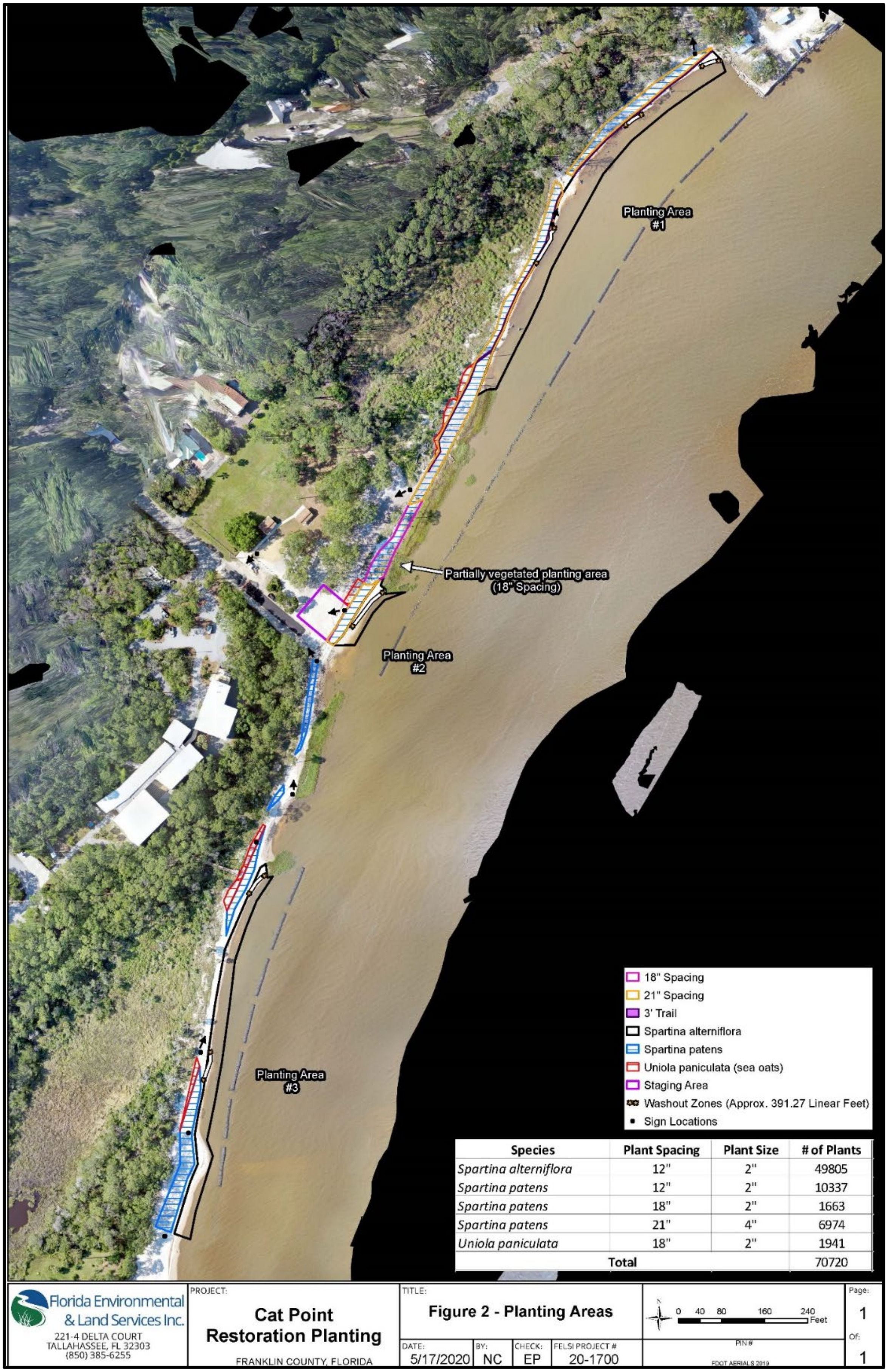
Marsh Plantings:

Initial 2020 planting:

The initial planting attempt to restore marsh vegetation along the shoreline took place in May 2020 and was performed by Florida Environmental and Land Services Inc. (FELSI). Three species were planted, including saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), and sea oats (*Uniola paniculata* – Table 2)**.** The plug size represents the size of the base of the square plug to be planted. A total of 1.87 acres, containing 71,748 individuals (they originally planned on planting 70,720 individuals) were planted. Individual plugs were planted with either 12, 18, or 21 inches of spacing (Figures 9 and 10).

Table 2. Initial planting in 2020.

Species	Number of Plants	Plug Size (inches)	Area (acres)
Spartina alterniflora	49,804	2”	1.29
Spartina patens	15,003	2”	0.35
Spartina patens	5,000	4”	0.13
Uniola paniculata	1,941	2”	0.1



Species	Plant Spacing	Plant Size	# of Plants
Spartina alterniflora	12"	2"	49805
Spartina patens	12"	2"	10337
Spartina patens	18"	2"	1663
Spartina patens	21"	4"	6974
Uniola paniculata	18"	2"	1941
Total			70720

Figure 9. Cat Point Living Shoreline original planting plan of 2020.

Polygon #	Area	Plant Species	Spacing	Number of Plants	Size of Plants
1	134	S.pat	9"	275	2"
2	133	S.alt	9"	273	2"
3	65	S.pat	14"	55	2"
4	372	S.alt	12"	430	2"
5	53	S.alt	12"	61	2"
6	1462	S.pat	12"	1688	4"
7	841	S.pat	16"	546	2"
7	2305	S.pat	16"	1497	4"
8	29935	S.alt	14"	25396	2"
9	240	S.alt	16"	156	2"
10	504	S.pat	8"	1309	2"
11	545	S.pat	14"	462	2"
12	141	S.pat	12"	120	4"
12	865	S.pat	14"	734	2"
13	1765	U.pan	20"	734	2"
14	420	S.alt	12"	485	2"
15	225	S.pat	12"	260	4"
15	4082	S.pat	14"	3463	2"
16	2001	S.pat	12"	2311	2"
17	878	U.pan	19"	404	2"
18	1621	S.alt	12"	1872	2"
19	3157	S.alt	12"	3645	2"
20	1446	S.pat	14"	1227	4"
21	272	S.pat	14"	231	2"
22	180	S.pat	12"	208	4"
22	873	S.pat	14"	741	2"
23	1156	S.pat	12"	1335	2"
24	544	S.pat	12"	628	2"
25	1266	U.pan	18"	650	2"
26	18270	S.alt	14"	15500	2"
27	1066	S.alt	14"	904	2"
28	298	U.pan	18"	153	2"
29	1910	S.pat	12"	2206	2"
30	396	S.alt	12"	457	2"
31	541	S.alt	12"	625	2"
32	1377	S.pat	18"	707	2"

Figure 10. Results of the initial Cat Point Living Shoreline planting in May 2020.

Wash-out Monitoring for 2020 Planting:

Monitoring of the initial planting efforts took place immediately after planting was completed. Daily monitoring and reporting were performed to observe any wash-out activity or die-offs. Evidence of plant wash-out was documented along the shoreline through September 2020. In total, 1,781 saltmarsh cordgrass plants and 1,366 saltmeadow cordgrass plants were documented as washouts. Many individual plants of both species were re-planted in an attempt to restore the planted areas. However, due to several storms (Tropical Storm Cristobal, Hurricane Marco, Hurricane Laura, and Hurricane Sally) and other persistent unfavorable conditions, most plants either died or washed away.

2021 and 2022 Plantings:

In response to a lack of success with previous planting methods, a new methodology was implemented where *Spartina alterniflora* individuals were planted in 0.25m² 'clumps'. The clumping configuration positively impacts survival and growth (stem density, biomass, expansion) of plantings, especially in higher physical-stress environments. This is likely because clumping provides both additional stability in situations of wave stress, and plantings adjacent to one another can alleviate anoxic stress by providing their neighbors with oxygen (Silliman et al. 2015). Additionally, plantings were performed earlier in the year to take advantage of low winter tides that allowed for better planting conditions and more time for plants to get established before storm season arrived.

Replanting areas (RPs) in 2021 were selected by determining areas most suitable for planting within the project footprint (adjacent to existing marsh, accreted sediments, low washouts, higher survival of original 2020 plantings). RPs in 2022 included areas that were suitable but not planted during 2021, as well as expanded on previously planted successful area. Areas that were prone to mortality the previous year were avoided, and areas with sediment accretion were favored.

Clumps of *Spartina alterniflora* were planted in rows with two meters between each clump. Rows were offset from one another, creating a one-meter diagonal spacing between clumps. The number of clumps in each RP varied and was determined based on the size of the area to be planted. Immediately before planting, meter-tape was laid out across the length of the area, parallel to the shoreline, and the locations of clumps were marked every 2 meters with flags. Shorter meter tapes were then used perpendicular to the shoreline to measure from the first rows to mark off columns, with 2 meters between each clump. The seaward extent of the planting area was determined by the seaward extent of adjacent existing marsh, or when the sediment became too soft for planting.

Each clump was installed in a 50cm x 50cm hole using hand labor, shovels, and 0.25m² quadrats for size reference. The depth of each planting hole was fixed so that the stem-root interface was positioned slightly below ambient grade, no more than four inches. Planting units were placed adjacent to one another within the hole, which was then closed around the units so that they remained erect after planting. Lastly, sediment was added to bring the 50cm x 50cm hole to ambient grade. Any remaining sediment was left seaward of the clump so that the rising tide could disperse it over the newly planted areas.

In 2021, in cooperation with the Conservation Corps of the Forgotten and Emerald Coasts, 25cm x 25cm pieces of *Spartina alterniflora* were harvested from the Duke Energy Mariculture Center donor marsh in Crystal River, FL, with roots and sediment intact to minimize transplant stress. During planting, about four of these 25cm x 25cm pieces were installed into each hole, with the addition of some individual plants to achieve a 0.25m² clump with a density equivalent to 16 four-inch plugs. Greenhouse-grown plants from the Northwest Florida Aquatic Preserves (NWFLAP) in four-inch pots were used for two of the 2021 plantings. These were planted by placing 16 or 25 (depending on the root density of the plugs) four-inch units adjacent to one another in each hole. In 2022, to retain sediment at the donor marsh and to maximize transport efficiency, plants were harvested in smaller units. Individual plants (or small clusters of plants) were cut and separated, and the sediment was gently removed to retain the root structure. During planting, approximately 36 of these smaller units were installed into each hole to create the 0.25m² clumps.

The results of the 2021 and 2022 plantings are listed in Table 3. Plants were received from different sources, including from the donor marsh at the Duke Energy Mariculture Center in Crystal River in partnership with the University of Florida's Institute of Food and Agricultural Services (UF/IFAS), local sources (salt marshes around Franklin County), and the Northwest Florida Aquatic Preserves. To date twelve different RPs have been planted. Eleven of these RPs were planted and are monitored by CPAP staff, and one area (RPC), has been set aside for ANERR's Education Department to conduct education programs with local school groups. RPC, also referred to as the 'Education Cove', is not protected by the newly constructed breakwater mattress scheme, and instead is shoreward of an existing rock breakwater structure. RPC is included in the total area of the project footprint but is excluded from subsequent monitoring and data collection efforts by CPAP. (Figure 11).

Table 3. Cat Point Living Shoreline planting information after replanting (2021-2022). *RPC is part of an area of planted marsh within the project footprint that is used by the ANERR education staff to teach students about marshes and living shorelines. Since 2010, fifth grade students have planted *S. alterniflora* each spring in this area. RPC contains the areas that were planted in 2021 and 2022 within the CPLS project timeline (no student planting occurred in 2020 due to COVID-19). The plants provided for education purposes have come from various sources.
**Area determined in April 2022.

Planting Area I.D.	Date Planted	Initial Area Covered (Acres)	Number of Plots	Estimated Total Plants	Source of Plants
RPB	1/28/2021	0.0824	117	1872	Duke Energy/UF IFAS
RPA	2/10/2021	0.0788	109	2725	Northwest AP
RPD	3/11/2021	0.0381	59	944	Duke Energy/UF IFAS
RPE	3/11/2021	0.0415	64	1024	Duke Energy/UF IFAS
RPF	2/24/2021	0.0674	101	1616	Duke Energy/UF IFAS
RPJ	4/07/2021	0.03	42	861	Local/Northwest AP
RPK	1/19/2022	0.0768	91	3276	Duke Energy/UF IFAS
RPL	2/3/2022	0.033	44	1584	Duke Energy/UF IFAS
RPA Addition	2/3/2022	-	3	108	Duke Energy/UF IFAS
RPD Addition	2/3/2022	-	4	144	Duke Energy/UF IFAS
RPH	3/2/2022	0.02	22	792	Duke Energy/UF IFAS
RPI	3/2/2022	0.035	40	1440	Duke Energy/UF IFAS
RPJ Addition	3/2/2022	-	14	504	Duke Energy/UF IFAS
RPE Addition	3/2/2022	-	25	900	Duke Energy/UF IFAS
RPL Addition	3/3/2022	-	5	180	Duke Energy/UF IFAS
RPG	4/1/2022	0.0354	47	1692	Duke Energy/UF IFAS
RPL Addition	4/1/2022	-	15	540	Duke Energy/UF IFAS
RPD Addition	4/1/2022	-	16	576	Duke Energy/UF IFAS
RPA Addition	4/1/2022	-	11	396	Duke Energy/UF IFAS
RPC*	04/2021; 2022	0.0162**	-	560	-
S. patens	2020	0.0479**	-	-	Earth Balance – Native Nursery
U. paniculata	2020	0.0154**	-	-	Aquatic Plants of Florida

Figure 11. The Cat Point Living Shoreline as of April 2022. The second round of planting areas (2021 and 2022), surviving high marsh plantings from 2020 (*S. patens* and *U. paniculata*), constructed breakwaters, MHWL, old rock breakwater structures, and the water quality sampling site are included.

Post Construction Monitoring of Breakwaters

Objective 1, Parameter 1: Reef height/elevation (m) and area (m^2):

Methods:

Reef height measuring methods were adopted from Dix and Marcum (2018). Reef height is measured from the crest of the reef to the sediment at three locations along each breakwater, at the north/northeast end, middle, and south/southwest end. A string with a level is stretched from the crest of the breakwater to a leveling rod that is placed on the surface of the sediment on the seaward side of the breakwater. The height from the sediment to the string is then measured. These measurements are averaged to obtain the average height of each breakwater. The seaward side was selected for standard breaktwater measurement because sediment is accreting on the landward side, creating a reduction in the height of exposed breakwater on this side.

Reef area has not been determined yet and will not be until lower winter tides are present. The area will be measured by walking the perimeter of the reefs using the Trimble® Geo7x sub-meter GPS unit.

Results:

Initially, the reef was designed to be two feet (0.61m) in height, but post-construction the typical reef height was 2.3 feet (0.69m). The reef covered an initial area of 0.43 acres (1740.2m^2). Reef height was re-measured in June 2022. All standard breakwaters had an average height at or above the original height of 0.69 meters. The only exception was breakwater 7, which averaged 0.65m in height, 4cm short of the original typical height. This is not considered a significant decrease in breakwater height and can be attributed to variations or inaccuracies in measurements. Average heights are found in Table 4. Reef area has not been measured at this point.

Table 4. The average heights of each breakwater as of June 2022. *Breakwater 16 is composed of only the bottom mattress layer and requires much lower tides to be exposed. This height was measured in August of 2022.

Breakwater Number	Average Height (meters)
1	0.70
2	0.72
3	0.73
4	0.72
5	0.70
6	0.69
7	0.65
8	0.75
9	0.74
10	0.75
11	0.78
12	0.70
13	0.75
14	0.71
15	0.72
16*	0.35*

Objective 1, Parameter 2: Bivalve species composition, density (bivalves/m^2), and size distribution (mm):

Methods:

Monitoring was performed according to the methods outlined in Baggett et al. (2014). Bivalve composition of the breakwaters was monitored during December 2021 (Year 1) and December 2022 (Year 2). Quadrats (0.25m^2) were placed along three transects on each breakwater, at the east end, middle, and west end. On each of these transects, a quadrat was placed on the landward side, crest, and seaward side (Figure 12). This was done across 16 breakwaters, resulting in 144 measured quadrats for a total area of 36m^2. In each quadrat, the number of oysters was counted, using visual approximation to divide them into size classes (Adults: ≥75mm; Seed: 26-74mm; Spat: ≤25mm), and the percent coverage of oysters was estimated. The only bivalve species observed were the eastern oyster (*Crassostrea virginica*) and Atlantic ribbed mussel (*Geukensia demissa*).

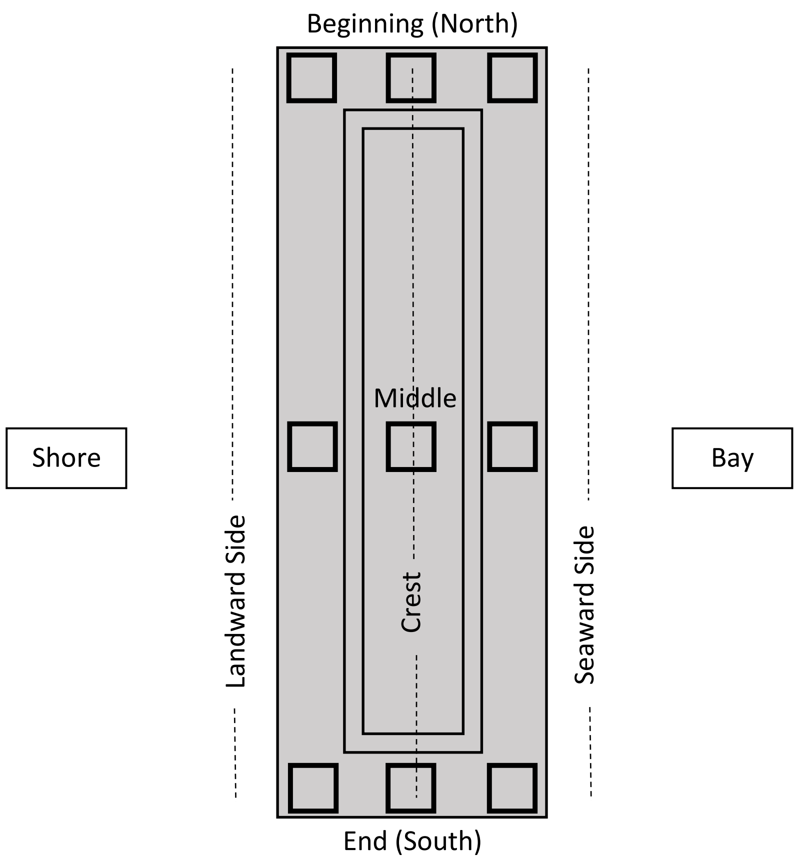


Figure 12. Diagram of transects and quadrat locations during bivalve composition monitoring of the breakwaters. Small squares represent the placements of each quadrat along the breakwater.

Results:

Year 2 of bivalve monitoring on the breakwater structures took place in December of 2022. During this time, 8560 live oysters and 3324 dead oysters were counted; the live oyster count was comprised of 695 adults, 3232 seed oysters, and 4633 spat. Graphical representation of oysters per breakwater can be found in Figure 13. This differs from the previous year's monitoring values, with a total of 14727 live oysters and 887 dead oysters documented in 2021.

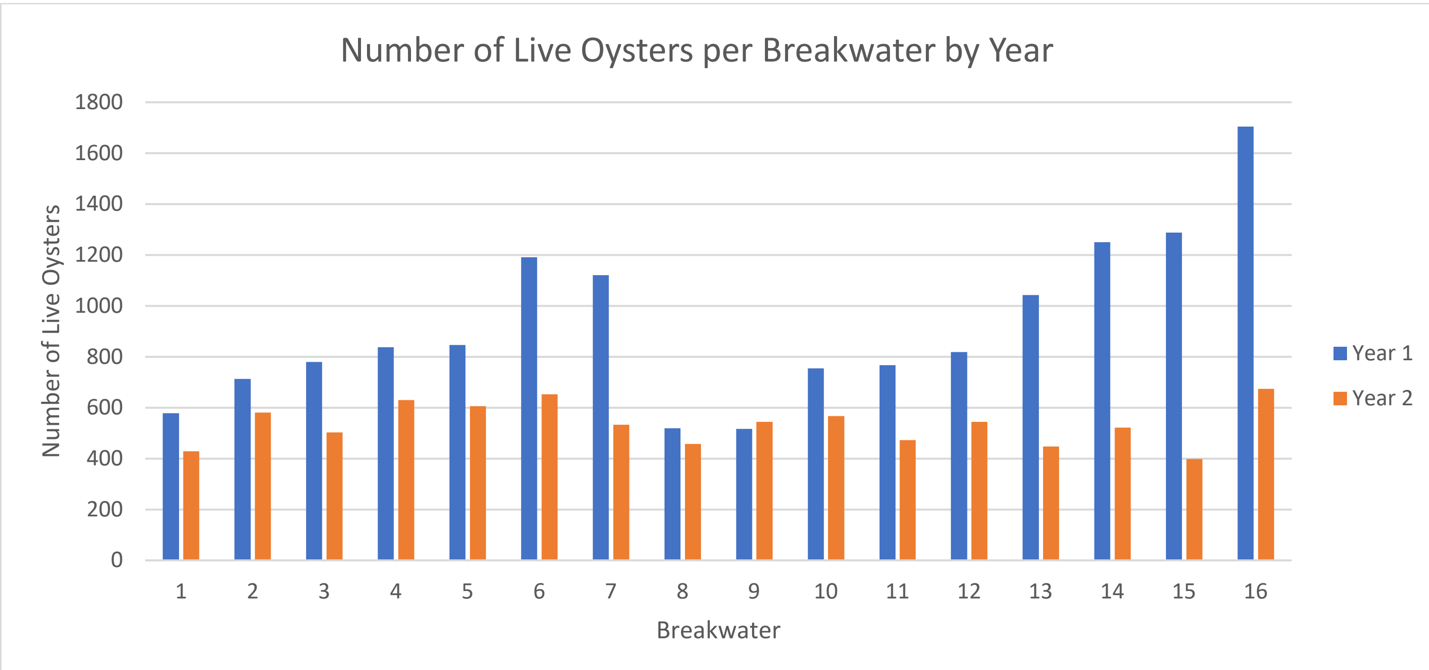


Figure 13. The sum of all live oysters counted on each breakwater by year.

The overall density of all live oysters counted along the breakwaters was 237.78 live oysters/m^2. The density of each size class across all the quadrats was also calculated (Figure 14). The highest density size class was again spat (128.69 live oysters/m^2), although less than the previous year 270.58 live oysters/m^2. As expected, the lowest density was observed in adult oysters, at 19.31 live oysters/m^2. This is an increase from the number of live adult oysters sampled in 2021 (5.1 live oysters/m^2). In Year 1, 887 dead oysters were observed. This value increased in Year 2 to 3324 dead oysters. Number of dead oysters observed by breakwater can be seen in Figure 15. Densities were calculated for the different quadrat locations along the length of breakwater structure (Figure 16), as well as for the different quadrat placements on the profile of the breakwater (Figure 17).

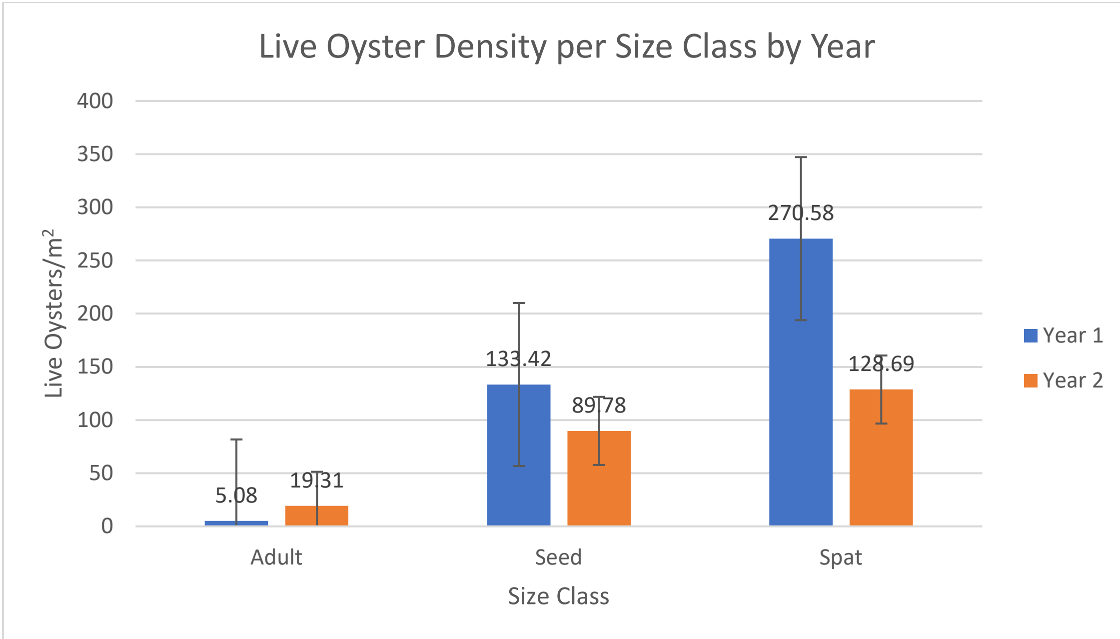


Figure 14. Density of oysters across all breakwaters per size class by year. Error bars represent standard error.

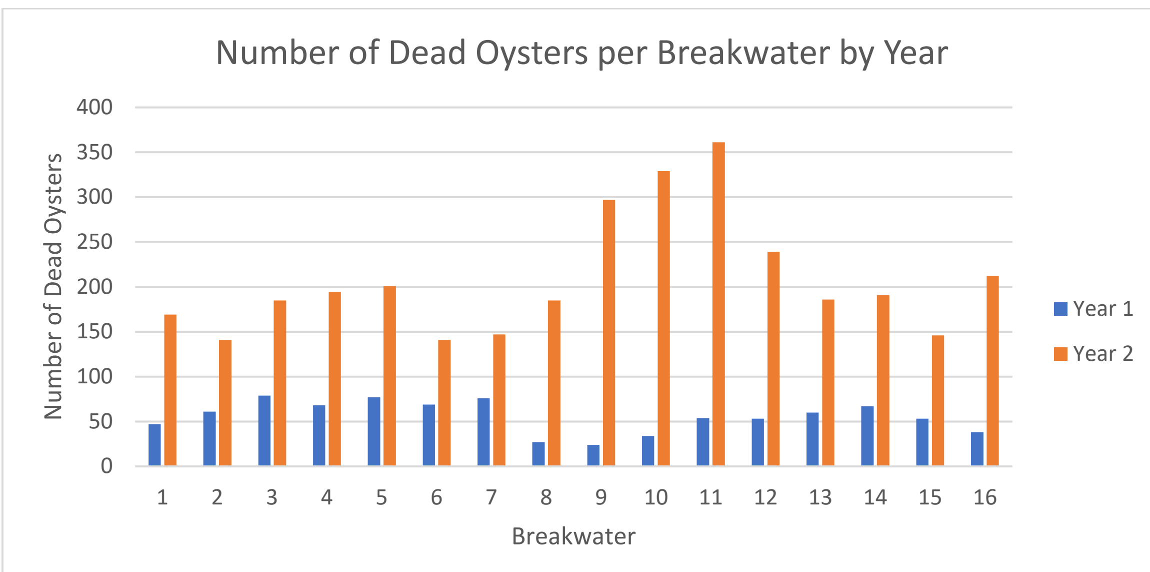


Figure 15. Number of dead oysters per breakwater by year.

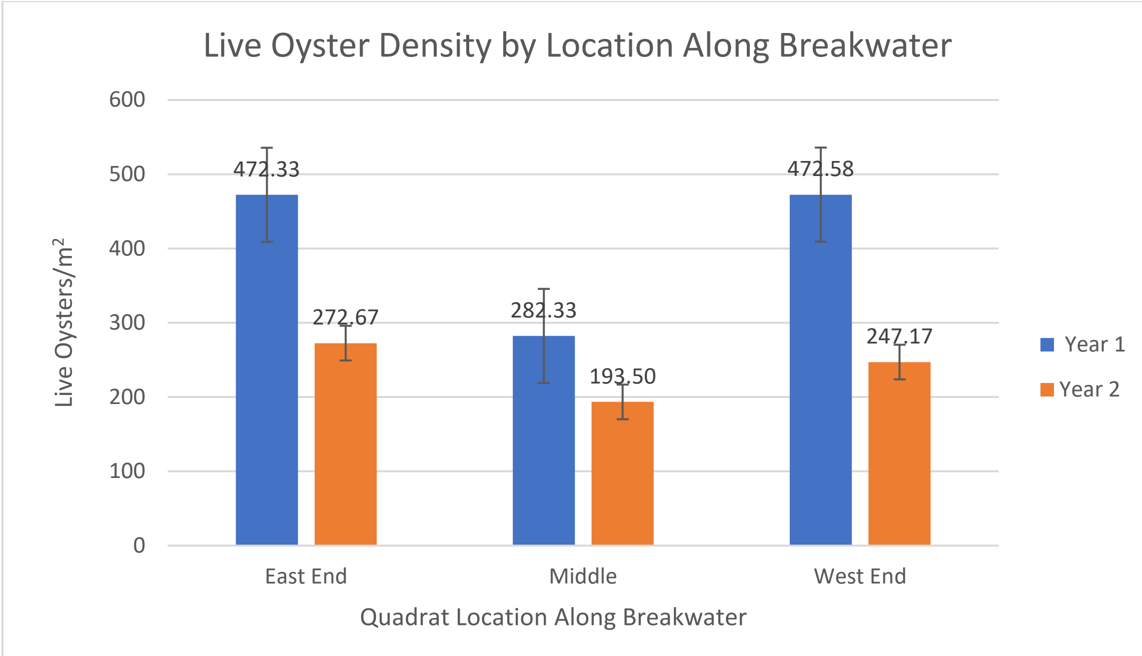


Figure 16. Density of live oysters based on quadrat locations on all breakwaters. Error bars represent standard error.

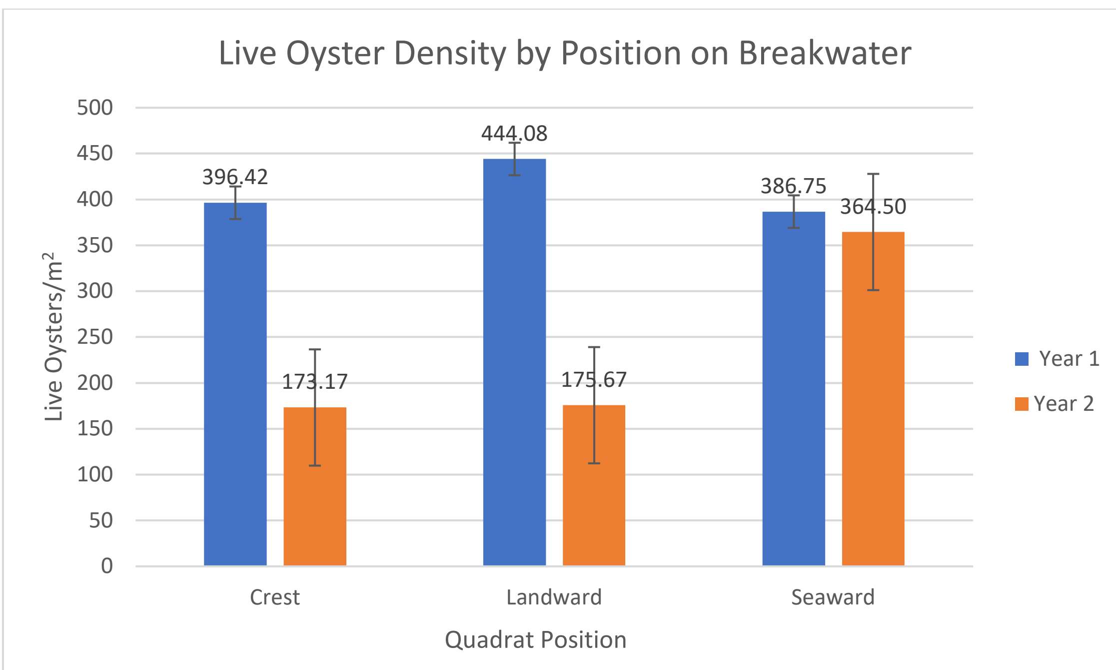


Figure 17. Density of live oysters by quadrat position on profile of all breakwaters. Error bars represent standard error.

The estimated percent coverage of live oysters across all breakwaters in Year 2 was 38.73%, a decrease from the overall estimated coverage of 56.30% in Year 1. Estimated percent cover of bivalves per breakwater is represented in Figure 18. The highest estimated percent coverage in Year 2 was Breakwater 6, with approximately 51.56% coverage. This breakwater also had one of the higher estimated values in Year 1 (70.00%). The lowest estimated percent coverage in Year 2 occurred at Breakwater 12, at 23.67% estimated bivalve coverage.

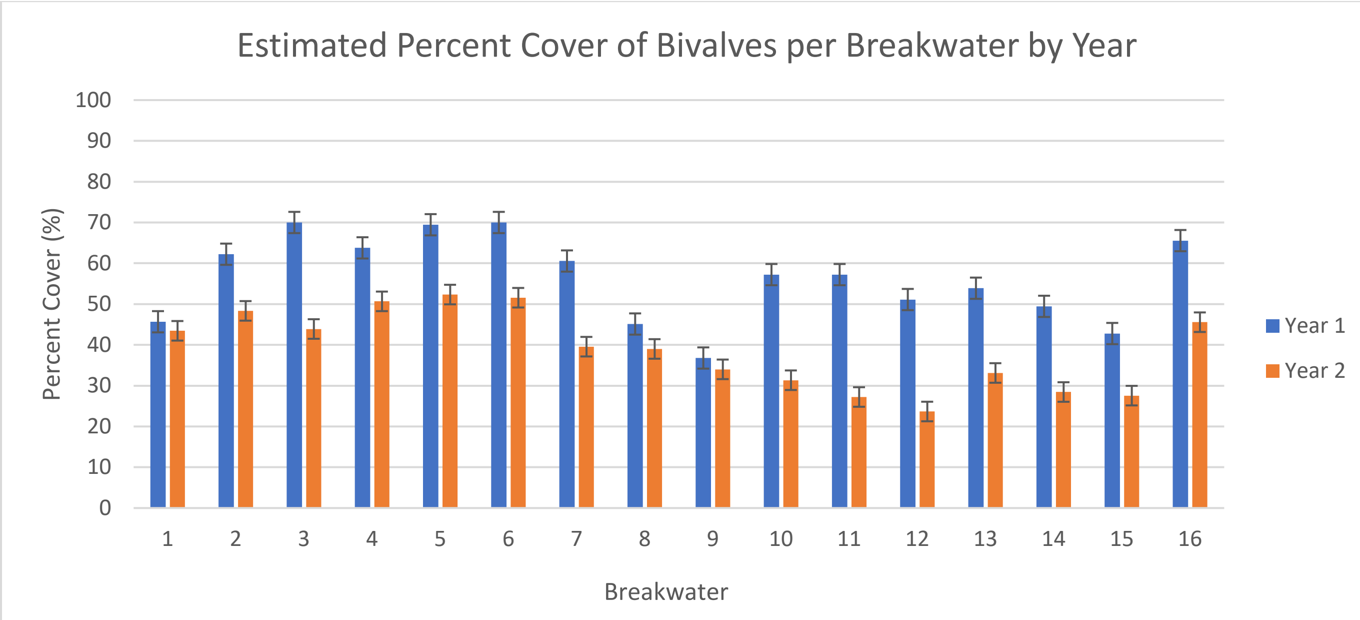


Figure 18. Average percent coverage of bivalves for each breakwater. Error bars represent the standard error.

Discussion:

It should be noted that this parameter is estimated via visual observation, as exact measurement of bivalves in the mattress structures is not feasible without destructive removal. Variations in visual approximations and counts can occur between observers.

In both years of observation, density of live oysters was highest on the ends of the breakwaters, with lowest live oyster density found along the middle transects. This is to be expected, as the ends of the breakwater systems have more surface area exposed to water flow, and therefore opportunities for larval settlement as well as nutrient sources. A notable decrease in live oyster density on the landward side of the breakwaters was observed from Year 1 to Year 2. Due to sediment accumulation on the landward side of the breakwater system, suitable structure for spat settlement has been covered on some of the breakwaters. Although this reduces the available area for live oyster settlement, it represents efficient sediment retention by the breakwater structures. The crest position had the lowest density of live oysters in Year 1 (173.17 live oyster/m^2). The crest position also had the highest number of dead oysters observed in both years. The crest of the breakwater structures, mimicking that of a natural intertidal reef, regularly transitions between submerged and exposed states. Opportunity for spat settlement is reduced on the crest when compared to the landward and seaward portions of the breakwater that are more frequently submerged. As the crest is of a higher elevation and is regularly exposed, any oysters that does settle on the crest will be subjected to harsher surivival conditions. Anecdotally, a number of birds that prey on bivalves have been observed utilizing the breakwater structures for hunting and foraging. The oysters on the crest of the mattress structures are more regularly subjected to predation events by non-aquatic predators. They are also more prone to dessication, overheating, and lack of sufficient food availability due to regular exposure.

<u>Objective 1, Parameter 3: Epifauna species composition, density (individuals/m^2), and biomass (g wet weight/m^2)</u>

Methods:

Epifauna species monitoring on the artificial breakwaters was performed according to the methods outlined in Baggett et al. (2014). To determine the epifauna species composition of the breakwaters, sediment trays consisting of 26.5"x 22" high-density polyethylene bread trays were deployed on each breakwater. The trays were lined with 2mm mesh and filled with 10kg of granite (same material used inside breakwater mattresses) and 5kg of oyster shell for a total substrate weight of 15kg. Each breakwater had one tray deployed at a random location on the landward side for a total of 16 sediment trays (240kg of fill material). Placement alternated between the base and the crest of the breakwaters. Sediment trays were deployed on October 14, 2022, and retrieved November 16&17, 2022 for Year 2 sampling. All substrate material was removed and weighed, and all organisms that were present were collected for future identification (Table 6).

All organisms collected were frozen to preserve them. Samples were later stored in formalin for three days and then transferred to 70% ethanol to better preserve the organisms. Individuals were viewed under a microscope, identified to the lowest possible taxon, and measured. Measurements were determined based on standard practices for specific taxa. (Table 6).

Results:

A total of 236.36kg of substrate was removed, 3.64kg less than was deployed. More than half of the sediment baskets showed a net loss of weight at time of retrieval. This decrease in weight can be attributed to a multitude of variables, including but not limited to: measurement error (human and/or equipment), loss of material due to natural processes such as wave action, and differences in deployment and retrieval techniques from the previous round. Results of the retrieval can be found in Table 6.

Table 5. Sediment tray deployment/retrieval data. Location along breakwater was measured starting from the eastern end. *The tray at Breakwater 16 will always be positioned at the base, as this breakwater does not have a crest.

Breakwater	Tray Location Along Breakwater (m)	Tray Position	Deployment Weight (kg)	Retrieval Weight (kg)	Wet Weight of Species Collected (g)
1	14	Base	15	15.18	20.76
2	2	Crest	15	14.7	8.75
3	18	Base	15	14.45	10.57
4	13	Base	15	14.57	23.83
5	11	Crest	15	14.27	8.50
6	17	Base	15	14.66	36.54
7	15	Base	15	14.14	10.10
8	21	Base	15	14.81	13.15
9	5	Crest	15	15.27	15.36
10	13	Base	15	15.39	12.10
11	17	Crest	15	14.26	2.62
12	8	Crest	15	14.88	19.62
13	12	Base	15	14.99	10.77
14	10	Crest	15	14.39	15.58
15	8	Crest	15	15.07	7.98
16*	9	Base	15	15.33	7.30

The preserved specimens were identified in Spring 2023. Measurements and the sexes of the individuals identified can be found in Appendix A, Table 10. The species found and the total number collected across all breakwater sediment trays can be found in Table 7. Approximately 20 different species were found in the sediment trays with 817 individuals, and a total wet weight of 223.54 grams. The average density between all sediment baskets collected was 135.76 individuals/m^2. The average biomass across all sediment baskets collected was 37.15 grams wet weight/m^2. Although wet weight and biomass remained relatively constant between both years, the density of live organisms (per m^2) more than doubled from Year 1 to Year 2. A comparison of density and biomass from both years of sampling can be found in Figures 19 and 20. There were several individuals that could not be identified down to species level, typically due to either missing or damaged identifying features. These individuals could be the same species as others that were identified, but it is possible that they could be additional species inhabiting the breakwaters.

Table 6. The organisms and how many were collected from the sediment trays. Some organisms could not be identified to the species because of damage to the individual, but all organisms collected were identified to the lowest possible taxon.

Grouping	Organism (lowest taxon possible)	Common Name	Total Number Collected
Crabs			
	Callinectes sapidus	Blue Crab	15
	Clibanarius vittatus	Thinstripe Hermit Crab	2
	Eurypanopeus depressus	Flatback Mud Crab	327
	Panopeus herbstii	Atlantic Mud Crab	44
	Petrolisthes armatus	Green Porcelain Crab	1
Shrimp			
	Alpheus estuariensis	Estuarine Snapping Shrimp	1
	Alpheus spp.	Unknown Snapping Shrimp	1
	Palaemon floridanus	Florida Grass Shrimp	3
	Palaemonetes spp.	Unknown Grass Shrimp	8
	Palaemonetes intermedius	Brackish Grass Shrimp	125
	Palaemonetes pugio	Daggerblade Grass Shrimp	153
Amphipods			
	Amphipoda (order)		2
Fishes			
	Gobiosoma bosc	Naked Goby	9
	Gobiesox strumosus	Skilletfish	1
	Bathygobius soporator	Frillfin Goby	1
	Symphurus plagiusa	Blackcheek Tonguefish	1
Mollusks	*Melongena corona*	Florida Crown Conch	1
Worms			
	Polychaeta (class)	Bristle worms/Polychaetes	8
Total:			**817 Individuals**

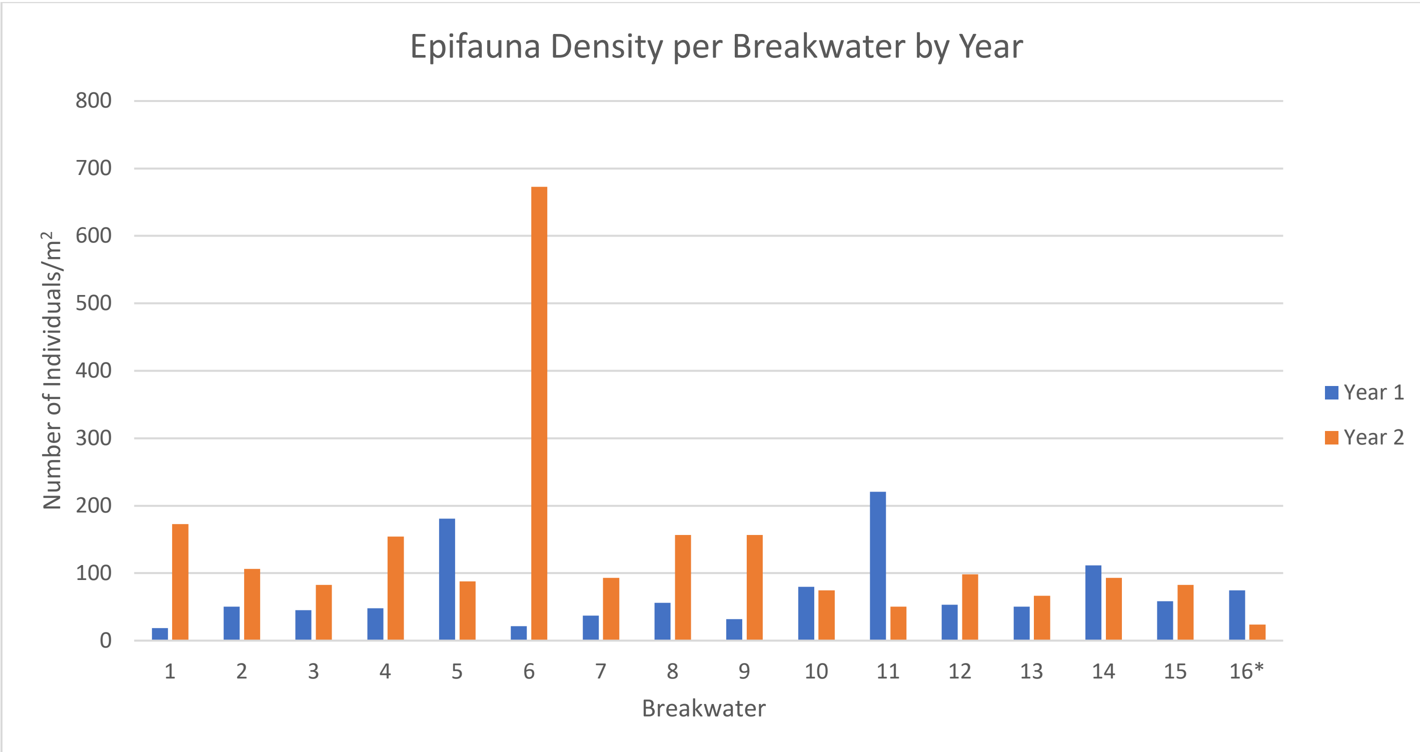


Figure 19. Epifauna density observed in the sediment trays per breakwater by year.

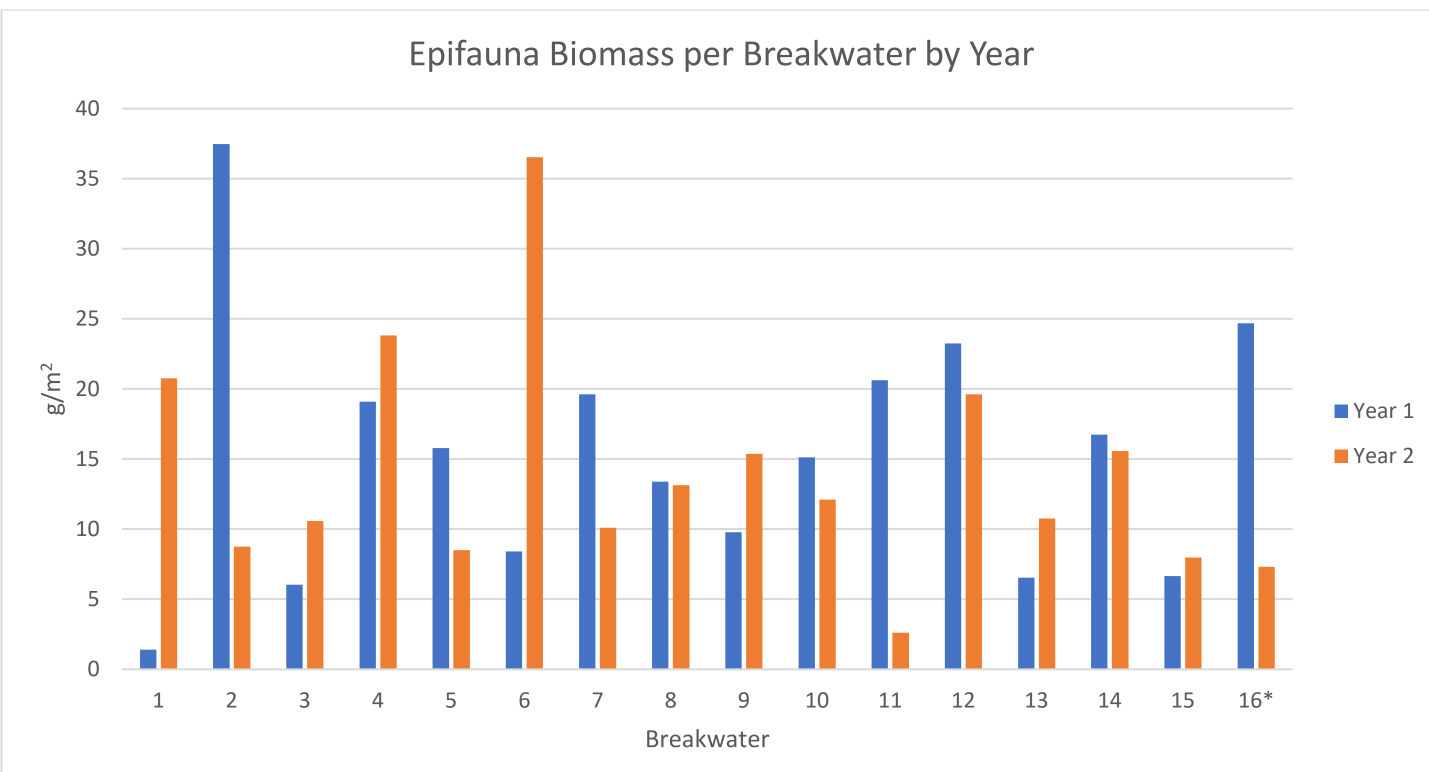


Figure 20. Epifauna biomass observed in the sediment trays per breakwater by year.

Discussion:

The most numerous organisms observed in Year 2 were the flatback mud crab (*Eurypanopeus depressus*) followed by the daggerblade grass shrimp (*Palaemonetes pugio*), comprising 58.75% of all individuals identified. Collectively, the crustaceans (shrimp, crabs, amphipods) comprised 97.43% of all individuals identified in the sediment trays in Year 2. The next most abundant taxon was the fishes, at 1.47% of the total individuals identified, followed by polychaete worms (0.98%), and mollusks (0.12%). Crustaceans are common, lower-level omnivores in estuarine food webs, feeding on sources of detritus and planktonic organisms. They also provide vital food sources for larger consumers, such as the various fishes and larger invertebrates that utilize intertidal habitats. As all of the species collected from the breakwaters are common, abundant benthic inhabitants of the Apalachicola Bay system, these data are consistent with the expected composition of a local intertidal system. Continued monitoring will allow for comparison between the artificial breakwater structures of the living shoreline project and the natural systems of Apalachicola Bay for efficacy in providing intertidal habitat. Species identification error by staff is possible, as many of these species are similar in appearance.

Vegetation Monitoring

Methods:

To date, vegetation monitoring has been performed at all RPs at approximately six months and at one year after the initial planting dates. For areas that were initially planted in 2021, the two-year annual monitoring has also been completed. (Table 8). Monitoring transects are located perpendicular to the shoreline and vary in length, depending on the size and shape of each planting area. Each transect was randomly generated within the planting area, and a sufficient number of transects were selected in each RP to ensure that a minimum of 10% of all planted clumps were included. (Figure 21). Starting from the seaward edge, a 1m^2 quadrat was flipped end to end along the length of the transect, and within each quadrat, percent cover and height were recorded. Percent cover was determined within each 1m^2 quadrat surveyed, and height was determined by measuring the height of ten 'haphazardly' selected stems within each quadrat. The percent original coverage was determined by estimating the coverage of any remaining plants from the original planted clump. Within that same area, the number of living plants was calculated and the percent survival was estimated from this evaluation. This process was repeated at Year 1 for all RPs. Future monitoring of plant height and total percent cover will be conducted annually through the culmination of the project.

Table 7. Monitoring dates for the planting areas (RPs). RPs denoted by a '°' represent areas whose plants were sourced from the Northwest Florida Aquatic Preserves (NWAP). These plants were grown in a greenhouse setting and fertilized. RPs denoted by a '*' represent RPs that had additional transects added later in the monitoring process. RPE had an additional transect planted approximately a year after initial planting date, and data was analyzed accordingly. RPF had additional transects added for more robust data, as initial transects overrepresented an area of die off in the RP.

Planting Area	Planting Date	6 Month	Year 1	Year 2
RPA°	2/10/2021	10/11/2021	2/15/2022	2/17/2023
RPB	1/28/2021	7/19/2021	2/15/2022	1/24/2023
RPD	3/11/2021	11/4/2021	3/3/2022	3/29/2023
RPE*	3/11/2021	11/4/2021	3/3/2022	3/29/2023
RPF*	2/24/2021	10/11/2021	2/15/2022	2/22/2023
RPG	4/3/2022	9/27/2022	4/3/2023	-
RPH	3/2/2022	9/14/2022	3/8/2023	-
RPI	3/2/2022	9/14/2022	3/8/2023	-
RPJ°	4/7/2021	11/1/2021	4/8/2022	4/3/2023
RPK	1/19/2022	8/16/2022	1/20/2023	-
RPL	2/3/2022	8/16/2022	2/16/2023	-

Figure 21. Vegetation monitoring transects over all planting areas (RPs) of Cat Point.

Objective 2, Parameter 1: Survival of Plantings:

Results:

The estimated survival of original plants after one year is 69.98%, which is 10.02% shy of the objective of 80% survival. (Figure 22)

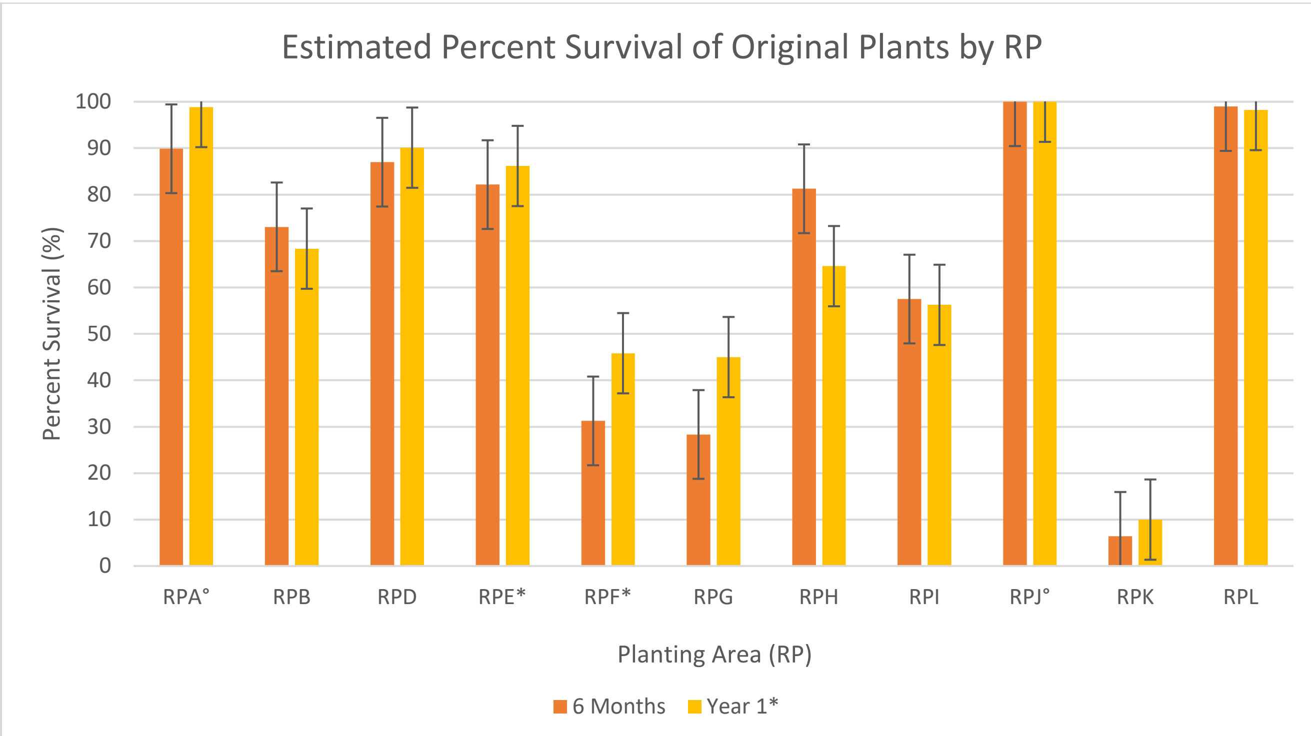


Figure 22. Average survival plantings after the first growing season, separated by planting area. Error bars represent the standard error. *RPE Year 1 data includes transects planted in 2021 as well as one planted in 2022. RPF Year 1 data included two additional transects to be more representative of the entire RP. °RPs A and J were planted using plants provided by NWAP's greenhouse. All other plants were sourced from Duke's Mariculture Center donor marsh.

Objective 2, Parameter 2: Vegetation species composition, percent cover, and height:

Results:

The estimated percent cover of each original planted area is shown in Figure 24. The estimated percent cover of original planted cover across all planting areas is 69.91%, 10.09% less than the goal of 80% at Year 1. The 5-year goal for this parameter is to reach 75% coverage within the project area. At 6 months, total project area coverage was approximately 19.70% and at one year, it had increased to 33.91%, showing a general trend of expansion since the initial plantings. Of the RPs that have been monitored for Year 2 thus far, current coverage of the planted project area is 75.28%. This is expected to change as RPs planted in 2022 are eventually included in the data, but a general trend of expansion has been observed across the project footprint. (Appendix B). All planting areas have shown an increase in estimated percent cover since the original planting (Figure 25).

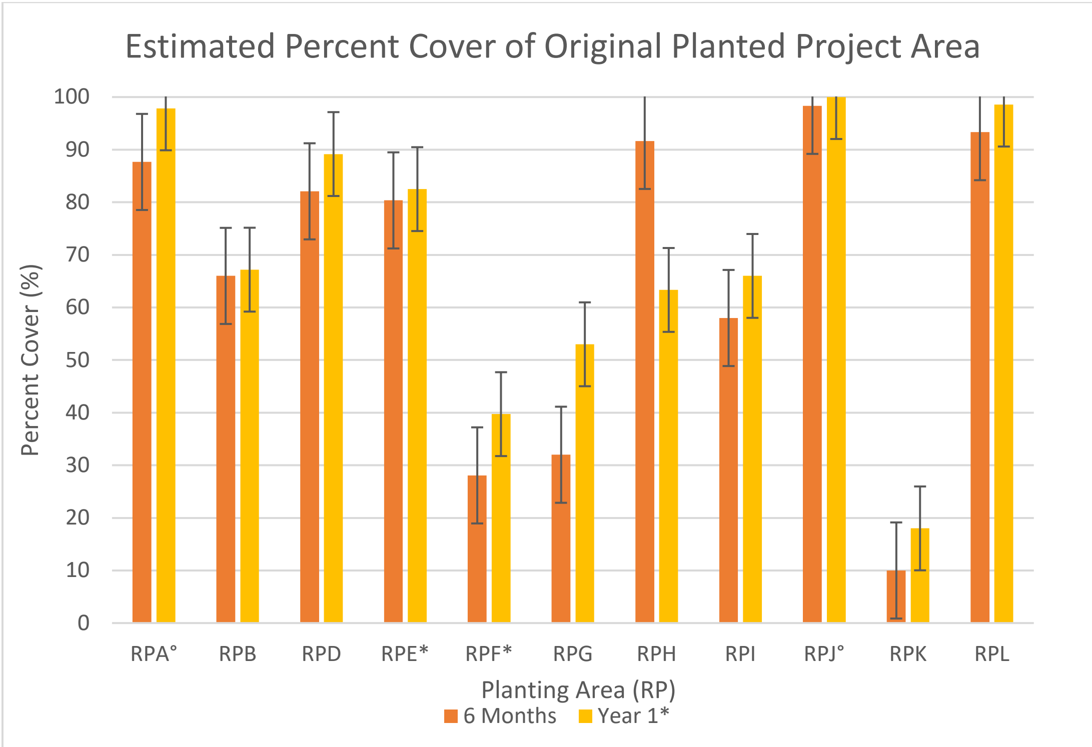


Figure 23. The estimated percent cover for original planted cover in each re-planting area. Error bars represent standard error. *RPE Year 1 data includes transects planted in 2021 as well as one planted in 2022. RPF Year 1 data included two additional transects to be more representative of the entire RP. °RPs A and J were planted using plants provided by NWAP's greenhouse. All other plants were sourced from Duke's Mariculture Center donor marsh.

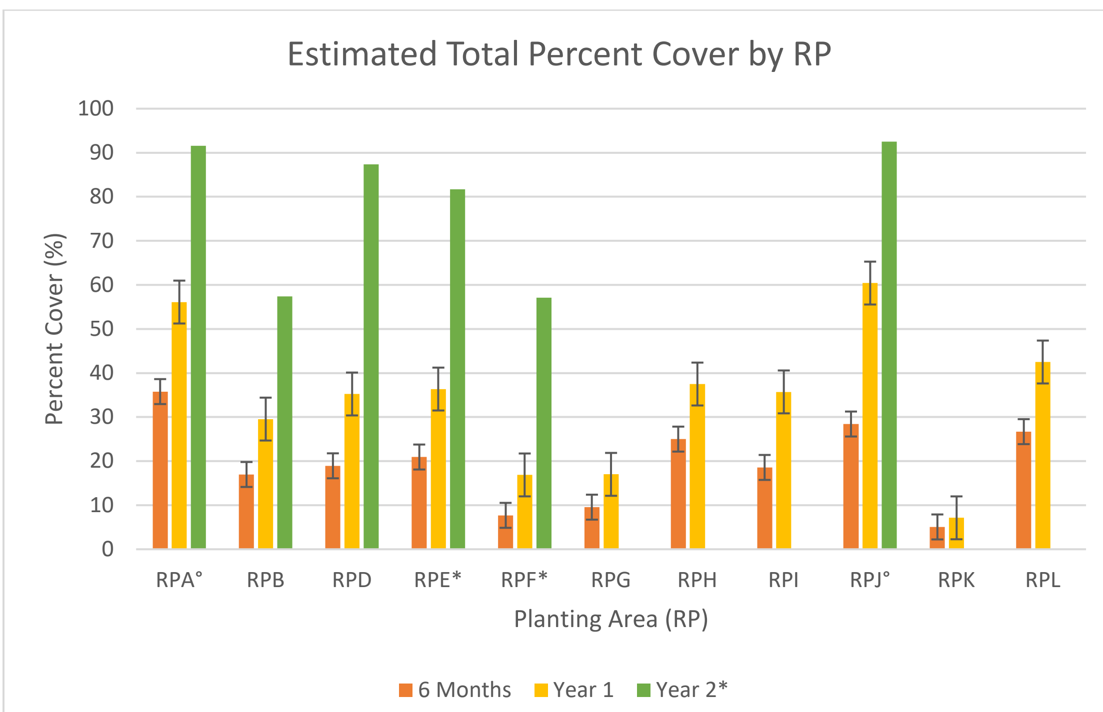


Figure 24. The average percent cover for each planting area. Error bars represent standard error. *RPF Year 1 data included two additional transects to be more representative of the entire RP. °RPs A and J were planted using plants provided by NWAP's greenhouse. All other plants were sourced from Duke's Mariculture Center donor marsh.

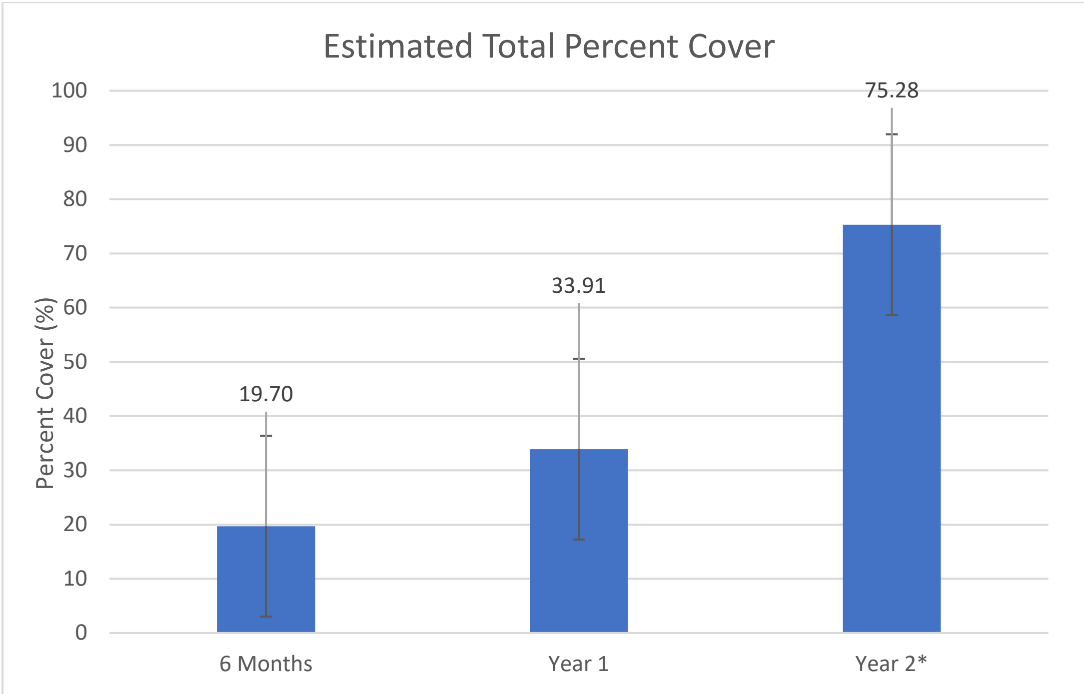


Figure 25. The estimated total percent cover across the entire project area at 6 months post-planting, one year post-planting, and two years post-planting. *Year 2 data currently only includes RPs planted in 2021. Error bars represent the standard error.

The average heights for each planting area are shown in Figure 26. The average height across all the planting areas was 44.98cm at 6 months, and 35.06cm at Year 1, and 64.98 cm at Year 2. The decrease in average plant height observed from 6 months to one year can be attributed to the inclusion of new, smaller growth in the stem height measurements.

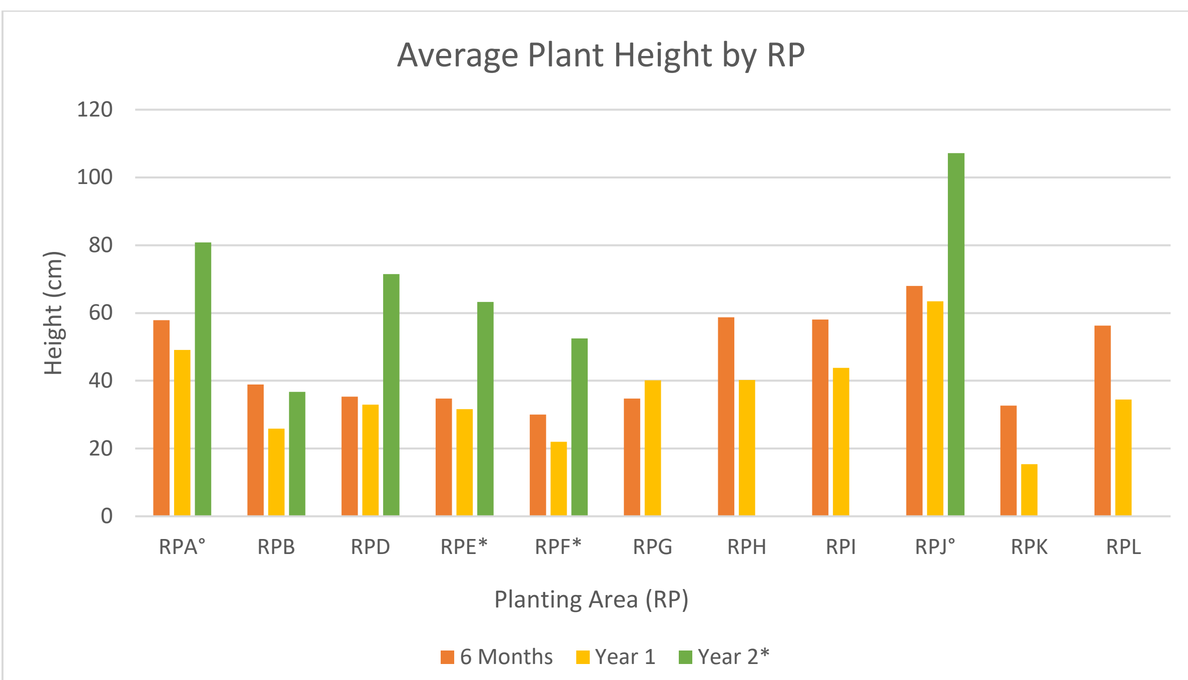


Figure 26. Average height of the plants by planting area after the first growing season. Error bars represent standard error.

It should be noted that half of the RPs were planted in 2021 and half were planted in 2022. Differences in planting area conditions, plant sources, and seasonal variability can contribute to differing growth and survival rates. A representation of the variation in data between plants planted in 2021 and those planted in 2022 can be seen in Figure 28.

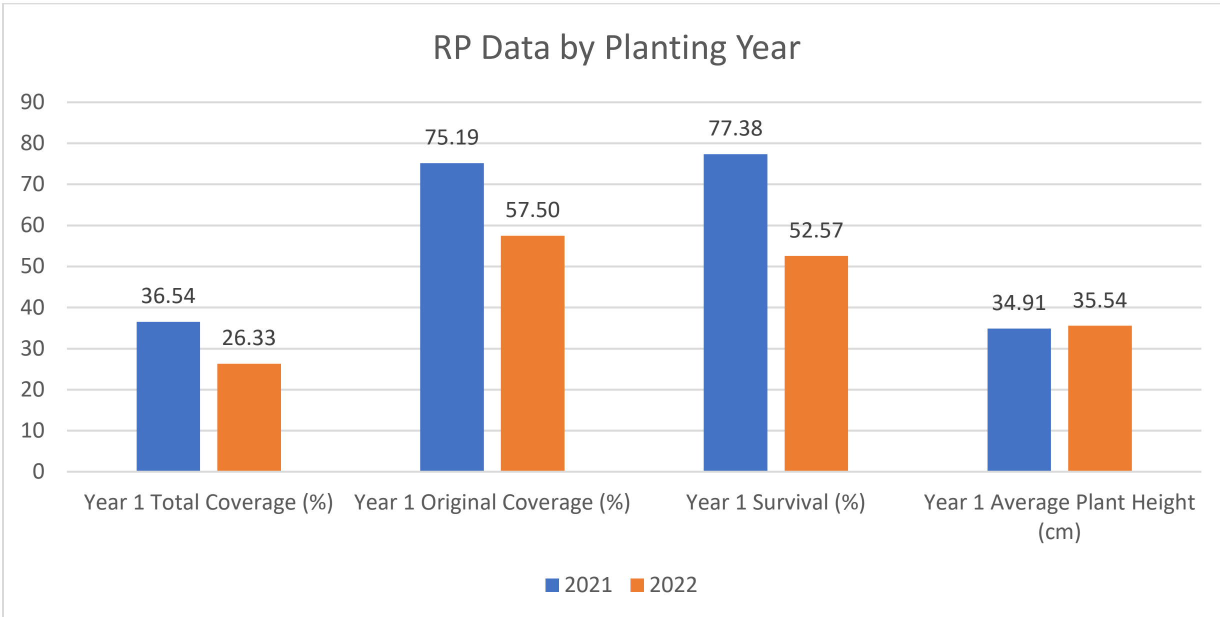


Figure 27. Various parameters displaying the differences between initial plantings in 2021 and 2022.

Discussion:

A total of 12 RPs have been planted to date in the Cat Point Living Shoreline Project, with 6 areas planted in 2021 and 6 areas planted in 2022 (refer to Table 8). Substantial variability in growth and survival rates have been observed across the different RPs. A number of factors can contribute to these variations, including but not limited to: exposure to wave action, elevation, water and sediment transport, nutrient and freshwater input, substrate suitability, and plant source. As can be viewed in Figure 11, the RPs vary in shape, size, and proximity to the breakwaters. The project footprint also extends along approximately 0.3 miles of dynamic and irregular shoreline. The variability of conditions within the project area undoubtedly contributes to variation in plant succession following initial planting events.

At the 6-month monitoring period, RPF had the lowest average survival, percent cover of original planted cover, total percent cover, and plant height of all areas planted in 2021. RPF was also the only area that demonstrated a loss in total percent cover between Year 0 (at planting) and 6 months. While RPF was the least successful of all replanting areas in 2021, these data do not accurately represent the planting area as a whole. This is because the randomly generated monitoring transects are over-representative of the die-off area on the eastern edge of RPF. In order to account for this misrepresentation, additional monitoring transects (NT1 and NT2) were added to RPF before Year 1 monitoring.

RPK, adjacent to RPF and the western-most of the planted areas, had the lowest overall survival of original plants (6.38%), lowest estimated original percent cover (18.00%), lowest total percent cover (7.13%), and lowest average plant height (15.35cm) at Year 1 post-planting. RPF and RPK, representing the least successful RPs, are also the only two planted located west of Millender Street. The western end of the project is the location of Breakwater 16, which lacks a crest mattress. This could potentially provide increased wave action and other conditions that affect plant growth and survival. The substantial die off and lack of expansion when compared to other planted areas within the project footprint suggest that conditions are less ideal for marsh succession along the western end of the project area.

In addition to spatial differences, temporal variation can contribute to varied success in plant survival and growth. As previously mentioned, half of the RPs were planted in 2021, and half in 2022. When compared by year, RPs planted in

2021 had higher total coverage, original planted area coverage, and survival at Year 1 than those planted in 2022. Average plant height was similar between RPs planted in 2021 and 2022. A decrease in average plant height was observed from 6 months to one year can be attributed to the inclusion of new, smaller growth in the stem height measurements.

Seasonal variability can also account for variation between RPs planted within the same year. Planting dates occurred in January through April of 2021 and 2022 to take advantage of low tides, as well as allow plants to establish and grow throughout the spring prior to the arrival of storm season. As the planting dates of the various RPs ranged from January to April, so too did the Year 1 monitoring dates. It is feasible that areas planted earlier in the season would have experienced different conditions than those planted later in the season, contributing to differences in plant growth and survival. All areas except for RPG experienced a decrease in average plant height from 6 months to 1 year. In the same time frame, all RPs also experienced an increase in total percent coverage of the planting area. This is expected, as established plants expand and exhibit new growth, shorter, newer stems will be included in the data collected.

Plants in RPA and portions of RPJ were obtained from a different source than the other replanting areas, likely contributing to differences in plant survival and growth. RPs J and A were planted with plants sourced from Northwest Florida Aquatic Preserves. These particular plants were harvested and then grown to size in a greenhouse with the use of fertilizers and daily maintenance, which may have contributed to the taller heights and more rapid expansion of these plants. RPA and RPJ were consistently among the highest average plant heights, highest survival, highest percent cover of original plants, and total percent cover. Additionally, there are two growth forms of *Spartina alterniflora*, a tall form that exists along creek banks and drainage channels and a short form that exists landward of the tall form (Smart 1982). It is possible that these plants (sourced from Northwest Florida Aquatic Preserves) were the taller of the two growth forms, while all other plants (sourced from Duke Energy) were the shorter growth form.

Objective 3, Parameter 1: Shoreline profile/elevation:

Methods/Results:

During the initial pre-construction survey in 2017, elevations at the shoreline as well as the mean high-water line (MHWL) were determined and mapped (Figures 2-6). The MHWL was 0.65ft as referenced to the North American Vertical Datum of 1988 (NAVD 88 – Figure 11). Geospatial data of the shoreline position was given to CPAP in order to compare changes over time. In May 2022, researchers from Texas A&M University collected imagery and lidar data in the project area. This data is being processed by the researchers, and once complete will be provided to CPAP so that we can compare changes in the shoreline profile over time.

Objective 3, Parameter 2: Marsh spatial extent/complexity:

Methods:

A Trimble® Geo7x is used to map the extent of the Cat Point Living Shoreline planted marsh areas with sub-meter accuracy. Using Trimble® TerraSync™ software, data is collected by walking the extent of the planting areas as the GPS continuously collects points to create a polygon. These polygons are then analyzed in ArcGIS® Pro to determine the spatial extent of each planting area. To date, total area calculations have been conducted biannually to both include newly planted areas and document expansion of existing RPs.

Results:

In 2021, pre-hurricane season, a total of 0.338 acres had been planted. Post-hurricane season, 0.351 acres were present due to expansion of plants in the RPs. Five additional RPs were planted in early 2022. Total acreage of the marsh created for the living shoreline project has continued to increase, and all but two areas (RPK & RPL) have experienced expansion since April of 2022. Area per RP from April 2022 to April 2023 is displayed in Figure 28. Seasonal variability in marsh acreage is expected, as natural conditions that support marsh succession fluctuate throughout the year. Higher growth rates and therefore marsh expansion is more likely in warmer seasons. In the shorter term, temperature anomalies and storm events can reduce or negatively affect plant growth and survival due to plant stress and even die off. As of April 2023, total area of RPs planted and monitored by is approximately 0.79 acres. This is 0.21 acres short of achieving the goal of creating one acre of saltmarsh habitat by Year 5. Inclusion of surviving upper marsh plants from the initial planting effort, as well as the planting efforts by the ANERR education programs in RPC, are not included in the total acreage above and will contribute positively to this acreage. Continued expansion of the current RPs is expected to occur, and future supplemental planning to meet the 5-year project goal will be evaluated in subsequent years.

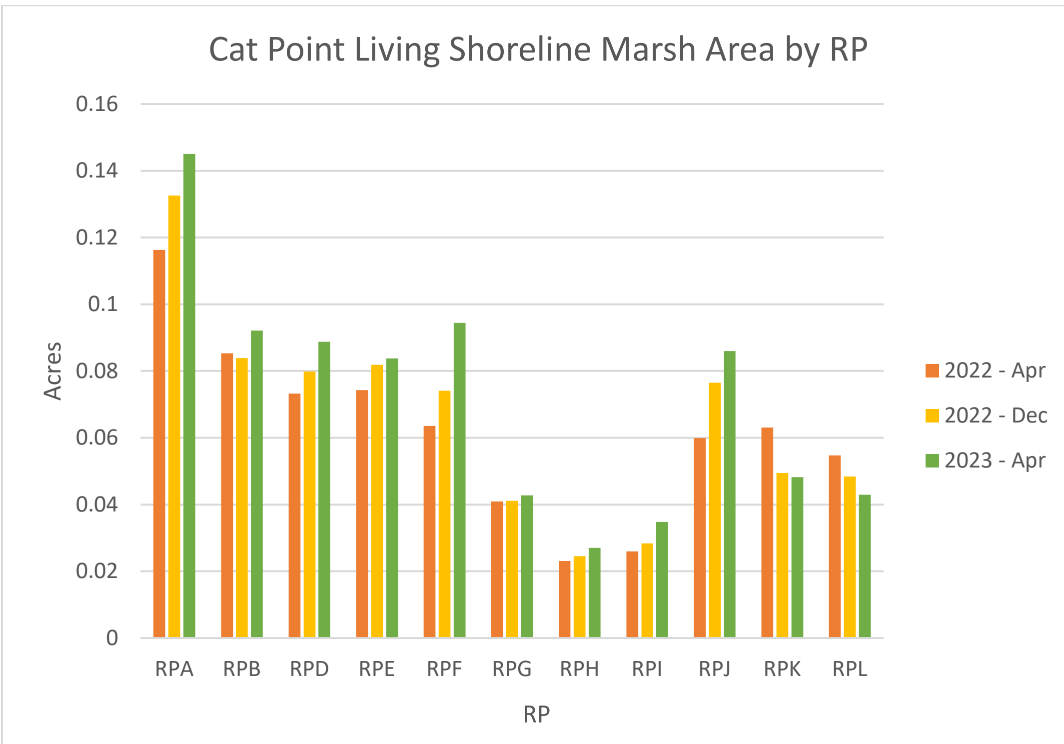


Figure 28. Marsh extent in acres per planting area (RP) from April 2022-April 2023.

Photo Point Monitoring

Methods:

Photo point monitoring began in May 2022. This was not part of the initial monitoring plan but has been implemented as another tool to monitor marsh expansion, sediment accretion landward of the breakwaters, planting success, and changes in the shoreline profile. This will allow CPAP to visualize and document any changes occurring along the shoreline in a consistent way. Five locations were established that cover all the project's planting areas. Multiple photos are taken at each location in predetermined directions to cover the entire view of the shoreline. Photos of each area along the project footprint, as well as during monitoring events, will continue throughout the course of the project. Additional monitoring may occur in special circumstances, such as before and after large storm events.

Water Quality Monitoring

Methods:

Water quality data has been collected weekly at Cat Point since December 2016. A Yellow Springs Instruments (YSI) ProDSS sonde is utilized to measure water temperature (°C), salinity (ppt), dissolved oxygen concentration (DO, mg/L), pH, and turbidity (FNU). The sampling site is at the end of Millender Street at the southwest edge of RPB (Figure 11). Water is sampled at the surface, approximately 0.1m deep, in roughly 0.3m deep water, although this varies with wind and tides. Collection of turbidity data began in March of 2021, when CPAP acquired a turbidity probe.

Results:

Water quality data trends at Cat Point from December 2016 – April 2023

Averages and trends for temperature, dissolved oxygen, pH, salinity, and turbidity for this same time period are shown in Figures 29-33.

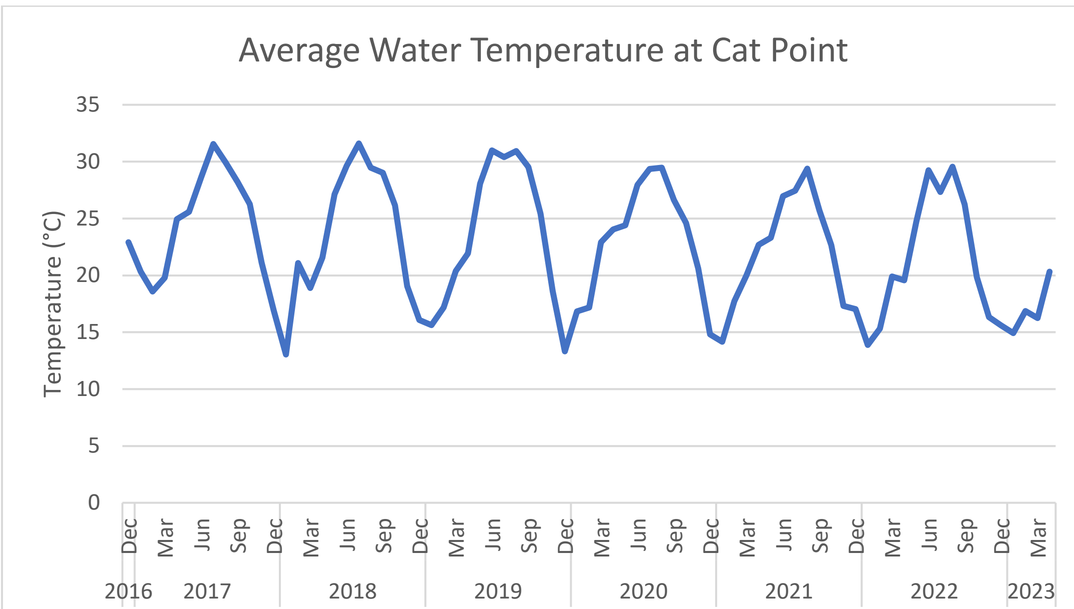


Figure 29. The average water temperature (°C) at Cat Point from December 2016 – April 2023.

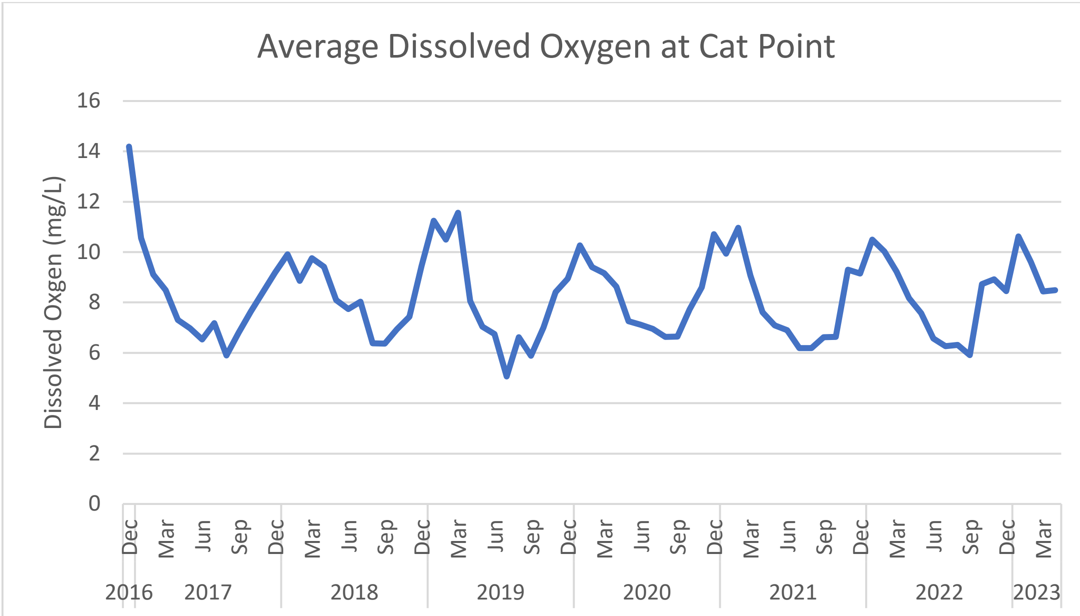


Figure 30. The average dissolved oxygen levels (mg/L) at Cat Point from December 2016 – April 2023.

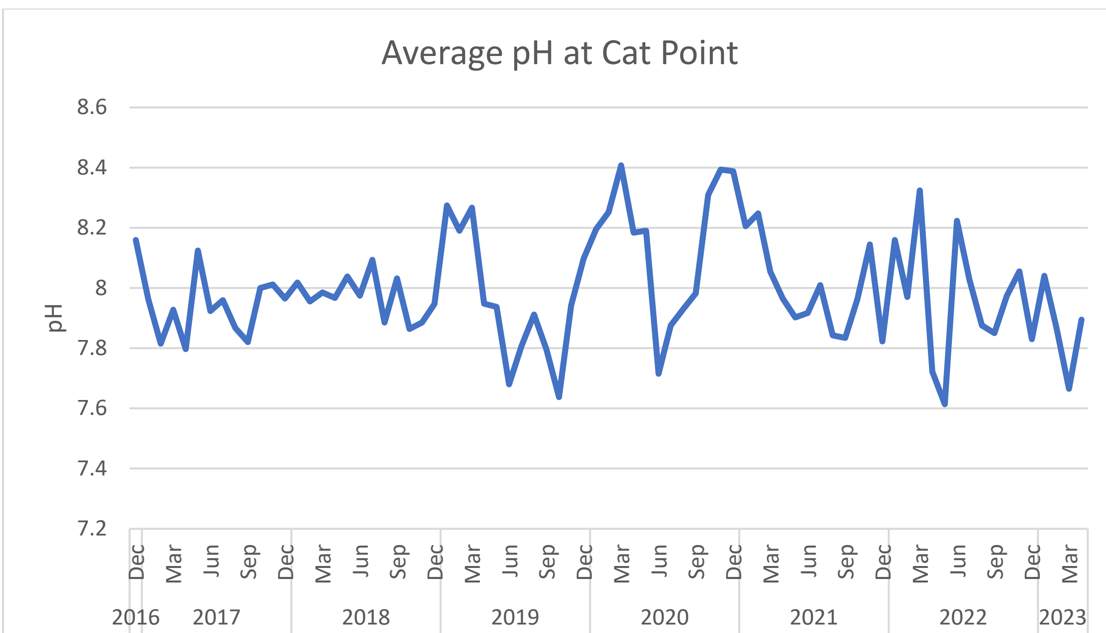


Figure 31. The average pH values at Cat Point from December 2016 – April 2023.

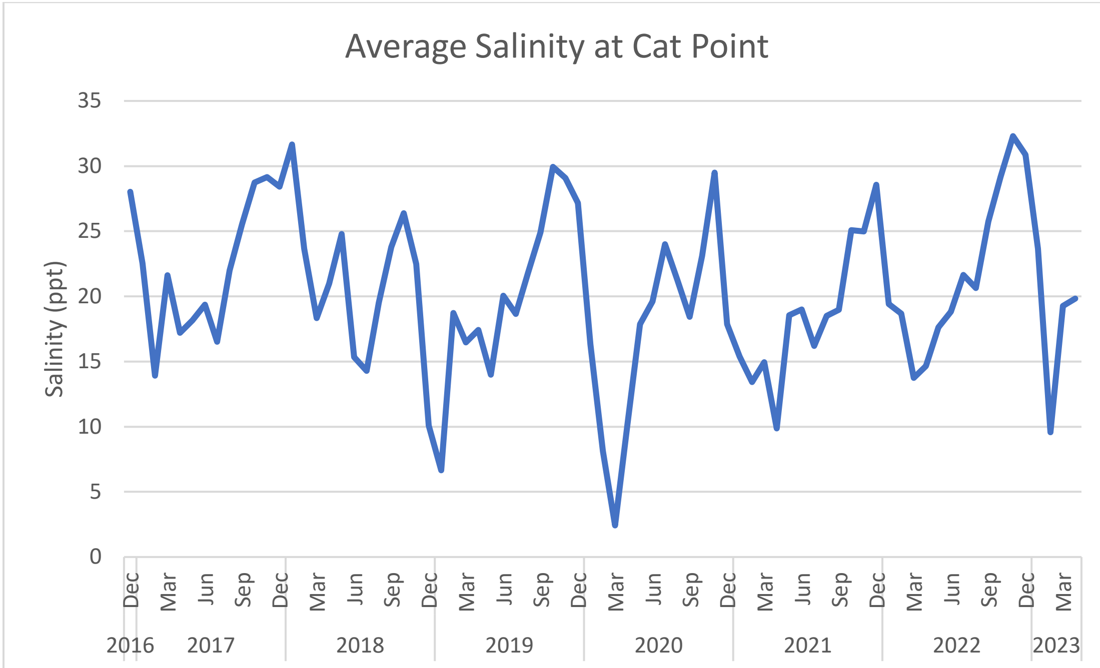


Figure 32. The average salinity (ppt) at Cat Point from December 2016 – April 2023.

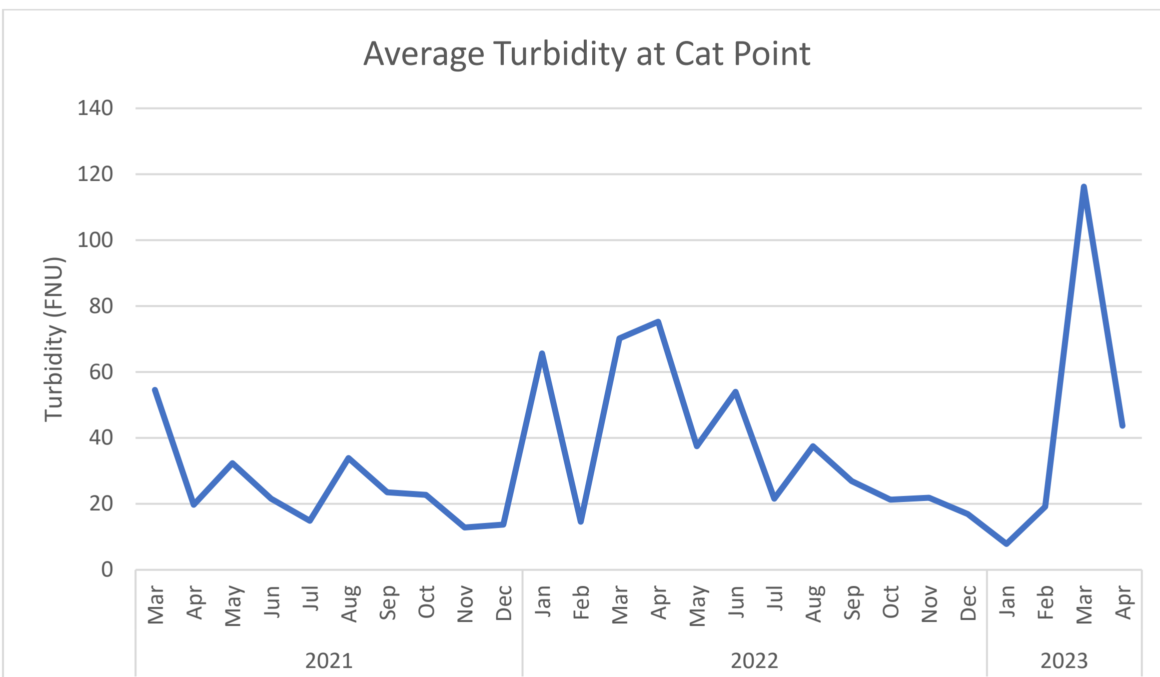


Figure 33. The average turbidity (FNU) at Cat Point from March 2021 – April 2023.

Sources:

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Appendix A – Sediment Tray Species I.D., Count, and Measurements:

Table 9. All organisms collected in 2022 from the breakwater sediment trays identified to lowest taxon.

Breakwater	Genus	Species	Sex	Length (mm)
1	*Panopeus*	*herbstii*	Female	23
1	*Panopeus*	*herbstii*	Female	26
1	*Panopeus*	*herbstii*	Female	13
1	*Eurypanopeus*	*depressus*	Male	16
1	*Eurypanopeus*	*depressus*	Male	10
1	*Eurypanopeus*	*depressus*	Male	6
1	*Eurypanopeus*	*depressus*	Male	9
1	*Eurypanopeus*	*depressus*	Male	5
1	*Eurypanopeus*	*depressus*	Male	4
1	*Eurypanopeus*	*depressus*	Male	4
1	*Eurypanopeus*	*depressus*	Female	8
1	*Eurypanopeus*	*depressus*	Female	5
1	*Eurypanopeus*	*depressus*	Female	5
1	*Eurypanopeus*	*depressus*	Unknown	3
1	*Palaemonetes*	*vulgaris*	Unknown	19
1	*Palaemonetes*	*vulgaris*	Unknown	21
1	*Palaemonetes*	*vulgaris*	Unknown	19
1	*Palaemonetes*	*vulgaris*	Unknown	20
1	*Palaemonetes*	*vulgaris*	Unknown	22
1	*Palaemonetes*	*vulgaris*	Unknown	20
1	*Palaemonetes*	*vulgaris*	Unknown	14
1	*Palaemonetes*	*vulgaris*	Unknown	17
1	*Palaemonetes*	*vulgaris*	Unknown	17
1	*Palaemonetes*	*vulgaris*	Unknown	15
1	*Palaemonetes*	*vulgaris*	Unknown	12
1	*Palaemonetes*	*vulgaris*	Unknown	21
1	*Palaemonetes*	*vulgaris*	Unknown	15
1	*Palaemonetes*	*vulgaris*	Unknown	17
1	*Palaemonetes*	*vulgaris*	Unknown	13
1	*Palaemonetes*	*vulgaris*	Unknown	13
1	*Palaemonetes*	*vulgaris*	Unknown	15
1	*Palaemonetes*	*vulgaris*	Unknown	24
1	*Palaemonetes*	*pugio*	Unknown	23
1	*Palaemonetes*	*pugio*	Unknown	23
1	*Palaemonetes*	*pugio*	Unknown	20
1	*Palaemonetes*	*pugio*	Unknown	13
1	*Palaemonetes*	*pugio*	Unknown	19
1	*Palaemonetes*	*pugio*	Unknown	21
1	*Palaemonetes*	*pugio*	Unknown	18
1	*Palaemonetes*	*pugio*	Unknown	18

1	*Palaemonetes*	*pugio*	Unknown	14
1	*Palaemonetes*	*pugio*	Unknown	19
1	*Palaemonetes*	*pugio*	Unknown	16
1	*Palaemonetes*	*pugio*	Unknown	16
1	*Palaemonetes*	*pugio*	Unknown	17
1	*Palaemonetes*	*pugio*	Unknown	14
1	*Palaemonetes*	*pugio*	Unknown	14
1	*Palaemonetes*	*pugio*	Unknown	22
1	*Palaemonetes*	*pugio*	Unknown	16
1	*Palaemonetes*	*pugio*	Unknown	11
1	*Palaemonetes*	*intermedius*	Unknown	21
1	*Palaemonetes*	*intermedius*	Unknown	20
1	*Palaemonetes*	*intermedius*	Unknown	18
1	*Palaemonetes*	*intermedius*	Unknown	21
1	*Palaemonetes*	*intermedius*	Unknown	17
1	*Palaemonetes*	*intermedius*	Unknown	15
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Palaemonetes*	*spp.*	Unknown	.
1	*Callinectes*	*sapidus*	Unknown	7
1	*Callinectes*	*sapidus*	Male	21
2	*Eurypanopeus*	*depressus*	Male	13
2	*Eurypanopeus*	*depressus*	Male	12
2	*Eurypanopeus*	*depressus*	Male	9
2	*Eurypanopeus*	*depressus*	Male	11
2	*Eurypanopeus*	*depressus*	Male	11
2	*Eurypanopeus*	*depressus*	Male	6
2	*Eurypanopeus*	*depressus*	Male	5
2	*Eurypanopeus*	*depressus*	Male	11
2	*Eurypanopeus*	*depressus*	Male	4
2	*Panopeus*	*herbstii*	Unknown	15
2	*Eurypanopeus*	*depressus*	Female	6
2	*Eurypanopeus*	*depressus*	Female	4
2	*Eurypanopeus*	*depressus*	Female	5
2	*Eurypanopeus*	*depressus*	Female	5
2	*Eurypanopeus*	*depressus*	Female	4
2	*Panopeus*	*herbstii*	Male	4
2	*Panopeus*	*herbstii*	Male	3
2	*Panopeus*	*herbstii*	Male	3
2	*Palaemonetes*	*vulgaris*	Unknown	17

2	*Palaemonetes*	*vulgaris*	Unknown	15
2	*Palaemonetes*	*vulgaris*	Unknown	15
2	*Palaemonetes*	*vulgaris*	Unknown	13
2	*Palaemonetes*	*vulgaris*	Unknown	14
2	*Palaemonetes*	*vulgaris*	Unknown	17
2	*Palaemonetes*	*vulgaris*	Unknown	16
2	*Palaemonetes*	*vulgaris*	Unknown	11
2	*Palaemonetes*	*vulgaris*	Unknown	10
2	*Palaemonetes*	*pugio*	Unknown	27
2	*Palaemonetes*	*pugio*	Unknown	9
2	*Palaemonetes*	*pugio*	Unknown	12
2	*Palaemonetes*	*pugio*	Unknown	15
2	*Palaemonetes*	*pugio*	Unknown	8
2	*Palaemonetes*	*pugio*	Unknown	12
2	*Palaemonetes*	*pugio*	Unknown	8
2	*Palaemonetes*	*pugio*	Unknown	9
2	*Palaemonetes*	*intermedius*	Unknown	8
2	*Palaemonetes*	*intermedius*	Unknown	8
2	*Gobiosoma*	*bosc*	Unknown	27
2	*Gobiosoma*	*bosc*	Unknown	24
2	*Polychaeta*	*spp.*	Unknown	.
3	*Eurypanopeus*	*depressus*	Male	12
3	*Eurypanopeus*	*depressus*	Male	11
3	*Eurypanopeus*	*depressus*	Male	4
3	*Eurypanopeus*	*depressus*	Male	12
3	*Eurypanopeus*	*depressus*	Male	8
3	*Eurypanopeus*	*depressus*	Male	6
3	*Eurypanopeus*	*depressus*	Male	10
3	*Eurypanopeus*	*depressus*	Male	7
3	*Eurypanopeus*	*depressus*	Male	8
3	*Eurypanopeus*	*depressus*	Male	9
3	*Eurypanopeus*	*depressus*	Male	7
3	*Eurypanopeus*	*depressus*	Female	10
3	*Eurypanopeus*	*depressus*	Female	9
3	*Eurypanopeus*	*depressus*	Female	9
3	*Eurypanopeus*	*depressus*	Female	8
3	*Eurypanopeus*	*depressus*	Female	11
3	*Eurypanopeus*	*depressus*	Female	10
3	*Eurypanopeus*	*depressus*	Female	8
3	*Eurypanopeus*	*depressus*	Female	6
3	*Eurypanopeus*	*depressus*	Female	7
3	*Eurypanopeus*	*depressus*	Female	6
3	*Eurypanopeus*	*depressus*	Female	4
3	*Eurypanopeus*	*depressus*	Female	11

3	*Eurypanopeus*	*depressus*	Female	12
3	*Palaemonetes*	*pugio*	Unknown	13
3	*Palaemonetes*	*pugio*	Unknown	11
3	*Palaemonetes*	*pugio*	Unknown	14
3	*Palaemonetes*	*pugio*	Unknown	10
3	*Palaemonetes*	*vulgaris*	Unknown	18
3	*Palaemonetes*	*vulgaris*	Unknown	14
3	*Palaemonetes*	*intermedius*	Unknown	17
4	*Panopeus*	*herbstii*	Female	24
4	*Panopeus*	*herbstii*	Female	16
4	*Eurypanopeus*	*depressus*	Male	22
4	*Eurypanopeus*	*depressus*	Male	14
4	*Eurypanopeus*	*depressus*	Male	13
4	*Eurypanopeus*	*depressus*	Male	9
4	*Eurypanopeus*	*depressus*	Male	10
4	*Eurypanopeus*	*depressus*	Male	7
4	*Eurypanopeus*	*depressus*	Male	8
4	*Eurypanopeus*	*depressus*	Male	4
4	*Eurypanopeus*	*depressus*	Male	5
4	*Eurypanopeus*	*depressus*	Male	6
4	*Eurypanopeus*	*depressus*	Male	3
4	*Eurypanopeus*	*depressus*	Female	13
4	*Eurypanopeus*	*depressus*	Female	9
4	*Eurypanopeus*	*depressus*	Female	6
4	*Eurypanopeus*	*depressus*	Female	5
4	*Eurypanopeus*	*depressus*	Female	4
4	*Callinectes*	*sapidus*	Unknown	16
4	*Panopeus*	*herbstii*	Male	5
4	*Petrolisthes*	*armatus*	Female	4
4	*Palaemonetes*	*intermedius*	Unknown	23
4	*Palaemonetes*	*intermedius*	Unknown	24
4	*Palaemonetes*	*intermedius*	Unknown	27
4	*Palaemonetes*	*intermedius*	Unknown	19
4	*Palaemonetes*	*intermedius*	Unknown	15
4	*Palaemonetes*	*intermedius*	Unknown	23
4	*Palaemonetes*	*intermedius*	Unknown	17
4	*Palaemonetes*	*intermedius*	Unknown	19
4	*Palaemonetes*	*intermedius*	Unknown	14
4	*Palaemonetes*	*pugio*	Unknown	25
4	*Palaemonetes*	*pugio*	Unknown	26
4	*Palaemonetes*	*pugio*	Unknown	20
4	*Palaemonetes*	*pugio*	Unknown	18
4	*Palaemonetes*	*pugio*	Unknown	20
4	*Palaemonetes*	*pugio*	Unknown	21

4	*Palaemonetes*	*pugio*	Unknown	37
4	*Palaemonetes*	*pugio*	Unknown	21
4	*Palaemonetes*	*pugio*	Unknown	17
4	*Palaemonetes*	*pugio*	Unknown	19
4	*Palaemonetes*	*pugio*	Unknown	17
4	*Palaemonetes*	*pugio*	Unknown	22
4	*Palaemonetes*	*pugio*	Unknown	16
4	*Palaemonetes*	*pugio*	Unknown	20
4	*Palaemon*	*floridanus*	Unknown	22
4	*Palaemon*	*floridanus*	Unknown	15
4	*Palaemon*	*floridanus*	Unknown	16
4	*Palaemonetes*	*vulgaris*	Unknown	17
4	*Palaemonetes*	*vulgaris*	Unknown	18
4	*Palaemonetes*	*vulgaris*	Unknown	16
4	*Palaemonetes*	*vulgaris*	Unknown	16
4	*Palaemonetes*	*vulgaris*	Unknown	24
4	*Palaemonetes*	*vulgaris*	Unknown	15
4	*Palaemonetes*	*vulgaris*	Unknown	14
4	*Palaemonetes*	*vulgaris*	Unknown	16
4	*Polychaeta*	*spp.*	Unknown	20
4	*Periclimenes*	*longicaudatus*	Unknown	15
4	*Symphurus*	*plagiusa*	Unknown	30
5	*Eurypanopeus*	*depressus*	Female	11
5	*Eurypanopeus*	*depressus*	Female	9
5	*Eurypanopeus*	*depressus*	Female	12
5	*Eurypanopeus*	*depressus*	Female	11
5	*Eurypanopeus*	*depressus*	Female	10
5	*Eurypanopeus*	*depressus*	Female	10
5	*Eurypanopeus*	*depressus*	Female	7
5	*Eurypanopeus*	*depressus*	Female	6
5	*Eurypanopeus*	*depressus*	Female	10
5	*Eurypanopeus*	*depressus*	Female	9
5	*Eurypanopeus*	*depressus*	Female	7
5	*Eurypanopeus*	*depressus*	Female	6
5	*Eurypanopeus*	*depressus*	Female	8
5	*Eurypanopeus*	*depressus*	Female	7
5	*Eurypanopeus*	*depressus*	Female	2
5	*Eurypanopeus*	*depressus*	Female	4
5	*Eurypanopeus*	*depressus*	Female	6
5	*Eurypanopeus*	*depressus*	Male	9
5	*Eurypanopeus*	*depressus*	Male	12
5	*Eurypanopeus*	*depressus*	Male	5
5	*Eurypanopeus*	*depressus*	Male	6
5	*Eurypanopeus*	*depressus*	Male	10

5	*Eurypanopeus*	*depressus*	Male	9
5	*Eurypanopeus*	*depressus*	Male	4
5	*Eurypanopeus*	*depressus*	Male	4
5	*Eurypanopeus*	*depressus*	Male	7
5	*Eurypanopeus*	*depressus*	Male	6
5	*Eurypanopeus*	*depressus*	Male	5
5	*Eurypanopeus*	*depressus*	Male	5
5	*Eurypanopeus*	*depressus*	Male	3
5	*Eurypanopeus*	*depressus*	Male	4
5	*Eurypanopeus*	*depressus*	Male	5
5	*Palaemonetes*	*pugio*	Unknown	15
6	*Panopeus*	*herbstii*	Female	21
6	*Panopeus*	*herbstii*	Female	20
6	*Panopeus*	*herbstii*	Female	8
6	*Panopeus*	*herbstii*	Female	3
6	*Panopeus*	*herbstii*	Female	4
6	*Callinectes*	*sapidus*	Unknown	19
6	*Callinectes*	*sapidus*	Male	38
6	*Eurypanopeus*	*depressus*	Female	8
6	*Eurypanopeus*	*depressus*	Female	7
6	*Eurypanopeus*	*depressus*	Female	9
6	*Eurypanopeus*	*depressus*	Female	4
6	*Eurypanopeus*	*depressus*	Female	15
6	*Eurypanopeus*	*depressus*	Female	9
6	*Eurypanopeus*	*depressus*	Female	7
6	*Eurypanopeus*	*depressus*	Female	9
6	*Eurypanopeus*	*depressus*	Female	7
6	*Eurypanopeus*	*depressus*	Female	5
6	*Eurypanopeus*	*depressus*	Female	4
6	*Eurypanopeus*	*depressus*	Female	5
6	*Palaemonetes*	*pugio*	Unknown	16
6	*Palaemonetes*	*pugio*	Unknown	23
6	*Palaemonetes*	*pugio*	Unknown	18
6	*Palaemonetes*	*pugio*	Unknown	23
6	*Palaemonetes*	*pugio*	Unknown	29
6	*Palaemonetes*	*pugio*	Unknown	16
6	*Palaemonetes*	*pugio*	Unknown	17
6	*Palaemonetes*	*pugio*	Unknown	21
6	*Palaemonetes*	*pugio*	Unknown	20
6	*Palaemonetes*	*pugio*	Unknown	21
6	*Palaemonetes*	*pugio*	Unknown	17
6	*Palaemonetes*	*pugio*	Unknown	16
6	*Palaemonetes*	*pugio*	Unknown	17
6	*Palaemonetes*	*pugio*	Unknown	24

6	*Palaemonetes*	*pugio*	Unknown	19
6	*Palaemonetes*	*pugio*	Unknown	15
6	*Palaemonetes*	*pugio*	Unknown	17
6	*Palaemonetes*	*pugio*	Unknown	22
6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*pugio*	Unknown	.
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6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*pugio*	Unknown	.
6	*Palaemonetes*	*intermedius*	Unknown	25
6	*Palaemonetes*	*intermedius*	Unknown	29
6	*Palaemonetes*	*intermedius*	Unknown	20
6	*Palaemonetes*	*intermedius*	Unknown	27
6	*Palaemonetes*	*intermedius*	Unknown	19
6	*Palaemonetes*	*intermedius*	Unknown	19
6	*Palaemonetes*	*intermedius*	Unknown	20
6	*Palaemonetes*	*intermedius*	Unknown	16
6	*Palaemonetes*	*intermedius*	Unknown	21
6	*Palaemonetes*	*intermedius*	Unknown	20
6	*Palaemonetes*	*intermedius*	Unknown	22
6	*Palaemonetes*	*intermedius*	Unknown	24
6	*Palaemonetes*	*intermedius*	Unknown	17
6	*Palaemonetes*	*intermedius*	Unknown	17
6	*Palaemonetes*	*intermedius*	Unknown	18
6	*Palaemonetes*	*intermedius*	Unknown	22
6	*Palaemonetes*	*intermedius*	Unknown	18
6	*Palaemonetes*	*intermedius*	Unknown	21
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6	*Palaemonetes*	*intermedius*	Unknown	.
6	*Palaemonetes*	*intermedius*	Unknown	.

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6	*Palaemonetes*	*intermedius*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	19
6	*Palaemonetes*	*vulgaris*	Unknown	27
6	*Palaemonetes*	*vulgaris*	Unknown	18
6	*Palaemonetes*	*vulgaris*	Unknown	18
6	*Palaemonetes*	*vulgaris*	Unknown	16
6	*Palaemonetes*	*vulgaris*	Unknown	27
6	*Palaemonetes*	*vulgaris*	Unknown	19
6	*Palaemonetes*	*vulgaris*	Unknown	16
6	*Palaemonetes*	*vulgaris*	Unknown	13
6	*Palaemonetes*	*vulgaris*	Unknown	15
6	*Palaemonetes*	*vulgaris*	Unknown	14
6	*Palaemonetes*	*vulgaris*	Unknown	12
6	*Palaemonetes*	*vulgaris*	Unknown	16
6	*Palaemonetes*	*vulgaris*	Unknown	19
6	*Palaemonetes*	*vulgaris*	Unknown	19
6	*Palaemonetes*	*vulgaris*	Unknown	20
6	*Palaemonetes*	*vulgaris*	Unknown	17
6	*Palaemonetes*	*vulgaris*	Unknown	16
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.

6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Palaemonetes*	*vulgaris*	Unknown	.
6	*Eurypanopeus*	*depressus*	Male	16
6	*Eurypanopeus*	*depressus*	Male	7
6	*Eurypanopeus*	*depressus*	Male	4
6	*Gobiosoma*	*bosc*	Unknown	29
6	*Gobiosoma*	*bosc*	Unknown	24
6	*Gobiosoma*	*bosc*	Unknown	28
6	*Gobiosoma*	*bosc*	Unknown	32
6	*Bathygobius*	*soporator*	Unknown	21
6	*Clibinarius*	*vittatus*	Unknown	65

7	*Eurypanopeus*	*depressus*	Female	9
7	*Eurypanopeus*	*depressus*	Female	12
7	*Eurypanopeus*	*depressus*	Female	10
7	*Eurypanopeus*	*depressus*	Female	9
7	*Eurypanopeus*	*depressus*	Female	15
7	*Eurypanopeus*	*depressus*	Female	7
7	*Eurypanopeus*	*depressus*	Female	12
7	*Eurypanopeus*	*depressus*	Female	6
7	*Eurypanopeus*	*depressus*	Female	10
7	*Eurypanopeus*	*depressus*	Female	4
7	*Eurypanopeus*	*depressus*	Female	10
7	*Eurypanopeus*	*depressus*	Female	4
7	*Eurypanopeus*	*depressus*	Male	14
7	*Eurypanopeus*	*depressus*	Male	10
7	*Eurypanopeus*	*depressus*	Male	4
7	*Eurypanopeus*	*depressus*	Male	9
7	*Eurypanopeus*	*depressus*	Male	7
7	*Eurypanopeus*	*depressus*	Male	3
7	*Eurypanopeus*	*depressus*	Male	6
7	*Eurypanopeus*	*depressus*	Male	12
7	*Eurypanopeus*	*depressus*	Male	4
7	*Eurypanopeus*	*depressus*	Male	9
7	*Eurypanopeus*	*depressus*	Male	8
7	*Eurypanopeus*	*depressus*	Male	7
7	*Eurypanopeus*	*depressus*	Male	5
7	*Eurypanopeus*	*depressus*	Male	10
7	*Eurypanopeus*	*depressus*	Male	5
7	*Eurypanopeus*	*depressus*	Unknown	5
7	*Eurypanopeus*	*depressus*	Unknown	3
7	*Eurypanopeus*	*depressus*	Unknown	2
7	*Eurypanopeus*	*depressus*	Unknown	4
7	*Palaemonetes*	*pugio*	Unknown	10
7	*Amphipoda*	*spp.*	Unknown	10
7	*Callinectes*	*sapidus*	Unknown	47
7	*Callinectes*	*sapidus*	Male	20
8	*Panopeus*	*herbstii*	Male	19
8	*Panopeus*	*herbstii*	Male	13
8	*Panopeus*	*herbstii*	Male	5
8	*Panopeus*	*herbstii*	Male	10
8	*Panopeus*	*herbstii*	Female	12
8	*Panopeus*	*herbstii*	Female	10
8	*Panopeus*	*herbstii*	Female	13
8	*Eurypanopeus*	*depressus*	Female	10
8	*Eurypanopeus*	*depressus*	Female	8

8	*Eurypanopeus*	*depressus*	Female	10
8	*Eurypanopeus*	*depressus*	Female	7
8	*Panopeus*	*herbstii*	Unknown	5
8	*Panopeus*	*herbstii*	Unknown	3
8	*Eurypanopeus*	*depressus*	Unknown	3
8	*Eurypanopeus*	*depressus*	Unknown	3
8	*Eurypanopeus*	*depressus*	Male	5
8	*Eurypanopeus*	*depressus*	Male	3
8	*Palaemonetes*	*pugio*	Unknown	25
8	*Palaemonetes*	*pugio*	Unknown	17
8	*Palaemonetes*	*pugio*	Unknown	28
8	*Palaemonetes*	*pugio*	Unknown	23
8	*Palaemonetes*	*pugio*	Unknown	19
8	*Palaemonetes*	*pugio*	Unknown	16
8	*Palaemonetes*	*pugio*	Unknown	15
8	*Palaemonetes*	*pugio*	Unknown	16
8	*Palaemonetes*	*pugio*	Unknown	24
8	*Palaemonetes*	*pugio*	Unknown	19
8	*Palaemonetes*	*pugio*	Unknown	17
8	*Palaemonetes*	*pugio*	Unknown	15
8	*Palaemonetes*	*pugio*	Unknown	10
8	*Palaemonetes*	*pugio*	Unknown	13
8	*Palaemonetes*	*pugio*	Unknown	14
8	*Palaemonetes*	*pugio*	Unknown	23
8	*Palaemonetes*	*pugio*	Unknown	21
8	*Palaemonetes*	*pugio*	Unknown	15
8	*Palaemonetes*	*pugio*	Unknown	17
8	*Palaemonetes*	*intermedius*	Unknown	24
8	*Palaemonetes*	*intermedius*	Unknown	27
8	*Palaemonetes*	*intermedius*	Unknown	14
8	*Palaemonetes*	*intermedius*	Unknown	15
8	*Palaemonetes*	*intermedius*	Unknown	15
8	*Palaemonetes*	*intermedius*	Unknown	14
8	*Palaemonetes*	*intermedius*	Unknown	17
8	*Palaemonetes*	*intermedius*	Unknown	15
8	*Palaemonetes*	*intermedius*	Unknown	16
8	*Palaemonetes*	*intermedius*	Unknown	17
8	*Palaemonetes*	*intermedius*	Unknown	20
8	*Palaemonetes*	*intermedius*	Unknown	21
8	*Palaemonetes*	*vulgaris*	Unknown	22
8	*Palaemonetes*	*vulgaris*	Unknown	16
8	*Palaemonetes*	*vulgaris*	Unknown	19
8	*Palaemonetes*	*vulgaris*	Unknown	19
8	*Palaemonetes*	*vulgaris*	Unknown	15

8	*Palaemonetes*	*vulgaris*	Unknown	17
8	*Palaemonetes*	*vulgaris*	Unknown	15
8	*Periclimenes*	*longicaudatus*	Unknown	18
8	*Gobiosoma*	*bosc*	Unknown	32
8	*Callinectes*	*sapidus*	Male	23
8	*Callinectes*	*sapidus*	Male	30
9	*Panopeus*	*herbstii*	Female	16
9	*Panopeus*	*herbstii*	Female	12
9	*Panopeus*	*herbstii*	Female	11
9	*Panopeus*	*herbstii*	Female	9
9	*Eurypanopeus*	*depressus*	Female	13
9	*Eurypanopeus*	*depressus*	Female	9
9	*Eurypanopeus*	*depressus*	Female	7
9	*Eurypanopeus*	*depressus*	Female	9
9	*Eurypanopeus*	*depressus*	Female	6
9	*Eurypanopeus*	*depressus*	Female	8
9	*Eurypanopeus*	*depressus*	Female	10
9	*Eurypanopeus*	*depressus*	Female	5
9	*Eurypanopeus*	*depressus*	Female	10
9	*Eurypanopeus*	*depressus*	Female	8
9	*Eurypanopeus*	*depressus*	Female	10
9	*Eurypanopeus*	*depressus*	Female	7
9	*Eurypanopeus*	*depressus*	Female	6
9	*Eurypanopeus*	*depressus*	Female	4
9	*Eurypanopeus*	*depressus*	Female	6
9	*Eurypanopeus*	*depressus*	Female	9
9	*Eurypanopeus*	*depressus*	Female	8
9	*Eurypanopeus*	*depressus*	Female	7
9	*Eurypanopeus*	*depressus*	Male	10
9	*Eurypanopeus*	*depressus*	Male	9
9	*Eurypanopeus*	*depressus*	Male	5
9	*Eurypanopeus*	*depressus*	Male	10
9	*Eurypanopeus*	*depressus*	Male	8
9	*Eurypanopeus*	*depressus*	Male	5
9	*Eurypanopeus*	*depressus*	Male	13
9	*Eurypanopeus*	*depressus*	Male	5
9	*Eurypanopeus*	*depressus*	Male	5
9	*Eurypanopeus*	*depressus*	Male	13
9	*Eurypanopeus*	*depressus*	Male	4
9	*Eurypanopeus*	*depressus*	Male	6
9	*Eurypanopeus*	*depressus*	Male	9
9	*Eurypanopeus*	*depressus*	Male	6
9	*Eurypanopeus*	*depressus*	Male	7
9	*Eurypanopeus*	*depressus*	Male	9

9	*Eurypanopeus*	*depressus*	Male	5
9	*Eurypanopeus*	*depressus*	Male	7
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	4
9	*Eurypanopeus*	*depressus*	Unknown	2
9	*Eurypanopeus*	*depressus*	Unknown	4
9	*Eurypanopeus*	*depressus*	Unknown	4
9	*Eurypanopeus*	*depressus*	Unknown	2
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Eurypanopeus*	*depressus*	Unknown	3
9	*Palaemonetes*	*intermedius*	Unknown	23
9	*Palaemonetes*	*intermedius*	Unknown	20
9	*Palaemonetes*	*intermedius*	Unknown	24
9	*Palaemonetes*	*pugio*	Unknown	25
9	*Palaemonetes*	*pugio*	Unknown	13
9	*Callinectes*	*sapidus*	Unknown	42
9	*Callinectes*	*sapidus*	Male	23
10	*Eurypanopeus*	*depressus*	Male	20
10	*Eurypanopeus*	*depressus*	Male	7
10	*Eurypanopeus*	*depressus*	Male	17
10	*Eurypanopeus*	*depressus*	Male	7
10	*Eurypanopeus*	*depressus*	Male	7
10	*Eurypanopeus*	*depressus*	Male	6
10	*Eurypanopeus*	*depressus*	Male	6
10	*Eurypanopeus*	*depressus*	Male	5
10	*Eurypanopeus*	*depressus*	Male	5
10	*Panopeus*	*herbstii*	Female	22
10	*Panopeus*	*herbstii*	Female	11
10	*Panopeus*	*herbstii*	Female	8
10	*Panopeus*	*herbstii*	Female	5
10	*Panopeus*	*herbstii*	Female	11
10	*Panopeus*	*herbstii*	Male	7
10	*Eurypanopeus*	*depressus*	Female	6
10	*Eurypanopeus*	*depressus*	Female	6
10	*Eurypanopeus*	*depressus*	Female	4
10	*Palaemonetes*	*intermedius*	Unknown	22
10	*Palaemonetes*	*intermedius*	Unknown	26
10	*Palaemonetes*	*intermedius*	Unknown	26
10	*Palaemonetes*	*intermedius*	Unknown	17
10	*Palaemonetes*	*pugio*	Unknown	17

10	*Palaemonetes*	*pugio*	Unknown	16
10	*Palaemonetes*	*pugio*	Unknown	23
10	*Palaemonetes*	*pugio*	Unknown	14
10	*Gobiosoma*	*bosc*	Unknown	31
10	*Gobiesox*	*strumosus*	Unknown	55
11	*Eurypanopeus*	*depressus*	Male	10
11	*Eurypanopeus*	*depressus*	Male	7
11	*Eurypanopeus*	*depressus*	Male	8
11	*Eurypanopeus*	*depressus*	Male	5
11	*Eurypanopeus*	*depressus*	Male	8
11	*Eurypanopeus*	*depressus*	Female	8
11	*Eurypanopeus*	*depressus*	Female	7
11	*Eurypanopeus*	*depressus*	Female	7
11	*Eurypanopeus*	*depressus*	Female	5
11	*Eurypanopeus*	*depressus*	Female	5
11	*Eurypanopeus*	*depressus*	Female	3
11	*Palaemonetes*	*pugio*	Unknown	14
11	*Palaemonetes*	*pugio*	Unknown	23
11	*Palaemonetes*	*pugio*	Unknown	17
11	*Palaemonetes*	*vulgaris*	Unknown	26
11	*Palaemonetes*	*intermedius*	Unknown	18
11	*Polychaeta*	*spp.*	Unknown	5
11	*Polychaeta*	*spp.*	Unknown	6
11	*Amphipoda*	*spp.*	Unknown	7
12	*Panopeus*	*herbstii*	Female	23
12	*Panopeus*	*herbstii*	Female	19
12	*Panopeus*	*herbstii*	Male	20
12	*Eurypanopeus*	*depressus*	Male	11
12	*Eurypanopeus*	*depressus*	Male	9
12	*Eurypanopeus*	*depressus*	Male	11
12	*Eurypanopeus*	*depressus*	Male	8
12	*Eurypanopeus*	*depressus*	Male	12
12	*Eurypanopeus*	*depressus*	Male	8
12	*Eurypanopeus*	*depressus*	Male	9
12	*Eurypanopeus*	*depressus*	Male	7
12	*Eurypanopeus*	*depressus*	Male	12
12	*Eurypanopeus*	*depressus*	Male	4
12	*Eurypanopeus*	*depressus*	Male	6
12	*Eurypanopeus*	*depressus*	Male	5
12	*Eurypanopeus*	*depressus*	Female	11
12	*Eurypanopeus*	*depressus*	Female	10
12	*Eurypanopeus*	*depressus*	Female	6
12	*Eurypanopeus*	*depressus*	Female	11
12	*Eurypanopeus*	*depressus*	Female	9

12	*Eurypanopeus*	*depressus*	Female	7
12	*Eurypanopeus*	*depressus*	Female	9
12	*Eurypanopeus*	*depressus*	Female	10
12	*Eurypanopeus*	*depressus*	Female	6
12	*Eurypanopeus*	*depressus*	Female	11
12	*Eurypanopeus*	*depressus*	Female	6
12	*Eurypanopeus*	*depressus*	Female	5
12	*Eurypanopeus*	*depressus*	Female	5
12	*Eurypanopeus*	*depressus*	Unknown	3
12	*Eurypanopeus*	*depressus*	Unknown	3
12	*Eurypanopeus*	*depressus*	Unknown	4
12	*Eurypanopeus*	*depressus*	Unknown	3
12	*Eurypanopeus*	*depressus*	Unknown	4
12	*Eurypanopeus*	*depressus*	Unknown	3
12	*Eurypanopeus*	*depressus*	Unknown	5
12	*Eurypanopeus*	*depressus*	Unknown	2
12	*Eurypanopeus*	*depressus*	Unknown	2
13	*Eurypanopeus*	*depressus*	Female	19
13	*Eurypanopeus*	*depressus*	Female	7
13	*Eurypanopeus*	*depressus*	Female	18
13	*Eurypanopeus*	*depressus*	Female	6
13	*Eurypanopeus*	*depressus*	Female	14
13	*Eurypanopeus*	*depressus*	Female	8
13	*Eurypanopeus*	*depressus*	Female	10
13	*Eurypanopeus*	*depressus*	Female	5
13	*Eurypanopeus*	*depressus*	Female	8
13	*Eurypanopeus*	*depressus*	Female	4
13	*Eurypanopeus*	*depressus*	Female	9
13	*Eurypanopeus*	*depressus*	Female	4
13	*Eurypanopeus*	*depressus*	Male	9
13	*Eurypanopeus*	*depressus*	Male	6
13	*Eurypanopeus*	*depressus*	Male	6
13	*Gobiosoma*	*bosc*	Unknown	42
13	*Palaemonetes*	*intermedius*	Unknown	18
13	*Palaemonetes*	*intermedius*	Unknown	23
13	*Palaemonetes*	*intermedius*	Unknown	17
13	*Palaemonetes*	*intermedius*	Unknown	18
13	*Palaemonetes*	*intermedius*	Unknown	15
13	*Palaemonetes*	*intermedius*	Unknown	15
13	*Palaemonetes*	*spp.*	Unknown	19
13	*Palaemonetes*	*vulgaris*	Unknown	19
13	*Callinectes*	*sapidus*	Male	24
14	*Panopeus*	*herbstii*	Female	15
14	*Panopeus*	*herbstii*	Female	11

14	*Panopeus*	*herbstii*	Female	11
14	*Eurypanopeus*	*depressus*	Male	18
14	*Eurypanopeus*	*depressus*	Male	7
14	*Eurypanopeus*	*depressus*	Male	7
14	*Eurypanopeus*	*depressus*	Male	5
14	*Eurypanopeus*	*depressus*	Male	8
14	*Eurypanopeus*	*depressus*	Male	8
14	*Eurypanopeus*	*depressus*	Male	10
14	*Eurypanopeus*	*depressus*	Male	9
14	*Eurypanopeus*	*depressus*	Male	10
14	*Eurypanopeus*	*depressus*	Male	7
14	*Eurypanopeus*	*depressus*	Male	9
14	*Eurypanopeus*	*depressus*	Female	13
14	*Eurypanopeus*	*depressus*	Female	10
14	*Eurypanopeus*	*depressus*	Female	9
14	*Eurypanopeus*	*depressus*	Female	14
14	*Eurypanopeus*	*depressus*	Female	9
14	*Eurypanopeus*	*depressus*	Female	6
14	*Eurypanopeus*	*depressus*	Female	10
14	*Eurypanopeus*	*depressus*	Female	9
14	*Eurypanopeus*	*depressus*	Female	11
14	*Eurypanopeus*	*depressus*	Female	10
14	*Eurypanopeus*	*depressus*	Female	9
14	*Eurypanopeus*	*depressus*	Female	7
14	*Eurypanopeus*	*depressus*	Female	9
14	*Eurypanopeus*	*depressus*	Female	6
14	*Panopeus*	*herbstii*	Male	14
14	*Polychaeta*	*spp.*	Unknown	9
14	*Eurypanopeus*	*depressus*	Unknown	3
14	*Alpheus*	*estuariensis*	Unknown	23
14	*Callinectes*	*sapidus*	Unknown	16
14	*Callinectes*	*sapidus*	Male	20
14	*Callinectes*	*sapidus*	Male	11
15	*Eurypanopeus*	*depressus*	Female	9
15	*Eurypanopeus*	*depressus*	Female	8
15	*Eurypanopeus*	*depressus*	Female	6
15	*Eurypanopeus*	*depressus*	Female	11
15	*Eurypanopeus*	*depressus*	Female	7
15	*Eurypanopeus*	*depressus*	Female	9
15	*Eurypanopeus*	*depressus*	Female	8
15	*Eurypanopeus*	*depressus*	Female	5
15	*Eurypanopeus*	*depressus*	Female	6
15	*Eurypanopeus*	*depressus*	Female	9
15	*Eurypanopeus*	*depressus*	Female	6

15	*Eurypanopeus*	*depressus*	Female	8
15	*Eurypanopeus*	*depressus*	Female	9
15	*Eurypanopeus*	*depressus*	Female	9
15	*Eurypanopeus*	*depressus*	Female	11
15	*Eurypanopeus*	*depressus*	Male	10
15	*Eurypanopeus*	*depressus*	Male	5
15	*Eurypanopeus*	*depressus*	Male	14
15	*Eurypanopeus*	*depressus*	Male	9
15	*Eurypanopeus*	*depressus*	Male	7
15	*Eurypanopeus*	*depressus*	Male	8
15	*Eurypanopeus*	*depressus*	Male	7
15	*Eurypanopeus*	*depressus*	Male	6
15	*Eurypanopeus*	*depressus*	Male	9
15	*Eurypanopeus*	*depressus*	Male	6
15	*Eurypanopeus*	*depressus*	Male	11
15	*Eurypanopeus*	*depressus*	Male	7
15	*Panopeus*	*herbstii*	Female	6
15	*Palaemonetes*	*intermedius*	Unknown	17
15	*Polychaeta*	*spp.*	Unknown	24
15	*Polychaeta*	*spp.*	Unknown	12
16	*Panopeus*	*herbstii*	Female	16
16	*Panopeus*	*herbstii*	Female	12
16	*Eurypanopeus*	*depressus*	Female	19
16	*Eurypanopeus*	*depressus*	Female	16
16	*Eurypanopeus*	*depressus*	Female	10
16	*Alpheus*	*spp.*	Unknown	21
16	*Polychaeta*	*spp.*	Unknown	35
16	*Melongena*	*corona*	Unknown	52
16	*Clibinarius*	*vittatus*	Unknown	28

Appendix B – Visual Evidence of Expansion of Planting Areas

Aerial imagery via drone conducted by ANERR staff representing each RP. Initial imagery was captured in January of 2022, and subsequent imagery was captured in April of 2022. Future aerial imagery is expected as an additional tool to monitor progress of the Cat Point Living Shoreline Project.

RPA

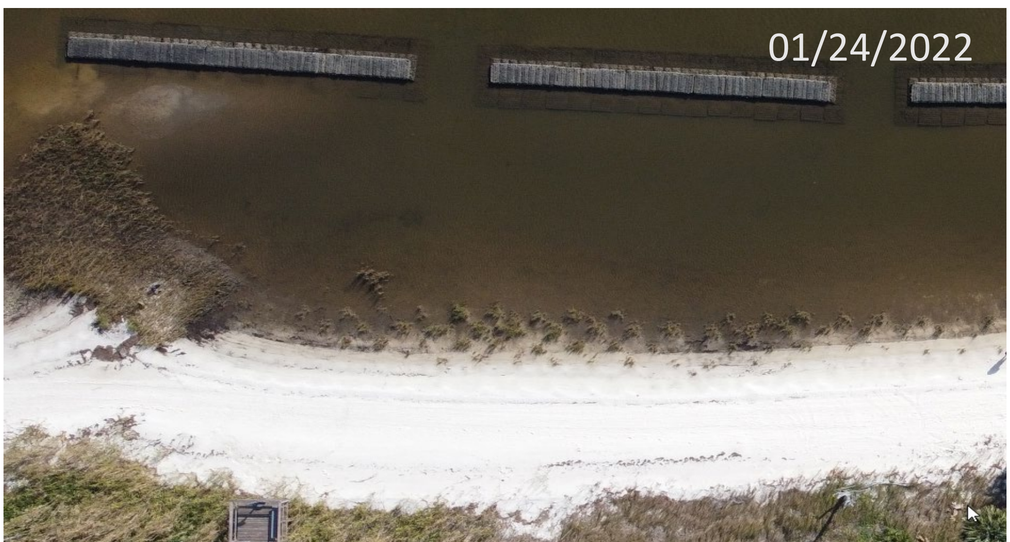
RPB

RPC

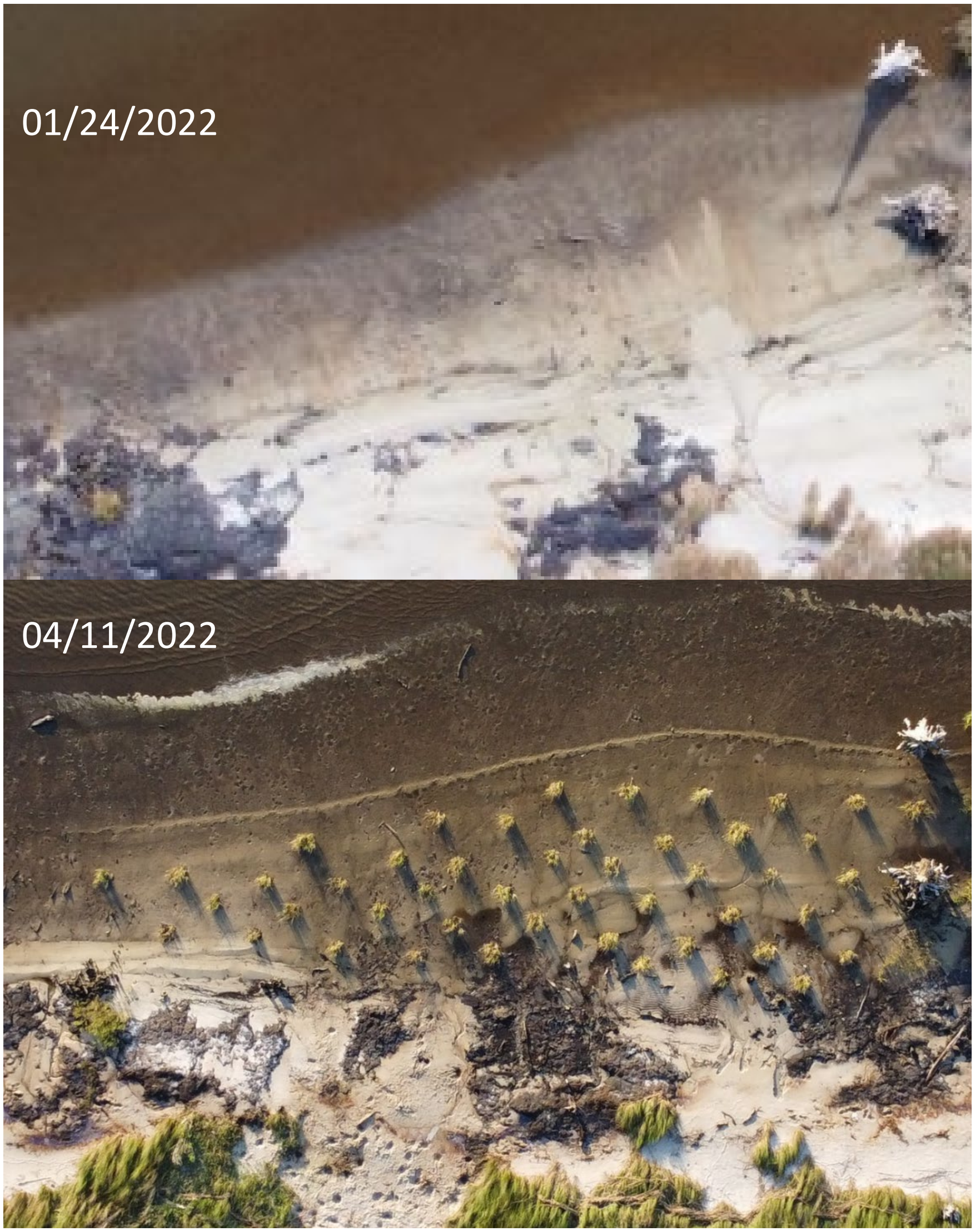
RPD

RPE

RPF



RPG



RPH/RPI

RPJ

RPK

RPL

Appendix C – Water Quality Measurements at Cat Point Living Shoreline from December 2016-April 2023

Table 10.

Date	Time	Temperature (^{0}C)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (FNU)
12/7/2016	14:10	22.9	28.02	14.19	8.16	.
1/4/2017	10:40	19.8	28.39	8.73	7.94	.
1/12/2017	11:56	17.9	22.18	10.84	7.92	.
1/18/2017	14:49	22.3	17.25	10.7	7.89	.
1/24/2017	13:48	21.3	22.32	11.99	8.1	.
2/2/2017	12:14	21.4	12.12	11.39	7.99	.
2/9/2017	9:25	17.3	14.94	10.3	7.82	.
2/16/2017	9:09	16.7	10.99	7.72	7.87	.
2/22/2017	10:11	18.9	17.6	7.04	7.58	.
3/2/2017	12:48	22.3	15.78	8.71	8.05	.
3/9/2017	10:57	21.3	27.98	7.62	8.15	.
3/15/2017	13:10	15.9	30.19	10.13	7.66	.
3/20/2017	10:51	17.2	13.4	9.3	8.13	.
3/30/2017	9:03	22.3	20.71	6.71	7.65	.
4/5/2017	10:15	24.4	12.32	7.52	7.96	.
4/11/2017	12:43	25.2	16.6	8.01	7.87	.
4/20/2017	10:55	25.2	29.16	6.57	7.55	.
4/28/2017	10:56	25	10.74	7.14	7.81	.
5/1/2017	12:17	24.9	15.13	7.62	8.02	.
5/12/2017	9:00	25	16.9	6.58	8.02	.
5/17/2017	9:21	26.2	23.15	7.01	8.15	.
5/23/2017	10:43	26.2	17.49	6.68	8.31	.
6/2/2017	13:33	29	22.22	6.32	8.27	.
6/5/2017	12:37	30.1	16.46	6.19	8	.
6/13/2017	10:29	26.1	25.83	6.6	7.7	.
6/19/2017	13:30	29.1	14.36	6.93	7.91	.
6/29/2017	12:45	28.8	17.96	6.62	7.74	.
7/6/2017	13:24	34.4	15.96	8.38	7.72	.
7/12/2017	11:53	31.2	14.55	6.76	8.03	.
7/20/2017	9:49	30	21.68	6.47	8.07	.
7/27/2017	10:45	30.6	13.85	7.13	8.02	.
8/4/2017	10:13	28.1	19.73	6.08	7.75	.
8/10/2017	12:08	32.9	22.07	6.86	7.95	.
8/17/2017	9:51	30.7	14.25	4.86	7.68	.
8/22/2017	9:27	30	25.53	5.67	8.09	.
8/29/2017	11:03	28	28.43	6.03	.	.
9/6/2017	10:52	28.4	18.25	6.95	7.21	.
9/15/2017	10:10	26.8	26.59	7.35	8.12	.

9/18/2017	11:10	28.6	25.94	6.61	7.96	.
9/27/2017	10:16	29	31.4	6.27	7.99	.
10/4/2017	12:32	25.6	30.45	7.14	7.8	.
10/11/2017	11:56	30.7	29.97	6.65	7.99	.
10/19/2017	12:45	25.5	30.46	9.05	7.99	.
10/27/2017	13:22	23.2	24.06	7.72	8.22	.
11/2/2017	10:55	20.2	23.3	9.52	7.68	.
11/9/2017	10:55	24.7	24.69	8.02	8.21	.
11/17/2017	13:19	21.6	32.52	8.04	8.21	.
11/21/2017	11:50	17	32.51	7.93	8.11	.
11/29/2017	14:43	22.1	32.78	8.57	7.85	.
12/7/2017	11:50	14.7	31.66	8.61	7.82	.
12/21/2017	11:01	19.1	25.19	9.76	8.11	.
1/4/2018	13:29	12	32.07	10.73	7.83	.
1/10/2018	10:44	14.3	32.99	8.66	8.01	.
1/16/2018	12:04	13.4	30.04	10.99	8.14	.
1/23/2018	8:46	11.4	32.34	9.1	8.08	.
1/31/2018	10:53	14.1	30.91	10.1	8.03	.
2/7/2018	13:07	18.1	32.12	8.91	7.76	.
2/15/2018	9:17	18.5	32.23	7.67	7.89	.
2/19/2018	13:21	24.5	15.32	10.75	8.38	.
2/26/2018	10:54	23.2	14.98	8.12	7.79	.
3/8/2018	13:12	20.3	15.86	10.38	8.03	.
3/14/2018	13:50	18.2	16.03	11.28	8.26	.
3/22/2018	11:10	15.8	18.48	9.23	7.82	.
3/27/2018	12:49	21.3	22.93	8.16	7.83	.
4/5/2018	9:46	16	25.25	9.06	7.79	.
4/13/2018	14:21	25	23.56	7.55	7.82	.
4/18/2018	11:49	21.5	12.13	10.55	8.17	.
4/25/2018	12:22	23.8	23.03	10.53	8.09	.
5/3/2018	11:09	23.1	25.61	7.66	7.84	.
5/11/2018	14:19	29.9	19.35	8.57	8.31	.
5/17/2018	10:01	25.6	29.6	5.9	7.98	.
5/25/2018	10:08	27.8	25.6	7.04	8.13	.
5/31/2018	12:09	29.3	23.77	11.32	7.93	.
6/6/2018	11:45	27.9	16.63	7.17	7.83	.
6/15/2018	14:24	29.5	8.92	9.43	8.1	.
6/19/2018	11:37	30.2	17.72	7.89	8.05	.
6/27/2018	11:09	31	18.1	6.48	7.92	.
7/18/2018	15:05	31.4	11.8	8.58	8.01	.
7/26/2018	12:06	32.4	19.61	8.1	8.27	.
7/31/2018	15:13	31	11.44	7.4	8	.
8/7/2018	11:32	30.9	20.85	7.04	7.75	.
8/14/2018	10:29	29.3	13.82	5.42	7.92	.

8/22/2018	13:22	30.8	14.84	7.56	8.1	.
8/30/2018	9:24	26.9	28.51	5.5	7.77	.
9/6/2018	10:06	27.5	26.6	6.58	7.8	.
9/14/2018	10:29	31.2	26.97	6.55	8.12	.
9/17/2018	8:38	30.1	16.47	6.2	8.21	.
9/24/2018	8:43	27.3	25.05	6.13	8	.
10/3/2018	11:00	28.9	25.84	6.21	7.77	.
10/8/2018	8:49	25.9	29.91	6.48	7.88	.
10/17/2018	10:58	27.8	28.25	7.04	7.82	.
10/24/2018	13:50	25.4	28.18	7.26	7.91	.
10/29/2018	10:05	22.8	19.71	7.69	7.94	.
11/5/2018	9:20	20.5	21.78	7.54	7.84	.
11/13/2018	9:40	21	29.85	6.61	7.88	.
11/20/2018	9:30	16.6	15.38	8.04	7.89	.
11/26/2018	9:13	18.1	22.96	7.55	7.93	.
12/3/2018	10:20	19.3	7.22	8.41	7.72	.
12/10/2018	10:25	13.9	15.89	10.68	8.24	.
12/17/2018	11:00	15	7.14	9.26	7.88	.
1/2/2019	13:22	21.7	5.51	9.43	7.86	.
1/9/2019	11:14	17	8.11	11.87	8.35	.
1/16/2019	15:19	14.6	2.2	12.99	8.76	.
1/23/2019	10:18	15	9.75	9.74	8.18	.
1/31/2019	11:20	9.8	7.67	12.21	8.22	.
2/4/2019	11:28	15.2	13.12	12.45	8.27	.
2/14/2019	11:42	15.4	16.98	9.97	8.38	.
2/20/2019	9:26	17.5	20.57	8.78	8.04	.
2/27/2019	13:48	20.6	24.26	10.79	8.07	.
3/5/2019	14:22	18.3	14.57	13.45	8.31	.
3/11/2019	14:21	23.4	11.66	11.39	8.4	.
3/18/2019	12:15	18.6	23.28	10.37	8.22	.
3/25/2019	11:41	21.2	16.41	11.04	8.14	.
4/2/2019	14:57	19.6	25.13	12.02	8.18	.
4/9/2019	9:01	21.3	21.39	6.01	7.73	.
4/18/2019	9:44	22.3	18.44	7.52	8.24	.
4/25/2019	11:57	22.8	10.78	8.28	7.74	.
4/30/2019	9:05	23.6	11.34	6.43	7.85	.
5/8/2019	10:57	26.34	10.18	7.13	7.95	.
5/14/2019	11:35	26	12.58	7.83	7.97	.
5/22/2019	8:32	28.1	16.75	6.38	7.88	.
5/31/2019	13:32	31.8	16.41	6.8	7.95	.
6/4/2019	11:03	30.4	13.22	6.9	7.4	.
6/11/2019	12:33	31	21.06	8.13	7.92	.
6/17/2019	9:18	27.8	20.37	5.96	7.68	.
6/27/2019	13:45	34.7	25.56	6.02	7.72	.

7/2/2019	12:25	32	17.09	7.75	8.08	.
7/10/2019	9:11	27.8	17.95	4.32	7.67	.
7/19/2019	9:45	31.8	18.18	5.39	7.95	.
7/23/2019	9:09	30	21.44	2.79	7.53	.
8/1/2019	14:46	33.5	25.88	8.11	7.99	.
8/5/2019	15:41	31.5	19.68	7.98	8.09	.
8/12/2019	12:05	32	17.76	7.24	7.96	.
8/22/2019	8:43	29	22.16	5.86	7.74	.
8/27/2019	8:22	28.7	23.47	3.94	7.78	.
9/3/2019	10:40	29.1	27.8	5.03	7.92	.
9/9/2019	12:47	32.6	17.05	8.07	8.25	.
9/18/2019	8:55	29.3	29.34	4.52	7.55	.
9/25/2019	8:34	27.1	25.44	5.94	7.46	.
10/2/2019	13:18	31.7	31.22	6.53	7.71	.
10/10/2019	8:32	23.7	32	6.02	7.55	.
10/18/2019	8:19	22.6	29.57	.	7.33	.
10/23/2019	11:08	20.9	29.72	7.48	7.65	.
10/31/2019	11:54	28.2	27.26	8	7.95	.
11/6/2019	15:23	25.4	31.21	7.21	7.86	.
11/14/2019	12:14	14.7	31.65	9.45	7.61	.
11/22/2019	10:21	16.8	28.67	8.93	8.07	.
11/27/2019	9:09	17.5	24.82	8.04	8.23	.
12/4/2019	8:13	14.1	19.26	8.69	8.3	.
12/13/2019	9:20	14.9	30.06	7.75	7.82	.
12/19/2019	10:36	9.6	27.83	9.93	7.96	.
12/24/2019	10:43	14.7	31.5	9.41	8.31	.
1/2/2020	10:18	15.8	11.21	9.48	8.26	.
1/10/2020	12:41	20.4	19.63	10.36	8.3	.
1/16/2020	11:57	22	20.01	11.02	8.41	.
1/23/2020	11:44	12.6	14.98	10.5	8.19	.
1/29/2020	15:35	13.4	15.75	9.95	7.82	.
2/6/2020	11:11	18.1	2.67	9.16	8.36	.
2/13/2020	9:04	18.6	10.48	8.55	8.24	.
2/18/2020	11:58	18.2	4.66	9.25	8.27	.
2/27/2020	9:59	13.8	14.68	10.65	8.14	.
3/5/2020	10:10	19	1.46	8.89	8.46	.
3/11/2020	11:51	21.1	6.17	11.03	8.13	.
3/19/2020	12:11	24.1	0.57	8.68	8.61	.
3/25/2020	12:01	27.5	1.49	8.03	8.43	.
4/1/2020	15:19	25.7	9.62	8.69	7.68	.
4/8/2020	10:47	24.3	4.97	7.52	8.28	.
4/14/2020	12:31	21.7	18.58	7.02	8.01	.
4/21/2020	13:56	27.1	13.61	11.41	8.39	.
4/29/2020	10:00	21.4	4.45	8.5	8.56	.

5/7/2020	13:03	26	6.85	8.4	8.13	.
5/14/2020	9:31	21.7	25.37	7.22	8.25	.
5/19/2020	9:56	24.9	13.81	7.29	8.46	.
5/27/2020	9:52	25	25.46	6.13	7.92	.
6/3/2020	12:10	26.2	26.2	6.81	7.9	.
6/10/2020	11:20	28.7	13.7	7.25	7.71	.
6/17/2020	13:40	27.6	25.31	7.22	7.68	.
6/24/2020	11:43	29.3	13.26	7.19	7.57	.
7/2/2020	8:54	28.1	15.28	5.64	7.84	.
7/10/2020	11:25	28.9	20.36	7.93	8.04	.
7/14/2020	11:37	30.3	21.57	6.79	7.96	.
7/24/2020	15:05	29	31.22	7.27	7.65	.
7/27/2020	14:20	30.5	31.56	7.13	7.89	.
8/5/2020	12:56	32.1	18	7.54	8.04	.
8/14/2020	11:29	29.2	20.43	4.91	7.82	.
8/21/2020	15:30	28.2	19.56	7.6	7.94	.
8/25/2020	10:22	28.4	26.93	6.48	7.92	.
9/3/2020	10:35	29.7	16.73	6.88	8	.
9/10/2020	10:08	27.7	29.22	6.17	7.72	.
9/17/2020	11:57	25.6	12.7	7.14	8.13	.
9/24/2020	12:35	24.8	22.16	6.96	7.8	.
9/29/2020	11:53	25.3	11.34	6.07	8.26	.
10/6/2020	9:12	20.9	17.9	7.67	9	.
10/15/2020	12:40	26.7	16.32	8.55	8.13	.
10/20/2020	12:15	26	28.02	8.18	8.12	.
10/27/2020	11:09	24.8	30.27	6.52	7.99	.
11/5/2020	10:30	17.6	29.17	8.15	8.3	.
11/12/2020	14:39	24.7	30.27	8.97	8.26	.
11/19/2020	15:34	19.5	29.04	8.69	8.62	.
12/3/2020	15:21	16.2	19.35	10.18	8.58	.
12/9/2020	10:57	12	16.38	10.73	8.51	.
12/16/2020	14:00	17.3	12.48	9.88	8.16	.
12/22/2020	10:30	14.9	23.92	9.49	8.23	.
12/28/2020	11:38	13.6	17.23	13.27	8.46	.
1/5/2021	10:47	15.8	17.21	9.87	8.27	.
1/12/2021	9:25	10.5	18.99	10.15	8.15	.
1/18/2021	10:11	11.3	10.43	9.8	7.96	.
1/27/2021	11:42	19	14.94	9.92	8.44	.
2/2/2021	16:11	14.8	8.94	14.12	8.53	.
2/10/2021	13:19	19	20.39	11.61	8.22	.
2/18/2021	8:58	14.6	16.39	8.86	7.86	.
2/25/2021	15:33	22.5	8	9.26	8.38	.
3/2/2021	13:10	17.9	12.62	9.05	7.81	16.8
3/9/2021	10:18	15.7	22.38	10.35	8.02	12.9

3/16/2021	15:22	24.2	8.97	8.31	8.17	27.4
3/24/2021	14:00	19.8	14.26	8.39	8.08	137.2
3/29/2021	13:06	22.5	16.5	9.28	8.19	78.6
4/9/2021	9:30	19.7	6.46	6.25	7.81	29.8
4/13/2021	14:31	26.6	6.8	9.57	8.21	22.9
4/21/2021	10:53	21.2	10.92	7.51	7.82	17.3
4/30/2021	9:23	23.2	15.3	7.14	8.02	9
5/3/2021	13:15	25.5	6.88	7.85	8.03	47
5/14/2021	9:44	20.8	15.66	7.44	8.01	28.6
5/19/2021	10:25	21.9	27.3	7.15	7.59	50.4
5/27/2021	8:41	25	24.36	5.95	7.98	3.6
6/7/2021	11:12	27.1	19.24	6.9	7.99	29.2
6/14/2021	11:37	28.5	16.48	7.23	7.95	9
6/23/2021	11:26	26.6	14.81	7.01	7.88	11.5
6/30/2021	14:41	25.7	25.5	6.45	7.85	36.6
7/8/2021	9:23	26.2	23.85	5.95	8.05	11.2
7/13/2021	13:44	28.6	11.96	8.26	8.05	29
7/22/2021	7:59	26.8	10.08	5.5	7.94	7.7
7/28/2021	8:28	28.2	18.94	5.07	8	11.5
8/3/2021	13:20	30.1	14.55	4.68	7.7	16.6
8/13/2021	14:42	34.1	25.42	6.67	7.91	50.2
8/17/2021	10:17	25.3	27.36	5.94	7.76	50.1
8/24/2021	11:30	28	6.73	7.46	8	18.6
9/1/2021	11:16	25.2	10.26	5.67	7.73	15.7
9/7/2021	11:25	27.7	17.19	6.83	7.73	15.8
9/15/2021	10:59	25.1	23.99	6.8	7.85	45.5
9/23/2021	9:34	23.1	20.96	6.66	7.9	32
9/29/2021	11:36	27.4	22.48	7.12	7.96	8.7
10/6/2021	9:07	23	22.25	6.27	7.74	44.9
10/14/2021	9:33	24.2	27.52	6.55	7.98	25.2
10/20/2021	10:29	21.1	27.56	8.02	8.07	16.6
10/26/2021	8:41	22.3	22.97	5.71	8.06	4.2
11/4/2021	11:35	18.4	21.97	10.07	8.16	19.5
11/9/2021	9:15	16.1	26.42	9.06	8.31	5.6
11/17/2021	15:42	21.8	20.98	9.15	8.26	12.45
11/23/2021	9:46	12.9	30.61	8.94	7.85	14
12/1/2021	12:11	14.8	28.68	9.4	7.65	7.3
12/9/2021	13:00	18.8	24.32	9.94	8.01	8.9
12/17/2021	11:22	19.5	30.95	9.14	7.74	12.5
12/20/2021	14:52	15	30.33	8.11	7.89	26.3
1/6/2022	10:51	16.2	17.63	11.17	8.3	14.8
1/12/2022	14:11	13.3	29.37	10.41	7.9	4.3
1/19/2022	12:24	15.3	13.23	12.63	8.31	62.3
1/26/2022	11:03	10.2	18.98	9.48	8.31	237.3

2/2/2022	12:48	15.8	15.78	10.36	8.33	26.4
2/9/2022	12:14	11	24.17	10.4	7.41	3.4
2/16/2022	12:48	18.8	15.69	11.41	8.05	15.1
2/24/2022	7:58	15.7	19.07	7.94	8.09	13.6
3/3/2022	13:36	22.3	15.7	11.19	8.35	8.1
3/9/2022	8:57	19.1	11.72	8.29	8.71	28.7
3/18/2022	11:43	20.5	13.3	9.62	8.35	92.4
3/25/2022	13:25	19.5	19.34	9.47	8.11	15.3
3/30/2022	9:18	18.1	8.7	7.56	8.1	206.6
4/6/2022	12:42	21.4	7.79	7.47	7.46	87.9
4/12/2022	10:45	19.3	13.62	9.14	8.11	63
4/20/2022	11:17	16.9	11.71	9.12	7.82	80.5
4/28/2022	8:10	20.7	25.46	6.94	7.5	69.8
5/5/2022	7:50	23.3	19.45	5.94	7.3	3
5/11/2022	10:03	20.5	21.44	8.45	7.49	7
5/17/2022	14:41	26.7	13.94	8.99	8.04	10.3
5/23/2022	14:00	25.7	15.1	7.42	7.49	116.3
5/31/2022	15:37	27.5	18.14	7.05	7.75	51.1
6/6/2022	14:56	29.5	24.48	6.95	8.56	53.9
6/13/2022	10:03	27	10.21	6.32	8.06	18.1
6/21/2022	15:25	31.2	21.81	6.45	8.05	90
7/1/2022	9:22	26.1	28.54	5.1	8.17	8.6
7/5/2022	9:14	27.3	24.26	5.88	8.19	10.3
7/11/2022	15:17	29.4	16.85	9.2	8.09	18.1
7/20/2022	10:31	27.4	16.19	6.27	7.9	9.8
7/25/2022	8:55	26.5	22.42	4.89	7.79	60.9
8/3/2022	8:08	26.3	14.45	5.48	7.96	21.9
8/8/2022	13:25	26.9	26.8	5.6	7.73	57.3
8/16/2022	13:00	31.8	11.74	8.03	7.94	25.58
8/23/2022	13:23	31.2	22.42	5.39	7.9	26.21
8/29/2022	13:11	31.6	27.77	7.1	7.85	56.7
9/15/2022	10:14	26.8	20.66	5.8	7.81	27.64
9/20/2022	11:41	28.2	27.42	6.09	7.8	31.16
9/27/2022	9:13	23.7	29.17	5.83	7.94	21.99
10/3/2022	11:38	20.9	30.1	7.79	8.11	22.49
10/13/2022	11:47	24.6	31.97	10.01	7.9	8.43
10/20/2022	12:05	15.5	25.38	9.63	8.01	2.54
10/28/2022	9:00	18.4	29.19	7.47	7.88	51.86
11/2/2022	13:14	20	33.73	8.2	7.99	14.79
11/9/2022	10:24	16	33.87	9.44	7.97	39.52
11/17/2022	10:11	12	32.66	9.53	8.16	13.04
11/29/2022	10:39	17.3	28.94	8.53	8.1	20.22
12/7/2022	15:04	20	31.2	8.17	7.9	8.5
12/14/2022	10:29	16.3	31.86	7.78	7.72	23.69

12/21/2022	11:18	10.5	29.57	9.41	7.87	18.71
1/5/2023	11:18	14.5	24.05	9.89	8	1.74
1/12/2022	9:18	14.4	17.86	8.78	7.98	9.5
1/20/2023	14:55	17	21.94	12.51	8.21	10.07
1/26/2023	10:33	13.3	24.99	9.48	7.91	11.75
2/1/2023	11:43	17.7	14.94	10.73	8.13	6.24
2/14/2023	8:17	9.6	6.52	9.58	7.73	12.85
2/20/2023	14:35	21.6	11.72	11.95	7.9	8.6
2/28/2023	8:19	18.6	5.1	6.15	7.71	48.99
3/8/2023	11:55	21.8	19.71	7.6	7.78	220.09
3/15/2023	9:25	10.1	18.61	9.4	7.73	121.63
3/22/2023	9:00	14.2	21.36	8.34	7.73	76.48
3/29/2023	12:24	18.9	17.41	8.4	7.42	46.75
4/6/2023	13:35	25.4	8.87	9.37	8.14	59.77
4/12/2023	12:02	16.3	25.95	8.17	7.86	65.42
4/20/2023	11:36	20.8	14.87	9.43	8.02	25.33
4/26/2023	10:00	18.8	29.68	7.01	7.56	24.27