LIVE OAK POINT LIVING SHORELINES

2024 (Spring) Project and Reference Site Monitoring Report

USACE Permit No.:	SAJ-2011-00287
FDEP Permit No.:	0387876-001-EI-66
Permittee:	Northwest Florida Water Management District 81 Water Management Drive Havana, FL 32333-4712 POC: Robert Lide (robertlide@nwfwater.com)
Entity Conducting Monitoring: (Vegetation Only)	Choctawhatchee Basin Alliance of Northwest Florida State College 109 South Greenway Trail Santa Rosa Beach, FL 32459-5415 POC: Rachel Gwin (gwinr@nwfsc.edu)
Project Location:	Live Oak Point Salt Marsh 30.43º North, -86.25º West (Project Site) 30.42º North, -86.27º West (Reference Site) Approximately 2 ½ Miles NW of Santa Rosa Beach Walton County, Florida

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Synopsis

Live Oak Point contains the largest salt marsh system (approximately 1,000 acres) in Choctawhatchee Bay. However, its ecological integrity and long-term survival is threatened by ongoing erosion and shoreline retreat. Analysis of historic aerials indicates that, since 1941, the salt marsh has retreated up to 300 FT along the northern edge. In situ measurements and analysis of recent digital orthophoto quads (DOQs) show that, prior to construction of breakwaters in 2021 – 2022, shoreline retreat averaged >4 FT per year.

The objectives of the Live Oak Point Living Shorelines project are 1) halting loss of salt marsh habitat at Live Oak Point, 2) restoring salt marsh habitat in a strip parallel to the current shoreline protected by limerock breakwaters, and 3) enhancing existing salt marsh habitat via improved buffers. To achieve these objectives, a living shoreline is being implemented along the northern edge of the Live Oak Point salt marsh.[1] Initial observations strongly suggest that, where breakwaters have been constructed, trajectories have been established that will result in all objectives being achieved.

New construction of approximately 3,440 FT of limerock breakwaters has been implemented at the project site (completed Fall 2022). An additional 1,250± FT of shoreline will be protected by reef balls or other, small (approximately 2-FT base), concrete structures known as "volcanoes" (anticipated to be completed no later than 2025). Plantings of salt marsh vegetation (*Spartina patens, Juncus roemarianus, Spartina alterniflora*) have been implemented along approximately 1,000 FT of shoreline, with additional plantings scheduled for 2024. Barring unforeseen events (e.g., major storms; lack of available plants; sourcing of reef balls or "volcanoes"), full completion of this project is anticipated by 2025.

The Live Oak Point Living Shorelines project is a component of the Northwest Florida Water Management District (NWFWMD) In-Lieu Fee (ILF) mitigation program (USACE Permit SAJ-2011-00287) and is expected to generate, upon full completion, 2.61 estuarine mitigation credits for use by the Florida Department of Transportation (FDOT).

This <u>2024 (Spring) Project and Reference Site Monitoring Report</u> has been developed to comply with federal and state monitoring requirements. It is the sixth monitoring report for the reference site and the second monitoring report for the project area (monitoring of the project area, as planned, commenced after limerock breakwater construction was completed and substantial planting of salt marsh vegetation had occurred). Parameters for the Spring 2024 project and reference site monitoring are vegetation cover, sediment accretion, panoramic and general photo documentation. The reference site has similar geomorphology, tidal range,

[1] The NWFWMD has contracted with the Choctawhatchee Basin Alliance of Northwest Florida State College (CBA) to implement the Live Oak Point Living Shorelines project. Limerock breakwaters (approximately 3,440± FT) were constructed 2021 – 2022. Reef balls or concrete "volcanoes" will be deployed in 2024 or 2025 along approximately 1,250± FT of shoreline where limerock breakwaters were not able to be constructed due to avoidance of submerged aquatic vegetation (SAV). Planting of additional marsh species will continue. Full project completion is anticipated by 2025.

elevations, and vegetation community structure when compared with the project site (the reference site is located approximately 3,000 FT southwest of the project site).

Results of the Spring 2024 vegetation monitoring indicate strong similarity between the project site and the reference site. The Sorensen's Similarity Index comparing the project site with the reference was 0.77. Vegetation diversity was limited (Simpson's Diversity Index [Project Site] = 0.67; Simpson's Diversity Index [Reference Site] = 0.72). At both the project and reference sites, the low marsh is dominated by *Spartina alterniflora*, the mid marsh is dominated by *Spartina patens*, and the high marsh is dominated by *Juncus roemerianus*). At the project site, sediment is generally accumulating behind the newly constructed breakwaters (e.g., see Figure 32), with *Spartina alterniflora* expanding in places (e.g., see Figure 33). Oyster colonies are rapidly becoming established on the breakwaters and submerged aquatic vegetation (SAV), primarily *Halodule wrightii*, has moved in behind breakwaters in multiple locations (e.g., see Figure 31).

Planted vegetation has generally done well in locations protected by limerock breakwaters (e.g., see Figure 35). Where breakwaters are absent (i.e., where breakwaters were not constructed due to SAV-avoidance concerns), planted vegetation has generally washed out (e.g., see Figure 36). Expectations that multiple rows of sandbag plantings (i.e., sandbags with three vegetation plugs per bag) would be sufficient to stop erosion where breakwaters were not constructed were not realized. Corrective measures will entail use of reef balls or concrete "volcanoes" along approximately 1,250± FT of shoreline where limerock breakwaters were not constructed.[2]

All monitoring reports for the Live Oak Point Living Shorelines project site and reference site are posted at https://www.nwfwater.com/Water-Resources/Regional-Wetland-Mitigation-Program/Regional-Mitigation-Plan/NWFWMD-Mitigation-Sites/Choctawhatchee-Watershed-Mitigation-Sites/Live-Oak-Peninsula-ILF/Living-Shorelines or any successor website.

[2] Because of the geometries of reef balls and "volcanoes," they can be positioned more precisely with less potential of disturbance to nearby SAV when compared to loose limerock.

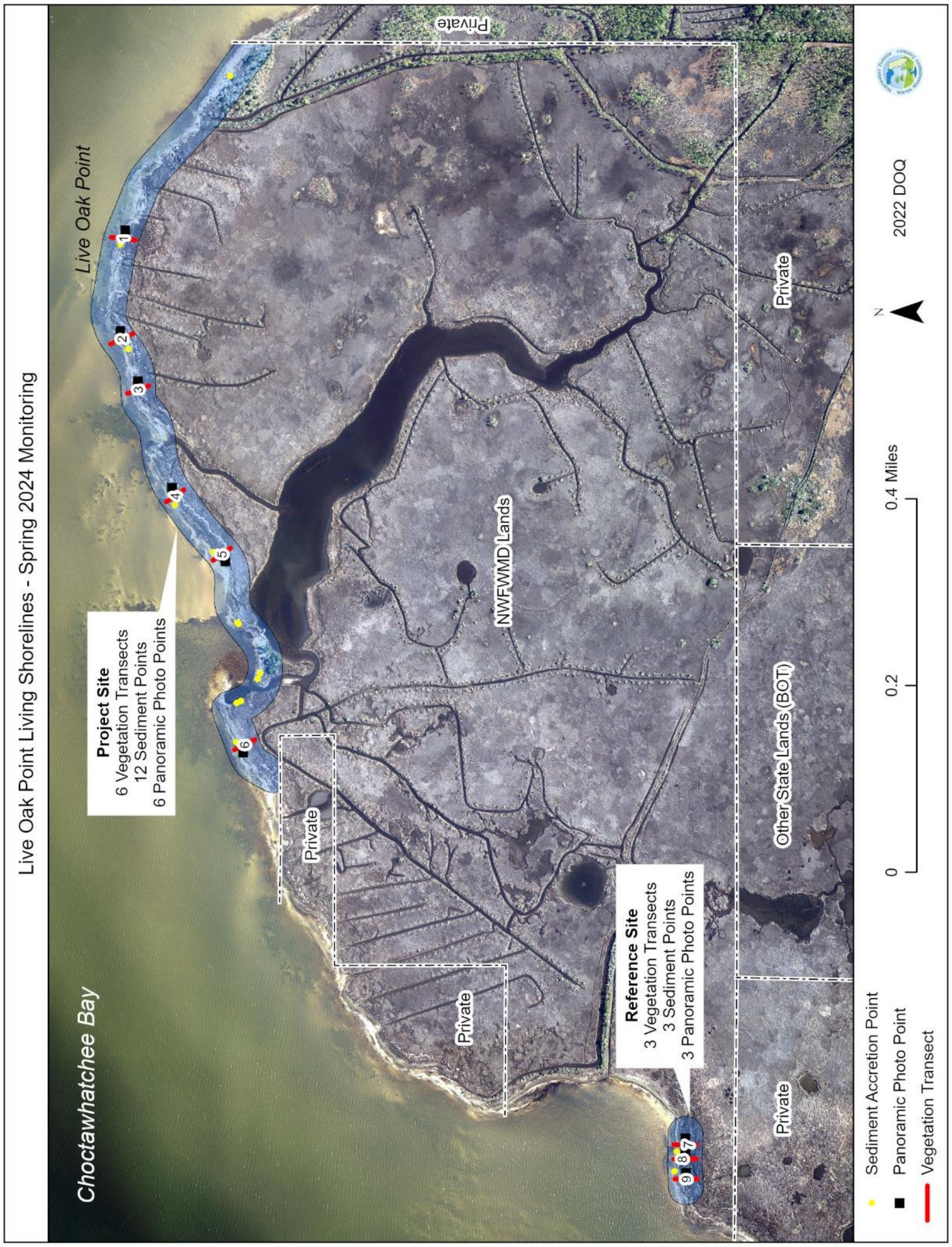

Figure 1. Spring 2024 Monitoring Overview

Figure 2. Spring 2024 Project Site Monitoring

Figure 3. Spring 2024 Reference Site Monitoring

Vegetation Monitoring

Vegetation cover at the project site and reference site was quantitatively measured on 4/15/2024 using a modified Daubenmire method.[3] Three (3) transects of variable length were previously established in the reference area and six (6) transects of variable length were previously established in the project area. Each transect began in the low marsh and extended into the high marsh. Twelve (12) 0.5-meter square ($0.25m^2$) quadrats were sampled along each transect. Four (4) quadrats were located in the low marsh, four (4) in the mid marsh, and four (4) in the high marsh. All plant species were identified in each quadrat. Percent cover of vegetation by species and bare ground was visually estimated.

No exotic or invasive plants were present in any transect. Data collected on 4/15/2024 indicate that, at both the project site and reference site, the low marsh is dominated by *Spartina alterniflora*, the mid marsh by *Spartina patens*, and the high marsh by *Juncus roemerianus*.

Average percent cover of live vegetation (derived from vegetation transects) for the low marsh was 32% at the project site compared with 45% for the reference site; for the mid marsh was 64% at the project site compared with 72% for the reference site; and for the high marsh was 49% at the project site compared with 47% for the reference site.

Table 1. Percent Cover of Vegetation (Spring 2024; Project Site versus Reference Site)

		Project Site	**Reference Site**
Low Marsh	Live Vegetation	32%	45%
	Bare Ground / Duff / Dead Vegetation	68%	55%
Mid Marsh	Live Vegetation	64%	72%
	Bare Ground / Duff / Dead Vegetation	36%	28%
High Marsh	Live Vegetation	49%	47%
	Bare Ground / Duff / Dead Vegetation	51%	53%

[3] Daubenmire, Rexford. 1959. A Canopy-coverage method of vegetational analysis. Northwest Science 33:43-64.

Simpson's Diversity Index ($D = 1 - \sum (P)^2$; where P = percent cover for a given species)[4] was similar at both the project site (D = 0.67) and the reference site (D = 0.71) and indicates limited species diversity consistent with typical saltmarsh habitat in Choctawhatchee Bay.[5]

Table 2. Simpson's Diversity Index (Spring 2024)

Species	**Project Site**		**Reference Site**	
	Percent Cover (P)	**P^2**	**Percent Cover (P)**	**P^2**
Distichlis spicata (Saltbush)	Not Present	Not Present	0.012	0.000135
Hadodule wrightii (Shoalweed)	0.001	0.000002	Not Present	Not Present
Iva Frutescens (Bigleaf Marsh Elder)	0.048	0.002261	Not Present	Not Present
Juncus roemerianus (Needle Rush)	0.449	0.201740	0.260	0.067735
Schoenoplectus pungens (Threesquare Bulrush)	0.003	0.000010	0.006	0.000037
Spartina alterniflora (Smooth Cordgrass)	0.232	0.053836	0.334	0.111486
Spartina patens (Saltmeadow Cordgrass)	0.261	0.068098	0.318	0.101259
Sporobolus spp. (Dropseed)	0.006	0.000033	0.070	0.004890
Total	1.000	0.3260	1.0000	0.2750
Simpson's Diversity Index (D) = $1 - \sum (P)^2$	0.67		0.72	

[4] Simpson, E.H. 1949. Measurement of Diversity. Nature, 163:688.

[5] Percent cover of bare ground, duff, and dead vegetation excluded from Simpson's Diversity Index calculations; D = 0 indicates infinite diversity and D = 1 indicates zero diversity.

Sorensen's Similarity Index (SI = 2C / A + B; where A = the number of species at the project site, B = the number of species at the reference site, and C = the number of species common to both sites)[6] was 0.77, indicating strong species composition similarity between the project site and reference site.

Table 3. Sorensen's Similarity Index (Spring 2024; Project Site and Reference Site)

A = Number of Species at Project Site	7
B = Number of Species at Reference Site	6
C = Number of Species in Common Between Project Site and Reference Site	5
Sorensen's Similarity Index (SI) = 2C / (A + B) = 2(5) / (7 + 6) = 10 / 13 = 0.77	

[6] Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. Kongelige Danske Videnskabernes Selskab. 5 (4): 1–34.

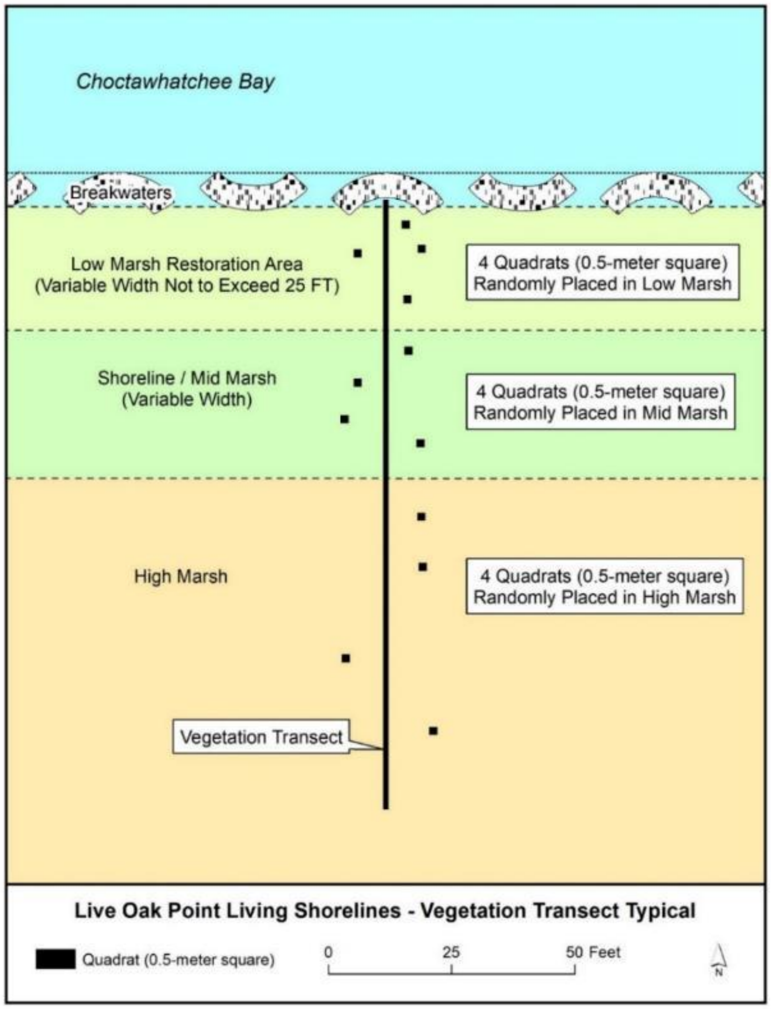

Figure 4. Vegetation Transect Sampling Design (Breakwaters Not Present at Reference Site)

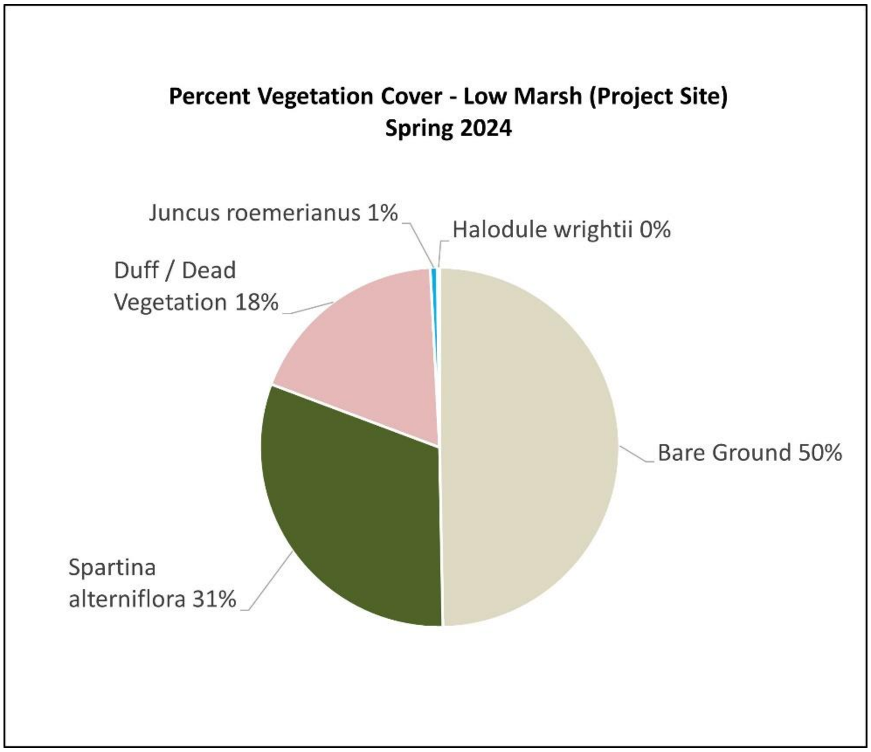

Figure 5. Project Site Low Marsh Vegetation (Average of Transects T1 - T6)

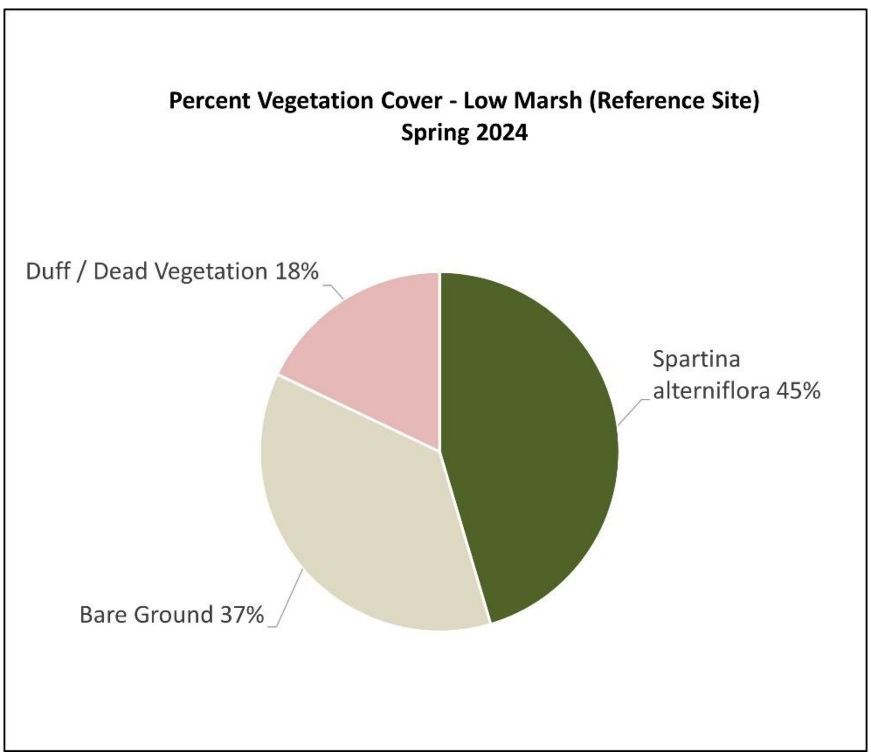

Figure 6. Reference Site Low Marsh Vegetation (Average of Transects T7 - T9)

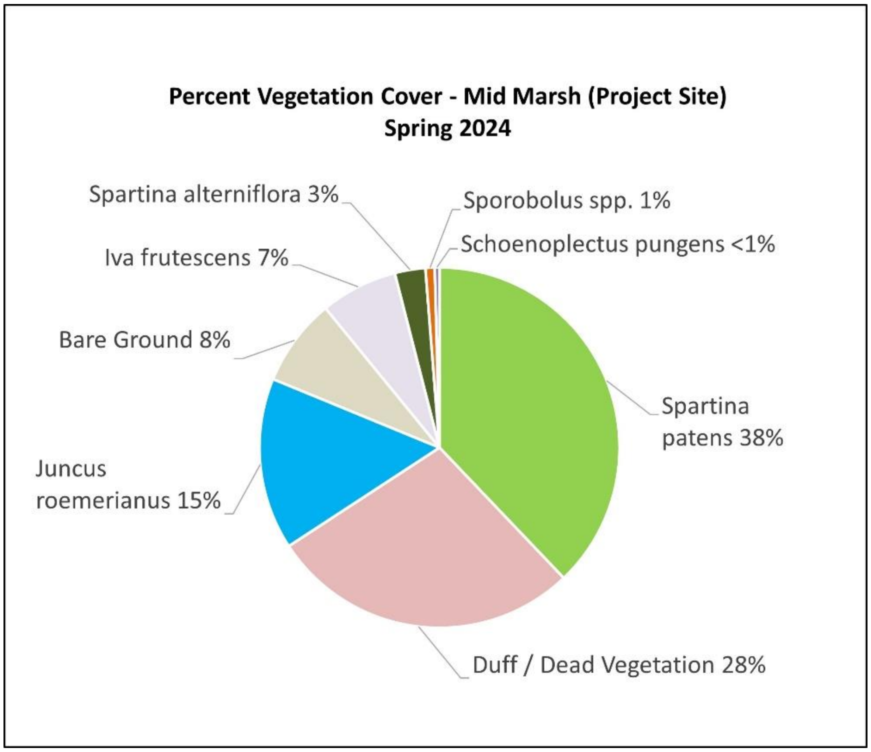

Figure 7. Project Site Mid Marsh Vegetation (Average of Transects T1 - T6)

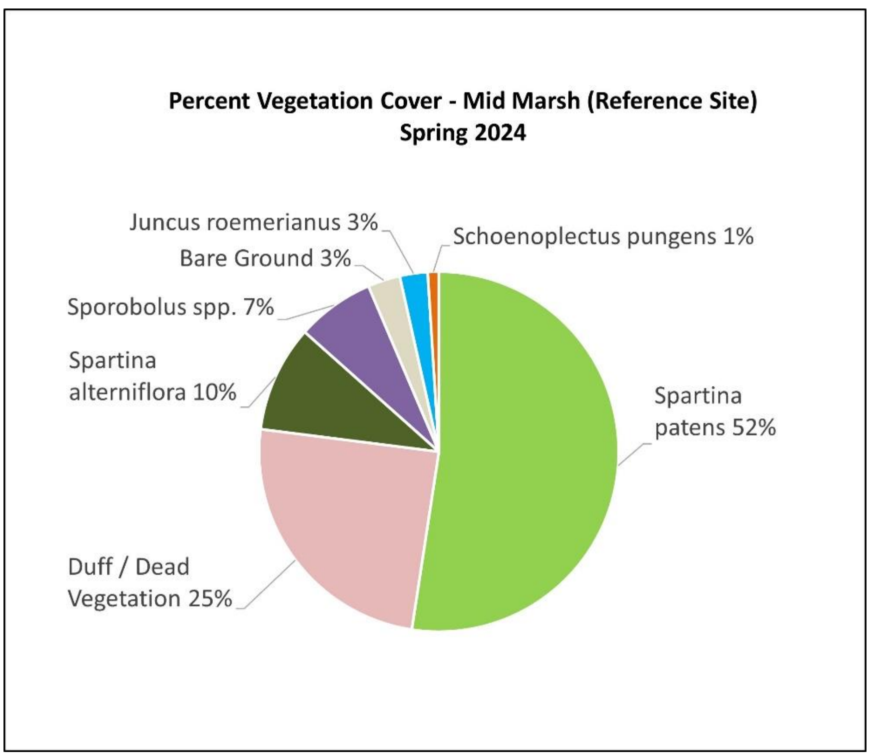

Figure 8. Reference Site Mid Marsh Vegetation (Average of Transects T7 - T9)

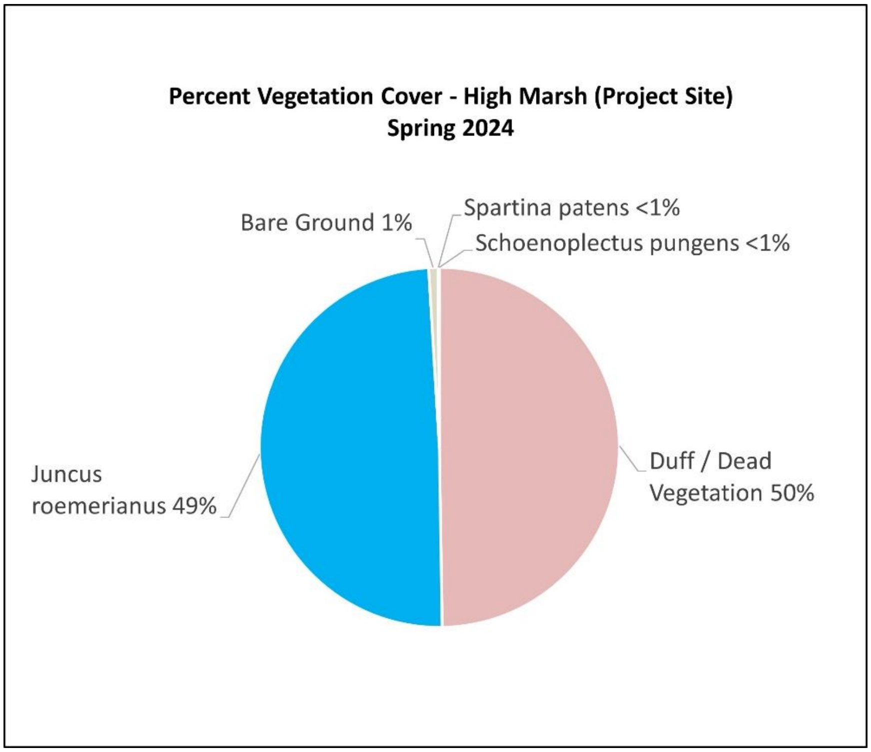

Figure 9. Project Site High Marsh Vegetation (Average of Transects T1 - T6)

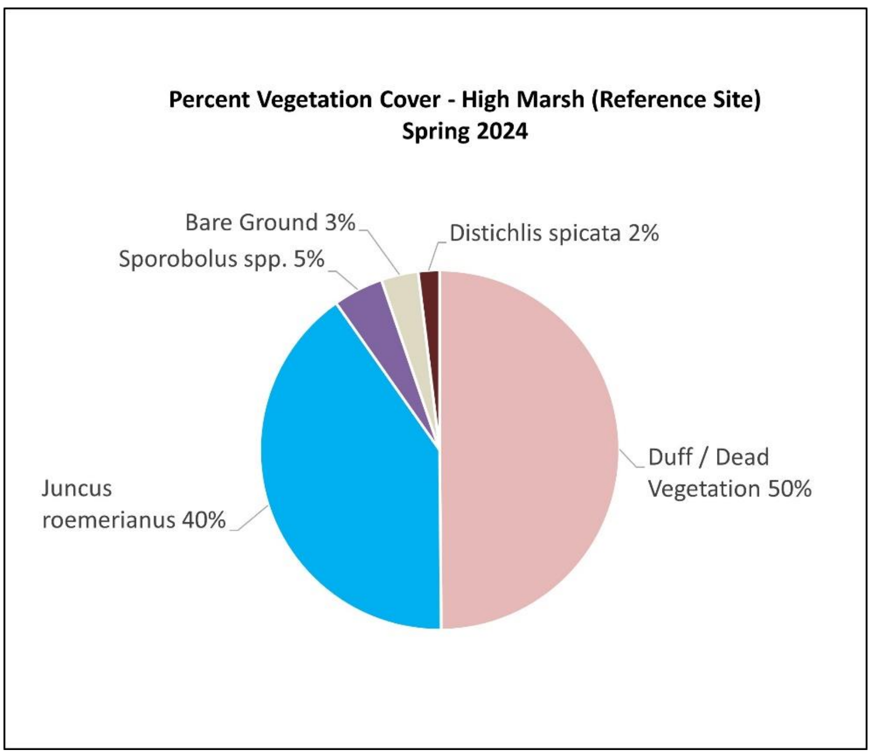

Figure 10. Reference Site High Marsh Vegetation (Average of Transects T7 - T9)

Table 4. Reference Site and Project Site Vegetation (Spring 2024) by Marsh Zone*

Species	Project Site			Reference Site		
	Low Marsh	Mid Marsh	High Marsh	Low Marsh	Mid Marsh	High Marsh
Bare Ground	49.71%	7.88%	0.83%	36.67%	2.92%	3.33%
Distichlis spicata (Saltgrass)	0%	0%	0%	0%	0%	1.92%
Duff / Dead Vegetation	18.46%	27.92%	49.75%	17.92%	24.58%	49.86%
Halodule wrightii (Shoalweed)	0.21%	0%	0%	0%	0%	0%
Iva frutescens (Bigleaf Marsh Elder)	0%	6.92%	0%	0%	0%	0%
Juncus roemerianus (Needle Rush)	0.63%	15.42%	49.29%	0%	2.50%	40.37%
Schoenoplectus pungens (Threesquare Bulrush)	0%	0.42%	0.04%	0%	1.00%	0%
Spartina alterniflora (Smooth Cordgrass)	31.00%	2.75%	0%	45.42%	9.58%	0%
Spartina patens (Saltmeadow Cordgrass)	0%	37.88%	0.08%	0%	52.42%	0%
Sporobolus spp. (Dropseed)	0%	0.83%	0%	0%	7.00%	4.52%

*Due to rounding, percentages may not sum to precisely 100%.

Sediment Accretion Monitoring

To roughly estimate vertical sediment accretion or decrease in the reference area and project area, fifteen sediment accretion monitoring points have been established with systematic data collection beginning May 2023.[7] Each point, assigned a unique ID of SB1 through SB15, consists of a 4" x 7" concrete paving stone placed, plus or minus, approximately 20 cm below the vegetated ground surface. Measurements are made by inserting a thin metal rod into the ground until it contacts the buried paving stone, retracting the rod, and then measuring the rod against a meter stick. By design, these points are located within the existing marsh and not within the marsh restoration zone (i.e., they are not placed in the area between the breakwaters and the existing marsh / shoreline).[8]

Use of buried markers (in this case, buried paving stones) is commonly used to monitor sediment accretion in salt marsh habitat. Our experience at the Live Oak Point Living Shorelines project indicates that useful data will be generated in the centimeter resolution range. However, the coarseness of data obtained from this technique may preclude obtaining definitive trends at millimeter resolutions. At face value, measurements from May 2023 to May 2024 indicate an annual accretion rate of 1.22 mm per year in the existing marsh at the reference site, whereas data from the project site indicate an annual loss of 9.79 mm per year in the existing marsh. Visual observations, however, strongly suggest that vertical erosion is not occurring in the existing marsh at either the project site or the reference site. The unevenness of the marsh surface at the monitoring points, the potential for continued settling of soil after burial of the paving stone, and possible imprecise leveling of the buried paving stone, makes millimeter to submillimeter resolution of sediment accretion trends problematic at best. Additional methods of measuring sediment accretion may become necessary, and sediment monitoring may be expanded into the restoration areas between the breakwaters and the existing marsh where sediment accretion is definitively occurring. Sea level rise for the Panama City area has been estimated by National Oceanic and Atmospheric Administration (2023) area at 3.10 mm per year.[9] Data collected at SB1 through SB15, and possibly other data collected in the future using more precise measurement techniques and/or data collected within the areas between the breakwaters and shoreline, will be used to establish sediment accretion trends for comparison with estimated sea level rise. One sediment accretion monitoring point (SB13; Figure 29), not protected by breakwaters and located in the marsh/water interface, is anomalous in that it has become fully exposed from shoreline erosion. The other fourteen monitoring points appear unlikely to become exposed from shoreline erosion.

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[7] Earlier attempts at measuring sediment accretion either washed out or were vandalized.

[8] When monitoring protocols for this project were being developed to comply with permit conditions, it was decided not to place sediment accretion monitoring points within the zone between the breakwaters and existing marsh because of expected volatility in sediment accumulation and movement within this area.

[9] Station 8729108 Panama City, Florida; Relative Sea Level Trend; 3.10 mm ± 0.55 mm per year based on monthly mean sea level data from 1973 to 2023.

Table 5. Vertical Sediment Accretion Monitoring

		Average Depth Below Ground Surface (cm)						
Site	**Point**	**4 MAY 2023** (Julian Date) 2460068	**18 MAY 2023** (Julian Date) 2460082	**21 JLY 2023** (Julian Date) 2460146	**18 OCT 2023** (Julian Date) 2460235	**3 MAY 2024** (Julian Date) 2460434	**Average Change (2023 – 2024) in Ground Surface Elevation (cm)**	**Annualized Rate of Change (mm/yr)**
Reference Site	SB1	17.1	15.8	16.6	17.4	19.2	2.1	20.61
	SB2B	-	19.0	18.0	18.1	18.0	-1.0	-10.02
	SB3B	-	18.1	17.2	17.3	17.5	-0.7	-6.91
	Reference Site Average:	17.1	17.6	17.3	17.6	18.2	0.1	1.22
Project Site	SB4	21.2	-	21.4	21.1	20.7	-0.5	-5.32
	SB5*	20.7	-	19.4	17.6	17.0	-3.7	-36.57
	SB6	17.3	-	16.9	16.8	16.3	-1.0	-9.64
	SB7	19.9	-	19.2	19.8	18.9	-0.9	-9.31
	SB8	24.5	-	24.1	23.8	23.9	-0.6	-6.15
	SB9*	11.6	-	6.9	2.8	9.3	-2.3	-22.60
	SB10	27.0	-	27.2	25.7	25.6	-1.4	-14.29
	SB11	17.7	-	17.4	16.3	15.6	-2.1	-20.61
	SB12	8.3	-	10.0	8.5	4.9	-3.4	-33.41
	SB13*	12.7	-	12.7	11.0	Exposed	Exposed	Exposed
	SB14	15.0	-	14.9	14.5	14.5	-0.5	-4.99
	SB15	11.2	-	10.9	10.8	12.7	1.6	15.62
	Project Site Average:	17.3	-	16.8	15.7	16.3	-1.3	-13.39
	Project Site Average*:	18.0	-	18.0	17.5	17.0	-1.0	-9.79

*These monitoring points are located at marsh/water interface; sediment accretion/erosion is strongly affected by wave action and subject to volatility.

**Project site average excluding SB5, SB9, and SB13 (these points excluded from project site average due to volatility).

Panoramic Photo Monitoring

Project Site Photo Photos

Figure 11. Project Site Photo Point T1 Looking East – 5/3/2024

Figure 12. Project Site Photo Point T1 Looking West – 5/3/2024

Figure 13. Project Site Photo Point T2 Looking East – 5/3/2024

Figure 14. Project Site Photo Point T2 Looking West – 5/3/2024

Figure 15. Project Site Photo Point T3 Looking East – 5/3/2024

Figure 16. Project Site Photo Point T3 Looking West – 5/3/2024

Figure 17. Project Site Photo Point T4 Looking East – 5/3/2024

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Figure 19. Project Site Photo Point T5 Looking East – 5/3/2024

Figure 20. Project Site Photo Point T5 Looking West – 5/3/2024

Figure 21. Project Site Photo Point T6 Looking East – 5/3/2024

Figure 22. Project Site Photo Point T6 Looking West – 5/3/2024

Reference Site Photos

Figure 23. Reference Site Photo Point T7 Looking East – 5/3/2024

Figure 24. Reference Site Photo Point T7 Looking West – 5/3/2024

Figure 25. Reference Site Photo Point T8 Looking East – 5/3/2024

Figure 26. Reference Site Photo Point T8 Looking West – 5/3/2024


Figure 27. Reference Site Photo Point T9 Looking East – 5/3/2024


Figure 28. Reference Site Photo Point T9 Looking West – 5/3/2024

Other Photo Documentation

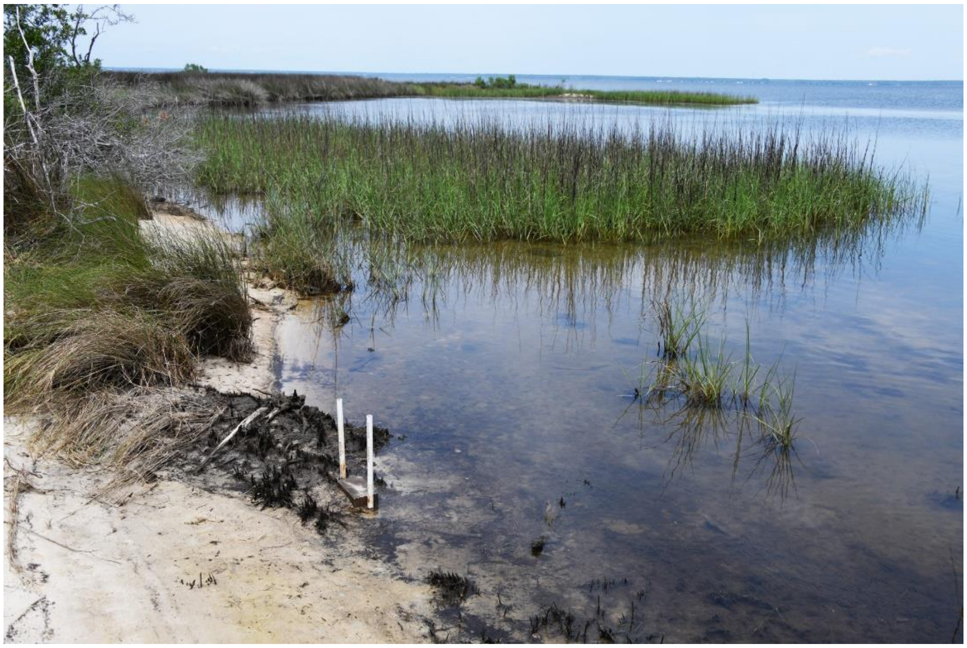

Figure 29. Sediment Accretion Monitoring Point SB13 Exposed from Erosion (5/3/2024)

Figure 30. Typical Sediment Accretion Monitoring Point Location in Existing Marsh (5/3/2024)

Figure 31. Oyster Colonization on Breakwater (5/3/2024)

Figure 32. Sediment Accumulation Behind Constructed Breakwaters (5/3/2024)

Figure 33. Expansion of *Spartina alterniflora* (5/3/2024)

Figure 34. Vegetation Sampling (4/15/2024)

Figure 35. Successful Supplemental Plantings Protected by Breakwaters

Figure 36. Washout of Planted Vegetation Not Protected by Breakwaters