Site Report: Jumbile Phase II

Original restoration completed in 2004

Jumbile Cove Phase II restoration was implemented in the winter of 2003-2004 by Texas Parks and Wildlife Division, with funding from the Galveston Bay Estuary Program, the Texas General Land Office, NOAA's Community Based Restoration Program, and the US Fish and Wildlife Service Coastal Program. The project footprint encompassed 48 acres, in which 18 acres of intertidal habitat was constructed.

Where, What, Why

Jumbile Cove in West Galveston Bay had suffered extensive losses of intertidal marsh in the latter half of the past century due to a combination of wave-induced shoreline erosion and accelerating rates of relative sea level rise. Aerial imagery-based estimates suggest that between 1930 and 1995 roughly 50% of the intertidal marsh and 70% of the tidal flat habitat in Jumbile Cove converted to open water. The restoration of estuarine habitat complex from the creation of multiple, circular, marsh mounds was intended to ***replace lost wetland acreage*** and ***baffle wave energy to slow the rate of erosion of the remaining natural marsh shoreline***. Additionally, the creation of protected, shallow areas between mounds was intended to ***provide suitable habitat for seagrass colonization***. The overall goal was to achieve a mosaic of 50% open water and 50% intertidal habitat.

Figure 1. Change in extent of marsh habitat in the western portion of Jumbile Cove over time.

How

The project was constructed by hydraulically dredging material from a nearby borrow site and using it to create multiple intertidal marsh mounds. Dredged sediments were described as predominately fine-grained, loose sands. The design and placement of marsh mounds was intended to allow unrestricted ebb and flow of tidal waters and ingress and egress of aquatic organisms. Mounds were constructed with a target elevation of 0.67 m [2.2 ft] NAVD88 based on elevation of nearby natural marsh and were planted by hand with *Spartina alterniflora.* The mounds were initially designed such that their higher, interior portions would remain above mean sea level to provide area for marsh to migrate into as sea levels rise. As a result, planting efforts focused on a band around the perimeter of each mound at intertidal elevations. The interior, higher portions of the mounds were left to colonize naturally. Individual mounds ranged in size from ~15 to 50 meters [50 to 150 ft] in diameter.

Site Physical Characteristics

While winds from the SSE are dominant in this region, the project site is relatively well-protected from southerly winds due its location on the northern shore of Galveston Island. In contrast, the site is fully exposed to winds from the north, and the strongest winds tend to blow from the NNW. Despite this wind exposure, shallow nearshore water depths limit average wave heights just offshore of the project area (Figure 2).

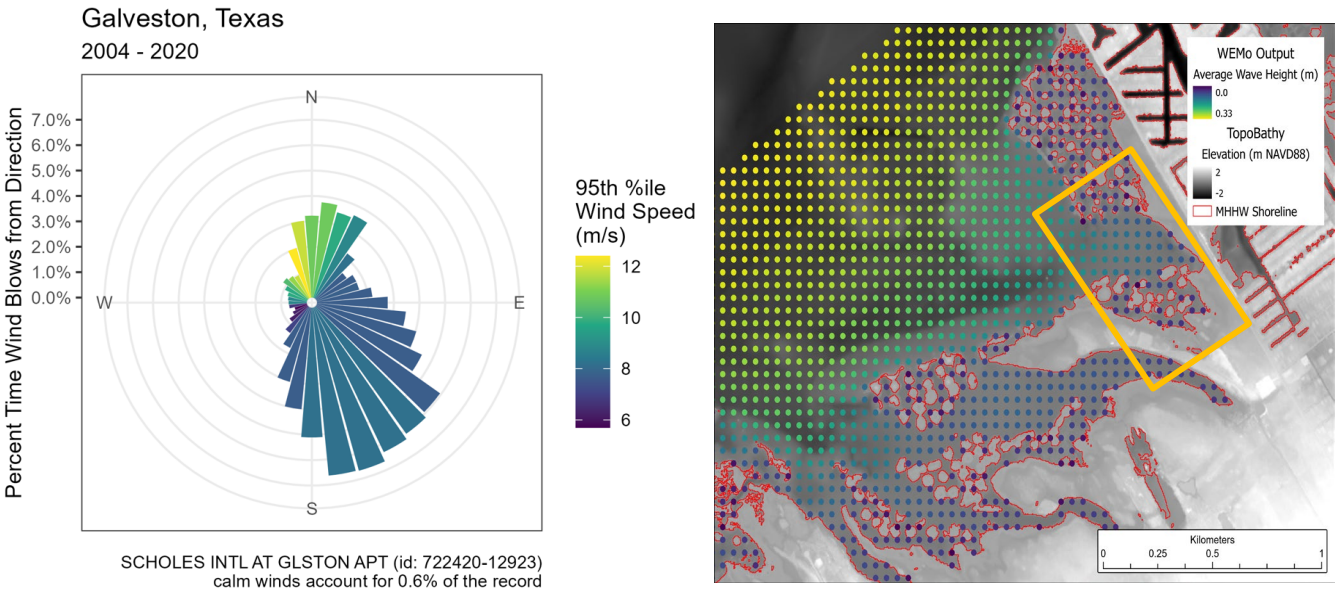

Figure 2. Average measured wind conditions over the project lifespan (left) were used to model wave energy conditions using the Wave Exposure Model (WEMo, right). Yellow box in the right panel outlines the approximate project footprint.

Performance Over Time

As of 2023 (19 years after project construction) 47 of 55 mounds constructed within the Jumbile II footprint are still present. Several mounds, primarily those that are on the seaward edge of the complex, have experienced significant losses in total area and have been reshaped by waves. Mounds with a more interior placement within the complex have been relatively stable in area over time. Changes in areal extent of constructed intertidal habitat based on delineation of the lowest extent of vegetated shoreline allow for an analysis of changes in total areal extent over time. This comparison indicates a 33% reduction in intertidal area over the past 22 years. (2010 total area = 17.1 acres, 2022 total area = 11.4 acres). The bulk of these losses has been from erosion of the wave exposed sides of outer islands.

Figure 3. Digitized shorelines from 2010 and 2022 (using imagery available from the Natural Agriculture Imagery Program; NAIP). Shoreline position was defined by the outer extent of vegetation on each mound.

The target elevation for constructed mounds was 0.67 m [2.2 ft] NAVD88 based on the elevation distribution of *Spartina alterniflora* on nearby natural shorelines. Elevation surveys conducted in 2009, 5 years after project completion, showed some early loss of elevation which was hypothesized to be the result of settling and spreading of the mounds under their own weight, but repeat surveys of those same transects indicate that they have been relatively stable since 2009. In the time since project implementation, local mean sea level has increased by 25 cm [9.8 inches]. Visual inspection of time

series aerial imagery illustrates the slow colonization of the interior, higher elevation portions of the mound by wetland vegetation, a trend that has likely been facilitated by sea level rise.

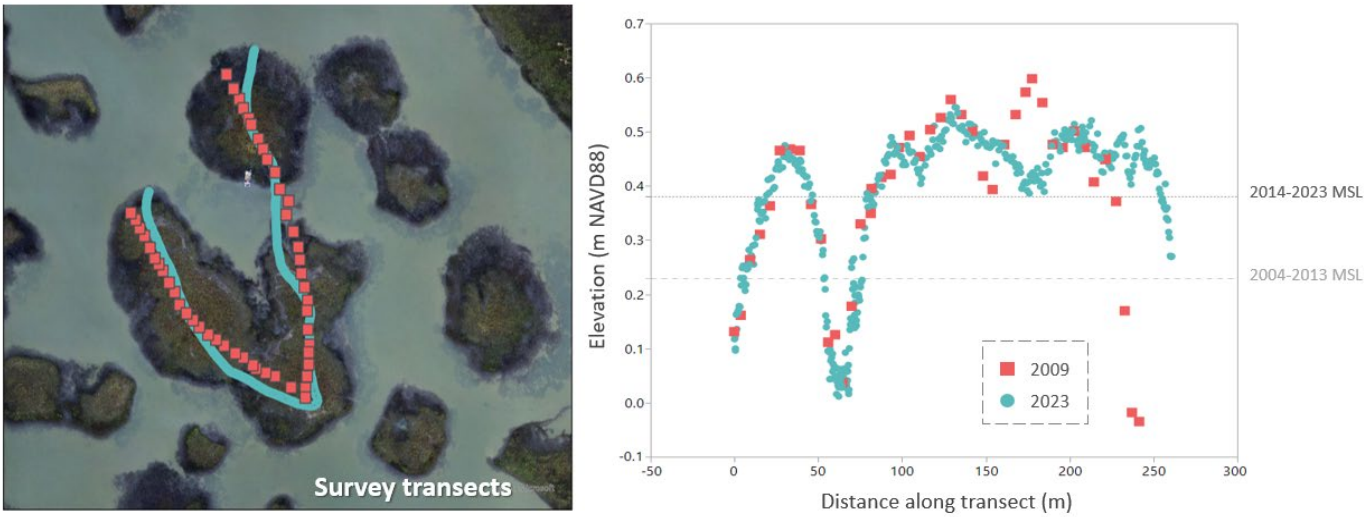

Figure 4. Elevation data collected by repeat GPS surveys of the same transect in 2009 and 2023 indicate that elevations of interior mounds have remained stable over time.

Current Habitat Distribution

As of 2023, the mound perimeters were vegetated with a monospecific band of tall form *S. alterniflora*. Mound interiors were vegetated with a mixed community of shorter growing *S. alterniflora*, *Salicornia spp*. and *Batis maritima*. We also noted the presence of sparsely distributed young black mangroves *Avicennia germinans* (~ 30 cm [1 ft] tall) on many mounds. Multiple patches of the seagrass *Halodule wrightii* were present within the project footprint, predominantly on the leeward side of mounds. Analysis of UAS imagery collected during the 2023 monitoring effort suggests that approximately 1.5 acres of *H. wrightii* were present at that time.

Figure 5. Habitat distribution as of 2023

Sediments and Carbon Accumulation

Analysis of sediment structure in placed sediments that are deeper than the root zone confirm that the sediments used for mound creation were > 90% sand with little organic content. As the created marsh has matured, the mounds have accumulated fine grained sediments (silt/clay) and organic matter from the production and turnover of plant roots. As of 2023, the surface sediments (upper 10 cm) were similar in sediment structure to those of nearby natural marshes. The organic matter content (%) in surface sediments (0-5 cm) of marsh mounds was 4% by weight, while that of nearby natural marshes at the same elevation was 8%. A back of the envelope carbon calculation based on the average carbon stock in the top 15 cm of sediment and total area of remaining intertidal habitat suggests that this site has accumulated on the order of 129,000 Kg of organic carbon since construction.

Performance Summary

The Jumbile Cove phase II restoration project resulted in an estuarine habitat complex that has been relatively stable in the 19 years since its creation. Despite losses in extent of some of the exterior mounds, 10 acres of intertidal habitat and 1.5 acres of seagrass habitat were present in 2023 as a result of this restoration effort. To the naked eye, the created habitat is indistinguishable from the adjacent natural marsh. While the mounds are not building elevation at the rate required to keep pace with local relative sea level rise, they have persisted and provided intertidal habitat for the nearly two decades since construction. They do seem to be meeting the goal of encouraging seagrass colonization and the wave model output indicates that the presence of mounds serves to protect the adjacent shoreline from wave energy.

Report Credit: Davis, J., LeClaire, A., Bost, M., Walker, Q., & Giannelli, R. (2024). Site Report: Jumbile Phase II. US DOC NOAA NOS National Centers for Coastal Ocean Science (NCCOS). Marsh Mounds: