State of Louisiana
Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2004 Operations, Maintenance, and Monitoring Report

for

ISLES DERNIERES RESTORATION TRINITY ISLAND

State Project Number TE-24
Priority Project List 2

May 2004
Terrebonne Parish

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Suggested Citation:

West, J.L. and D. Dearmond. 2004. *2004 Operations, Maintenance, and Monitoring Report for Island Dernieres Restoration Trinity Island.* Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux, Louisiana. 21pp.

2004 Operations, Maintenance, and Monitoring Report
For
Isles Dernieres Restoration Phase 1 (TE-24)

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I. Introduction

Trinity Island is part of the Isles Dernieres barrier island chain and is located along the southern Louisiana coast in Terrebonne Parish at 29^{o} 02' 46" N and 90^{o} 43' 48" W (figure 1). The Isle Dernieres, which separate Terrebonne Bay, Lake Pelto, and Caillou Bay from the Gulf of Mexico, is a 20 mile (32 km) long island arc segmented into four islands: Raccoon Island, Whiskey Island, Trinity Island, and East Island (McBride et al. 1989). Like all of Louisiana's barrier islands, Trinity Island is experiencing island narrowing and land loss as a consequence of a complex interaction among global sea level rise, compactual subsidence, wave and storm processes, inadequate sediment supply, and significant anthropogenic disturbances (Penland et al. 1988, McBride et al. 1989, Penland and Ramsey 1990, List et al. 1997).

The Louisiana deltaic plain is fronted by a series of headlands and barrier islands that were formed as a result of the Mississippi River deltaic cycle. The Isles Dernieres is a barrier island arc transformed from the abandonment of the Caillou headland (part of the Lafourche delta complex), which occurred approximately 500 years B.P. (Frazier 1967, Penland and Boyd 1985). Following deltaic abandonment, headland sand deposits were reworked and deposited longshore forming flanking barriers (Penland et al. 1988). Submergence of the abandoned delta separated the headland from the shoreline forming a barrier island arc. The transgressive island arc cannot keep pace with the high rate of relative sea level rise and will eventually become an inner-shelf shoal (Penland et al. 1988).

Currently, the Isles Dernieres arc is exhibiting some of the highest rates of erosion of any coastal region in the world (Khalil and Lee *in press*). Erosional models have estimated that the Isles Dernieres would gradually narrow, fragment, and transgress through time eventually becoming subaqueous sand shoals between 2007 (McBride et al. 1991) and 2019 (Penland et al. 1988) unless restoration efforts are made. Between 1887 and 1988 the average annual rate of land loss was 69.6 ac yr^{-1} (28.2 ha yr^{-1}) while the average rate of shoreline retreat has been estimated between 36.4 – 60.4 ft yr^{-1} (11.1 – 18.4 m yr^{-1}; McBride et al. 1989, McBride et al. 1991). Between 1978 and 1988, shoreline erosion was even as high as 116.6 ft yr^{-1} (47.2 ha yr^{-1}; McBride et al. 1989). Trinity Island has decreased in area from 1317.1 acres (533 ha) in 1978 to 901.9 acres (365 ha) in 1988. These conditions have led to the rapid landward migration, termed barrier island rollover, and disintegration of the Isles Dernieres as well as a decrease in the ability of the island chain to protect the adjacent mainland marshes and wetlands from the effects of storm surge, saltwater intrusion, an increased tidal prism, and energetic storm waves (McBride and Byrnes 1997).

TE-24 (Trinity Island) is considered Phase 1 of the Isles Dernieres Restoration Plan. This plan was designed to restore this barrier island in the Isles Dernieres chain in Terrebonne Parish, Louisiana by increasing the elevation and width of the island, closing existing breaches, and restoring back barrier marshes. The Trinity Island Restoration project created

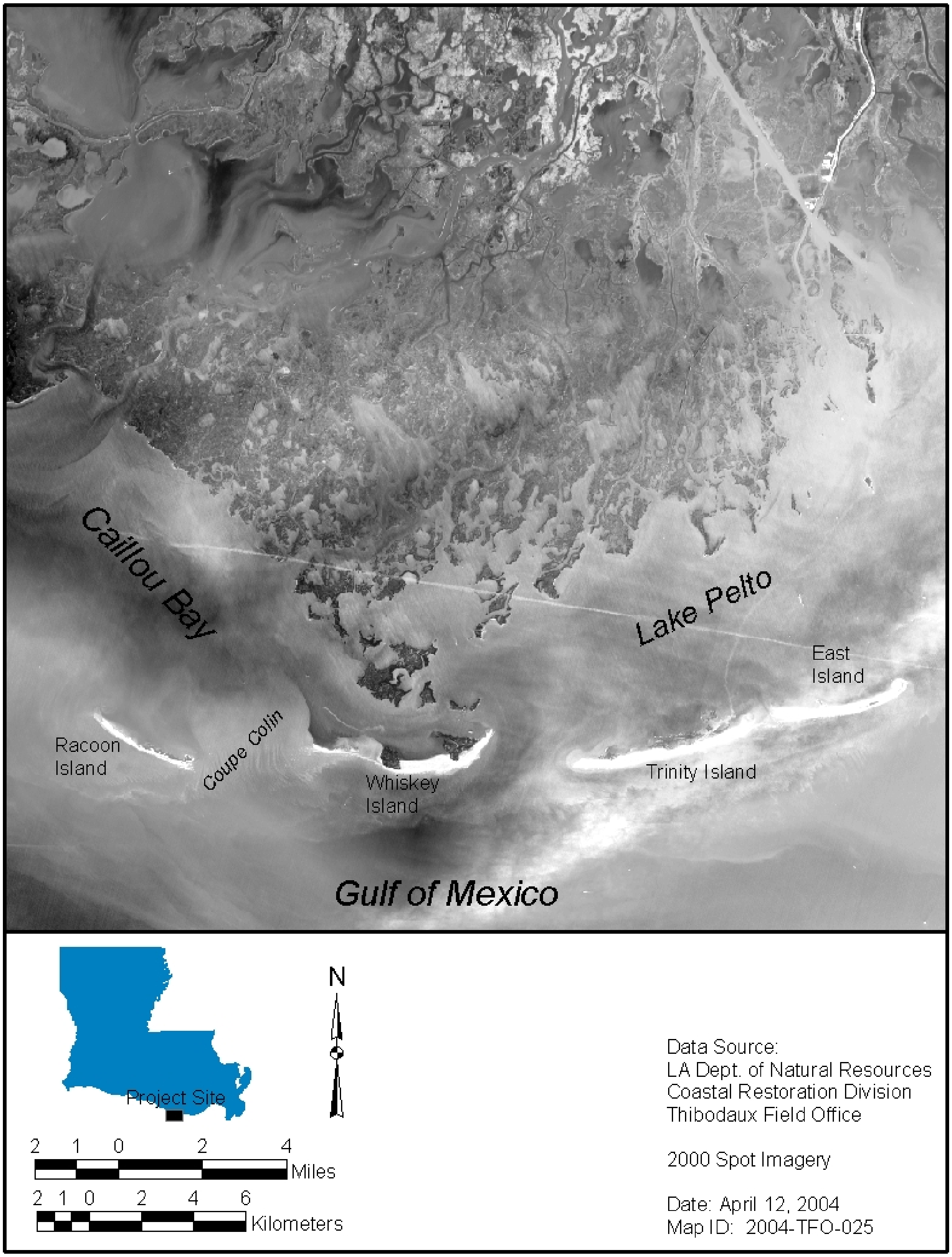

Figure 1: Isles Denieres islands, Terrebonne Parish, Louisiana.

approximately 353 acres (143 hectares) of dunes and wetland including supratidal (beach, dune, barrier flat) and intertidal (beach, marsh) habitat using sediments dredged from Whiskey Pass (figure 2). Sand fencing was constructed on the gulf side of the dune to trap blowing sand and to minimize wind-driven export of sediment (figure 3). The sediment transferal phase of the construction of the Trinity Island Restoration project commenced January 1998 and was completed May 1999. The first phase of construction included hydraulic dredging of sediments from Whiskey Pass using a 30" Cutter Head Suction Dredge (7,200 hp) and Booster Pump Barge and was completed in October 1998. Approximately 4.8 million cubic yards (3.7 million m^3) of borrow sediment were used to construct dune/berm, dune, and marsh platform features. The dune/berm, dune, and marsh platform extended the entire length of the island approximately 23,000 feet. Target elevations ranged from +2 ft (0.6 m) to +8 ft (2.4 m) North American Vertical Datum of 1988 (NAVD 88). Immediately post-dredging, aerial seeding with *Cynodon dactylon* (Bermuda grass) was conducted (figure 2).

During the second phase of construction, vegetation was planted between May 12 and 26, 1999 to stabilize the emplaced sediment on the newly created dune area, in the back-bay area, and on spurs from the dune area across the island to the back-bay area. Hand-planted vegetation included *Spartina patens* (marshhay cordgrass), *Spartina alterniflora* (smooth cordgrass), and *Panicum amarum* (bitter panicum). In total, 8,348 *S. alterniflora*, 10,579 *S. patens*, and 10,579 *P. amarum* were planted. The first vegetation sampling was conducted August 26 and 31, 1999 and additional vegetation sampling occurred September 19, 2001 and September 16, 2003.

II. Maintenance Activity

This project has no operations and maintenance budget and no maintenance has been done.

III. Operation Activity

This project has no operations and maintenance budget and no operations are required.

IV. Monitoring Activity

a. Monitoring Goals

The objectives for the Isles Dernieres Restoration Phase 1 (Trinity Island) project were to restore the coastal dunes of Trinity Island, reduce loss of sediment, and enhance the physical stability of Trinity Island utilizing hand planted vegetation.

The following goals will contribute to the evaluation of the above objectives:

1. Increase the height and width of Trinity Island and close breaches using dredged sediments

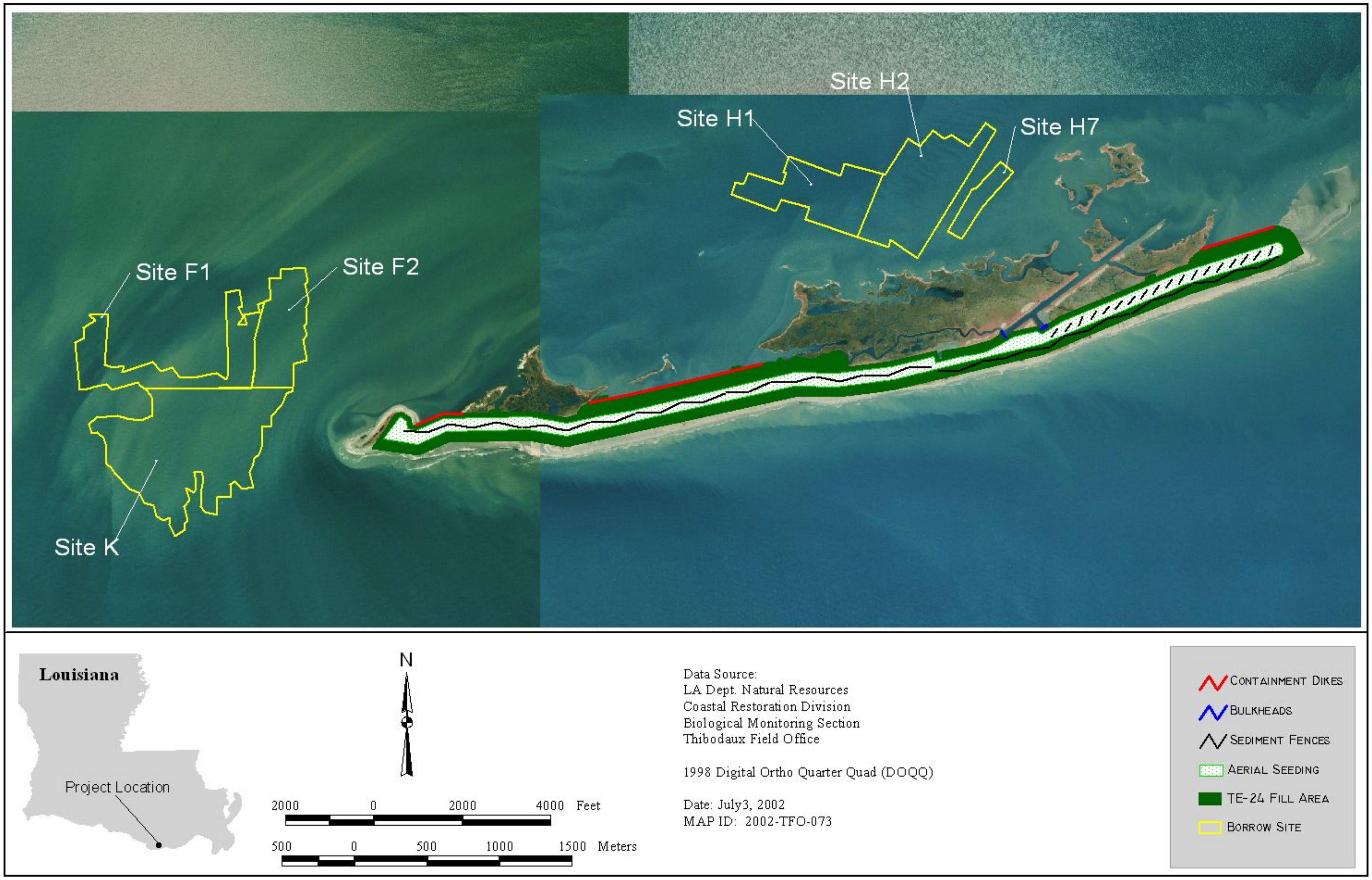

Figure 2: Trinity Island fill areas and borrow sites.

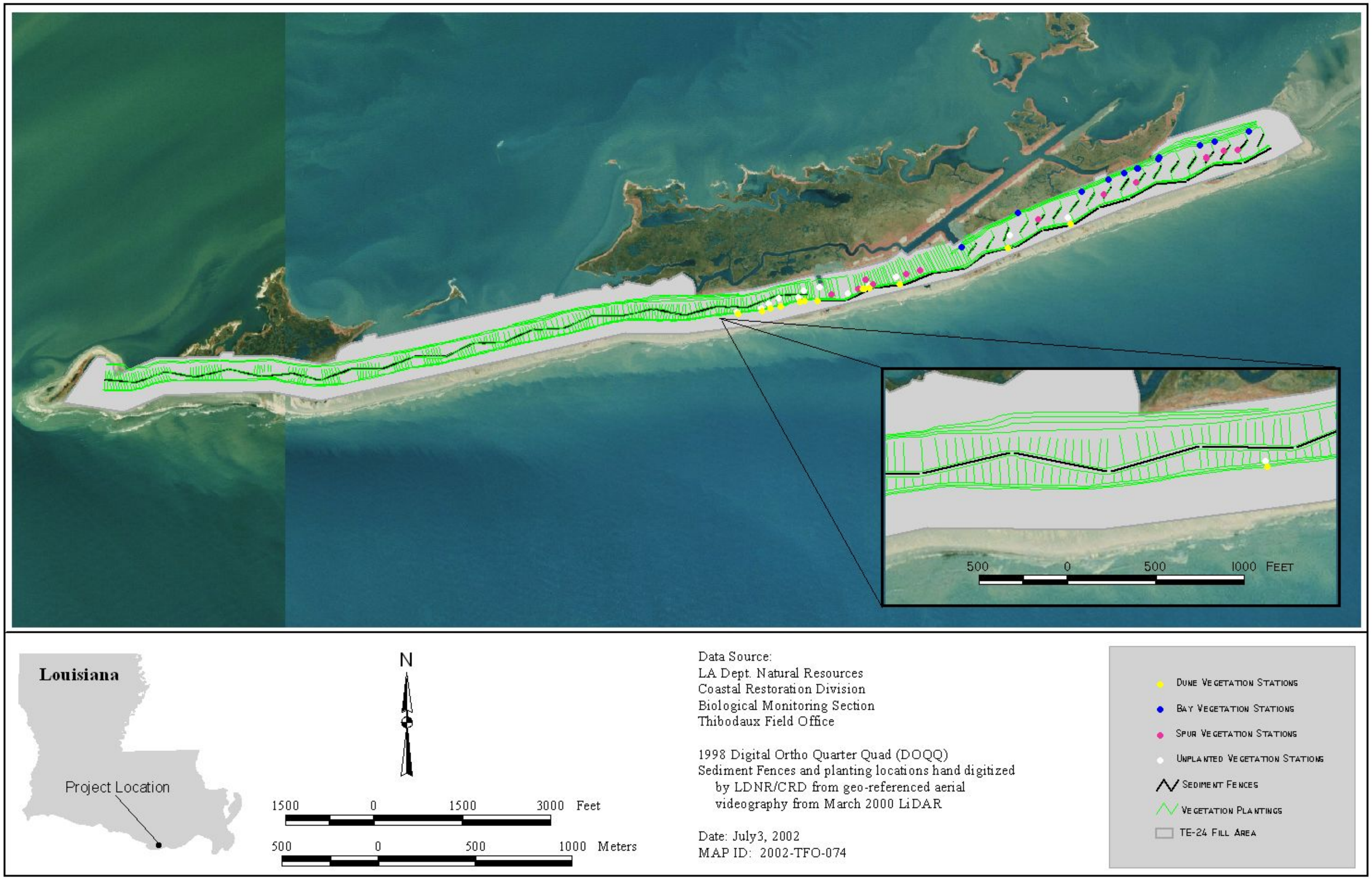

Figure 3: Trinity Island vegetation plantings and sediment fencing layout.

2. Reduce loss of sediment through vegetative plantings therefore increasing the stability of the island

b. Monitoring Elements

Aerial Photography

The 1997, near vertical color-infrared 1:12,000 scale aerial photography, obtained by the United States Geological Survey/National Wetlands Research Center (USGS/NRWC) was checked for flight accuracy, color correctness, and clarity. The original film was archived and duplicate photography was indexed and scanned at 300 dots per inch. Using ERDAS Imagine[7], an image processing and geographic information systems (GIS) software package, individual frames of photography were geo-rectified using a real-time differentially corrected global positioning system (DGPS) data with sub-meter accuracy. These rectified frames were then assembled to produce a mosaic for the island. This mosaic provides a pre-construction picture of the island. Due to budgetary constraints and project goals and objectives, Photography and analysis was removed from the project monitoring.

During April and November 2002, Coastal Research Laboratory, University of New Orleans (UNO) acquired color-infrared (CIR) aerial photographs of the project area [and also for East Island (TE-20), Whiskey Island, (TE-27) East Timbalier Phase 1 (TE-25), and East Timbalier Phase 2] for the purpose of Adaptive Management Review of constructed projects and post hurricane Lili assessments. Habitat analysis was conducted and change comparisons were provided by UNO to 1996 photography.

Elevation

To document both horizontal and vertical change along the constructed area of Trinity Island, transect lines were established at 200 ft (60.9 m) intervals by professional surveyors before construction. Elevation was determined every 100 ft (30.5 m) across the island along each transect. Post-construction (as-built) surveys were conducted in December 1998 to correspond with vegetation sampling and to avoid disturbance of nesting birds on the island. Beginning in 2000, airborne light detection and ranging (LiDAR) surveys replaced conventional on-the-ground surveys. Airborne LiDAR surveys collect data along lines the entire length of the island versus the traditional transects used in conventional surveys. LiDAR surveys were conducted in October 2000 by Morris P. Hebert, and again in 2001 and 2002 by USGS. LiDAR surveys will be repeated in 2007 and 2016. Data collected was used to develop elevational triangulation-based (TIN) surface generation models and subsequent Grid models in ArcView®. Difference grids were created by subtracting earlier grids from succeeding grids. Volume change for these difference grids as well as volume for each of the 2000, 2001, and 2002 LiDAR grids were calculated with the cut/fill calculator in the LiDAR data handler extension of ArcView®. All grids were clipped to the same area as volume calculations that include areas with no data cannot be performed. The 2000 LiDAR survey has ± 10 cm accuracy while surveys performed in 2001 and 2002 have ± 15 cm accuracy (Sallenger et al. 2003). LiDAR grids were not filtered for vegetation.

Vegetation

Species composition and percent cover of vegetation in four treatments, dune, spur, bay, and unplanted areas (figure 3), were determined using the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) as described in Steyer et al. (1995). Species in 4 m^2 plots were recorded, and visual estimates of percent cover for the total plot and individual species were made. Cover classes used were: solitary, <1%, 1-5%, 6-25%, 26-50%, 51-75%, and 76-100%. Vegetation outside of each plot but within 33 ft (10 m) were also identified and recorded. Vegetation plots were chosen randomly in the planted areas (dune, spur, and bay). Each plot was established using a vegetation station marker stake as its southeast corner and plots were oriented in a North-South direction. Unplanted treatment plots were established between the spurs, using randomly chosen distances from the spur plots. Twelve plots were established in August 1999 for each of the treatments. Planted vegetation consisted of *P. amarum* and/or *S. patens* in the dune plots, *P. amarum* in the spur plots, and *S. alterniflora* in the bay plots. Differential Global Positioning System (DGPS) coordinates were also collected at each stake to facilitate re-establishment of stations in the future. Vegetation sampling for each of the dune, bay, spur, and unplanted 4 m^2 plots continued in September 2001 and 2003. Field personnel made visual estimates of percent cover for the total plot and each individual species. If a plot was unable to be located (i.e., the marker stake was gone), a new plot was established. However, a new plot was not established if the original plot was now underwater or had eroded. In these cases, percent cover was recorded as 100% open water for data analysis.

Importance values were calculated by adding the relative percent cover to the relative frequency for each species (Courtemanche et al. 1999). Mean importance values were determined by separating species into categories of planted, seeded, appearance via natural vegetative recruitment or re-colonization, and bare ground. Importance values provide a useful and more realistic measure of dominance. Plots located in open water were not used in importance value calculations.

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Analysis done by UNO indicated that the project contributed to a 92.64 acre increase in the overall size of the island from pre- to post-construction (1996 to May 2002) (table 1). Penland et. al. (2003) stated that this project's gains accounted for a predicted 8 year increase in island longevity. However, after Tropical Storm Isidore and Hurricane Lili in 2002, post-storm photography showed 47.36 acres of land loss, or approximately one-half of the initial gains, to a total land mass of 662.63 acres.

Elevation

Currently, we are still in the process of converting pre-construction and as-built survey data collected via conventional survey methods to Louisiana Department of Natural Resources-South Louisiana Coastal Wetland GPS network datum. LiDAR surveys conducted in 2000, 2001, and 2002 displayed that initially Trinity Island along with the other Isles Dernieres may have been gaining volume prior to Tropical Storm Isidore (September 2002) and Hurricane Lili (October 2002) striking the island (figure 4). Calculated changes for Trinity Island include a 5% increase in volume between 2000 and 2001 and a 17% decrease between 2001 and 2002 surveys. These percentage changes in volume are consistent with other Isles Dernieres (see figure 4; West 2007a, b).

Vegetation

Initial monitoring indicated that fences have accumulated sand to create dunes, and that vegetation survival was high (>80%) after one growing season (Belhadjali et al. 2002). Vegetation survival was attributed to uncharacteristic low precipitation levels between initial planting and vegetation sampling (Townson et al. *Unpublished*). Percent survival was not measured in 2001 or 2003. Percent cover of vegetation in 1999 was low (<25%) indicating that an alternate planting design needs to be considered in future projects to maximize

Table 1: Habitat classification acreages for 1996 and 2002 Photography by UNO.

Classification	1996	5/14/2002	11/7/2002
beach	188.26	89.75	56.60
bare	14.42	272.06	323.40
marsh	386.32	268.08	235.81
barrier vegetation	28.35	80.10	46.82
structure	0.00	0.00	0.00
rip rap	0.00	0.00	0.00
intertidal	143.09	34.88	215.39
total land only	***617.35***	***709.99***	***662.63***

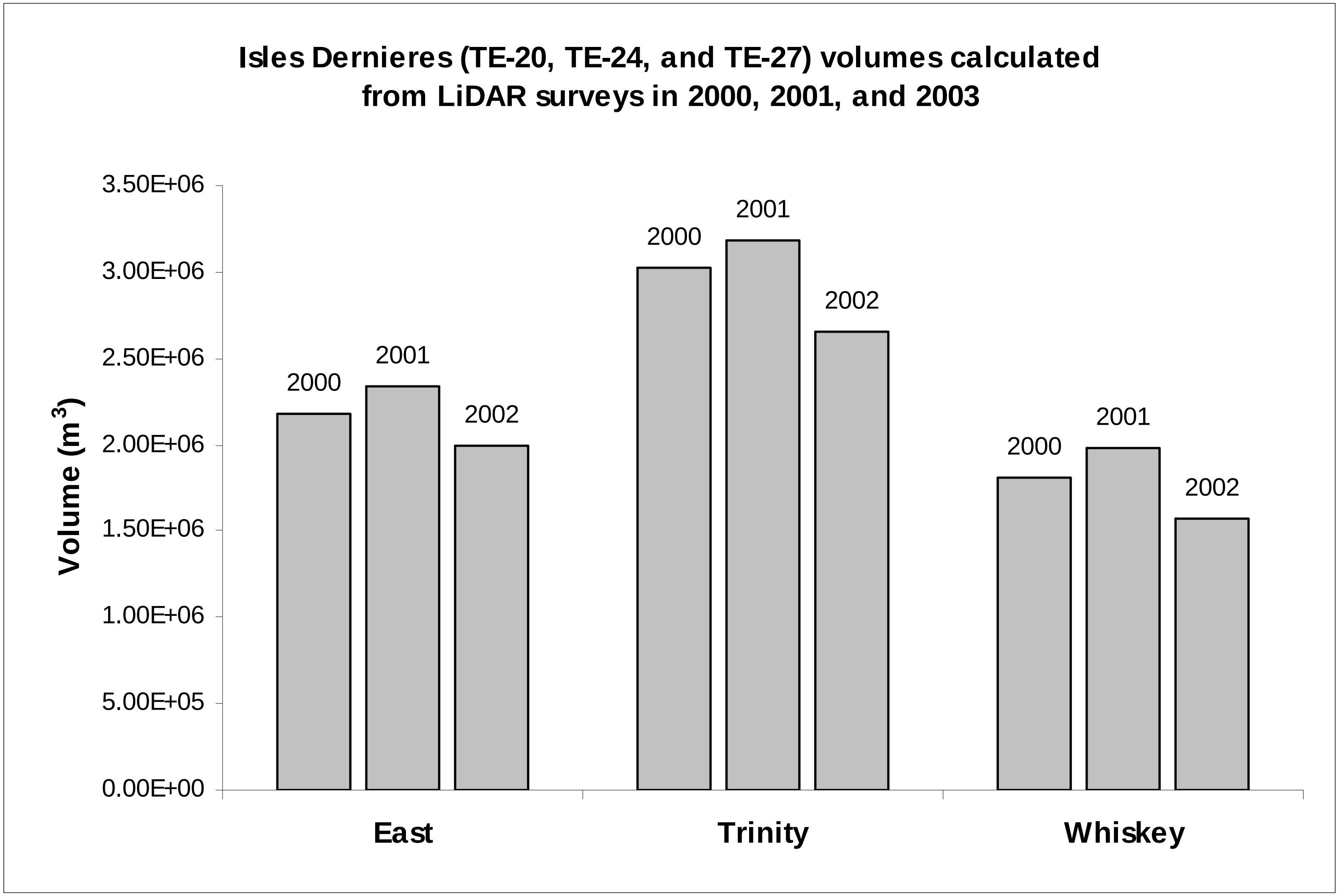

Figure 4: Volumes of East, Trinity, and Whiskey Isles Dernieres calculated from grids created from LiDAR surveys in ArcView®.

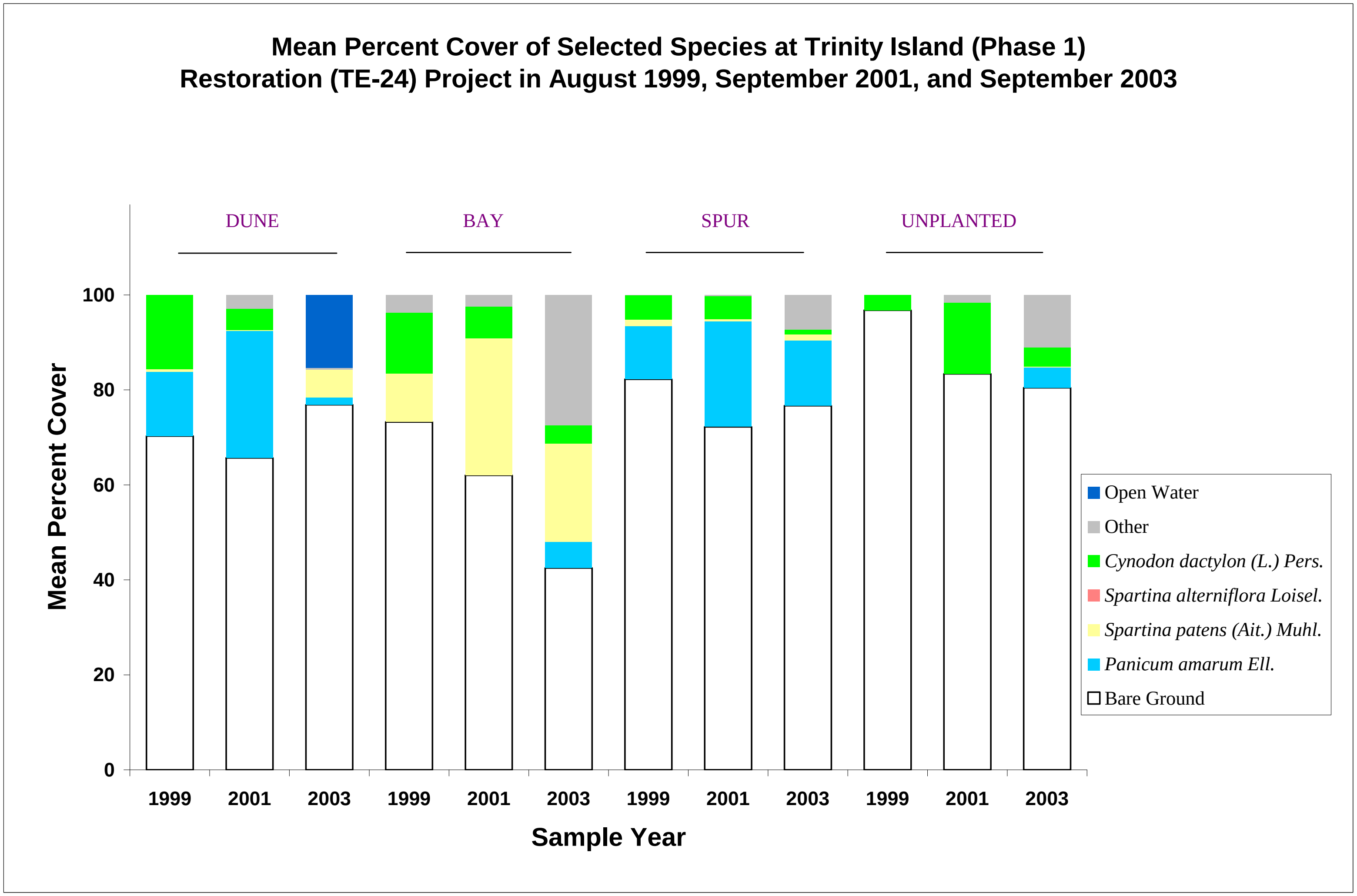

Figure 5: Mean percent cover for selected vegetation species at Trinity Island Restoration (TE-20).

cover of bare sediment faster (Belhadjali et al. 2002). A subsequent sampling trip in 2001 revealed that vegetative cover was dominated by the planted and aerially seeded vegetation. Percent cover may be attributed to several variables including precipitation, elevation, soil type, or soil nutrients (Townson et al. *Unpublished*).

Two of the dune vegetation plots were under water when revisited in 2003. Additionally, many of the plots were in the surf zone, or beach area. Nine of 13 dune plots (one plot was lost in 2001 and replaced but found in 2003), 3 of 12 spur plots, and 6 of the unplanted spur plots were in the surf zone and had 100% bare ground. This trend is evident as 76.8% of all dune plots were bare ground (figure 5). Vegetative cover decreased from 34.4% to 7.8% between 2001 and 2003 in the dune plots. Vegetative cover increased in successive sampling trips among all bay plots and increased between 1999 and 2001 for spur and unplanted plots. Between 2001 and 2003, a slight decrease in mean vegetative cover occurred in spur and unplanted sites, as many of the plots were in the surf zone.

C. dactylon, which was aerially-seeded post construction in 1999, was observed in many of the bay (3.8% cover), spur (3.2% cover), and unplanted (4.0% cover) plots in 2003. Percent cover of *C. dactylon* decreased to some extent in each of the 3 plot treatments between 2001 and 2003 (table 1) and was not recorded in any dune plots.

Of the planted vegetation plots, *S. patens* tended to have the same mean cover among all sampling years and plots, but did show a slight increase in dune treatments. However, this result may be misleading as only one dune plot contained *S. patens* with 76% cover. There was no evidence of *S. alterniflora* in any of the plots sampled in 1999 or 2003. However, sparse cover for *S. alterniflora* was observed in 2001 in one of the bay plots. *P. amarum* percent cover in dune and spur plots increased approximately two-fold between 1999 and 2001 but decreased between 2001 and 2003. Percent cover for *P. amarum* decreased from 26.7% to 1.5% between 2001 and 2003 in dune plots. Native vegetation, including *Conyza canadensis* (Canadian horseweed), *Croton punctatus* (beach tea), *Eustoma exaltatum* (catchyfly prairie gentian), *Sesbania herbacea* (bigpod sesbania), *Solidago sempervirens* (seaside goldenrod), and *Strophostyles helvula* (trailing fuzzy bean), increased in bay, spur, and unplanted treatments. Diversity was highest in the bay plots in 2003 suggesting a heterogeneous habitat possibly caused by irregular flooding and sands shifting to the back of the island.

Vegetation sampling within the 4 m^2 plot consistently underestimated species richness as compared to the surrounding 10 ft (33 m) of the plot (figure 6).

Table 2: Estimated mean percent cover for all species occurring during the 1999, 2001, and 2003 sampling of the 2x2 m Braun-Blanquet vegetation plots at Trinity Island.

	Dune					
	1999		2001		2003	
Species	**% Stations**	**Mean Cover**	**% Stations**	**Mean Cover**	**% Stations**	**Mean Cover**
Bare Ground	100.00	71.75	100.00	69.58	76.92	99.90
Andropogon glomeratus (Walt.) B.S.P.						
Baccharis halimifolia L.			16.67	2.05		
Chloris canterai Arech.						
Conyza canadensis (L.) Cronq.						
Conyza canadensis (L.) Cronq. var. canadensis						
Croton punctatus Jacq.			8.33	0.50		
Cynodon dactylon (L.) Pers.	83.33	19.20	91.67	5.29		
Cyperus L.					7.69	0.10
Cyperus odoratus L.			8.33	0.50		
Cyperus oxylepis Nees ex Steud.						
Cyperus polystachyos Rottb.						
Cyperus strigosus L.			8.33	0.50		
Digitaria bicornis (Lam.) Roemer & J.A.						
Distichlis spicata (L.) Greene					7.69	1.00
Eupatorium capillifolium (Lam.) Small						
Eustoma exaltatum (L.) Salisb. ex G. Don						
Fimbristylis castanea (Michx.) Vahl						
Ipomoea imperati (Vahl) Griseb.						
Lolium perenne L.						
Panicum amarum Ell.	100.00	13.83	100.00	28.33	7.69	20.00
Paspalum L.						
Paspalum urvillei Steud.						
Phyla nodiflora (L.) Greene						
Sabatia stellaris Pursh			8.33	5.00		
Sesbania herbacea (P. Mill.) McVaugh						
Sesuvium portulacastrum (L.) L.			8.33	0.50		
Solidago sempervirens L.						
Solidago sempervirens L. var. mexicana						
Spartina alterniflora Loisel.						
Spartina patens (Ait.) Muhl.	16.67	3.00	16.67	1.05	7.69	76.00
Strophostyles helvula (L.) Ell.			16.67	5.25		
Suaeda linearis (Ell.) Moq.			8.33	15.00		
Typha domingensis Pers.					7.69	2.00
Vigna luteola (Jacq.) Benth.					7.69	2.00
Open Water					15.38	100.00

Table 2 cont.

	Bay					
	1999		2001		2003	
Species	% Stations	Mean Cover	% Stations	Mean Cover	% Stations	Mean Cover
Bare Ground	100.00	74.75	100.00	67.08	100.00	42.69
Andropogon glomeratus (Walt.) B.S.P.					30.77	4.25
Baccharis halimifolia L.			41.67	4.66	61.54	4.90
Chloris canterai Arech.						
Conyza canadensis (L.) Cronq.					7.69	2.00
Conyza canadensis (L.) Cronq. var. canadensis					23.08	3.33
Croton punctatus Jacq.					7.69	1.00
Cynodon dactylon (L.) Pers.	83.33	15.65	83.33	8.75	15.38	25.00
Cyperus L.					7.69	0.50
Cyperus odoratus L.			8.33	2.00	7.69	0.10
Cyperus oxylepis Nees ex Steud.					30.77	2.50
Cyperus polystachyos Rottb.	8.33	10.00				
Cyperus strigosus L.			8.33	0.50		
Digitaria bicornis (Lam.) Roemer & J.A.						
Distichlis spicata (L.) Greene						
Eupatorium capillifolium (Lam.) Small					7.69	5.00
Eustoma exaltatum (L.) Salisb. ex G. Don					30.77	1.90
Fimbristylis castanea (Michx.) Vahl					23.08	2.00
Ipomoea imperati (Vahl) Griseb.						
Lolium perenne L.						
Panicum amarum Ell.					30.77	18.00
Paspalum L.	8.33	10.00				
Paspalum urvillei Steud.					7.69	1.00
Phyla nodiflora (L.) Greene						
Sabatia stellaris Pursh					7.69	0.10
Sesbania herbacea (P. Mill.) McVaugh					23.08	40.67
Sesuvium portulacastrum (L.) L.	8.33	1.00	8.33	1.00		
Solidago sempervirens L.			8.33	5.00	30.77	3.00
Solidago sempervirens L. var. mexicana					7.69	1.00
Spartina alterniflora Loisel.			8.33	0.10		
Spartina patens (Ait.) Muhl.	100.00	10.46	100.00	31.17	76.92	27.10
Strophostyles helvula (L.) Ell.					84.62	11.09
Suaeda linearis (Ell.) Moq.	8.33	25.00			7.69	2.00
Typha domingensis Pers.						
Vigna luteola (Jacq.) Benth.						
Open Water						

Table 2 cont.

Species	Spur 1999 % Stations	Spur 1999 Mean Cover	Spur 2001 % Stations	Spur 2001 Mean Cover	Spur 2003 % Stations	Spur 2003 Mean Cover
Bare Ground	100.00	82.33	100.00	77.08	100.00	76.67
Andropogon glomeratus (Walt.) B.S.P.						
Baccharis halimifolia L.			16.67	1.55	8.33	6.00
Chloris canterai Arech.						
Conyza canadensis (L.) Cronq.					16.67	17.50
Conyza canadensis (L.) Cronq. var. canadensis					8.33	1.00
Croton punctatus Jacq.					8.33	5.00
Cynodon dactylon (L.) Pers.	83.33	6.20	75.00	6.94	25.00	4.33
Cyperus L.						
Cyperus odoratus L.						
Cyperus oxylepis Nees ex Steud.						
Cyperus polystachyos Rottb.						
Cyperus strigosus L.						
Digitaria bicornis (Lam.) Roemer & J.A.						
Distichlis spicata (L.) Greene						
Eupatorium capillifolium (Lam.) Small						
Eustoma exaltatum (L.) Salisb. ex G. Don					16.67	0.55
Fimbristylis castanea (Michx.) Vahl						
Ipomoea imperati (Vahl) Griseb.					8.33	1.00
Lolium perenne L.	8.33	0.50				
Panicum amarum Ell.	66.67	16.75	66.67	35.63	50.00	27.50
Paspalum L.						
Paspalum urvillei Steud.						
Phyla nodiflora (L.) Greene						
Sabatia stellaris Pursh						
Sesbania herbacea (P. Mill.) McVaugh					16.67	0.55
Sesuvium portulacastrum (L.) L.						
Solidago sempervirens L.						
Solidago sempervirens L. var. mexicana						
Spartina alterniflora Loisel.						
Spartina patens (Ait.) Muhl.	16.67	8.50	16.67	2.75	16.67	7.50
Strophostyles helvula (L.) Ell.					33.33	9.25
Suaeda linearis (Ell.) Moq.			8.33	0.10		
Typha domingensis Pers.						
Vigna luteola (Jacq.) Benth.						
Open Water						

Table 2 cont.

	Unplanted					
	1999		2001		2003	
Species	% Stations	Mean Cover	% Stations	Mean Cover	% Stations	Mean Cover
Bare Ground	100.00	96.83	100.00	88.33	100.00	80.45
Andropogon glomeratus (Walt.) B.S.P.						
Baccharis halimifolia L.			33.33	2.13		
Chloris canterai Arech.					9.09	0.10
Conyza canadensis (L.) Cronq.			16.67	0.30		
Conyza canadensis (L.) Cronq. var. canadensis					9.09	10.00
Croton punctatus Jacq.			8.33	0.50	9.09	0.10
Cynodon dactylon (L.) Pers.	100.00	3.25	100.00	15.92	36.36	11.00
Cyperus L.						
Cyperus odoratus L.						
Cyperus oxylepis Nees ex Steud.					9.09	33.00
Cyperus polystachyos Rottb.						
Cyperus strigosus L.			8.33	0.50		
Digitaria bicornis (Lam.) Roemer & J.A.			8.33	0.10		
Distichlis spicata (L.) Greene						
Eupatorium capillifolium (Lam.) Small						
Eustoma exaltatum (L.) Salisb. ex G. Don						
Fimbristylis castanea (Michx.) Vahl						
Ipomoea imperati (Vahl) Griseb.						
Lolium perenne L.						
Panicum amarum Ell.			8.33	0.10	36.36	11.75
Paspalum L.						
Paspalum urvillei Steud.						
Phyla nodiflora (L.) Greene			8.33	10.00	9.09	1.00
Sabatia stellaris Pursh						
Sesbania herbacea (P. Mill.) McVaugh						
Sesuvium portulacastrum (L.) L.			8.33	0.10	9.09	3.00
Solidago sempervirens L.					9.09	0.10
Solidago sempervirens L. var. mexicana						
Spartina alterniflora Loisel.						
Spartina patens (Ait.) Muhl.			8.33	0.10	9.09	2.00
Strophostyles helvula (L.) Ell.					18.18	37.50
Suaeda linearis (Ell.) Moq.						
Typha domingensis Pers.						
Vigna luteola (Jacq.) Benth.						
Open Water						

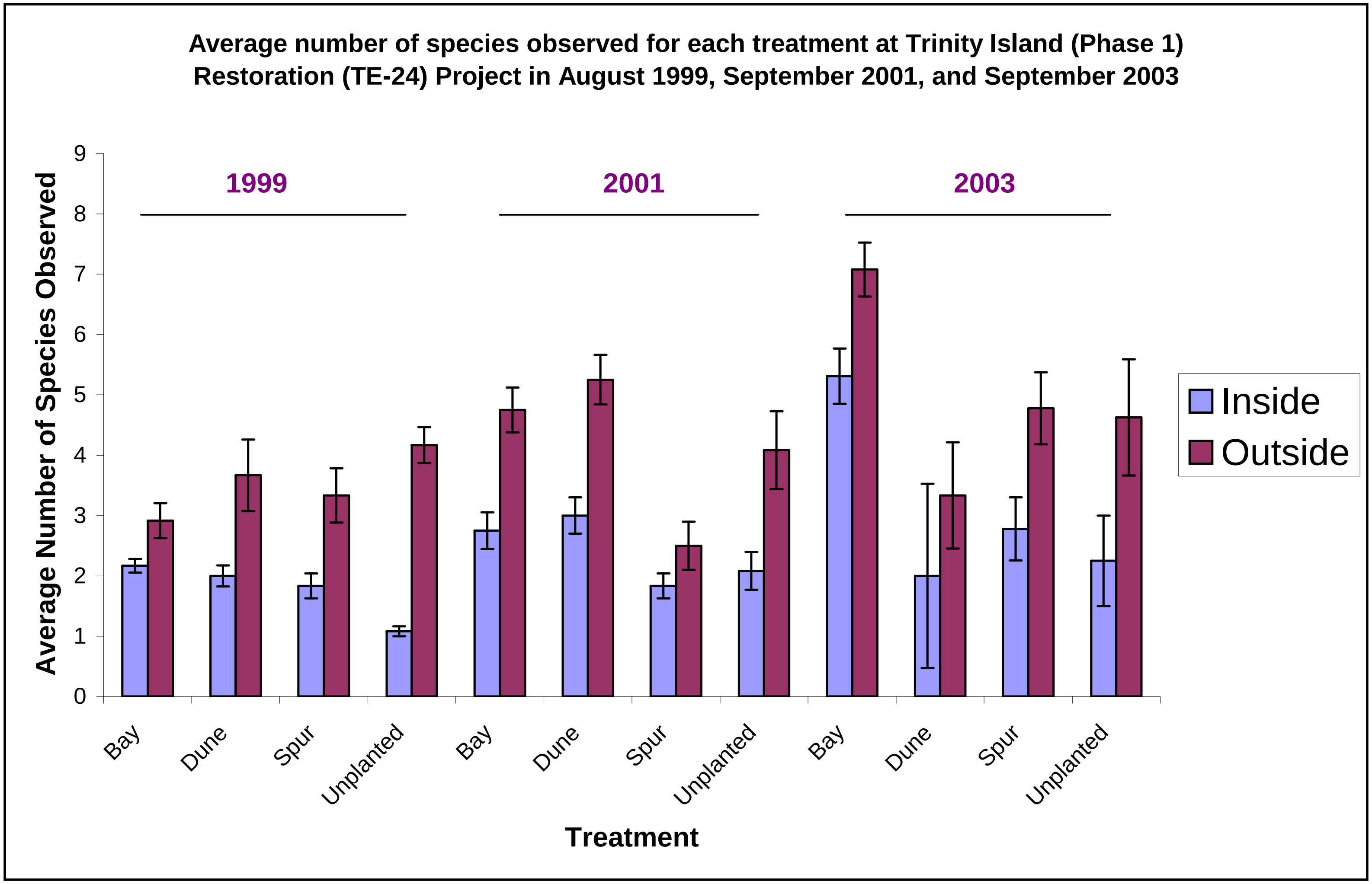

Figure 6: Average number of different vegetation species recorded inside and outside of each 4 m^2 plot at Trinity Island Restoration (TE-24). Error bars represent one standard deviation from the mean.

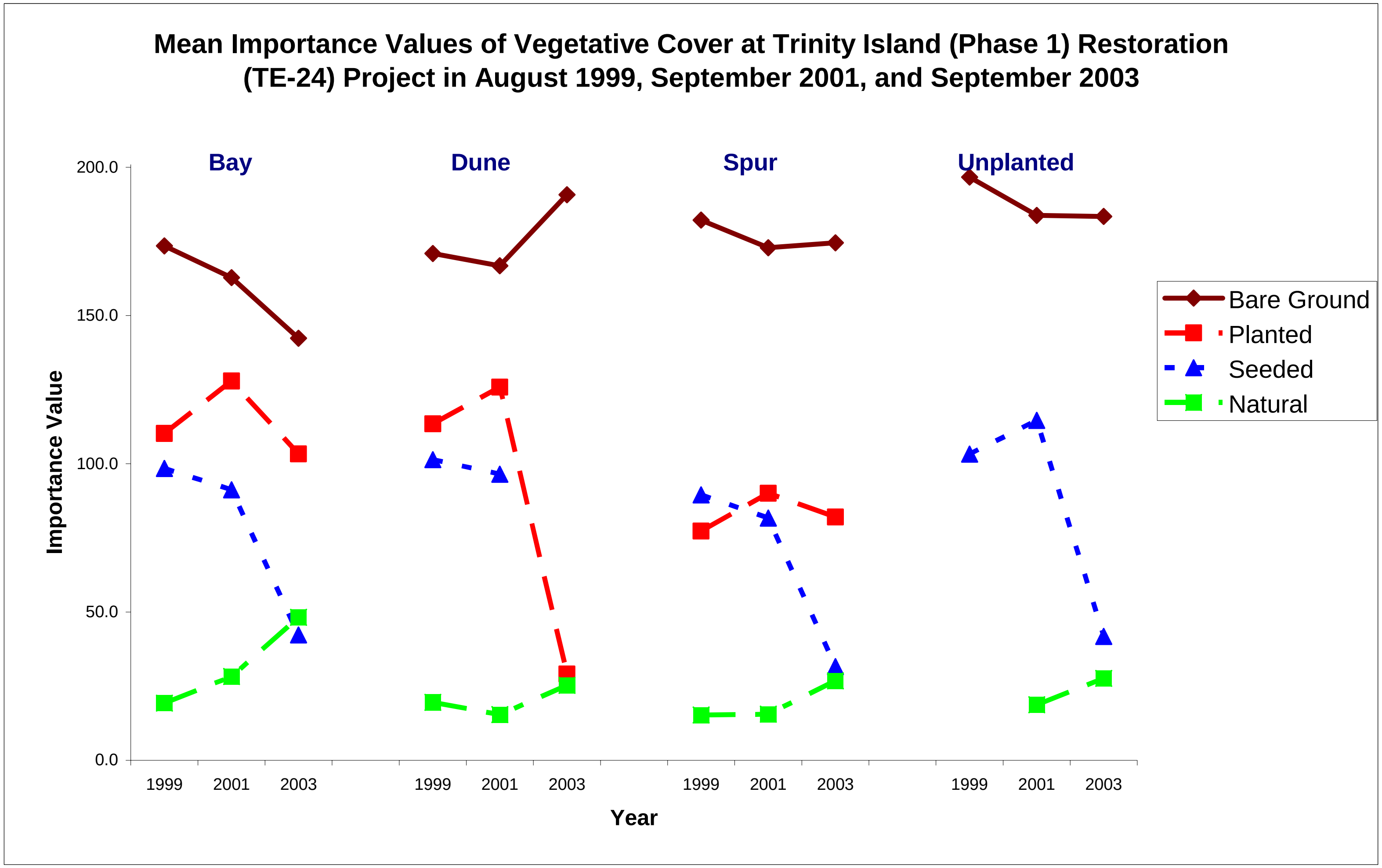

Figure 7: Mean importance values of different vegetation categories calculated at Trinity Island (TE-24). The term natural represents species that were neither planted nor seeded and assumed colonized via natural means.

This result may indicate an insufficient number of plots established to accurately characterize the vegetative communities on the island. However, there was an observed increase in species richness with each successive sampling trip. The appearance of vegetation colonization via natural means resulted in an increased importance value in both 2001 and 2003 (figure 7). Planted and seeded species importance values decreased substantially between 2001 and 2003. Bare ground importance value decreased between 1999 and 2001 but increased between 2001 and 2003 in the dune and spur plots as a result of many of these plots were in the surf zone. These findings suggest that as time increases after initial construction, more and more species are re-colonizing the island and displacing some of the seeded and planted species. These results are consistent with observations at East Island (West 2007a).

V. Conclusions

a. Project Effectiveness

Preliminary observations alleged that this project was effective at reducing barrier island erosion. Khalil and Lee (*in press*) reported that sand fencing aided in the trapping of sand and the formation of dunes prior to site visits in 2003. However, subsequent sampling trips, especially those after Hurricane Lili, revealed that some of the land was in the surf zone and that this island may be exhibiting rollover. The survival of the bay and dune plots, in particular, is a factor of how the island shape is altered by wind and wave action. LiDAR results after Isidore and Lili further help to support these findings as well as provide evidence of elevational/volume decreases.

An increase in the number of species in vegetation plots does suggest that planting along the spurs and in the bay area helped to anchor fill material and sand in place as well as to allow native vegetation to disperse into newly created habitat. The increase in vegetative cover each year (except in dune plots) may also be indicative of some success at project effectiveness. However, landward migration may continue and future sampling trips may yield more losses of vegetation stations to open water.

This project may have succeeded its goal of increasing the height and volume of the island prior to the compounding effects of Isidore and Lili. Although some sediment was lost, this island did not become subaqueous due to proactive sediment fill and maintained some protection for mainland areas from these storms. Increases in species richness and vegetative cover in some areas of the island may further promote sediment stability facilitate further synergistic effects of vegetation growth and volume maintenance.

b. Recommended Improvements

Funding for maintenance of barrier island restoration projects was not considered due to the expense involved with replenishment of dredge material over the life expectancy of the project. In forgoing the funding of a barrier island maintenance program to replenish sediment lost to normal storm events, claims for FEMA assistance resulting from extensive or catastrophic storm damage to barrier islands from unexpected storms events such as tropical storms and hurricanes are considered ineligible. Based on monitoring activity of these islands, it has been documented that these barrier island are experiencing significant land loss due to barrier island rollover and island narrowing resulting from such unexpected storm events. Therefore, it is recommended that maintenance funds be provided for the implementation of an inspection and maintenance program for assessment and replacement of dredged sediment and sand fencing necessary to maintain the integrity of these islands. The implementation of a maintenance program for barrier island projects would enable these projects to qualify for assistance under the Federal Emergency Management Program.

c. Lessons Learned

Initial lessons learned include adjusting the establishment of planting survival plots to better analyze the yearly success of planted vegetation (cf. Townson et al. *Unpublished*). This adjustment can include resizing plots or increasing the number of the plots established. Increasing the number of the established plots may also help accurately characterize the vegetative communities on the island.

The use of dredged sediment, sand fencing, and vegetative plantings are plausible ways to create quasi-stabilization and further prolong the lives of barrier islands. These three techniques should be used in conjunction and the construction of sand fencing as well as vegetative planting should occur as soon as possible after the placement of dredged sediment to minimize soil loss. Furthermore, a different vegetative planting design must be determined to allow vegetative colonization in a sufficient time frame as to maximize sediment stabilization.

Barrier islands are often exposed to storm events resulting in substantial over-wash and breaching. To combat these processes, it is important that a continuous dune of sufficient height and width is maintained on these islands. Other than periodically replenishing sediment by hydraulic dredge, sand fencing has proven to be an effective technique in rebuilding dunes by capturing wind blown sediment. We have learned from past projects that orienting the sand fencing parallel to the shore face and perpendicular to the predominant wind direction has maximized the potential for maintaining a viable dune section.

References

Belhadjali, K., C.F. Robertson, and K.R. Balkum. 2002. Coastal Restoration Division Annual Project Reviews: December 2002. Louisiana Department of Natural Resources, Baton Rouge, LA. 96 pp.

Courtemanche, R.P., M.W. Hester, and I.A. Mendelssohn. 1999. Recovery of a Louisiana barrier island marsh plant community following extensive hurricane-induced overwash. Journal of Coastal Research 15:872-883.

Frazier, D.E. 1967. Recent deposits of the Mississippi River, their development and chronology. Transactions, Gulf Coast Association of Geological Societies 17: 287-311.

Khalil, S.M. and D.M. Lee. *In Press*. Restoration of Isles Dernieres, Louisiana: some reflections on morphodynamic approaches in the northern Gulf of Mexico to conserve coastal/marine systems. Journal of Coastal Research.

List, J.H., B.E. Jaffe, A.H. Sallenger, and M.E. Hansen. 1997. Bathymetric comparisons adjacent to the Louisiana barrier islands: processes of large scale change. Journal of Coastal Research 13:670-678.

McBride, R.A., and M.R. Byrnes 1997. Regional variations in shore response along barrier island systems of the Mississippi River Delta Plain: historical change and future prediction. Journal of Coastal Research 13: 628-655.

McBride, R.A., M. W. Hiland, S. Penland, S.J. Williams, M.R. Byrnes, K.A. Westphal, B.E. Jaffee, and A.H. Sallenger, Jr. 1991. Mapping barrier island changes in Louisiana: techniques, accuracy, and results. Seattle, WA: Coastal Sediments '91 Proceedings. pp 1011-1025.

McBride, R.A., S. Penland, B.E. Jaffe, S.J. Williams, A.H. Sallenger, and K.A. Westphal. 1989. Erosion and deterioration of the Isles Dernieres barrier island arc-Louisiana, U.S.A.: 1853-1988: Transactions of the Gulf Coast Association of Geological Societies 39:431-444.

Mueller-Dombois, D. and H. Ellenberg. 1974. *Aims and Methods of Vegetation Ecology*. John Wiley and Sons, New York. 547 pp.

Penland, S., and R. Boyd. 1985. Transgressive depositional environments of the Mississippi River delta plain: A guide to the barrier islands, beaches and shoals of Louisiana: Louisiana Geological Survey Guidebook Series No. 3, 233 pp.

Penland, S., P. Conner, F. Cretini, and K. Westphal. 2003. CWPPRA adaptive management: Assessment of five barrier island restoration projects in Louisiana. Prepared for LA Dept. Natural Resources, Office of Coastal Restoration and Management, Baton Rouge, LA by the Pontchartrain Institute for Environmental Sciences, Univ. of New Orleans. New Orleans, LA. 64 pp + appendices

Penland, S. and Ramsey, K.E. 1990. Relative sea-level rise in Louisiana and the Gulf of Mexico: 1908-1988. Journal of Coastal Research 6:323-342.

Penland, S., J.R. Suter, and R. Boyd. 1988. The transgressive depositional systems of the Mississippi River delta plain: A model for barrier shoreline and shelf sand development. Journal of Sedimentary Petrology 58:932-949.

Sallenger, A.H., W.B. Krabill, R.N. Swift, J. Brock, J. List, M. Hansen, R.A. Holman, S. Manizade, J. Sontag, A. Meredith, K. Morgan, J.K. Yunkel, E.B. Frederick, and H. Stockdon. 2003. Evaluation of airborne topographic LiDAR for quantifying beach changes. Journal of Coastal Research. 19:125-133.

Steyer, G.D., R.C. Raynie, D.L. Steller, D. Fuller and E. Swenson. 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.

Townson, M.A., C.K. Armbuster, and N. Clark. *Unpublished*. Isles Dernieres Restoration Project Phase 1 (TE-24) Progress Report.

West, J.L. and D. Dearmond. 2007a. 2004 Operations, Maintenance, and Monitoring Report for Isles Dernieres Restoration East Island (TE-20), *Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux, Louisiana.* 21pp.

West, J.L. and D. Dearmond. 2007b. 2004 Operations, Maintenance, and Monitoring Report for Whiskey Island Restoration (TE-27), *Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux, Louisiana.* 27pp.