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

2004 Operations, Maintenance and Monitoring Report

for

CHANDELEUR ISLANDS MARSH RESTORATION

State Project Number PO-27
Priority Project List 9

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Orleans Parish

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2004 Operations, Maintenance, and Monitoring Report
For
Chandeleur Islands Marsh Restoration (PO-27)

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Preface

The 2004 OM&M Report format is a streamlined approach which combines the Operations and Maintenance annual project inspection information with the Monitoring data and analyses on a project-specific basis. This new reporting format for 2004 includes monitoring data collected through December 2003, and annual Maintenance Inspections through June 2004. Monitoring data collected in 2004 and maintenance inspections conducted between July 2004 and June 2005 will be presented in the 2005 OM&M Report.

I. Introduction

The Chandeleur Islands are a 72-km long barrier island chain located in easternmost St. Bernard and Plaquemines Parishes, Louisiana about 70-miles (113-km) east of downtown New Orleans. The islands are bound by the Gulf of Mexico to the north, south, and east, and by Chandeleur and Breton Sounds to the west. Classified as a wilderness area, the islands are contained within the Breton National Wildlife Refuge and managed by the United States Fish and Wildlife Service (USFWS). The Chandeleur Islands Restoration (PO-27) project area encompasses Chandeleur Island, the northernmost island in the Chandeleur Island chain (Figure 1).

The islands, which comprise the largest and oldest transgressive barrier island arc in the northern Gulf of Mexico, are the remnant land mass of the St. Bernard delta complex which was abandoned some 1,500 years ago (Debusschere et al. 1990; Suter et al. 1988). Delta abandonment initiates barrier island development through the erosion of abandoned headlands and the redistribution of eroded sediments as flanking barrier islands (Penland et al. 1985; Penland et al. 1988). Subsidence of the abandoned delta leads to the detachment of the barrier shoreline and the creation of a barrier island arc, such as the Chandeleur Islands, which migrates landward from its initial position. The final stage in barrier shoreline evolution occurs when erosional factors such as relative sea level rise and storm impacts begin to overcome the ability of the island arc to regenerate itself through washover deposits and flood tidal delta deposits. This eventually transforms the barrier arc to a submerged inner shelf shoal.

The Chandeleur Islands have been retreating west-northwest toward the mainland for the last 100 years at rates greater than 15-m yr^{-1} in the southern islands, and decreasing northward to less than 5-m yr^{-1} (Penland et al. 1985). The asymmetric morphology of the island arc is due to its almost parallel orientation to the dominant southeasterly wave approach, causing extensive northward longshore transport. The northern portion of the island arc is dominated by wide beaches with multiple bars and large washover fans separated by hummocky dune fields. The dune zone is vegetated by shrubs and grasses, and grades into a high salt marsh populated by black mangrove (*Avicennia germinans*) and smooth cordgrass (*Spartina alterniflora*) (Kahn and Roberts 1982). Other species which occur on the islands include inland saltgrass (*Distichlis spicata*), wiregrass (*Spartina patens*), gulf croton (*Croton*

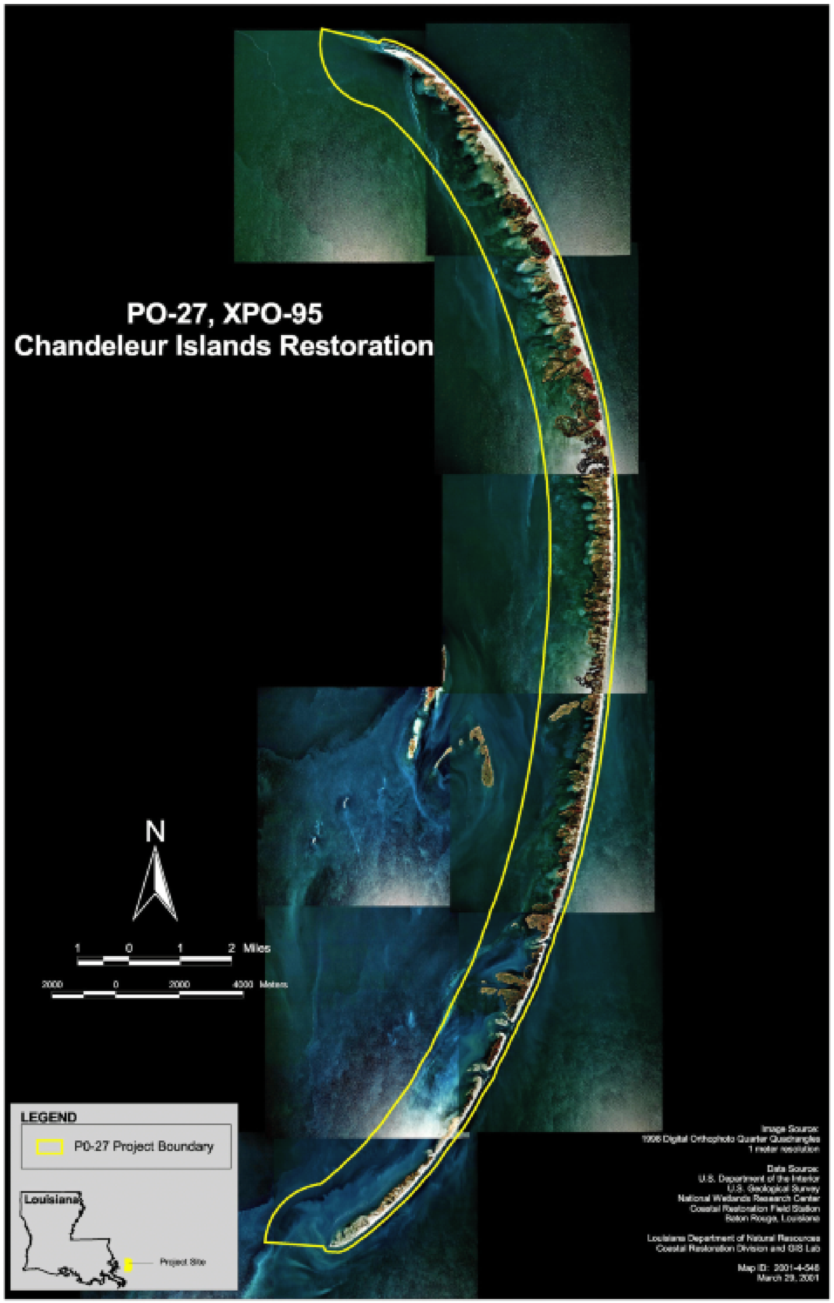

Figure 1. Chandeleur Islands Marsh Restoration (PO-27) project boundary.

punctatus), beach morning-glory (*Ipomoea imperati*), wax myrtle (*Myrica cerifera*), and eastern baccharis (*Baccharis halimifolia*). The southern islands are narrower, lower in elevation, and eventually give way to small island fragments and shoals separated by tidal inlets toward the southern tip. The barrier beach generally consists of broken *Rangia* and oyster-shell litter mixed with well-sorted fine quartzose sand (Kahn and Roberts 1982).

The Chandeleur Islands have experienced an average land loss rate of 0.08-km^2 yr^{-1} since 1869 (Penland et al. 1985). At current land loss rates, the islands are expected to become subaqueous in about 200 years (Suter et al. 1988; Penland and Suter 1988). According to Kahn and Roberts (1982), the long-term deterioration of the island arc is being enhanced by 1) subsidence of the St. Bernard delta sediments, 2) absence of sediment supply, and 3) the frequent passage of destructive tropical cyclones. For instance, Hurricanes Camille and Georges reduced the area of the islands by 35% and 40% respectively. During storm events, sediment is eroded from the beach face and nearshore bars of barrier islands and is deposited seaward. The constructive period between storms is usually of insufficient length to allow the barrier island to completely regenerate. In many transgressive barrier island systems, such as the Chandeleurs, sediment is often deposited as overwash on the landward side of the island (or seaward side depending on direction of storm surge flooding) due to overtopping or breaching of the barrier during storm events. Overwash deposits in the backbarrier marshes are often colonized by salt marsh vegetation and sea grasses, counteracting some beach erosion and promoting landward migration of the islands (Debusschere et al. 1990).

The Chandeleur Islands are frequently overwashed due to the passage of cold fronts and tropical storms (Boyd and Penland 1981). Extensive overwash and breaching of the islands occurred with the passage of Hurricane Georges in 1998. The hurricane passed within five miles east of the islands creating over 100 washover channels through the barrier chain. Ritchie and Penland (1988) note the importance of vegetation in the establishment and stabilization of coastal dunes. If a washover area is not subjected to repeated disruption due to overwash events, plant colonization produces ground cover and encourages sand aggradation. The objective of the Chandeleur Islands Marsh Restoration project is to stabilize 364-acres (1.47-km^2) of unvegetated hurricane washover deposits on 22 overwash fan sites through the use of *Spartina alterniflora* plantings to trap and hold sediments. Stabilization of washover deposits will allow for the accretion of back barrier marshes through sediment trapping, the re-colonization of SAV beds due to stabilization of sub-tidal sand flats, and the protection of up to 30-acres (0.12-km^2) of main island habitat through wave reduction and sediment trapping.

The specific goals of the project are to 1) increase percent cover of emergent vegetation in planting areas, and to 2) maintain or increase intertidal area, as indexed by elevation data, within and adjacent to the planting sites. Areas within the elevation range of mean low water and mean high water will be defined as 'intertidal'. Phase I of the project, which accounts for 40% of the total plantings, was completed in July 2001. A total of 80,730 plants were installed at 10 overwash sites (Figure 2). Each site was planted with two rows of plants below mean tide, plus additional rows to reach the mean high tide line at 1.06-ft NAVD88 (0.32-m). Rows were spaced 10-ft (3-m) apart. A total of 35,100 linear ft (10,698-m) of shoreline were

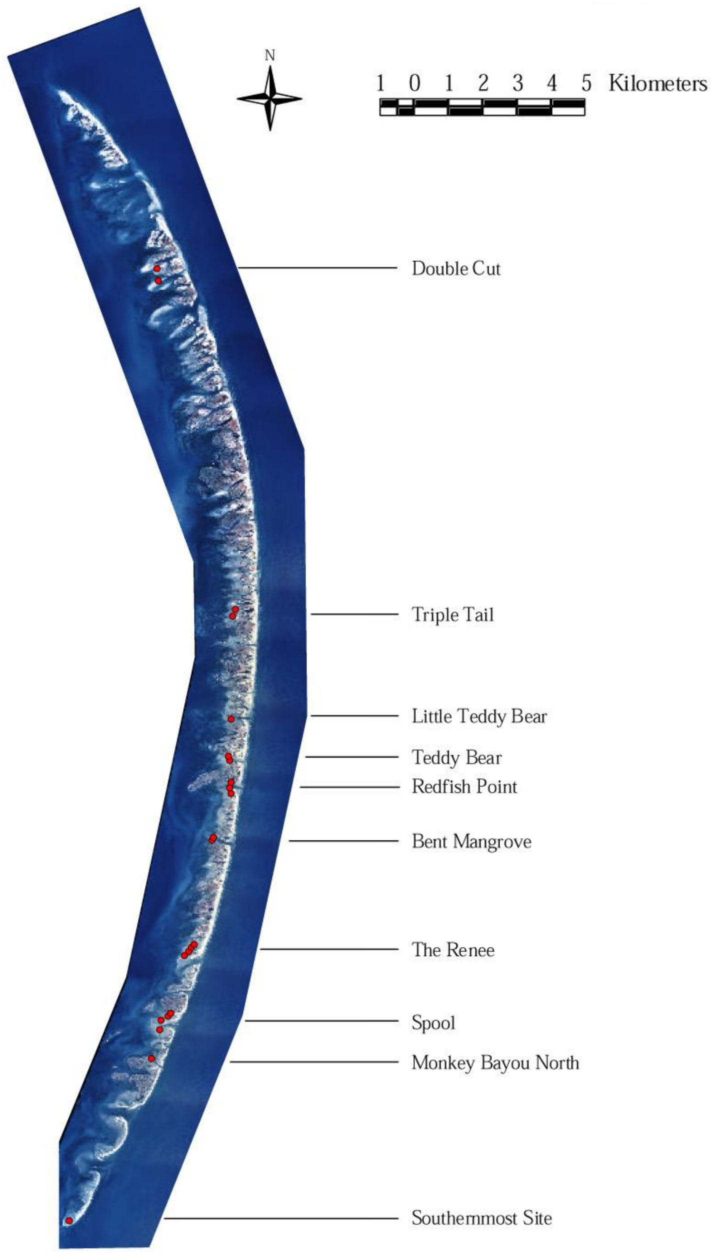

Figure 2. Chandeleur Islands Marsh Restoration (PO-27) Phase I planting site locations.

planted. A site visit to the Chandeleur Islands on May 12-13, 2003 by LDNR and NOAA Fisheries staff revealed that there is not a significant number of planting sites that required further work, as defined by the criteria established during a test planting in 2000. This test planting determined the optimal planting elevation to be at mean water level. Therefore, Phase II of the project, which includes the remaining 60% of the proposed plantings, will not be planted.

II. Maintenance Activity

a. Project Feature Inspection Procedures

Maintenance activities and funds were not authorized for this project. Therefore, maintenance inspections or work has not been conducted.

III. Operation Activity

a. Operation Plan

There is no operations activity on this project, and therefore, there is not an operation plan.

IV. Monitoring Activity

This is a comprehensive report and includes all data collected from the pre-construction period and the post-construction period through December 2003.

a. Monitoring Goals

The objective of the Chandeleur Islands Marsh Restoration Project is to stabilize overwash deposits resulting from Hurricane Georges in 1998 through the use of vegetation plantings to trap and hold sediments.

The specific monitoring goals which will be used to evaluate the above objective are to 1) determine if percent cover of emergent vegetation increases within planting areas, and to 2) determine if the intertidal area increases or is maintained, as indexed by elevation data, within and adjacent to the planting sites.

b. Monitoring Elements

Aerial Photography: Color-infrared aerial photography (1:12,000 scale) will be obtained and analyzed to determine land:water ratios. Each planting site will be quantified separately.

Photography was obtained in November 2000 (pre-construction) and 2003 (post-construction) and will be obtained in 2005.

Vegetation Surveys: Percent cover and species composition will be determined at five of the planting sites. The Braun-Blanquet method was used to survey vegetation in 4-m^2 plots along randomly selected transects, which bisect the planting elevation contours. The number of transects and vegetation plots were determined by the relative size of each planting area; however, a minimum of three transects and twelve plots (4 plots/transect) were established at each site. Surveys were conducted in spring of 2001 (as built) and in early fall in years 2001, 2002, and 2003. Surveys will be conducted again in 2004 and 2005.

Elevation Surveys: Elevation surveys will be conducted along the same transects established for vegetation monitoring. The temporary benchmark installed at each site will be used for horizontal and vertical control. Elevations were recorded using a GTS 3020 Electronic Total Station at 20-ft (6.1-m) maximum intervals along each transect as well as at any significant changes in elevation within those intervals. The transects were carried out at least 60-ft (18.3-m) beyond the most seaward planted row. The transects were also carried across any interior unplanted area, in the case of an island planting. In addition, elevation was taken at the southeast corner of each vegetation plot. A permanent benchmark was established on the island to be used as a reference datum. Surveys were conducted in conjunction with vegetation surveys in the spring of 2001 (as built) and in 2003. One more survey will be conducted in 2005.

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Aerial photography was obtained in November 2000 (pre-construction) and in November 2003 (post-construction). The photography is currently being analyzed to determine land/water ratios. Once both sets of photography have been analyzed, pre-construction and post-construction land-water ratios will be compared. The results of this analysis will be available in the 2005 OM&M report. Photography and LIDAR data obtained in October 2002 in response to Hurricane Lili are also being analyzed.

Vegetation Surveys

Vegetation surveys were conducted in July 2001 (as built), October 2001, October 2002, and September 2003. The planting sites selected for vegetation monitoring were (north to south) Tripletail, Little Teddy Bear, Redfish Point, Spool, and North Monkey Bayou. A total of 72 4-m^2 (2m X 2m) Braun-Blanquet plots were surveyed, with the number of plots at each site ranging from 12 to 20 (Table 1).

Table 1. The number of 4-m^2 vegetation plots established at each monitored planting site for the Chandeleur Islands Marsh Restoration (PO-27) project.

Site name	# of plots
Tripletail	12
Little Teddy Bear	12
Redfish Point	16
Spool	20
North Monkey Bayou	12
Overall	72

Mean percent cover of *Spartina alterniflora* across all 72 vegetation plots has increased every year since the as-built survey in 2001 (Figure 3). The mean percent cover increased from 14% in 2002 to 21% in 2003. The mean percent cover increased at each of the individual planting sites from 2002 to 2003 except at Redfish Point (Figure 4). Since 2002, the percent of plots containing no *S. alterniflora* decreased at Tripletail, Spool, and North Monkey Bayou indicating that the plants 'spread' by seed or underground shoots from nearby stands into those previously empty plots (Figure 5). This is encouraging because so many plants at Spool and North Monkey Bayou were impacted during the tropical storm season in 2002. However, more than half of the plots at Spool, as well as at Redfish Point, still contain no *S. alterniflora*. Redfish Point has been greatly affected by overwash since the plants were installed, either through plant burial or the formation of new cuts through the planting area.

The northern two sites, Tripletail and Little Teddy Bear, appear to be the healthiest planting sites with regard to the number of plots vegetated as well as a greater cover of plants within vegetated plots. The lower three sites are located on a narrower part of the island and are therefore more susceptible to overwash events. While the plants remaining at these three sites were generally healthy and spreading, large areas of the planted site remain unvegetated. Many of these lost plantings at Spool and North Monkey Bayou resulted from the 2002 storm season, whereas Redfish Point has had a high number of empty plots since the fall survey in 2001. In addition, the plantings at Redfish Point seem to be degrading further, while the two more southern sites have improved. Redfish Point seems to be the highest energy site with washover events occurring more frequently than at the other sites.

Plant diversity within the planting sites increased between the 2002 and 2003 surveys, particularly at Redfish Point. In 2002, the only species besides *S. alterniflora* (i.e. unplanted) observed within the planting area was *Avicennia germinans* (black mangrove) near one plot at the Tripletail site. In 2003, we observed a total of 13 species inside or within 5 meters of the 72 vegetation plots (Table 2). The most diverse site was Redfish Point with a total of 13 species. The number of species observed at the remaining sites ranged from two to five.

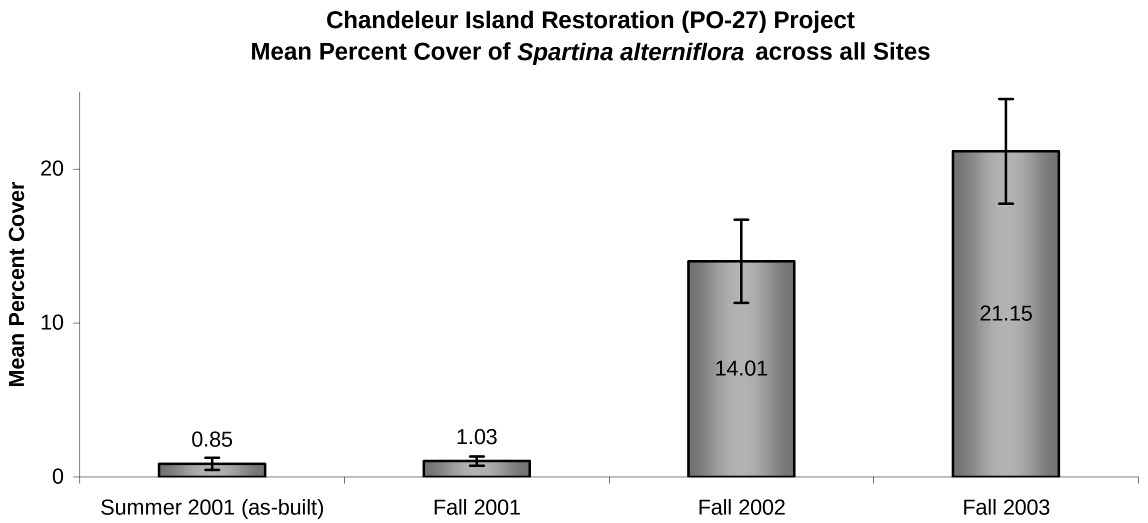

Figure 3. Mean percent cover of *Spartina alterniflora* across 72 4-m^2 Braun-Blanquet vegetation plots within the five selected plantings sites of the Chandeleur Islands Restoration (PO-27) Project from 2001 to 2003.

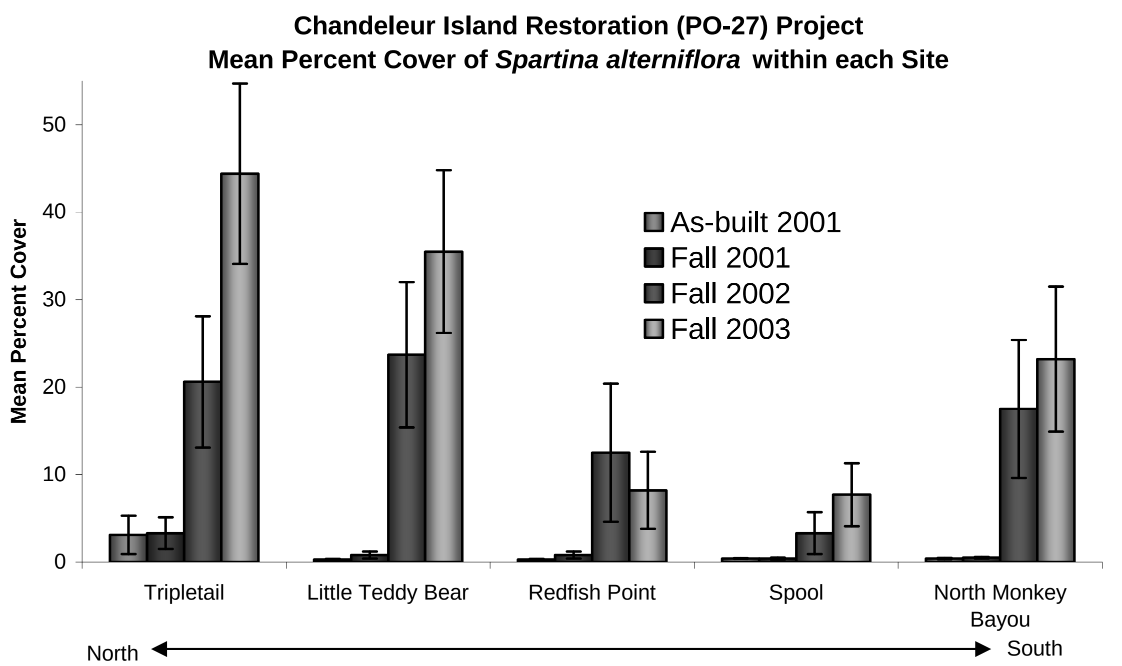

Figure 4. Mean percent cover of Spartina alterniflora across all 4-m^2 vegetation plots within each of the five selected plantings sites of the Chandeleur Islands Restoration (PO-27) Project from 2001 to 2003.

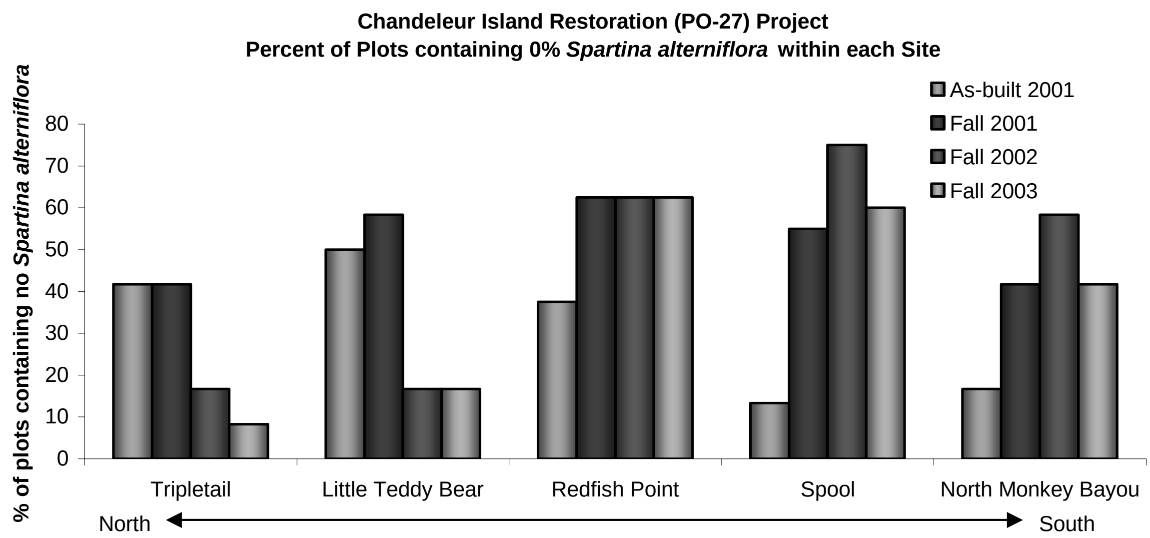

Figure 5. Percent of vegetation plots containing no *Spartina alterniflora* at each monitored planting site of the Chandeleur Islands Restoration (PO-27) Project from 2001 to 2003.

Table 2. Species observed inside or within 5-meters of the 72, 4-m^2 vegetation plots at the five monitored planting sites of the Chandeleur Islands Restoration (PO-27) Project in September 2003.

Species List	Tripletail	Little Teddy Bear	Redfish Point	Spool	North Monkey Bayou
Amaranthus australis southern amaranth			X		
Avicennia germinans black mangrove	X	X	X		X
Batis maritima turtleweed			X	X	
Distichlis spicata inland saltgrass			X	X	
Iva frutescens Jesuit's bark			X		
Limonium carolinianum Carolina sealavender			X		
Phyla nodiflora turkey tangle frogfruit			X		
Salicornia bigelovii dwarf saltwort		X	X	X	
Salicornia virginica Virginia glasswort			X	X	
Sesuvium portulacastrum shoreline seapurslane			X		
Spartina alterniflora smooth cordgrass	X	X	X	X	X
Suaeda linearis annual seepweed			X		
Vigna luteola hairypod cowpea			X		

Elevation Surveys

Elevation surveys were conducted in July 2001 (as built) and September 2003 (post-construction). ANOVA results showed a significant increase in the overall mean elevation at the five monitoring sites from 0.22±0.01 m NAVD88 (0.72±0.03 ft) in July 2001 to 0.29±0.01 m NAVD88 (0.95±0.03 ft) in September 2003 ($p<0.0001$). Elevations at the individual sites ranged from 0.16 m (0.51 ft) to 0.25 m (0.82 ft) in 2001 and from 0.05 m (0.16 ft) to 0.61 m (2.00 ft) in 2003 (Figure 6). At the Little Teddy Bear planting site, two of the survey transects were extended to bisect nearby unvegetated intertidal sand flats, which were to be used as informal reference sites. However, these were lower elevation areas that had already become subtidal by 2003 and were not included in the analysis (Figure 6).

Changes in topography within the individual sites from 2001 to 2003 varied widely depending upon how the sites were impacted during the 2002 storms. All of the planting sites experienced some increase in elevation between the 2001 and 2003 surveys except for the Little Teddy Bear site. The increase in elevation at the Tripletail site was minimal, with no part of the planting area experiencing significant scour or sediment deposition (Figure 7). The Little Teddy Bear site experienced an overall decrease in elevation due to sediment loss in the central and southern areas of the planting lobe, but gained elevation eastward toward the beach (Figure 8). The Redfish Point site showed extreme changes in topography from 2001 to 2003 (Figure 9). In 2001, all of the plantings at this site were in the intertidal range, mostly at or slightly above mean tide, and the entire site was between the mean low and mean high tide elevations. By 2003, the maximum elevation surveyed was above the high tide elevation due to the deposition of about 0.4 m of overwash deposits in some areas. Other areas of the site, however, experienced a loss of sediment due to scour. The main channel bisecting this site migrated northward during the storms, effectively eroding away the majority of the plantings on the northern lobe of the site. While the Spool site also experienced major changes in topography, the overall net change in elevation at this site was minimal (Figure 10). This site experienced severe erosion in some areas and deposition of about two feet of overwash sediment in other areas. The North Monkey Bayou site also showed areas of erosion and sediment deposition although the impacts were not as severe as at the Redfish Point and Spool sites (Figure 11).

One of the specific goals of the project is to maintain or increase intertidal area, as indexed by elevation data, within and adjacent to the planting sites. Areas within the elevation range of mean low water and mean high water were to be defined as the ‘intertidal’ range, which was determined during a pre-construction survey of the planting sites to be between 0 m NAVD88 (mean low tide line) and 0.37 m NAVD88 (mean high tide line). The percentage of the elevation survey points falling within this intertidal range decreased at all of the surveyed sites from 2001 to 2003 (Figure 12). The percentage decrease in intertidal points ranged from 10% at the Tripletail site to 82% at the Redfish Point site. Based on this data, it can be concluded that the goal of increasing or maintaining intertidal area is not being met. However, some of the areas that are no longer within intertidal range are now at higher elevations, which is obviously preferable to those areas which have become subtidal or open water. The increase in mean elevation at four of the sites indicates that a loss in intertidal area does not necessarily indicate a net loss in land area. While these higher elevation areas are no longer within the optimum growth range for *S. alterniflora*, they are intermittently flooded sand flats now capable of supporting many other species, such as those observed at Redfish Point in 2003. Storm events, however, are the main driving factor in these topographical changes. The magnitude of topographical changes at Redfish Point, for example, indicates that the changes would have occurred regardless of the presence of the plants. It is also important to note that the baseline elevation of the planting sites in 2001 was almost completely intertidal because the layout of the sites followed the mean tide line contour surveyed just before construction. This 2001 as-built layout in effect represented the 'best case scenario' elevation for survival of *S. alterniflora*. It may have been an ambitious goal to expect that the intertidal area of these sites would be maintained or even improved in a high energy environment such as the Chandeleur Islands.

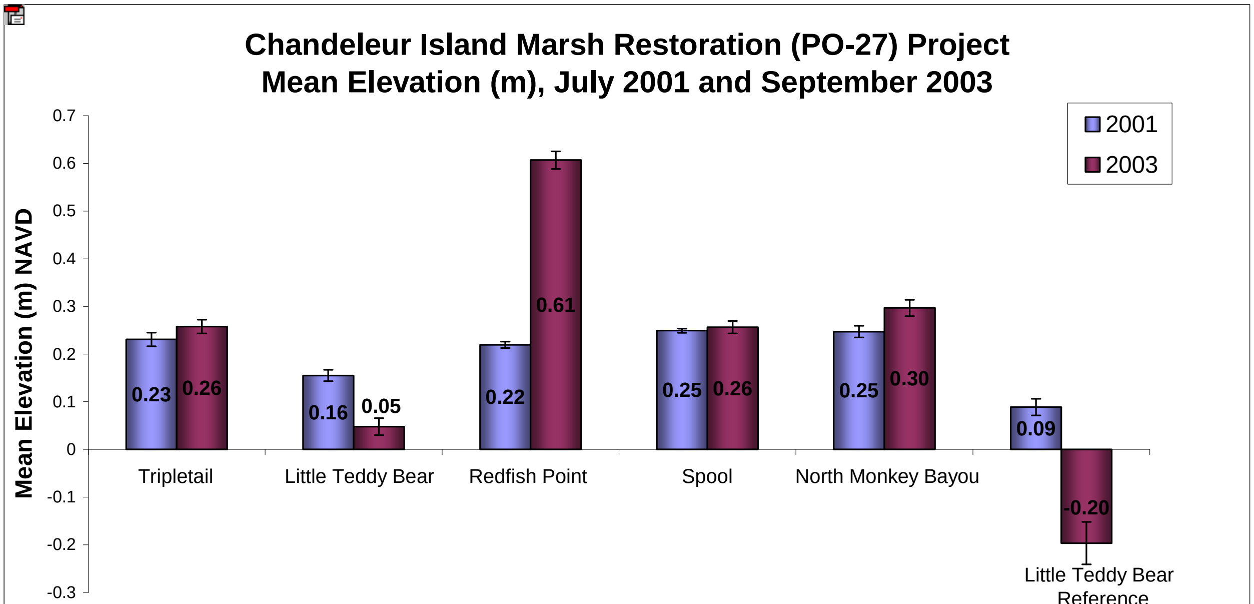

Figure 6. Mean elevation (m) at five planting sites and one unplanted reference area of the Chandeleur Island Restoration (PO-27) Project in 2001 and 2003. Elevation readings were taken along three to five transects per planting site.

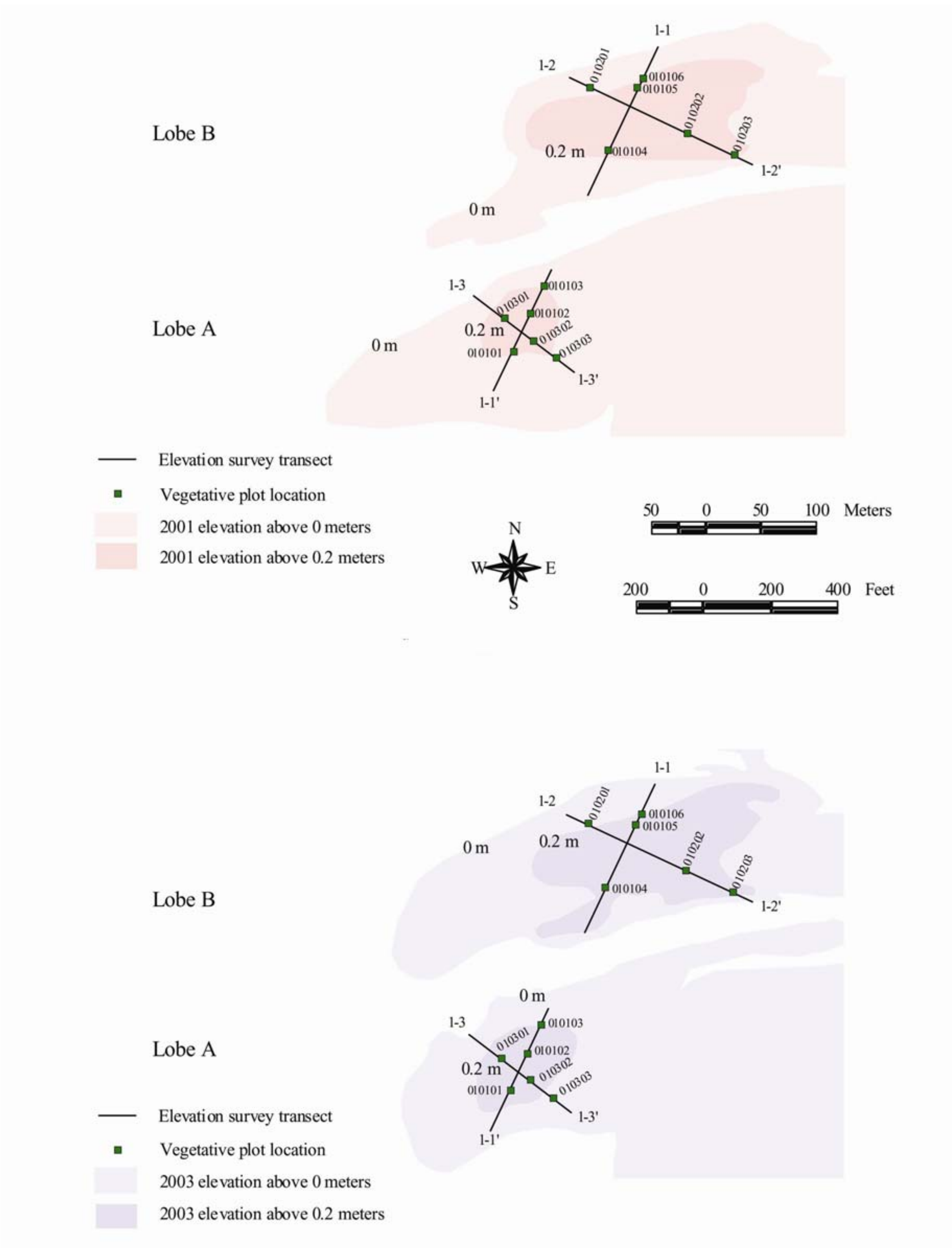

Figure 7. Elevation contour maps of the Tripletail planting site based on surveys conducted in 2001 and 2003 of the Chandeleur Islands Marsh Restoration (PO-27) Project.

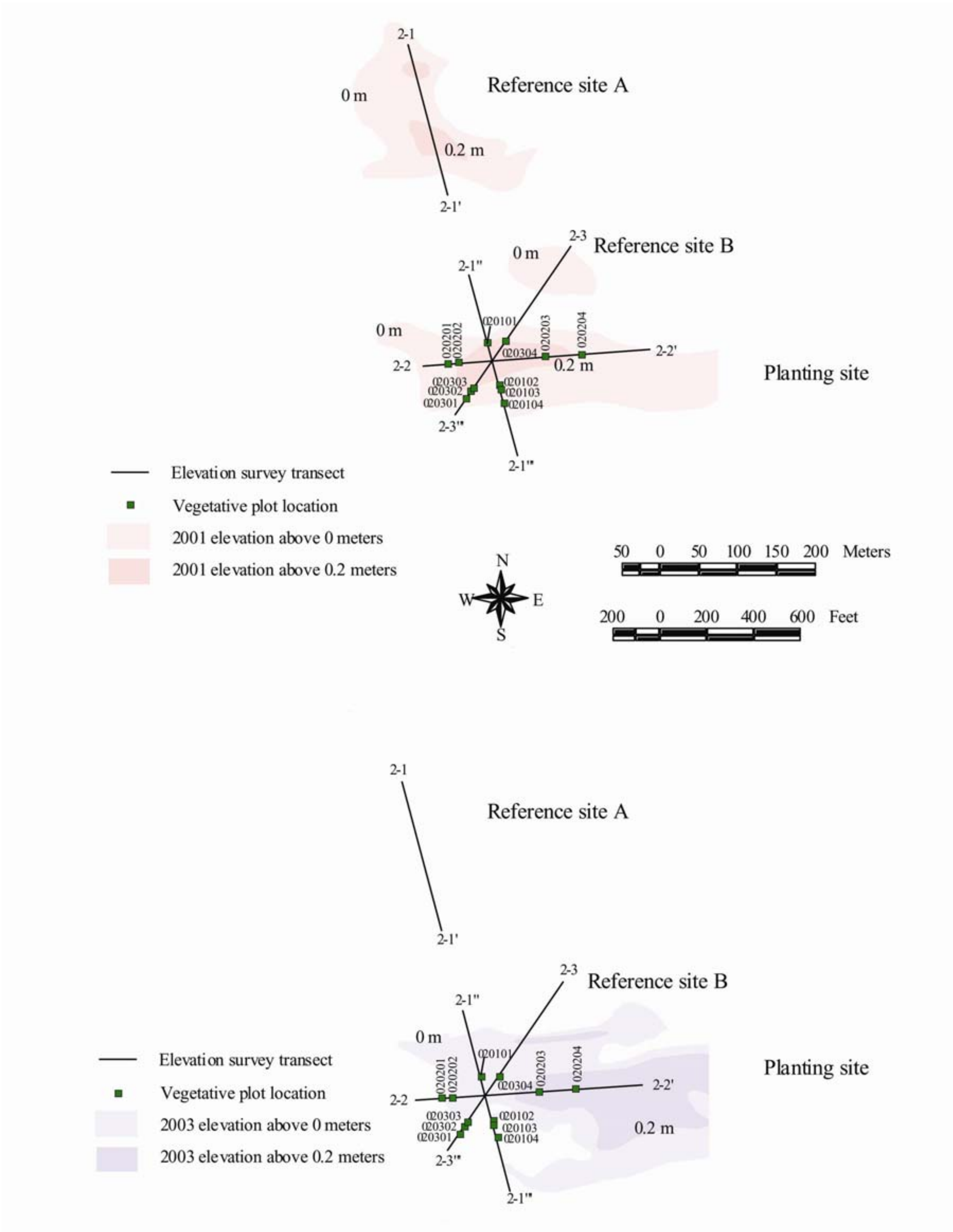

Figure 8. Elevation contour maps of the Little Teddy Bear planting site based on surveys conducted in 2001 and 2003 of the Chandeleur Islands Marsh Restoration (PO-27) Project.

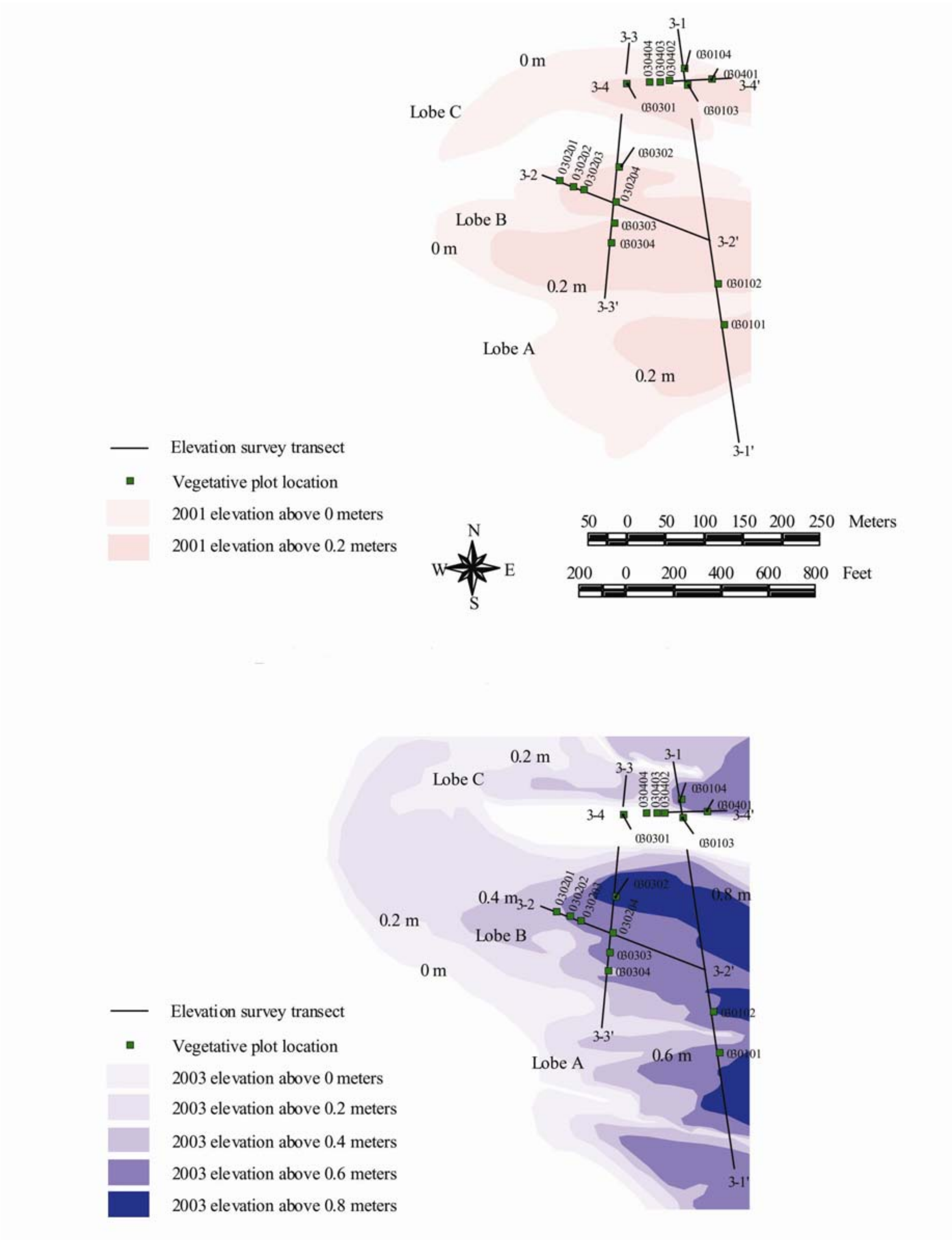
0 m
Lobe C
Lobe B
0 m
0.2 m
Lobe A
0.2 m
3-1
3-1'
3-2
3-2'
3-3
3-3'
3-4
3-4'
030404
030403
030402
030104
030401
030301
030103
030201
030202
030203
030302
030204
030303
030304
030102
030101
Elevation survey transect
Vegetative plot location
2001 elevation above 0 meters
2001 elevation above 0.2 meters
N
W
E
S
50 0 50 100 150 200 250 Meters
200 0 200 400 600 800 Feet
0.2 m
Lobe C
0.4 m
0.8 m
0.2 m
Lobe B
0 m
0.6 m
Lobe A
Elevation survey transect
Vegetative plot location
2003 elevation above 0 meters
2003 elevation above 0.2 meters
2003 elevation above 0.4 meters
2003 elevation above 0.6 meters
2003 elevation above 0.8 meters

Figure 9. Elevation contour maps of the Redfish Point planting site based on surveys conducted in 2001 and 2003 of the Chandeleur Islands Marsh Restoration (PO-27) Project.

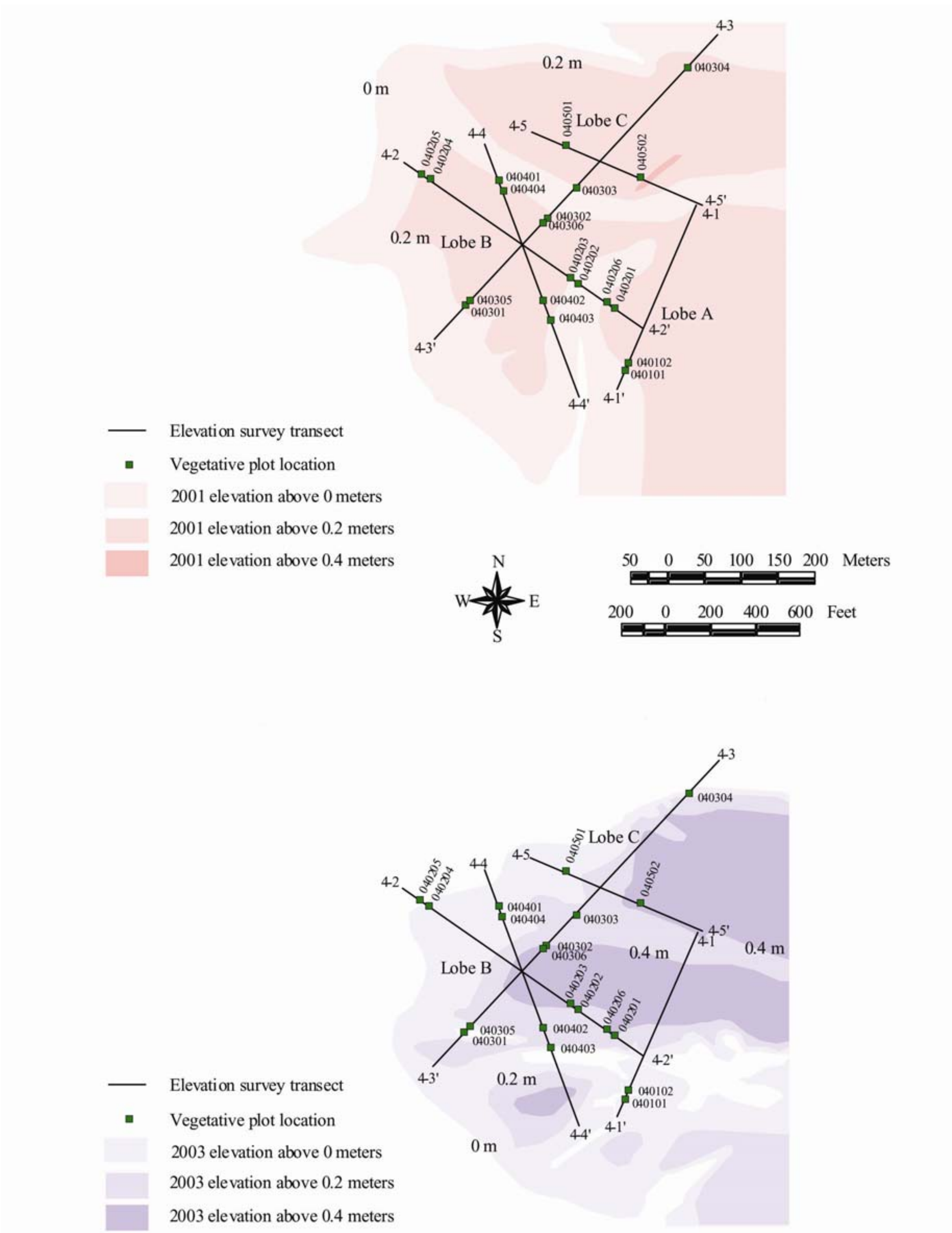

Figure 10. Elevation contour maps of the Spool planting site based on surveys conducted in 2001 and 2003 of the Chandeleur Islands Marsh Restoration (PO-27) Project.

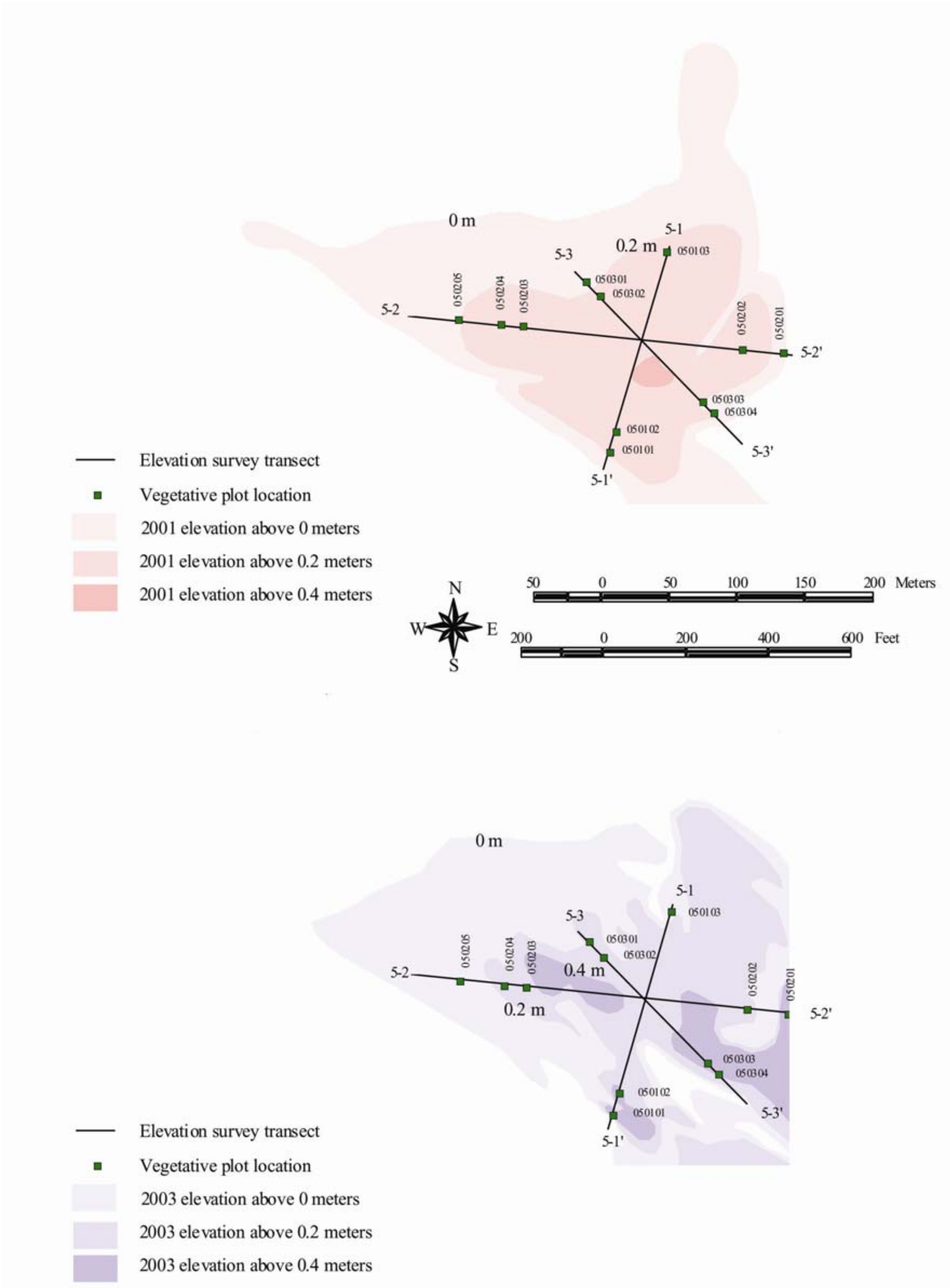

Figure 11. Elevation contour maps of the North Monkey Bayou planting site based on surveys conducted in 2001 and 2003 of the Chandeleur Islands Marsh Restoration (PO-27) Project.

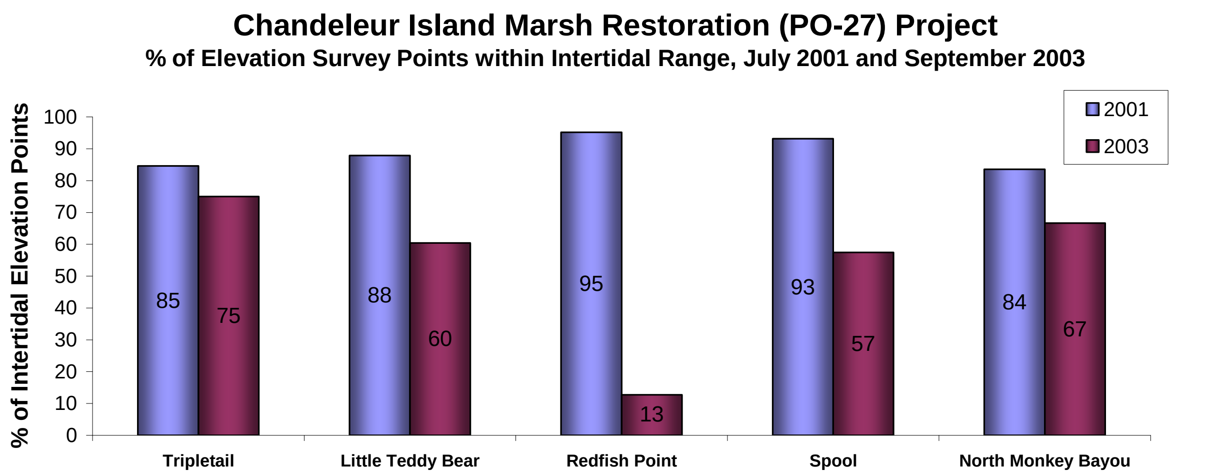

Figure 12. Percentage of elevation survey points falling within the 'intertidal' elevation range at five planting sites of the Chandeleur Island Marsh Restoration (PO-27) Project in 2001 and 2003. The intertidal range was determined to be between 0 m NAVD 88 (mean low tide line) and 0.37 m NAVD 88 (mean high tide line).

V. Conclusions

a. Project Effectiveness

The vegetation survey data have shown an increase in percent cover of *Spartina alterniflora* each year since project construction, however a decrease in the intertidal area within the planting sites between 2001 and 2003 indicates a loss of optimum *S. alterniflora* habitat. It is expected that the increase in vegetative cover should encourage some sand retention and trapping within the planting areas, however storm events are the driving factor for elevation changes in the planting areas. Although we have seen some success at each of the planting sites, island overwash events, particularly during the 2002 storm season, destroyed some of the planted areas before the plants were able to become fully established. During these overwash events, plants were either washed away through the formation of new cuts through the island, or buried through sand deposition. Because the southern portion of the island is more narrow and fragmented, the southern planting sites, particularly Redfish Point and Spool, were most affected by overwash. Although the northern sites are doing well and the southern sites are showing signs of improvement, it was decided that Phase II plants would not be installed due to the uncertainty of future storm damage coupled with the high cost of construction. The total cost of the planting operation was $388,743 ($11.08 per linear ft of planted rows), which included cost to acquire, deliver and install the plants. In addition, several of the originally proposed sites, which had initially been selected using aerial photographs, turned out to be poor candidates for planting based on sub-optimal mean elevation.

b. Recommended Improvements

We recommend that the twelve unplanted Phase II sites be evaluated as possible informal reference sites to the planted areas. Differences in land/water ratios over time between the unplanted and planted sites should be compared. The unplanted sites should also be visited to qualify any emergent vegetation species which have naturally colonized the overwash areas.

c. Lessons Learned

Due to the dynamic nature of the barrier island environment, the success of the plantings was ‘hit or miss’. The plants were planted in unstable overwash areas, and therefore were highly susceptible to be overwashed again. The plantings did very well in areas where they were able to establish themselves, which accounted for an increase in percent cover each year since project construction. However, the loss of large areas of the plantings made the construction of Phase II cost-prohibitive.

d. Things to Consider for Future Chandeleur Island Projects

The *S. alterniflora* cultivar that was planted on the project was the ‘Vermillion’ cultivar released by the NRCS-Plant Material Center. We believe that this ecotype may not be best suited for the growing conditions of the Chandeleur Island. The ‘Vermillion’ cultivar’s robust form is inherently at a disadvantage in the harsh environment of the island. We feel that a ‘barrier island ecotype’ has a morphology that is more suited to the growing conditions that exist on the Chandeleur Island. The individuals in the native stands of *S. alterniflora* have the physiology and morphology that are required to survive and thrive on the island.

It is the recommendation of the LDNR staff that the state of Louisiana pursue the addition of sand to nourish the fragile beach on the Chandeleur Islands. The volume of sand on the beach has been significantly reduced following Hurricane Georges in 1998. The Chandeleur Islands protect unique habitat of a protected shallow bay behind the island which supports beds of manatee grass, shoal grass, turtle grass, and widgeon grass.

VI. References

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