

**Dagger Island Restoration
19-053-000-B087**

**Final Report
August 2021**

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Project Background:

Dagger and Ransom Islands (Figure 1) form a protective barrier between the southwestern section of Redfish Bay State Scientific Area (RBSSA) (Figure 2) and the Corpus Christi Ship Channel (CCSC) in Nueces County, TX. The scope of this project only addressed Dagger Island, which is due west of Ingleside, TX on the southern edge of Redfish Bay just north of Corpus Christi Bay.

Dagger Island was once a nearly contiguous narrow island separating Corpus Christi Bay and Redfish Bay. Island degradation and shoreline erosion from natural and anthropogenic causes have significantly decreased the size of the single island into a chain of smaller islands and altered the function and values they provide to this bay system (Figures 3 and 4). These low-lying narrow islands have sand and shell hash shorelines leading to scarped banks that transition to typical high marsh vegetation (saltwort, glasswort, saltmeadow cordgrass, saltgrass, wolfberry) including patches of mangrove on the Corpus Christi Bay side (south) of the island. On the Redfish Bay side (north) the high marsh transitions to *Spartina* marsh then to tidal flats.

The restoration project focused on protecting shallow aquatic habitat, submerged aquatic vegetation, intertidal habitat, oyster reefs, emergent marsh, mangrove marsh, mangroves, tidal flats, benthic life and associated uplands important for the health of the entire bay ecosystem. This project created oyster, invertebrate and fisheries habitat with the construction of the shoreline and nearshore breakwaters. These habitats are critical for water quality in the bays and for sustaining a range of vertebrate and invertebrate species many of which are of economic and recreational importance. The construction of the living shorelines further enhances the goal of the overall restoration project.

The project protects Dagger Island at two identified priority sites that are subject to high erosion rates. At priority site 1, a nearshore breakwater was constructed to reduce or eliminate shoreline erosion and create additional hard surface habitat. Priority site 2 was created as a beneficial use (BU) site that consolidated the eroded smaller islands into one island of historical dimensions and ecological services with a rock shoreline breakwater to prevent erosion and island migration. The breakwater also provides hard structure for oyster habitat and interstitial habitat for commercially and recreationally important marine invertebrate and fish species as well as resting, loafing and feeding habitat for avian species. This project addressed both the current and future need for shoreline stabilization. The dredge material will be filled to elevations similar to those on the adjacent Ransom Point. This will allow for future development of sand and shell shoreline, low and high marsh, upland, freshwater marsh, smooth cordgrass, tidal flat habitats.

The natural resource objectives of this project were to eliminate shoreline erosion of the island, create oyster, invertebrate and fisheries habitat, development of a natural living shoreline behind both breakwaters and restore approximately 28 acres of land lost to historical island erosion. The living shorelines (Figures 5 and 6) were constructed behind the breakwaters through the planting of smooth cordgrass, *Spartina alterniflora*, and saltmeadow cordgrass, *Spartina patens*. These living shorelines will reduce erosion, decrease wave energy, provide additional habitat, and filter runoff throughout Dagger Island and the Redfish Bay State Scientific Area.

The construction of the nearshore breakwaters and BU was funded through the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund.

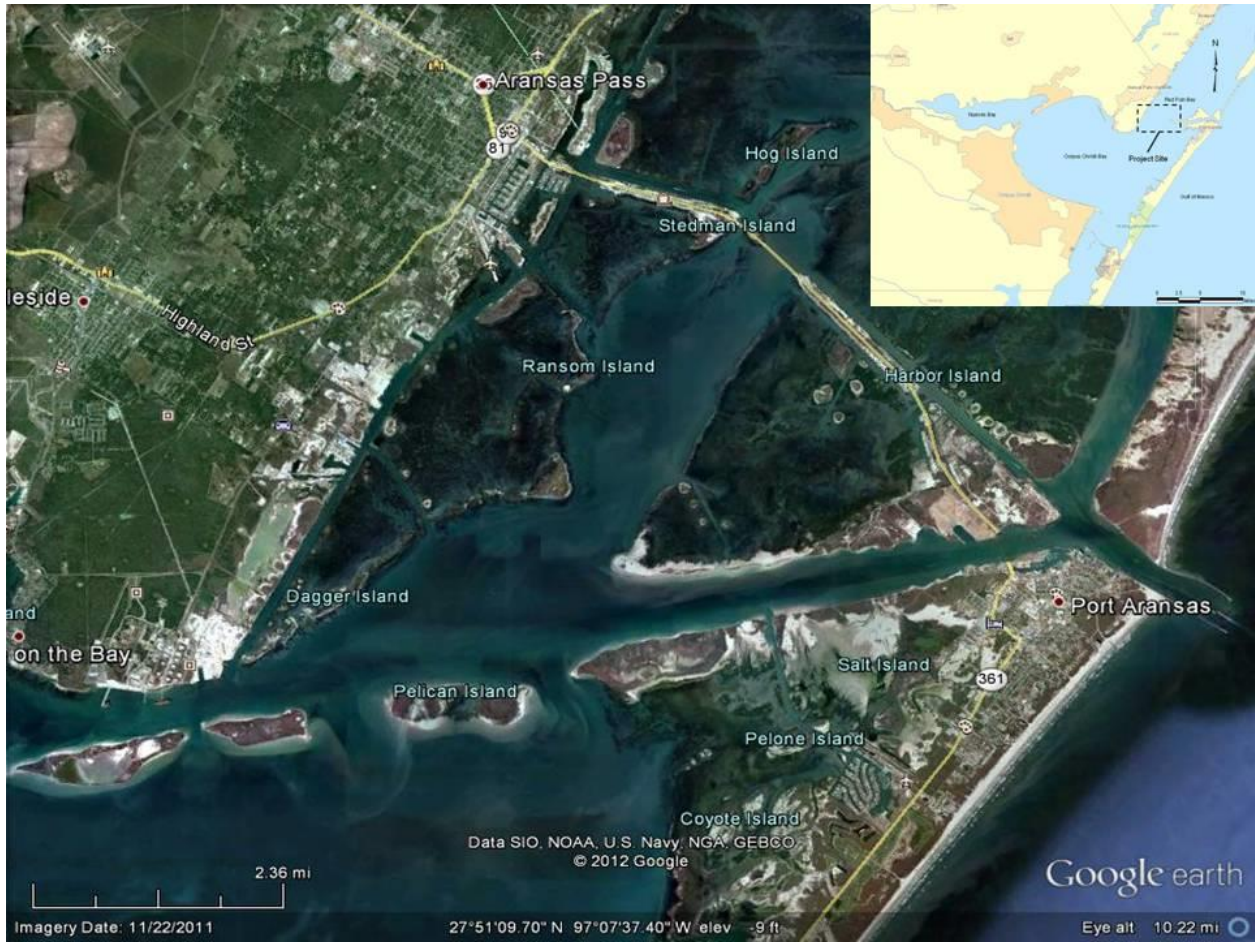


Figure 1. Dagger Island location.

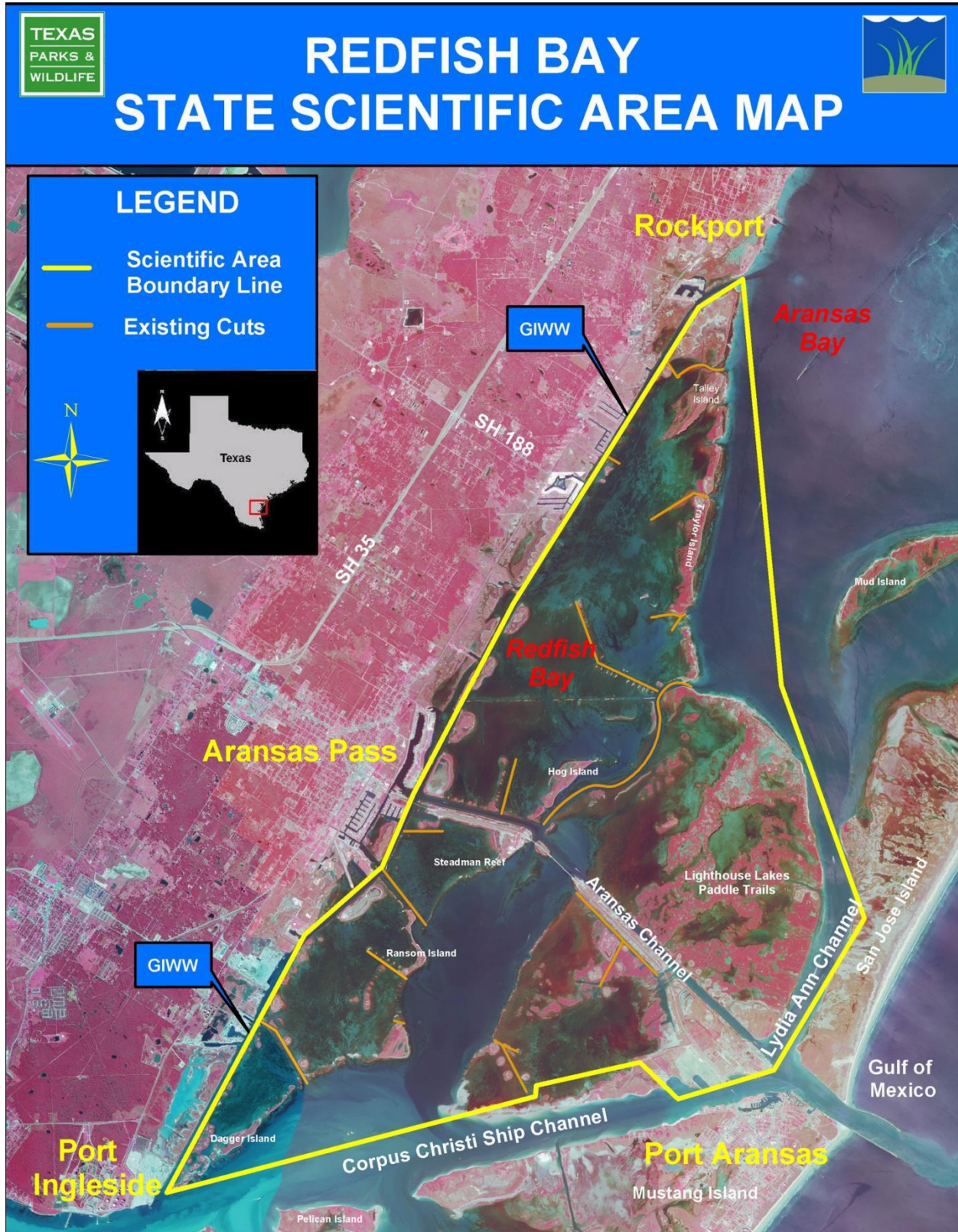


Figure 2. Redfish Bay State Scientific Area.



Figure 3. Comparison of the 1956 outline of Priority site 1 Southern Dagger Island (yellow) with the 2011 remnants of Dagger Island (red). In 1956 this section of Dagger Island was 136 acres in size, but now encompasses only 47 acres.

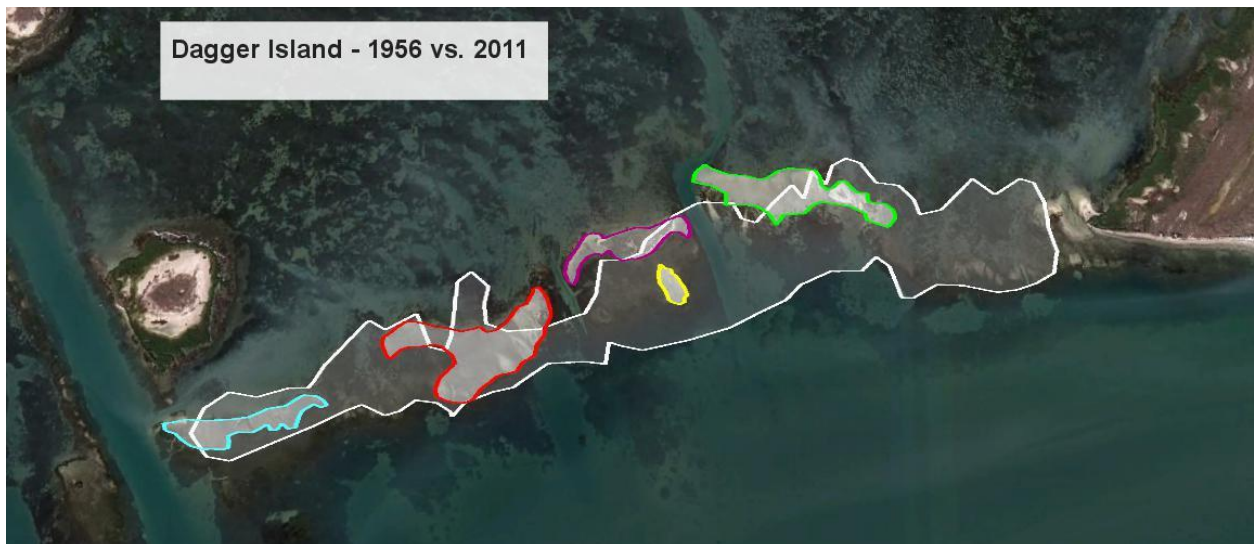


Figure 4. Comparison of the 1956 outline of Priority site 2 Northern Dagger Island (white) with the 2011 remnants of Dagger Island (colored). In 1956 this section of Dagger Island was 48.9 acres in size, but now encompasses only 13.22 acres.



Figure 5. Site 1 - southern living shoreline location.



Figure 6. Site 2 - northern living shoreline location.

Task 1 Summary: Design, Permitting and Building

Design

TPWD hired Ducks Unlimited to design a nearshore breakwater and an armored dredge material BU area. The construction site was surveyed in December 2018 to evaluate any bathymetry impacts or changes due to Hurricane Harvey. The results showed major changes in the bathymetry and project plans were revised and approved August 2019.

Based on the revised breakwater and BU plans, TPWD developed a Request for Proposals to solicit design services for the living shoreline construction at the Dagger Island restoration site. Triton Environmental Solutions, LLC (TES) was awarded the contract to provide the design, construction plans, and conduct the planting of smooth cordgrass and saltmeadow cordgrass for the living shoreline behind the constructed breakwaters. Because the TES bid was lower than the grant amount awarded, an additional services contract was developed to increase vegetation planting, provide irrigation events to enhance plant survival and install the GLO CMP required signage at the project site. The planting design was revised to include the planting of 2.4 acres of smooth cordgrass (original contract) plus 1.03 acres of smooth cordgrass and 2.7 acres of saltmeadow cordgrass (additional service contract).

Permitting

TPWD received a permit from the U.S. Army Corps of Engineers (USACE) in July 2018 for construction of the breakwaters and BU site. Construction bids were received and were over the NFWF budget. Additional funds were obtained from the Coastal Conservation Association and North American Waterfowl Conservation Act but did not cover the budget deficit. Because the original construction bids were obtained in 2014, construction alternatives were developed as a contingency (inflation, design changes, material and labor costs) for a budget deficit. The size of the beneficial use site was reduced to meet budget constraints. TPWD submitted a project amendment to the USACE and since the changes reduced the overall footprint of the project, USACE did not express any concerns. TPWD also received a no cost time extension for 6 months from the GLO.

TES obtained the required Scientific Collection Permit, GLO surface leases, and the Permit to Introduce Fish, Shellfish or Aquatic Plants into Public Waters to perform the necessary tasks to complete the construction of the living shorelines.

Building

Padgett Construction was hired to construct the 1.17 miles of BU containment levees and the 1.26 miles of nearshore breakwaters. Construction activities began January 2020 and were completed July 2020. Figures 7 – 12 show photos from before and after construction. There were some design modifications to some of the constructed features, relative to the original construction plans due to impacts from Hurricane Harvey. Additional rock had to be obtained to complete the southern breakwater and TPWD received \$81,481 of Gulf of Mexico Energy Security Act (GOMESA) funding which was added to the Coastal Management Program (CMP) grant.

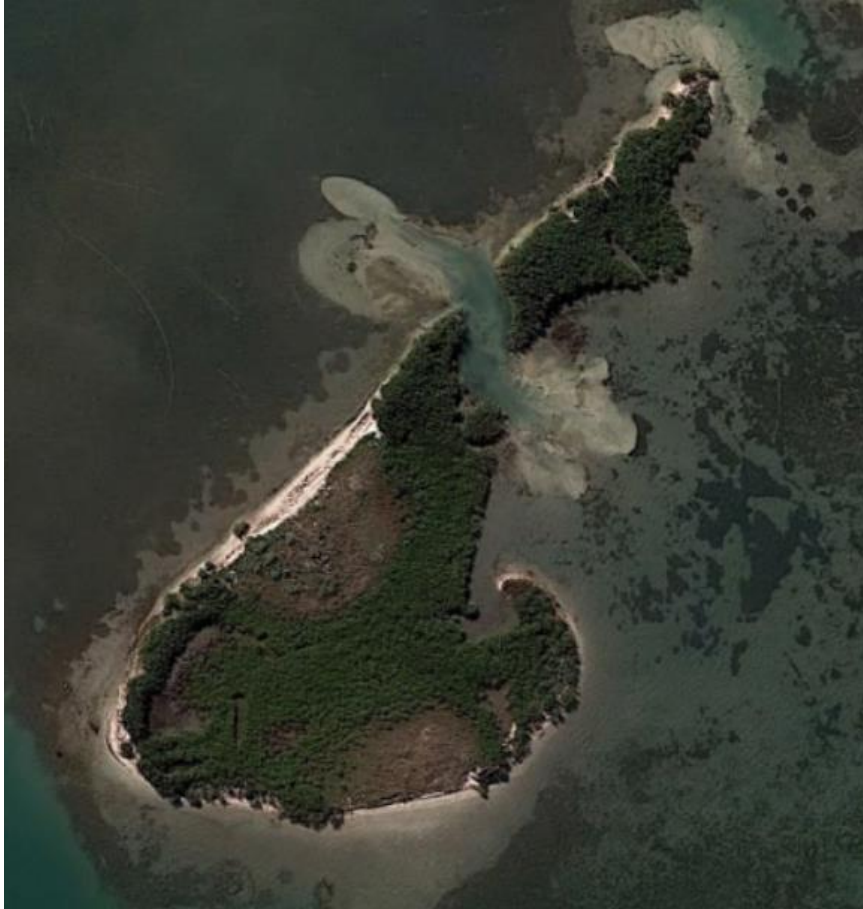


Figure 7. South Dagger Island breakwater - north to south - before construction (January 2020).



Figure 8. South Dagger Island breakwater - north to south - after construction (August 2020).



Figure 9. South Dagger Island breakwater - south to north - before construction (January 2020).



Figure 10. South Dagger Island Breakwater - south to north - after construction (August 2020)



Figure 11. Breakwater and beneficial use site before construction (2017).



Figure 12. Breakwater and beneficial use site after construction (August 2020).

Task 2 Summary: Living Shoreline Creation

Planting design plans for two sites were submitted and approved June 2020. An additional services contract was developed to increase the number of plants and provide supplemental watering to enhance plant survival. TES was required to obtain the TGLO surface leases from adjacent marsh sites to harvest the required plants and complete the plantings (Figures 14 - 17) at both sites 1 and

2. TES also installed two TGLO CMP signs (Figure 13), one at Site 1 and one at Site 2, using wooden posts to a height of five feet.

Smooth Cordgrass (*Spartina alterniflora*) Harvest and Planting

Planting units were harvested by hand utilizing a shovel and/or a post-hole digger. A limit of one, 6-inch diameter plug of source material per one square yard was obtained from within the harvest site boundaries. TES maintained and delivered harvested planting units to the project site within 24 hours of harvesting. Planting units were stored with source water in large burlap oyster sacks. Planting units were installed within the designated planting areas on 3.0-foot centers.

Saltmeadow Cordgrass (*Spartina patens*) Harvest and Planting

Planting units were harvested from Triton leased lands. Planting units were dug by hand utilizing a shovel and/or a post-hole digger. Triton personnel carefully divided whole plants into 1-inch planting units. Planting units were installed within the designated planting areas on approximately 3- to 4-foot centers. Planting units were installed at the project site within 48 hours from harvest.

TES harvested and transplanted 8,750 saltmeadow cordgrass sprigs on the higher elevations of sites 1 and 2 during July 2020. TES harvested smooth cordgrass within the beneficial use levees and transplanted them to the intertidal zone between the breakwater and levee at site 2. TES also harvested smooth cordgrass sprigs from the TGLO lease sites and transplanted them to sites 1 and 2 behind the breakwaters. TES conducted four weekly irrigation events to provide fresh water to the newly planted sprigs. TES completed all planting efforts on July 24, 2020.

- 17,500 three-stem units smooth cordgrass planting units
- 8,750 one-inch units saltmeadow cordgrass planting units
- Transplant Initiation: July 6, 2020
- Saltmeadow cordgrass transplant completion: July 10, 2020
- Smooth cordgrass transplant completion: July 24, 2020



Figure 13. Installed GLO CMP sign.



Figure 14. Planting saltmeadow cordgrass at site 1 (July 2020).



Figure 15. Planting saltmeadow cordgrass at site 2 (July 2020).



Figure 16. Planting smooth cordgrass at site 1 (July 2020).



Figure 17. Planting smooth cordgrass at site 2 (July 2020).

Hurricane Impacts

Dagger Island was impacted by Hurricane Hanna which made landfall just north of Port Mansfield as a category 1 hurricane on July 25, 2020. A site visit July 28, 2020 determined plantings of both *S. patens* and smooth cordgrass were damaged, buried, and washed away. Damage (Figures 18 - 23) included thick debris/wrack, scouring at levee crest, and shoreline erosion and undercutting in the northernmost section of the beneficial use levees. TPWD was able to obtain funding to hire Padgett Construction to repair the levee damage caused by the hurricane. Repairs were completed and a site visit conducted in August 2020 to confirm the site was restored to design plans and specifications.



Figure 18. Site 1: saltmeadow cordgrass comparison, pre-Hurricane Hanna.



Figure 19. Site 1: saltmeadow cordgrass comparison, post-Hurricane Hanna.



Figure 20. Site 2: levee face comparison, pre-Hurricane Hanna.



Figure 21. Site 2: levee face comparison, post-Hurricane Hanna.



Figure 22. Site 2: smooth cordgrass comparison, pre-Hurricane Hanna.



Figure 23. Site 2: smooth cordgrass comparison, post-Hurricane Hanna.

Survival monitoring

Tropical Storm Marco and Hurricane Laura (August 24 - 28, 2020) high tides delayed TES from conducting the 30-day plant survival monitoring as planned.

- 30-Day Survival Monitoring (saltmeadow cordgrass): completed August 10, 2020.
- 30-Day Survival Monitoring (smooth cordgrass): August 24, 2020 (attempted but postponed due to Marco and Laura development) - occurred September 1, 2020.

30-day survival monitoring conducted August 10 and September 1, 2020 Results

Site 1 experienced less damage and transplant survival was relatively high.

- Roughly 0.2-acres (6%) of planting area and 821 (6%) planting units were damaged.
- Saltmeadow cordgrass survival (66%), smooth cordgrass survival (69%) without adjustment from storm damage.

Site 2 experienced significant damage to transplants from scouring, wrack/debris fill, and contractor levee repair following impacts from two hurricane events at the site.

- Roughly 2.1-acres (72%) of planting area and 8,623 (68%) planting units were damaged.
- Saltmeadow cordgrass survival (33%), smooth cordgrass survival (3%) without adjustment from storm damage.

Saltmeadow cordgrass had an overall survival rate of 40.7% while smooth cordgrass had an overall survival rate of 46.1% (site 1 and 2 combined).

Replanting

Since the survival rate did not meet success criteria due to unforeseen circumstances, a second planting event was required. TES proposed delayed transplant effort due to the prediction of more tropical storms accompanied by high tide events and the request was approved by TPWD and GLO. Texas experienced a winter freeze during the last two weeks of February resulting in a further reduction of plant survival. TES conducted a spring assessment survey on April 15, 2021 to determine which areas to replant that would provide the highest potential of plant survival. After reviewing the data, TPWD and TGLO agreed that the replanting efforts should be done at Site 1 due to a higher survival rate and the presence of birds at Site 2. TES submitted a planting contract amendment for a second planting that was approved in June 2021. TES replanted 3,847 three-stem units of smooth cordgrass, approximately one acre, at Site 1 on July 5-6, 2021 (Figure 24).



Figure 24. Smooth cordgrass replanting.

Survival monitoring

TES conducted a 30-day post-transplanting survival survey on August 17, 2021.

30-day post-transplanting survival survey

- 30-day post-transplanting survival was 88.1% (3,390 3-stem plugs) for smooth cordgrass.
- 30-day post-transplanting mortality was 11.9% (457 3-stem plugs) for smooth cordgrass.

TES conducted a one-year post-transplanting survey for saltmeadow and smooth cordgrass survival on July 15 and 26, 2021.

One-year post-transplanting survey results

- Saltmeadow cordgrass transplant area of site 1 was trending towards success, with 42.65% total vegetative cover.
- Total vegetative cover within the saltmeadow cordgrass transplant area of site 2 was relatively low (5.09%).
- Smooth cordgrass vegetative cover totaled 24.12% at site 1 compared to 0.90% at site 2.

South Dagger Island (Site 1)

- Saltmeadow cordgrass: 9.85% cover.
- Total vegetation within saltmeadow cordgrass transplant area: 42.65% cover.
- Smooth cordgrass – Breakwater Area: 17.33% cover.
- Smooth cordgrass – Deep-water Area: 6.79% cover.
- Total vegetation within smooth cordgrass transplant area: 24.12% cover.

North Dagger Island (Site 2)

- Saltmeadow cordgrass: 0.00% cover.
- Total vegetation within saltmeadow cordgrass transplant area: 5.09% cover.
- Smooth cordgrass: 0.52% cover.
- Total vegetation within smooth cordgrass transplant area: 0.90% cover.

Task 3 Summary: Project Monitoring and Reporting

TPWD will continue annual monitoring to ensure 70% vegetative cover after three years.

Summary Report for the Dagger Island Restoration

Dagger Island separates Corpus Christi Bay from Redfish Bay, serving as a protective barrier to valuable feeding and nursery habitats for both commercial and recreational fisheries as well as avian species. These habitats include seagrass, oyster reefs, mangroves, and estuarine marshes. Natural and anthropogenic forces, including predominant southeast winds, storm events, sea level rise, high energy ship wakes, and extensive oil and gas dredging, have fragmented Dagger Island into a chain of smaller, low-lying islands, diminishing the function and value that the barrier provides to the ecosystem. Over the past 60 years, Dagger Island has lost over 125 acres of land due to erosion. Proposed enhancements for shipping activities, including the deepening and widening of the Corpus Christi Ship Channel and the construction of the new Harbor Bridge on U.S. Highway 181, will further exacerbate erosion, resulting in additional degradation and loss of habitat.

To restore some of these functions and values lost to erosion, nearshore breakwaters were constructed along a portion of Dagger Island. In addition, 3.4 acres of smooth cordgrass and 2.7 acres of saltmeadow cordgrass were planted to create a living shoreline. Hurricane Hanna and a winter freeze reduced plant survival and a replanting was required as the survival rate did not meet

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success criteria. One-year post-transplanting survey results are trending towards success and future monitoring will be conducted to ensure vegetative cover requirements are met.