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COMPREHENSIVE MONITORING REPORT NO. 1
For the period October 1, 1996 to November 1, 1999

Coast 2050 Region 2

Barataria Bay Waterway Wetland Creation BA-19 (BA-19)

First Priority List Marsh Creation Project
of the Coastal Wetlands Planning, Protection, and Restoration Act
(Public Law 101-646)

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Acknowledgments

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Abstract

The Barataria Bay Waterway Wetland Creation (BA-19) project is located approximately1 mile (1.61 km) east of mile 3 of the Barataria Bay Waterway in Jefferson Parish, Louisiana. The goals of this restoration project were to create 9.0 acres (3.6 ha) of vegetated wetlands and to increase the marsh surface elevations on Queen Bess Island through disposal of dredged mineral sediments. An indirect goal was to increase eastern brown pelican *(Pelecanus occidentalis carolinensis)* reproductive capacity by increasing vegetated wetland area and elevation on the island. To assess these goals, vegetation, vertical accretion, and sediment elevation were monitored in the project and reference areas while dredged-material settlement was monitored only in the project area. Eastern brown pelican reproductive data were obtained from the Louisiana Department of Wildlife and Fisheries (LDWF) to assess the effect of the project on the pelican population. To date, no appreciable amount of vegetation has colonized the project area, the dredged materials have not consolidated, and sediment elevation in the project area was below the projected elevation established in the project design. However, sediments on remnant Queen Bess Island (the vertical accretion project area) seem to have accreted at a higher rate than on nearby Mendicant Island (the vertical accretion reference area) due to spillover effects of dredged material effluent. While the eastern brown pelican population on Queen Bess Island has expanded dramatically, pelican populations have been expanding on other islands along the Louisiana coast as well, indicating that other, non-project factors are contributing to population growth. The results of this study indicate that no new wetlands were created on Queen Bess Island by this project while larger quantities of sediments were deposited on remnant Queen Bess Island than the vertical accretion reference area.

Introduction

The Barataria Bay Waterway Wetland Creation (BA-19) project is a Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III) project that is administered jointly by the U. S. Army Corps of Engineers New Orleans District (USACE-NOD) and the Louisiana Department of Natural Resources/Coastal Restoration Division (LDNR/CRD). This restoration project is located on Queen Bess Island, within the southeastern portion of Barataria Bay (figure 1). The project is approximately 1 mile (1.61 km) east of the Barataria Bay Waterway at mile 3 and north of Grand Isle and Grand Terre Islands in Jefferson Parish, Louisiana.

Queen Bess Island is part of the abandoned Lafourche Delta Complex, which includes the Caminada-Moreau Headland, Grand Isle, and Grand Terre Island. Due to natural and anthropogenic alterations in hydrology, this delta has been separated from the sediment rich waters of the Mississippi River (Reed 1995). As a result, subsidence and shoreface erosion have reduced the size of Queen Bess Island from 45 acres (18.2 ha) in 1956 to 17 acres (6.9 ha) in 1989, and the elevation has been reduced such that the island is frequently over-washed by small storms (Raynie and Sutton 1992). Queen Bess Island is one of only six eastern brown pelican *(Pelecanus occidentalis carolinensis)* nesting colonies in Louisiana (figure 2). The eastern brown pelican was reintroduced into Louisiana from 1968 to 1976, by releasing pelicans from Florida onto Grand Terre Island. In 1971, the first eastern brown pelican breeding colony was established on Queen Bess Island. While the pelican population on Queen Bess Island has been expanding, reduction in island size as well as the loss of *Avicennia germinans* (black mangrove) from the island has severely limited their nesting habitat (McNease et al. 1992; McNease 1999).

In 1990, LDNR/CRD and USACE-NOD initiated the Queen Bess Island (BA-05b) marsh creation project. Sediment was obtained from maintenance dredging of the Barataria Bay Waterway navigation channel through USACE-NOD's Beneficial Use of Dredged Material Program (BUMP). These dredged sediments were pumped into a disposal area created by the placement of an 1,800 ft (549 m) rip-rap levee along the western edge of Queen Bess Island (figure 3). The Queen Bess Island Restoration (BA-05b) project was successful in extending the size of the remnant island by 15.3 acres (6.2 ha) and creating 8.0 acres (3.2 ha) of vegetated wetlands (Alonzo 1996). Therefore, the size of the island was expanded from 17 acres (6.9 ha) in 1990 to 32.3 acres (13.1 ha) in 1996. In addition, construction of this restoration project divided the island into 2 distinct regions (figure 3).

In 1996 the Barataria Bay Waterway Wetland Creation (BA-19) project was established to further expand the size and elevation of Queen Bess Island (figure 3). The objectives of the Barataria Bay Waterway Wetland Creation (BA-19) project are to create vegetated wetlands using sediment from maintenance dredging of the Barataria Bay Waterway, and benefit wetlands adjacent to the disposal area. These objectives will be achieved by creating an additional 9.0 acres (3.6 ha) of vegetated wetlands and increasing the sediment elevation on the other 2 regions of the island through deposition of dredged effluent.

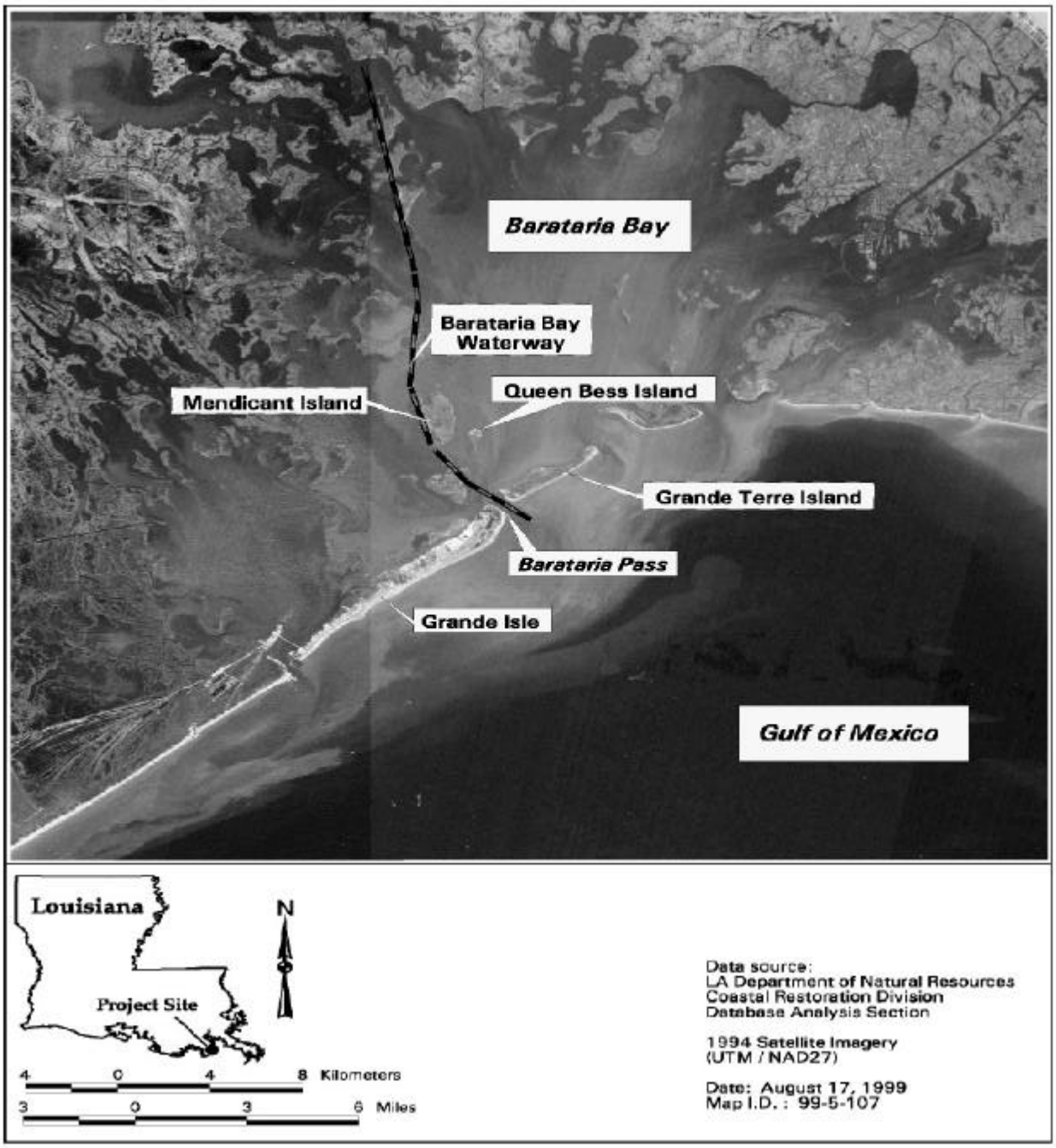

Figure 1. Location of Queen Bess Island and Mendicant Island along mile 3 of the Barataria Bay Waterway.

Figure 2. Eastern brown pelican nests on Queen Bess Island.

Figure 3. Location of the Barataria Bay Waterway Wetland Creation (BA-19) project area, the Queen Bess Island (BA-05b) project area, and remnant Queen Bess Island (photo taken August 1998).

Methods

Project Features

The project attempted to increase the size and elevation of Queen Bess Island through installation of several features. A 1,650 ft (503 m) aggregate shell dike was constructed to an elevation of 5.22 ft (1.59 m) National Geodetic Vertical Datum of 1929 (NGVD 29) to create a 9.0 acre (3.6 ha) containment area along the southwest side of Queen Bess Island (figure 3). Dredged material from maintenance dredging of the Barataria Bay Waterway was pumped into the containment area to an elevation of approximately 3.72 ft (1.13 m) NGVD 29 with the effluent routed through the 8.0 acres (3.2 ha) of wetlands created in 1990 and the natural wetlands of the remnant island. Silt screens were placed in the effluent outfall area to prevent impacts to adjacent oyster reefs. The project construction began in August 1996 and was completed in November 1996. Following 2 years of consolidation, the containment area was anticipated to have a final elevation of approximately 1.22 ft (0.37 m) NGVD 29. To avoid the nesting season of the eastern brown pelican, no work was conducted on Queen Bess Island from November through July.

Monitoring Design

A detailed description of the monitoring design over the entire project life can be found in Smith (1998). Variables chosen to evaluate the project effectiveness were vegetation, vertical accretion, dredged material settlement, marsh surface elevation, and eastern brown pelican nesting.

Vegetation: To assess the establishment of vegetation, 7 stations were established in the project area and 5 stations were established in the reference area (remnant Queen Bess Island) (figure 4). Ocular estimates of species composition and percent cover were recorded for a 1-m-wide transect along each station in both the project and the reference area (Steyer et al. 1995). Vegetation sampling was conducted on November 11, 1996 (immediate post-construction), December 12, 1997 (1 year post construction), and November 17, 1998 (2 years post-construction).

Vertical Accretion: To estimate the impact of dredged material effluent from the Barataria Bay Waterway Marsh Creation project on the remnant Queen Bess Island marsh surface, feldspar marker accretion stations were established. These stations were established in the vertical accretion project area on remnant Queen Bess Island and were compared to accretion stations placed in the reference area on Mendicant Island (figure 5). Mendicant Island was chosen because of it's similar vegetative community, soil type (U.S. Soil Conservation Service 1983), and hydrology to the remnant Queen Bess Island area. Ten accretion plot stations (0.5 m x 0.5 m) were placed along three transects in the project area and ten plots were placed in the reference area on September 17, 1996. The feldspar accretion plot stations were sampled on December 12, 1997 (1 year post-construction) using a cryogenic corer (Knaus and Cahoon 1990; Steyer et al.1995). The average vertical accretion rate in the project was compared to that in the reference area to determine the effect of the effluent on remnant Queen Bess Island.

Dredged Material Settlement: To estimate the change in dredged material surface height over time, twelve sediment staff gauges were installed at random heights in the project area prior to the deposition of dredged material (figure 6). These staff gauges were not tied to a vertical datum. Therefore, they will measure sediment relative height levels and not sediment elevation. The relative

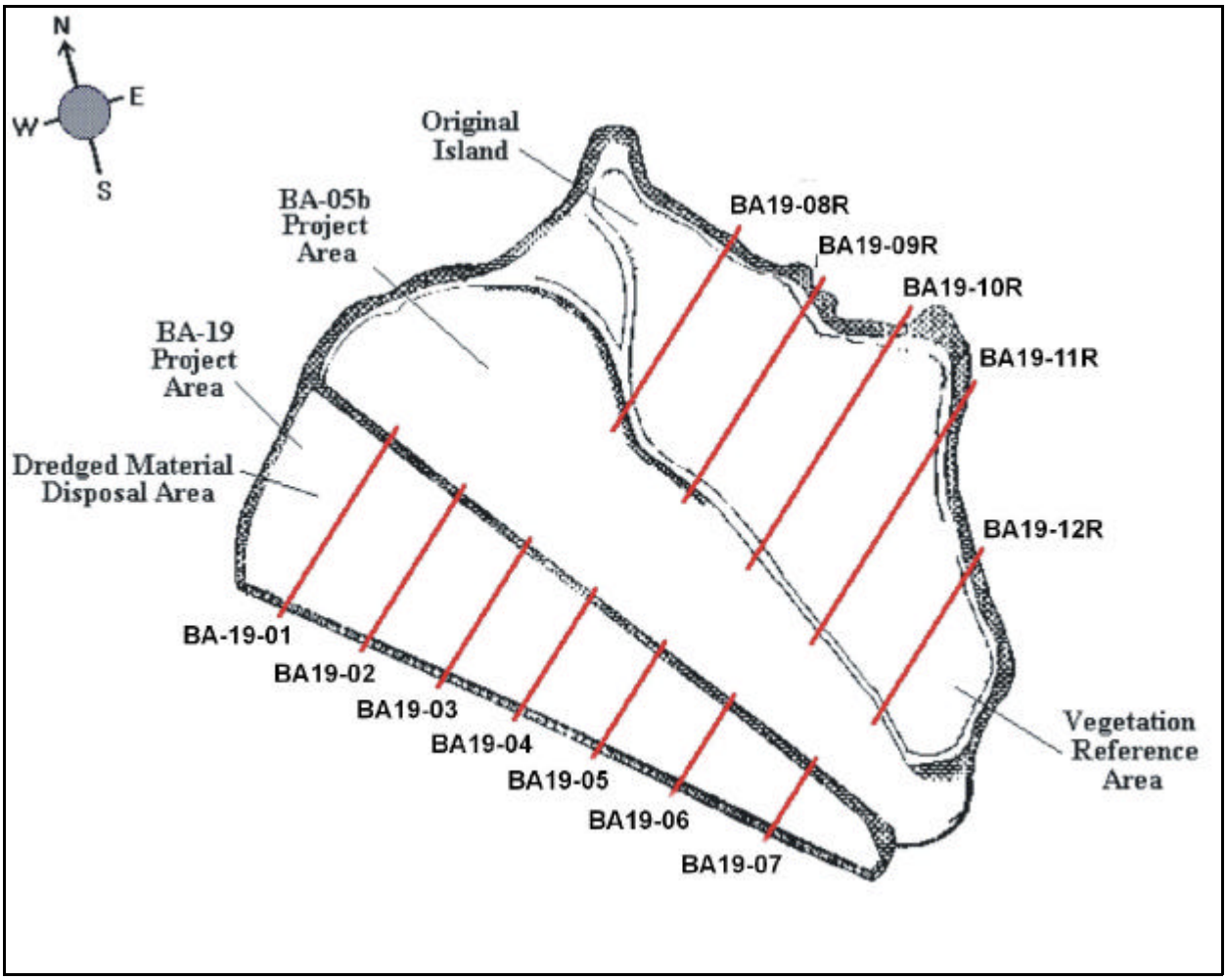

Figure 4. Location and station numbers for the Barataria Bay Waterway Wetland Creation (BA-19) project and reference vegetation stations.

height of the dredged material was measured on November 20, 1996 (immediate post-construction) and November 17, 1998 (2 years post-construction). From these data the average dredged material height for each sampling period was obtained and used to calculate changes in the dredged material surface, and the average rate of dredged material settlement per year.

Topographic Elevation Survey: To establish the marsh surface and dredged material elevations, a post-construction elevation survey was conducted with a real time Kinematic GPS Total Station on January 27, 1999 (2 years post-construction) using Louisiana State Plane, South Zone Coordinate System, in the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) in meters (T. Baker Smith & Son Inc. 1999). The vertical datum was then converted to NGVD 29, using the survey benchmark's published adjustment (D. Martinez, T. Baker Smith & Son, pers. comm.). This allowed for comparison with construction designs. The average marsh surface elevations for the reference area (remnant Queen Bess Island) and the project area (the dredged material disposal area) were found by calculating the average of 20 random survey points.

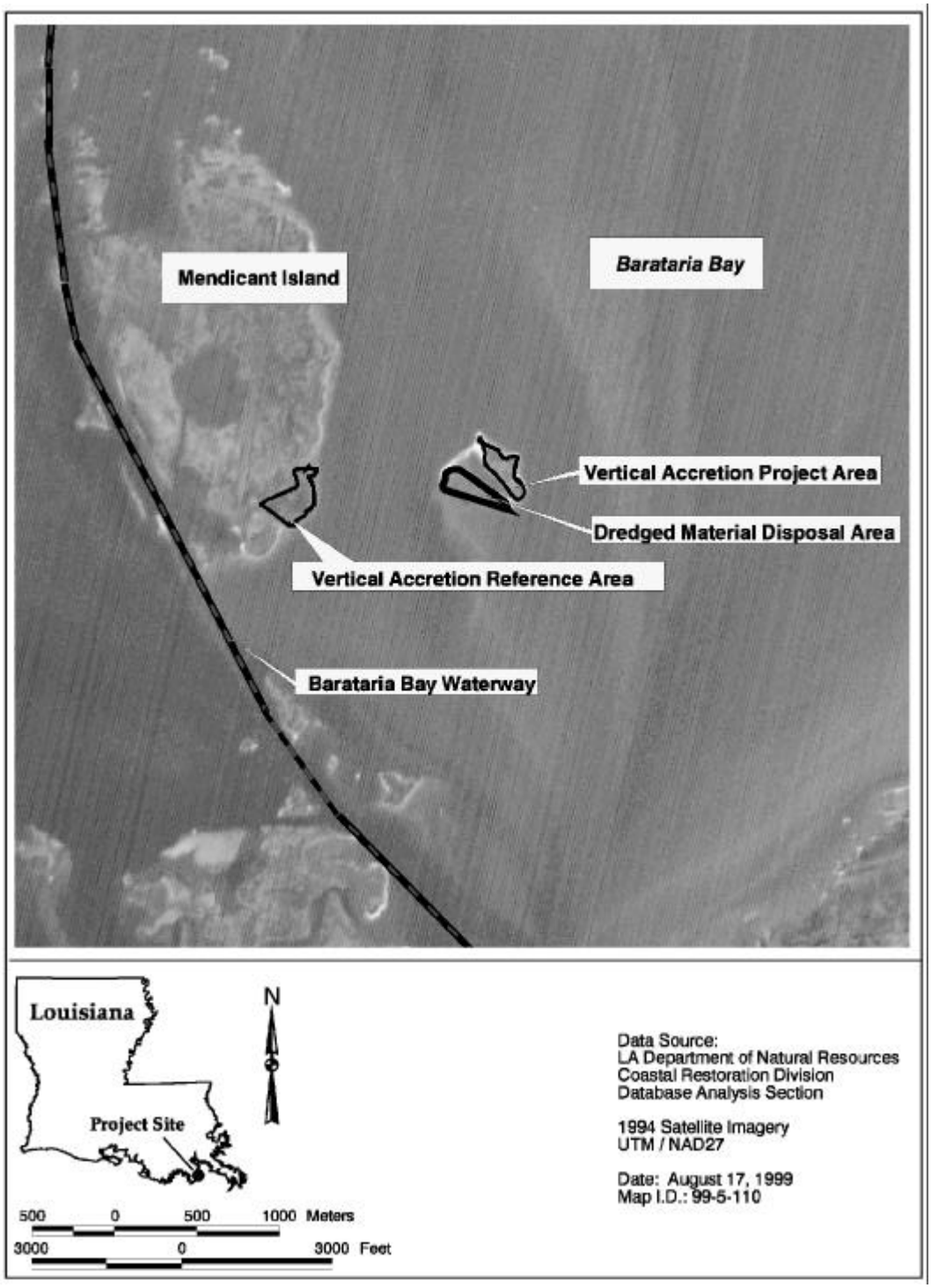

Figure 5. Location of the vertical accreation project and reference areas for the Barataria Bay Waterway Wetland Creation (BA-19) project.

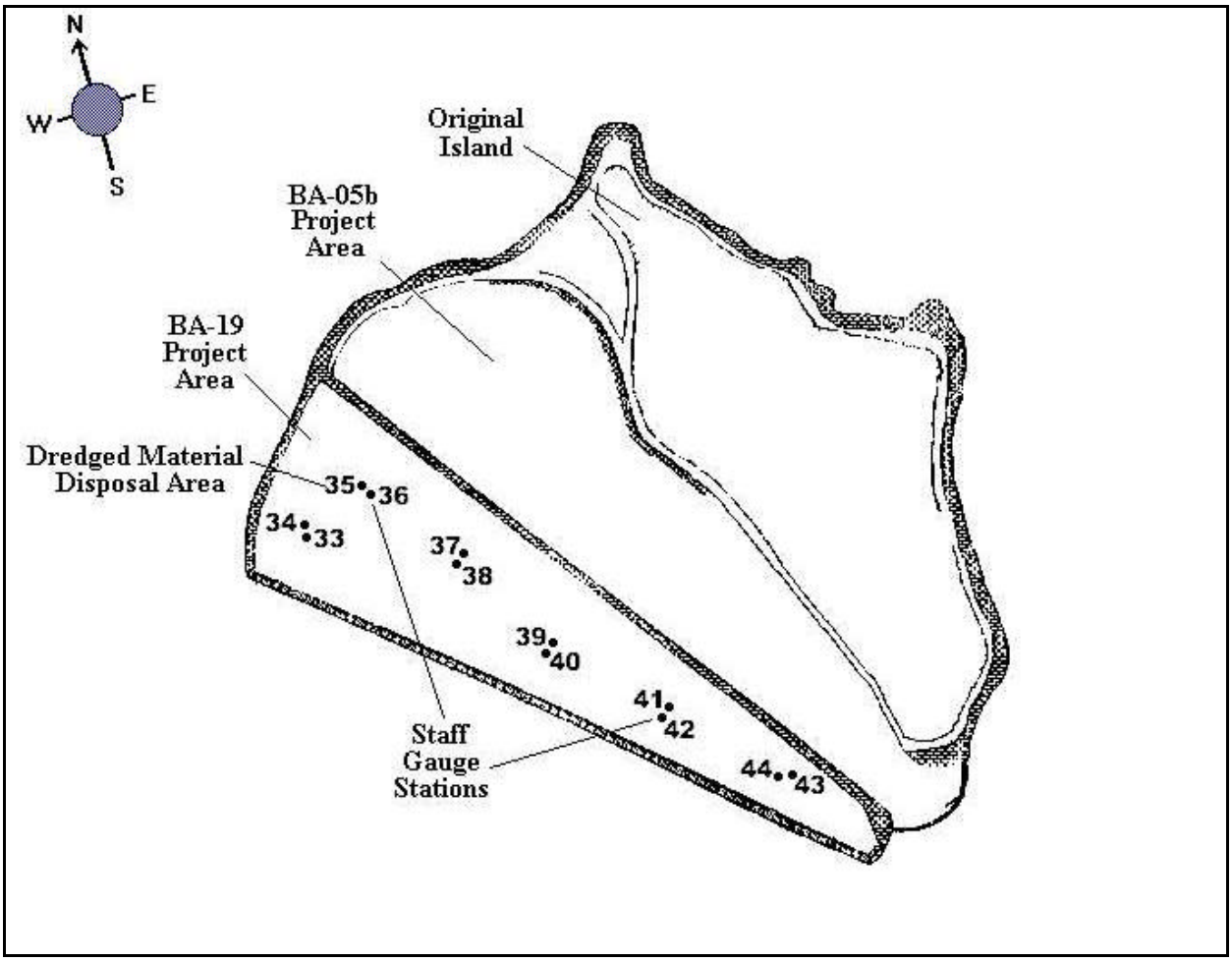

Figure 6. Location and station numbers for the sediment staff gauges in the dredged material disposal area.

Eastern Brown Pelican Reproduction: To determine the impact of the Queen Bess Island marsh creation projects on the reproductive success of the eastern brown pelican, reproductive statistics were obtained from the Louisiana Department of Wildlife and Fisheries (LDWF) (McNease et al. 1992; McNeese 1999), which has been monitoring eastern brown pelican populations on the island since 1971. Pre-construction data were collected on Queen Bess Island from 1971 to 1989, Queen Bess Island (BA-05b) post-construction data were collected between 1990 and 1996 (no data were collected in 1991), and Barataria Bay Waterway (BA-19) post-construction data were collected from 1996 to 1998. Pelican colonies on North Island and Last Island in Louisiana were used as reference populations. Data on the number of pelican nests, pelican chicks fledged, and pelican fledglings per nest were compiled, and used to estimate the annual eastern brown pelican natality for Queen Bess Island, North Island, and Last Island.

Pelican and BUMP Monitoring Methods: In addition to the CWPPRA funded biological monitoring conducted by LDNR/CRD, other governmental agencies monitor the progress of this restoration project. The BUMP program periodically monitors the habitat on Queen Bess Island using aerial photography, ground truthing, and survey transect methodologies (Penland et al.1998) while LDWF monitors the Queen Bess Island eastern brown pelican colony using aerial photography and ground surveys (McNease et al. 1992).

Results

Vegetation: Estimated vegetative cover in 1996 was 24.5% ± 17.4% in the reference area, while no vegetation colonized the project area (figure 7). *Spartina alterniflora* (saltmarsh cordgrass) was the dominant species found in 1996. The only other species was *Lycium carolinanum* (Carolina wolf-berry), which was only present in small percentages (< 1.0%) at stations BA19-8R and BA19-9R. In 1997, average vegetative cover was 66.0% ± 37.8% in the reference area and less than 1.0% in the project area (figure 7). No vegetation was seen at 6 of the 7 vegetation stations in the project area in 1997, and *S. alterniflora* was the only species identified in both the project and reference areas. The average vegetative cover in the reference area during 1998 sampling was 76.0% ± 13.7% while no vegetation was found in the project area 2 years after sediment deposition (figure 7). *S. alterniflora* remained the dominant species in the reference area, but four other species inhabited the reference area in small percentages. *Distichlis spicata* (seashore saltgrass) and *Batis maritima* (salt-wort) were found at two stations while *Borrichia frutescens* (wooly sea-ox-eye) and *Panicum amarun* (bitter panicum) were found at one station.

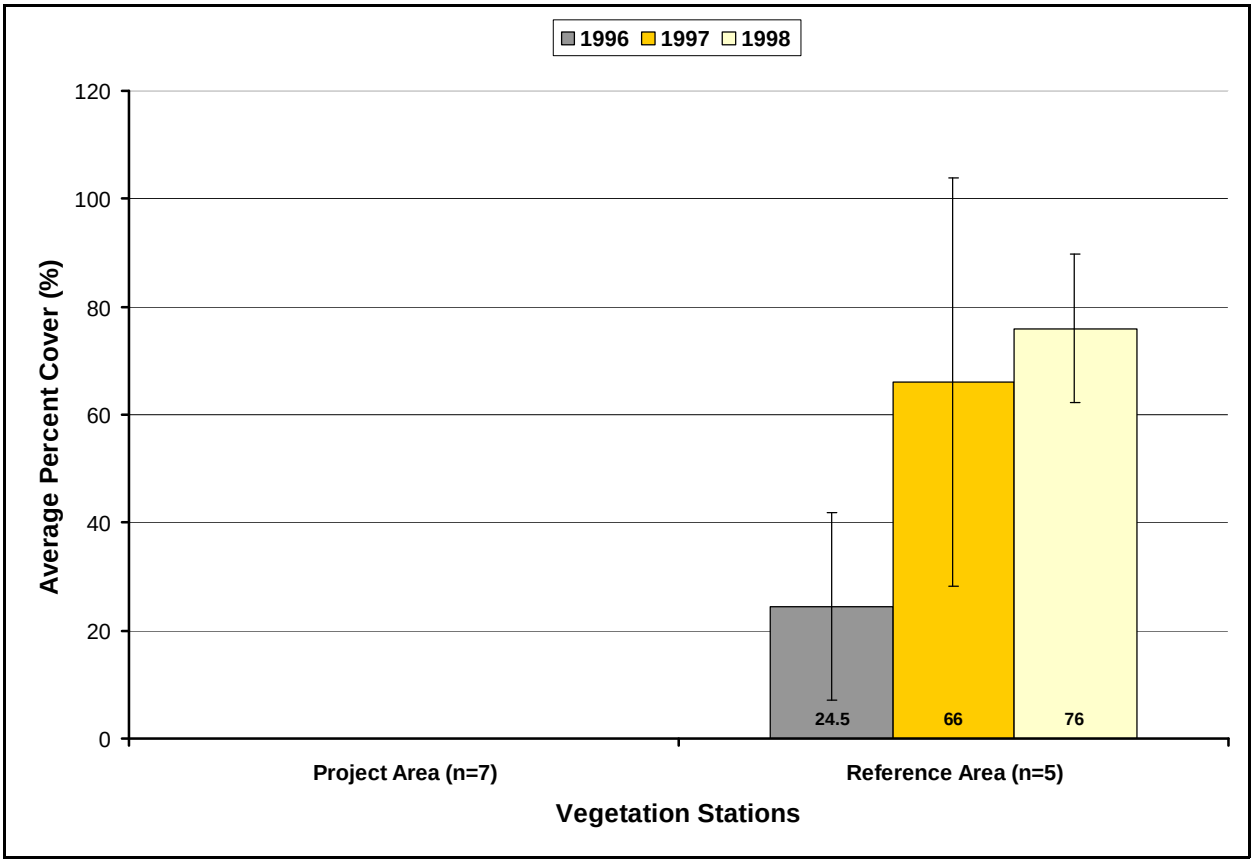

Figure 7. Average percent cover during each sample period for the project disposal site and remnant Queen Bess Island reference area at Barataria Bay Waterway Wetland Creation (BA-19) project.

Vertical Accretion: In1997, all but 1 of the accretion plot stations in the reference area were found, while only 2 of the 10 accretion stations in the project area could be located. The average vertical accretion rate in the project area was 2.98 ±0.14 in/yr (75.7 ± 3.68 mm/yr, n = 2) while that in the reference area was 1.31 ± 0.70 in/yr (32.2 ± 17.7 mm/yr, n = 9; figure 8). The 8 missing feldspar marker horizons were likely displaced by the movement of the effluent stream through the remnant Queen Bess Island wetlands.

Dredged Material Settlement: The change in height for each sediment staff gauge station from 1996 to 1998 is delineated in figure 9. The average change in dredged material height for this period was -0.29 ± 0.44 ft (-0.09 ± 0.13 m) which corresponds to an annual dredged material settlement rate of -0.14 ft/yr (-0.04 m/yr).

Topographic Elevation Survey: The post-construction (1999) average surface elevation in the reference area was 1.63 ± 0.17 ft (0.50 ± 0.053 m) while the average surface elevation in the project area was 0.79 ± 0.17 ft (0.24 ± 0.052 m). The project area surface elevations were taken along the inside edge of the retainment levees due to soft soil (slushy) conditions encountered (T. Baker Smith & Son Inc. 1999).

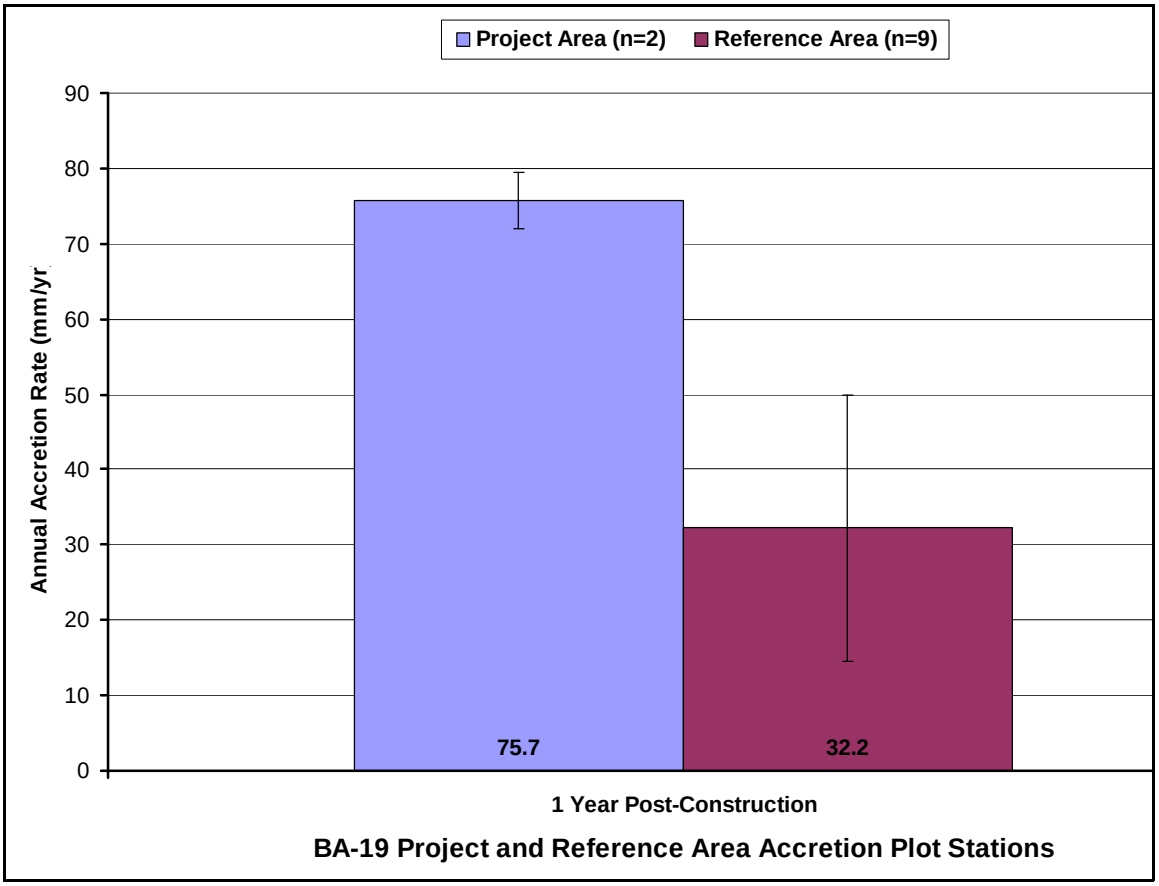

Figure 8. **Average accretion in the project and reference areas for 1 year post-construction at the Barataria Bay Waterway Wetlands Creation (BA-19) project.**

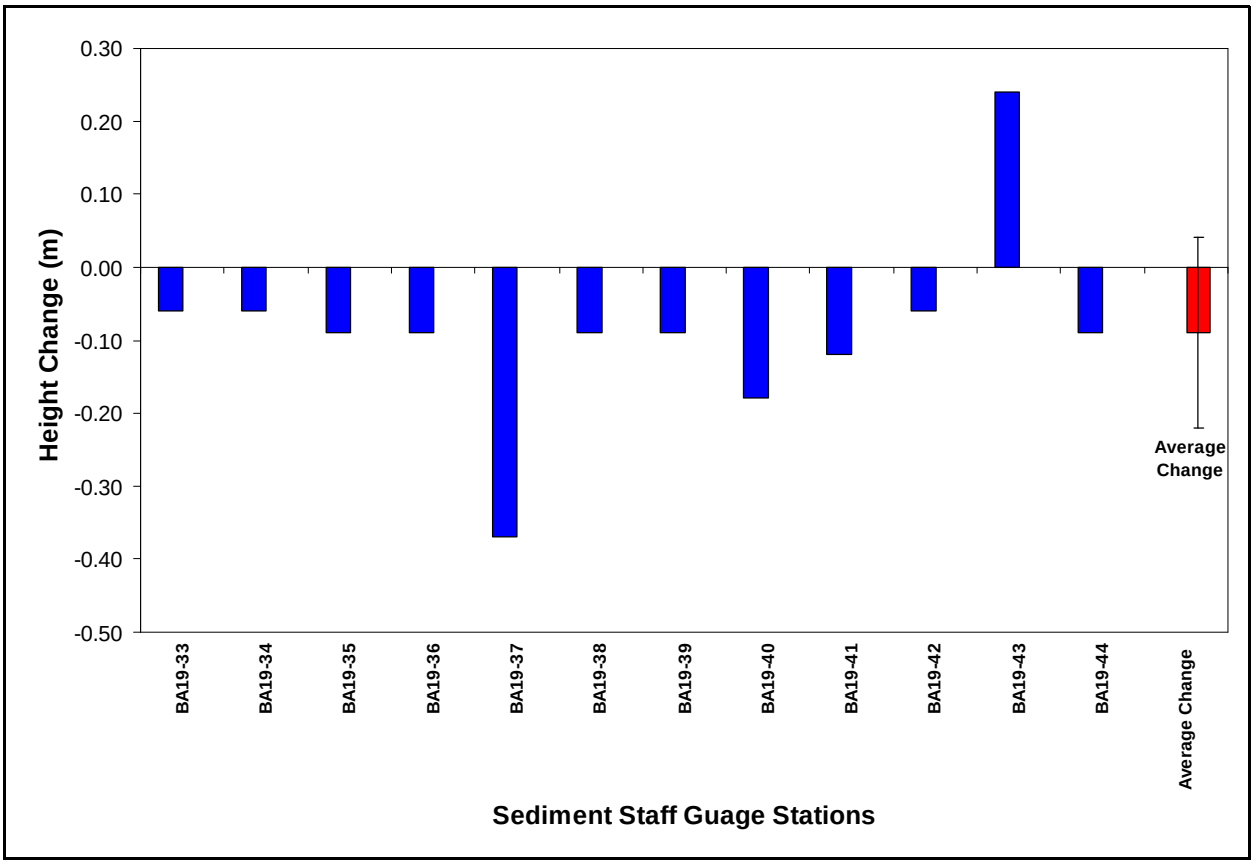

Figure 9. Relative change in dredged material surface elevation from 1996 to 1998 at the Barataria Bay Waterway Wetland Creation (BA-19) project.

Eastern Brown Pelican Reproduction: Figure 10 illustrates the total number of pelican fledglings hatched on Queen Bess Island, North Island, and Last Island before the Queen Bess Island (BA-05b) and Barataria Bay Waterway (BA-19) marsh creation projects. Reproductive data from McNease et al. (1992) and McNease (1999) indicate that the number of pelican chicks fledged each year on Queen Bess Island has increased since nesting was first recorded in 1971.

Figure 11 shows that pelican reproduction on the 3 islands after construction of the Queen Bess Island (1990-1996) and Barataria Bay Waterway (1996-1998) marsh creation projects, continued to increase. The Queen Bess Island (BA-05b) project increased that island's area by only 32% but pelican fledglings increased from 500 in 1990 to 1400 in 1996, or 280%. The number of pelicans fledged on Queen Bess Island was even greater 1996-1998 than 1990-1996 despite the lack of any new nesting habitat created in the dredge material disposal area. Continued increases in pelican fledglings were also seen on North Island and Last Island in 1996-1998. These data indicate that factors other than increased nesting habitat are affecting the number of chicks fledged at Queen Bess.

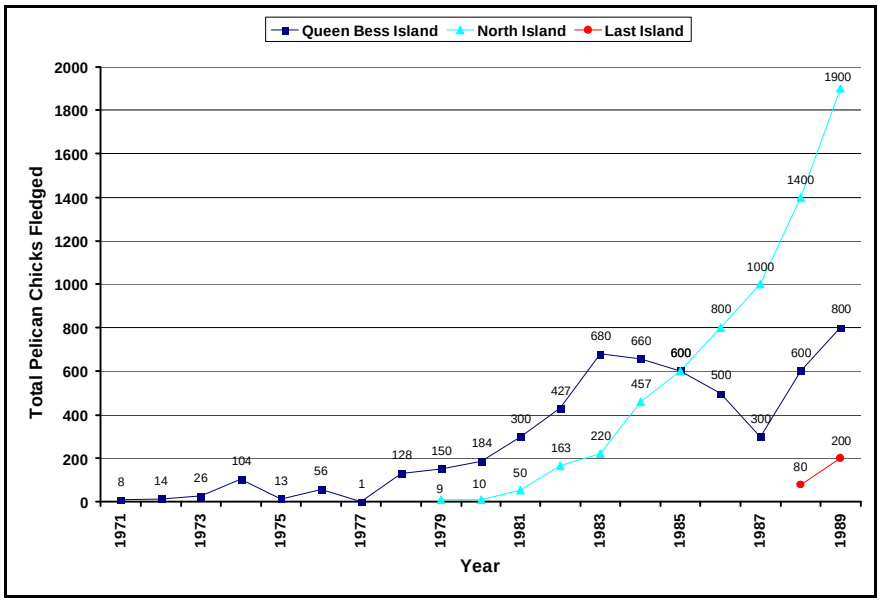

Figure 10. Total number of eastern brown pelican chicks fledged per year on Queen Bess Island, North Island, and Last Island before construction of the Queen Bess Island Restoration (BA-05b) project in 1990.

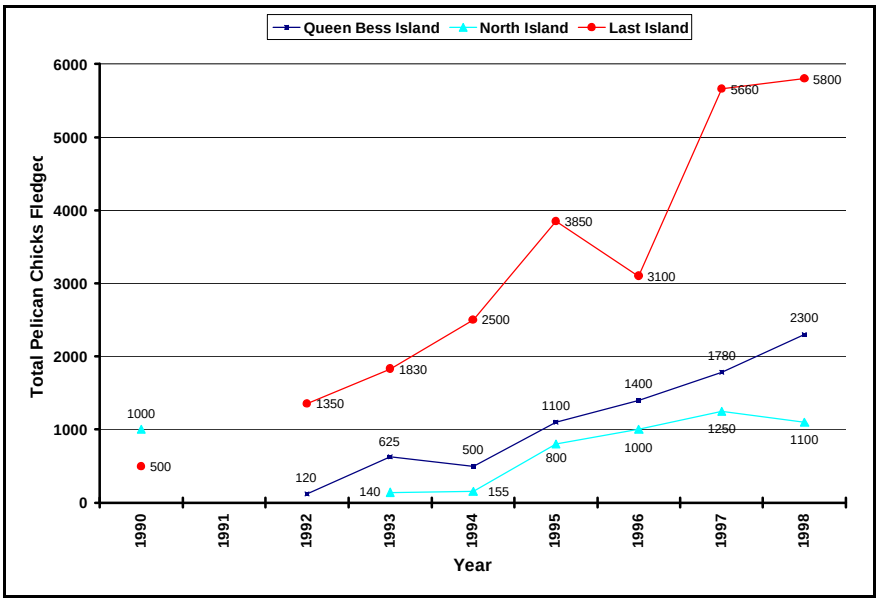

Figure 11. The number of eastern brown pelicans chicks fledged per year on Queen Bess Island, North Island, and Last Island in 1990 and 1992 to 1998.

Discussion

To date, the sediments in the BA-19 project area are not within the targeted elevational range more than 3 years post-deposition. To gather data from sediment staff gauges, the project area was traversed with the aid of a pirogue because the unconsolidated dredged material was waterlogged during all sampling events (M. Townson, LDNR/CRD, pers. comm.). While soil bulk density and percent organic matter were not estimated for the dredged materials, the absence of sediment consolidation indicates that these soils are likely to have low bulk densities and a high organic content. Storm surges from major weather events have historically submerged parts of Queen Bess Island and likewise Hurricane Danny inundated much of Queen Bess Island in 1997 (E. Lear, LDNR/CRD, pers. comm.). As a result of these storm surges, unconsolidated sediments in the project area may have been suspended in the water column and reworked with these high energy events into Barataria Bay or other parts of the island. Therefore, the staff gauges may be indicators of sediment transport as well as sediment consolidation.

The average surface elevation measured in the dredged material disposal area [0.79 ft (0.24 m) NGVD 29] was well below the projected elevation of 1.22 ft (0.37 m) NGVD 29 established in the engineering design. The actual average dredged material surface elevation may differ from the measured value because the surface elevations were only taken along the interior perimeter of the rock wall due to waterlogged conditions encountered in the project area (T. Baker Smith & Son 1999). However, the dredged material disposal area seems to have formed a poorly drained basin encircled by a 5.22 ft (1.59 m) NGVD 29 aggregate shell levee. In other words, the BA-19 restoration project appears to have created an impounded basin with exchange between the project area and Barataria Bay only during storm surges (figure 12). The average marsh surface elevation in the reference area (remnant Queen Bess Island) was considerably higher than the project area with a marsh elevation of 1.63 ft (0.50 m) NGVD 29. Hence, the reference area appears to have better drainage than the project area. Additionally, it should be noted that the remnant Queen Bess Island marsh elevation is higher than the design elevation of the project.

No appreciable amount of vegetation has colonized the project area while the reference area has experienced an increase in vegetative cover from 24.5% in 1996 to 76.0% in 1998 (figure 7). The low vegetative cover in the reference area in 1996 was induced by excess dredged material effluent being deposited on remnant Queen Bess Island during project construction. This effluent stream partially or entirely engulfed the vegetation in the reference area (Alonzo 1997). However, the vegetation recovered after initial impacts from sedimentation. Although 3 salt tolerant, fleshy-leaved shrubs (*L. carolinianum, B. maritima,* and *B. frutescens*) and 2 grasses (*D. spicata* and *P. amarun*) were sporadically found on this island in low numbers, the vegetative community on Queen Bess Island is essentially monotypic, *S. alterniflora.*

S. alterniflora distribution in coastal environments is influenced by tidal amplitude and elevation (Eleuterius and Eleuterius 1979). Consequently, salt marsh vegetation has been found to grow at lower elevations along the northern Gulf of Mexico than along the Atlantic coast of the U.S. because

Figure 12. View of impounded water within the Barataria Bay Waterway Wetland Creation (BA-19) project area (photo taken December 1996).

tidal amplitude is much lower (Eleuterius and Eleuterius 1979; Delaune et al. 1983). As a result, soils seem to be inundated for longer periods along the Gulf coast for a given marsh elevation. Still, seasonal increases in the frequency and duration of flooding may inhibit the establishment of *S. alterniflora* in response to changes in soil chemistry induced by increases in tidal inundation (Webb and Dodd 1989). Poorly drained saline environments, like the Barataria Bay Waterway Wetland Creation (BA-19) project area, tend to promote reductions in sediment redox potential (Eh), increases in the induction of alcohol dehydrogenase (ADH) in *S. alterniflora* roots (anaerobic metabolism), increases in soil pore water sulphide concentrations (Mendelssohn and McKee 1988; Mendelssohn et al. 1982; Howes et al. 1986; DeLaune et al. 1993; DeLaune et al. 1984; DeLaune et al. 1983), and shallow rooting systems (DeLaune et al. 1993; Craft et al. 1993). These soil chemical and physical properties, and subsequent plant responses, retard the vegetative growth and establishment of euryhaline wetland plants (DeLaune et al. 1993). *S. alterniflora* has been found to grow in wetlands that are flooded 87% of the time as long as these low lying marshes are periodically drained during low tides (Eleuterius and Eleuterius 1979). Therefore, it seems plausible to infer that low elevation and poor drainage have inhibited the establishment of salt tolerant vegetation in the project area. Conversely, the greater elevations and soil drainage encountered in the reference area probably induce soil characteristics and plant responses that enhance the establishment of saltwater vegetation (Mendelssohn and McKee 1988; Mendelssohn et al. 1982; DeLaune et al. 1993).

While the average sediment accretion rate in the project area (remnant Queen Bess Island) was considerably higher than the reference area (Mendicant Island), only 2 out of 10 accretion stations in the project area could be found (figure 8). Therefore, the project area vertical accretion estimates may not be representative. Nevertheless, Alonzo (1997) found large quantities of sediment from the effluent outfall deposited on the existing vegetation. While the accretion rate on remnant Queen Bess Island has been enhanced by the deposition of dredged material, the dredged material disposal area will not vertically accrete without the addition of mineral sediments since vertical accretion in regularly flooded marshes occur through inputs of mineral sediments (Craft et al. 1993). However, based on the accretion results it is evident that very little mineral accretion occurs in this area. Moreover, saltwater marshes require larger quantities of mineral sediments to vertically accrete than brackish and fresh marshes (DeLaune et al. 1993). In addition, vertical accretion in irregularly flooded wetlands occurs through accumulation of organic matter (decomposition of plant matter) (Craft et al. 1993). However, no emergent vegetation exists in this impounded basin.

The number of eastern brown pelican fledglings on Queen Bess Island has increased dramatically since the creation of 8.0 acres (3.2 ha) of vegetated wetlands by the Queen Bess Island marsh creation (BA-05b) project (figures 10 and 11; McNease 1999), and the number of fledglings per nest was well above the established recruitment standard to maintain a stable population (Henny 1972). Since the construction of the Barataria Bay Waterway Wetland Creation (BA-19) project, the pelican reproduction on Queen Bess Island has continued to expand although no new pelican nesting habitat was created by this project. This is surprising because spatial constraints and low elevation have been found to adversely impact pelican natality (McNease et al. 1992). Pelican reproduction on Last Island and North Island have likewise grown between 1996 and 1998. The causes of this increase in pelican reproduction are not clear, but is seems unlikely that the Barataria Bay Waterway Wetland Creation (BA-19) project had any effect on the reproductive success of the Queen Bess Island brown pelican colony. However, this marsh creation project could positively affect pelican reproduction if new nesting habitat is created by deposition of additional mineral sediments from dredging of nearby water bodies, like the Barataria Bay Waterway.

Conclusion

The monitoring data from the Barataria Bay Waterway Wetland Creation (BA-19) project indicate that some of the goals established in project design have not been achieved although marsh elevation on remnant Queen Bess Island was increased. Dredged sediments have not consolidated to within the target elevation, and no new vegetated wetlands have been established. While eastern brown pelican populations on Queen Bess Island have increased considerably since the construction of both marsh creation projects, other locations have also shown increases, indicating factors other than the projects have contributed to pelican reproductive success. Spatial constraints may eventually limit the reproductive success of the eastern brown pelican populations on Queen Bess Island, but we have little evidence to support this argument at this time.

Future marsh creation projects should take into account chemical and physical properties of dredged sediments along with hydrological conditions created by sediment elevation and tidal fluctuations to promote the growth of emergent vegetation.

The habitat on Queen Bess Island is periodically monitored through the USACE -NOD, BUMP program, and the eastern brown pelican populations are monitored by LDWF. Since existing data indicate new wetlands will not be created without the addition of mineral sediments, LDNR/CRD will recommend to the Federal sponsor that monitoring of the Barataria Bay Waterway Wetland Creation (BA-19) project be discontinued through CWPPRA funds and only monitored by BUMP and LDWF.

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