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COMPREHENSIVE MONITORING REPORT

DEWITT-ROLLOVER PLANTINGS (ME-08)

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

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ABSTRACT

The Dewitt-Rollover Plantings (ME-08) demonstration project was designed to evaluate the ability of vegetative plantings to stabilize mudflats accreting along the Louisiana–Gulf of Mexico shoreline, and to determine whether a vegetation buffer could be established to protect the shoreline from further erosion. The accreting mudflat area for which this planting project was initially designed became vegetated naturally, necessitating relocation of the demonstration site. An alternate site was chosen on the remaining mudflat area available, which is situated along the more actively eroding shoreline to the west of the original site. In July 1994, 6,083 transplants of smooth cordgrass (*Spartina alterniflora* Loesel.) were planted along approximately 1.5 mi of shoreline between Dewitt Canal and Rollover Bayou, Vermilion Parish. By 10-mo postplanting, survival in 16 vegetative planting sampling plots was 0%, and only 38 of the original transplants could be located outside of the plots. Shoreline erosion in the project planting area for this 10-mo period was estimated to average 15.3 ft/yr, which is consistent with the range of erosion rates (16.4 ft/yr to 26.2 ft/yr) determined for this area for the past 100-yr period. The results indicate that the smooth cordgrass plantings for this project were inadequate for controlling erosion in this high energy environment. These results do not support the use of smooth cordgrass plantings for shoreline stabilization in high energy sites that are experiencing high rates of erosion.

INTRODUCTION

The First Priority Project List of the Coastal Wetlands Planning, Protection, and Restoration Act (Public Law 101 ! 646) of 1990 provided funding for four demonstration projects to investigate the suitability of vegetative plantings for erosion control in four different coastal wetland environments. The Dewitt-Rollover Plantings (ME-08) project was planned to examine the efficacy of using vegetative plantings to stabilize accreting mudflats along the southwestern Louisiana shoreline.

A major concern with coastal restoration work in southwestern Louisiana is beach erosion along the Louisiana–Gulf of Mexico shoreline (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF] 1993a, b). In areas where sediment influx is low and wave energy is high, previously deposited sediments on the beach are pushed landward over the existing shoreline (U. S. Department of Agriculture, Soil Conservation Service [USDA/SCS] 1992). This results in breaching of the beach rim along the shoreline, exposing the back marsh soils to wave attack and rapid erosion. Protection of the back marsh from erosion is essential in preserving the integrity of coastal marshes and estuaries.

Studies on shoreline erosion along the southwestern Louisiana coastline indicate that shoreline changes involve the westward transport of sediment, with distinct alternating zones of updrift erosion and downdrift accretion (Gould and McFarlan 1959; McBride and Byrnes 1995). In general, the sediment from eroding zones is transported and deposited along the shoreline of the adjacent zone to the west, prograding the shoreline seaward. In addition, major streams that drain into the Gulf of Mexico supply additional pulses of sediment that are carried westward by gulf currents, contributing material for land building in downdrift accretion zones through longshore drift.

In the 1950's, Morgan et al. (1953) documented the occurrence of mud deposits along the southwestern Louisiana coast from Marsh Island to Rollover Bayou, and tied their origin to the Atchafalaya River, which was developing a new subaqueous delta in Atchafalaya Bay. Through analysis of aerial photography, Wells and Kemp (1981, 1982) documented a westward shift in sedimentation along the coast from Marsh Island to Rollover Bayou between 1954 and 1981, and predicted that accelerated growth of the chenier plain can be expected when Atchafalaya Bay becomes sediment filled, allowing greater volumes of sediment to be transported westward through longshore drift. Wells and Kemp (1981, 1982) further hypothesized that the time scale for widespread reversal in present coastal erosion was perhaps 50 to 100 years, as continued sedimentation along the chenier plain allows transitory mudflats to appear and merge with existing mudflats, which will stabilize and grow seaward, providing a suitable environment for marsh vegetation to become established. From their study, Wells and Kemp (1981) found little evidence that large-scale mudflat stabilization by marsh vegetation presently occurs under normal conditions, although localized hurricane mud deposits have become permanent shoreline features in the recent past (Morgan et al. 1958).

Adams et al. (1978) estimated the average shoreline erosion rate in the vicinity of Dewitt Canal and Rollover Bayou to be from 26.6 ft/yr to 49.2 ft/yr between 1952 and 1974. A more recent study (Byrnes et al. 1995) indicates an average shoreline erosion rate for the chenier plain (from the Old Mermentau River east to Dewitt Canal) of 28.5 ft/yr for the past 100-yr period, with "hot spots" experiencing rates up to 41.0 ft/yr. The latter study indicates erosion rates in the Dewitt-Rollover Plantings project area ranging from approximately 16.4 ft/yr to 26.2 ft/yr for this 100-yr period.

A number of techniques have been used in the United States to abate shoreline erosion, including the construction of different types of hard structures designed to break wave energy before it reaches the shoreline (U. S. Army Corps of Engineers [USACE] 1977). Vegetative plantings of dominant marsh plants have also been used successfully as a means to protect shorelines subject to low energy wave action (Knutson 1977b; Woodhouse 1979; Broome et al. 1982, 1988). In the eastern United States, the rhizomatous, tidal marsh grass, smooth cordgrass (*Spartina alterniflora* Loisel.), has proven to be as useful as hard structures for damping low-energy wave action (Knutson et al. 1982). This species is now widely planted for shore protection in tidal marshes in the United States, including coastal Louisiana.

Project Location

As originally proposed by the U. S. Department of Agriculture, Soil Conservation Service (USDA/SCS 1991) and subsequently described in several reports (LCWCRTF 1991, 1992; LDNR 1993), this demonstration project was to include vegetation plantings along approximately 6 mi of beach from Dewitt Canal westward to Rollover Bayou, in Vermilion Parish, Louisiana (figure 1). During the planning phase, the project planting area was reduced in scope to extend from the consolidated mudflats newly colonized by stands of smooth cordgrass at Dewitt Canal, westward for approximately 1 mi (USDA/SCS 1992).

On subsequent trips in October 1993, and April and May 1994, the amount of vegetation observed growing naturally on the mudflats and beach in the selected planting site steadily increased. By May 1994, the entire 5,500-ft stretch of mudflats proposed for planting was supporting a mixture of common marsh plants, including amaranth (*Amaranthus* sp.), aster (*Aster* sp.), marine ivy (*Cissus incisa* (Nutt.) Des Moul.), seaside heliotrope (*Heliotropum curassavicum* L.), marsh mallow (*Hibiscus* sp.), bigleaf marsh elder (*Iva frutescens* L.), roseau (*Phragmites australis* (Cav.) Trin. ex Steud.), frogfruit (*Phyla nodiflora* (L.) Greene), rattle box (*Sesbania drummondii* (Rydb.) Cory), seaside goldenrod (*Solidago sempervirens* L. var. *mexicana* (L.) Fern.), smooth cordgrass (*Spartina alterniflora*), marshhay cordgrass (*S. patens* (Ait.) Muhl.), saltwort batis (*Batis maritima* L.), saltgrass (*Distichlis spicata* (L.) Greene), Carolina wolfberry (*Lycium carolinianum* Walt.), and Bigelow's glasswort (*Salicornia bigelovii* Torr.). This naturally occurring vegetation had expanded to the point where it was no longer feasible nor necessary to proceed with the project as planned.

Consequently, in May 1994, it was decided to proceed instead with planting the adjacent 1.5 mi of unvegetated, less developed mudflats and beach (figure 1), beginning approximately 1 mi west of Dewitt Canal and continuing westward (LDNR 1994).

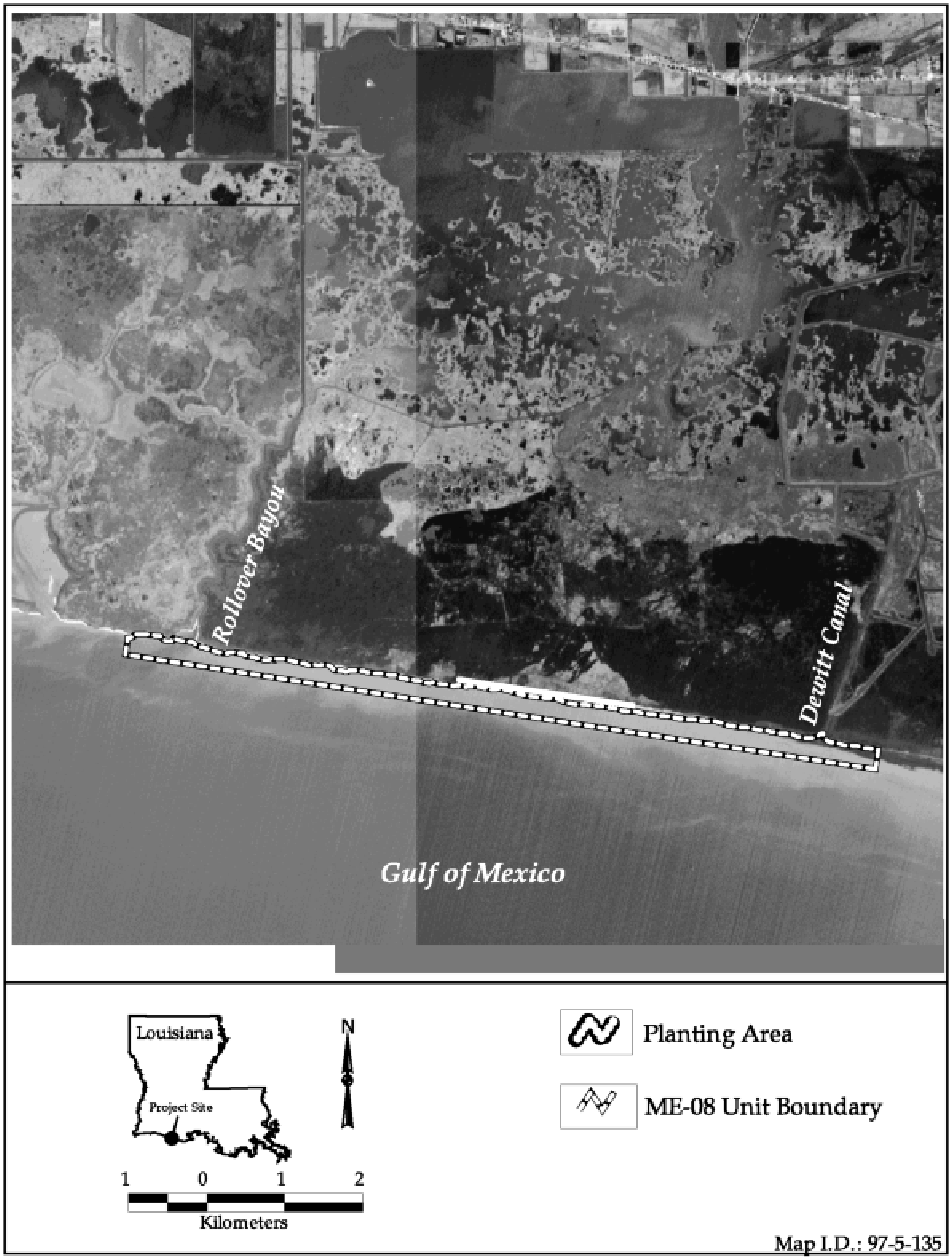


Figure 1. Dewitt-Rollover Plantings (ME-08) project area showing smooth cordgrass planting area.

Geologically, the project area comprises the transition between the western portion of the Mississippi River Delta Plain and the eastern portion of the marginal or chenier plain (Gould and McFarlan 1959). Soils in the project area are classified as coastal beaches (U. S. Department of Agriculture, Natural Resources Conservation Service [USDA/NRCS] 1996), which are characterized as unvegetated strips of mixed sand, clay, and shell fragments, with a slope of less than 1% that occur along the Louisiana–Gulf of Mexico shoreline. Coastal beaches are typically covered with water at high tide and exposed during low tide. The coastal beaches are subject to continual wave wash, and the higher parts are generally covered with debris that washes ashore during high tides and storms.

The project area is subdivided into three specific environments: beach, mudflats, and near-shore marine (USDA/SCS 1992). A well-defined beach rim vegetated with bigleaf marsh elder, roseau cane, and marshhay cordgrass is present along the high water line between the beach and a back marsh of predominantly marshhay cordgrass, smooth cordgrass, and leafy three-square *(Scirpus robustus* Pursh). Mudflats on the eastern end of the project area, in the vicinity of Dewitt Canal, are prograding in response to the accumulation of sediment being carried westward from the Atchafalaya Delta region. This sediment is forming subaqueous mud shoals, semifluid intertidal mudflats, and consolidated mudflats that are being added to the shoreface. Farther west, where there is less sediment influx, the shoreline is retreating. Along the mudflats, the near-shore marine environment provides a reservoir of sediment that is being reworked along the shoreline.

Project Purpose/Objectives

The purpose of this demonstration project was to investigate the ability of vegetative plantings of smooth cordgrass to (1) colonize the newly accreted mudflat environment to enhance sediment trapping, and (2) to establish a buffer of vegetation to protect the beach environment from erosion.

The project objectives were to 1) restore wetland productivity through planning, designing and implementing vegetative planting projects that protect and enhance coastal and inland wetlands, and (2) establish a buffer of vegetation (using smooth cordgrass) between the Gulf of Mexico and coastal wetlands to reduce wave energy and trap sediment. The specific project goals were to (1) decrease the rate of shoreline erosion along 1.5 miles of the Louisiana–Gulf of Mexico shoreline, and (2) increase the coverage of vegetation between the Gulf of Mexico and adjacent coastal wetlands.

METHODS

Construction

The project consisted of planting 6,083 trade-gallon-size transplants of smooth cordgrass along approximately 1.5 mi of the Louisiana–Gulf of Mexico shoreline, beginning approximately 1 mi west of Dewitt Canal and extending westward (figure 1). The transplants were planted on 5-ft centers on rows placed 5 ft apart, on the suitable stretches of intertidal mudflats and lower beach in the project planting area designated for planting by U.S. Department of Agriculture, National Resources Conservation Service[1] (USDA/NRCS) personnel. Due to site-specific variations in the available width of the planting zone, the number of rows planted in each designated stretch of beach varied from 2 to 7. Immediately prior to planting, each transplant was fertilized with a slow-release nitrogen fertilizer pushed into the top 2 in. of the plant rootball. Each plant placed in the two rows closest to the Gulf of Mexico on the westernmost stretch of beach designated for planting was anchored with a 0.25-in. diameter iron reinforcing rod. The transplants were planted between July 17 and July 31, 1994.

Monitoring

The methods used to monitor this project follow the procedures summarized in Steyer et al. (1995). The effectiveness of the smooth cordgrass plantings at achieving the project objectives was evaluated by determining if the two project goals were being met, using data collected on three monitoring elements, which are habitat mapping, shoreline markers, and vegetative plantings (LDNR 1994).

Habitat mapping

To document vegetated and nonvegetated areas and to document annual shoreline movement, color-infrared aerial photography (1:12,000 scale) taken in November 1993 at the preplanting stage was obtained by the National Wetland Research Center (NWRC). NWRC personnel obtained ground control points and entered the data into a data base to photomosaic, georectify, and digitize the aerial photography. Detailed photo interpretation, mapping, and GIS analysis are not planned. The preplanting stage photography was to be compared with aerial photography scheduled to be taken three times postplanting. However, postplanting aerial photography will not be obtained for this project since the vegetative plantings were lost to erosion and project monitoring was discontinued.

[1]Formerly known as the U.S.D.A., Soil Conservation Service

Shoreline markers

To document annual shoreline movement, the preplanting shoreline position was established by placing shoreline markers at the high water line on the existing shoreline adjacent to the vegetative plantings at 16 points approximately 500 ft apart. A reference area was established by similarly placing three additional markers along the existing contiguous shoreline west of the planting area. Since the project plantings were lost to erosion, changes in shoreline position relative to the shoreline markers were determined by direct measurement only once at 10-mo postplanting in May 1995.

Vegetative Plantings

The general condition of the plantings was documented using methodology similar to that of Mendelssohn and Hester (1988) and Mendelssohn et al. (1991). Survivorship (percent survival) and percent cover were evaluated by monitoring a 5% sample of the smooth cordgrass plantings in a stratified block design.

The stretches of beach designated for planting by USDA/NRCS personnel were divided into five blocks or "land types" based on a combination of soil and beach morphology characteristics (table 1). The blocks were delineated using the 19 shoreline markers, which like the blocks, run from east to west in ascending order. The number of plants installed within each block was determined using as-built drawings prepared by NRCS personnel. An appropriate number of 16-plant sampling plots were then established randomly within each of the five blocks to achieve a 5% sample of the vegetative plantings within each block, based on the following formula:

(total plants per block x 0.05)/16 =number of sampling plots per block.

A total of 19 sampling plots were established to monitor the project (table 2). Eighteen plots consisting of 16 plants each (8 plants on each of two adjacent rows) were established. One plot (number 19) fell on a stretch of beach where one of the two rows of smooth cordgrass planted was lost to erosion before the plots were established. Therefore, this plot consisted of a single row of 16 plants. Individual plants were randomly chosen within each block and marked with a 10-ft PVC pole to establish the required number of sampling plots. Each randomly selected plant served as a "corner plant" within each 2-row plot (or an end plant in the single-row plot), which ran westward from the corner plant.

The 16 smooth cordgrass plants within each sampling plot were evaluated for percent survival. In addition, the vegetation in a 1 m^2 subsample plot centered around each plot's selected corner plant was evaluated for percent cover by species. The plantings were evaluated at 1-mo postplanting. The 6-mo postplanting evaluation, which fell in February 1995 when the surviving plantings were still dormant, was postponed until May 1995 to allow ample time for the production of spring growth. Although vegetation data were to be collected at 1-mo, 6-mo, and 12-mo postplanting, and at 3-yr intervals thereafter, the plantings only survived long enough to be evaluated at 1-mo (September 1994) and 10-mo (May 1995) postplanting.

Table 1. Block characterizations, plant totals, number of sampling plots/block, and random numbers used for the selection of the 16-plant sampling plots established in August 1994 to monitor the smooth cordgrass plantings in the project area.

[1]BLOCK	[3]BEGIN-END SHORELINE MARKERS	BEACH CHARACTERISTICS	TOTAL NO. PLANTS	5% OF PLANT TOTAL	NO. OF 16-PLANT PLOTS	RANDOM NOS. FOR CORNER PLANT SELECTION
1	1-5	Moderately sloped, broad, sand-hash with 4'!10'-wide strip along waterline covered with 2" of mud, and with 116'-300'-wide fluid mudflat along the beach.	1,686	84	5	6, 208, 419, 689, 863
2	5-7	Steeply sloped, broad sand, with 20'!100'-wide fluid mudflat along the beach.	1,153	58	4	276, 602, 880, 1026
3	7-10	Moderately sloped, broad to narrow, sand-mud on hash, without mudflat along the beach; all plants on sand-mud.	1,348	67	4	42, 429, 522, 596
[2]4b	10-11	Moderately sloped, narrow, with scalloped coves between eroding points; sand with lower half covered with 4"!8" of mud in diminishing width from the centers of coves to eroding points.	240	12	1	930
5	11-13	Moderately sloped, broad, sand, without mudflat along the beach.	885	44	3	65, 112, 214
[2]4a	13-17	Moderately sloped, narrow, with scalloped coves between eroding points, sand with lower half covered with 4"!8" of mud in diminishing width from the eroding points to centers of coves.	771	39	2	135, 215
		PLANT/PLOT TOTALS:	6,083	304	19	

[1]Monitoring blocks correspond with the land types identified on the basis of beach characteristics.
[2]Blocks 4a and 4b correspond with land type 4, which occurs in two separate areas.
[3]Shoreline markers 17–19 demarcate the reference area adjacent to the west end of the project planting area.

Table 2. Site-specific characteristics of the 19 random, 16-plant sampling plots, along with percent survival of smooth cordgrass plantings in the plots, and percent cover of a single smooth cordgrass planting in the associated 1 m^2 plots, as observed at 1-mo (September 1994) and 10-mo (May 1995) postplanting, at the project area along the Louisiana–Gulf of Mexico shoreline.

				1-MONTH POSTPLANTING					10-MONTHS POSTPLANTING				
BLOCK NO.	PLOT NO.	RANDOM CORNER PLANT NO.	PLOT LOCATION IN ROWS PLANTED	NO. LIVE	NO. DEAD	NO. ABSENT	% SURVIVAL	% COVER	NO. LIVE	NO. DEAD	NO. ABSENT	% SURVIVAL	% COVER
1	1	6	1-2 of 4	16	0	0	100	5	0	0	16	0	0
1	2	208	1-2 of 4	16	0	0	100	10	0	0	16	0	0
1	3	419	1-2 of 4	16	0	0	100	8	0	0	16	0	0
1	4	689	2-3 of 4	15	1	0	93.75	3	0	0	16	0	0
1	5	863	1-2 of 6	16	0	0	100	8	0	0	16	0	0
2	6	276	2-3 of 4	15	1	0	93.75	3	0	0	16	0	0
2	7	602	4-5 of 6	6	0	10	37.5	3	0	0	16	0	0
2	8	880	2-3 of 6	8	1	7	50.0	3	0	0	16	0	0
2	9	1026	1-2 of 6	4	0	12	20.0	5	0	0	16	0	0
3	10	42	6-7 of 7	15	0	1	93.75	1	0	0	16	0	0
3	11	429	5-6 of 7	16	0	0	100	3	0	0	16	0	0
3	12	522	2-3 of 6	16	0	0	100	5	0	0	16	0	0
3	13	596	4-5 of 5	16	0	0	100	5	0	0	16	0	0
4b	14	930	1-2 of 2	8	0	8	50.0	0	0	0	16	0	0
5	15	65	3-4 of 6	0	0	16	0	0	0	0	16	0	0
5	16	112	2-3 of 5	0	0	16	0	0	0	0	16	0	0
5	17	214	3-4 of 5	6	0	10	37.5	5	0	0	16	0	0
4a	18	135	1-2 of 3	1	0	15	0	0	0	0	16	0	0
4a	19	215	1 of 2	0	0	16	0	0	0	0	16	0	0
			MEAN:	10	0.2	5.8	61.9	3.5	0	0	16	0	0
		STANDARD DEVIATION:		6.6	0.4	6.7	42.0	3.0	0	0	0	0	0

Statistical Analyses

Paired t-tests and analyses of variance (ANOVA) were planned to compare measured rates of shoreline movement with recent historical values and to evaluate the success of the vegetative plantings, using the monitoring data collected. However, since almost all the plantings were either dead or missing at 10-mo postplanting, conclusions were drawn without performing an ANOVA. Paired t-test was used to compare site-specific shoreline movement within the project area. Descriptive and summary statistics were used to document the vegetative planting data. The project goals and hypotheses evaluated are presented below.

Goal 1: Decrease the rate of shoreline erosion along 1.5 mi of the Louisiana–Gulf of Mexico shoreline.

H_o: Shoreline retreat rate postplanting WILL NOT be significantly less than the shoreline retreat rate in previous years.

H_a: Shoreline retreat rate postplanting WILL be significantly less than the shoreline retreat rate in previous years.

Goal 2: Increase the coverage of vegetation between the Gulf of Mexico and adjacent coastal wetlands.

H_o: Postplanting coverage of vegetation along the shoreline at time point i + 1 WILL NOT be more than coverage of vegetation at time point i.

H_a: Postplanting coverage of vegetation along the shoreline at time point i + 1 WILL be more than coverage of vegetation at time point i.

RESULTS

Shoreline Erosion

The results of a paired t-test indicate that the overall shoreline erosion rate in the project area between 0-mo and 10-mo postplanting was significantly greater than zero ($p<0.001$). The shoreline erosion rate at the shoreline markers in the project area ranged from 0 ft/yr at shoreline markers 4 and 9 to 50.2 ft/yr at shoreline marker 1 (figure 2). The overall average shoreline erosion rate within the project area was 15.3 ft/yr (standard deviation [SD]: 12.4 ft/yr). This is consistent with the range of erosion rates of approximately 16.4 ft/yr (5 m/yr) to 26.2 ft/yr (8 m/yr) determined for this area for the past 100-yr period (figure 3) by Byrnes et al. (1995). Measurements at shoreline marker 18 in the reference area indicated an erosion rate of 30 ft/yr. Since only 1 of the 3 shoreline markers in the reference area remained intact at 10-mo postplanting, it was impossible to compare statistically the erosion rates between the reference and the planting areas. Furthermore, the 10-mo monitoring period was too brief to provide enough data to test the null hypothesis and to compare the shoreline retreat rate observed to the rate determined for previous years.

Vegetative Plantings

By 1-mo postplanting, the mean planting survival was 61.9% (SD: 42.0%), based on data collected in the 19 sampling plots (table 2) on September 20, 1994. The mean vegetation cover within the sampling plots was estimated to be 3.5% (SD: 3.0%), and consisted of only the cover provided by the single smooth cordgrass planting in each 1 m^2 subsample plot (table 2). By the end of 1 mo, half or more of the plants in plots 7, 8, 9, 14, 17, and 18, and all of the plants in plots 15, 16, and 19 were either dead or absent (table 2).

On May 26, 1995, 10-mo postplanting survival (table 2) was 0% (SD: 0%) in all 19 sampling plots. Percent cover in the associated 1 m^2 subsample plots was also 0% (SD: 0%) for all 19 plots.

The results are the same for all sampling plots, regardless of the block (land type) and the number of rows of vegetation planted at a particular plot (table 2). There is no difference in percent survival or percent cover between blocks or plots, and the number of rows of plantings. At 1-mo postplanting, only a small percentage of the losses were observed to be due to the death of plantings. Because all of the plants in the sampling plots were absent by 10-mo postplanting, there is no way to know precisely how many plants actually died. However, the majority of the plantings appear to have been dislodged and washed away through wave erosion. Many of them may have first been smothered by debris washed in with the tides.

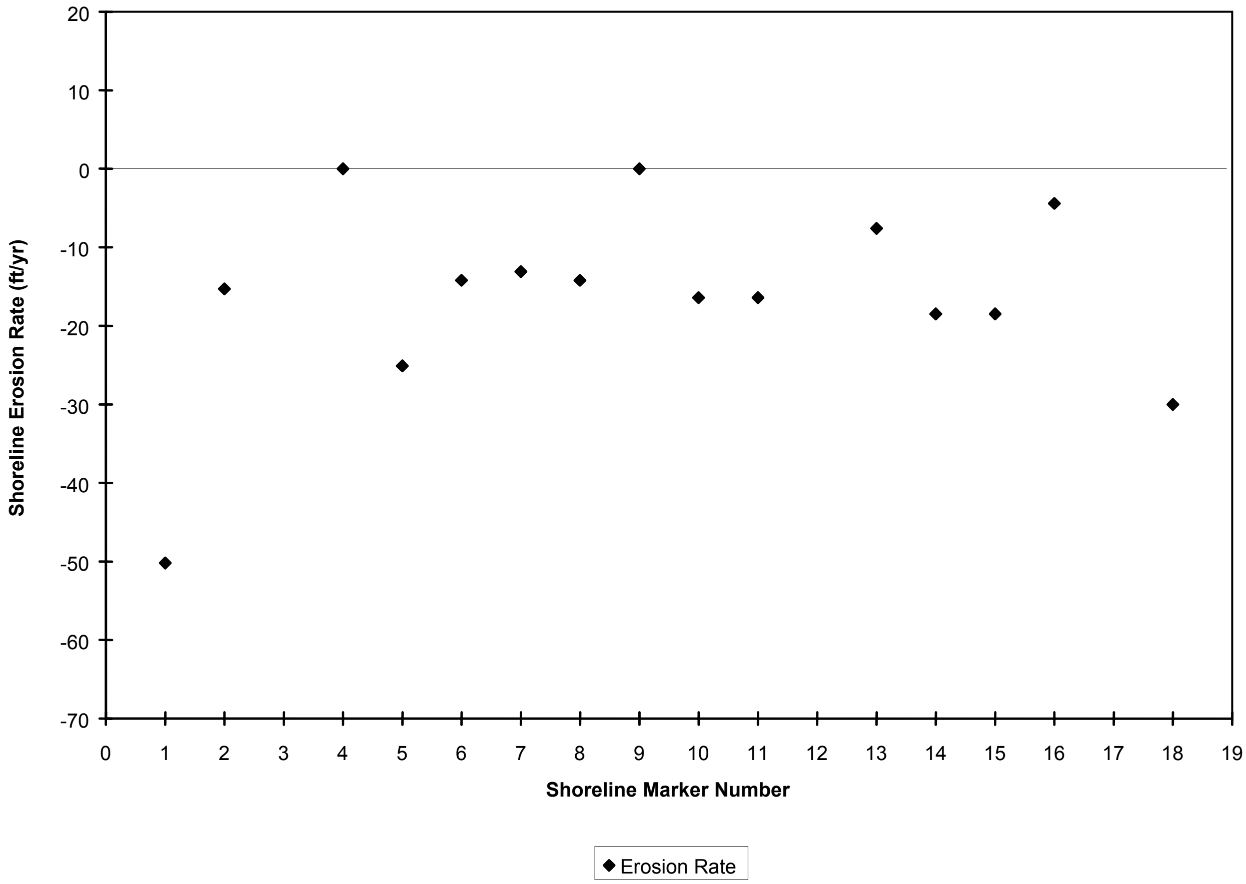


Figure 2. Beach erosion rates at 15 of 19 shoreline markers placed at approximately 500-ft intervals along the beach in the Dewitt-Rollover Plantings (ME-08) project and reference areas along the Louisiana-Gulf of Mexico shoreline, Vermilion Parish, Louisiana, for the period August 1994 to May 1995. Markers 1-16 were placed along the planting area and markers 17-19 along the reference area. (Note: shoreline markers 3, 12, 17, and 19, were lost as a consequence of beach erosion, consequently, erosion rates could not be determined for these stations.)

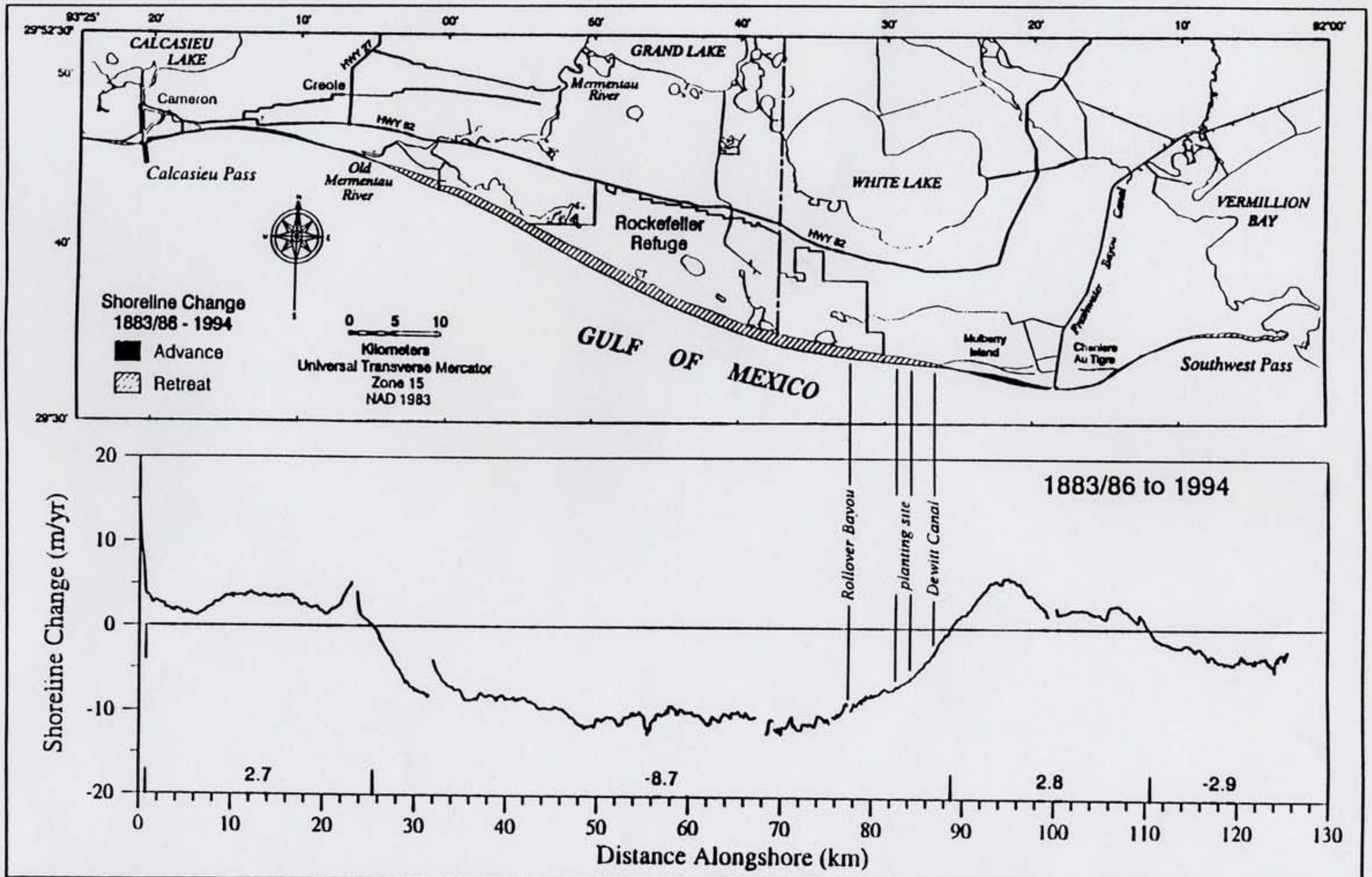


Figure 3. Net shoreline change along the Louisiana–Gulf of Mexico shoreline between Calcasieu Pass and Southwest Pass, from 1884/86 to 1994. Change rates are shown below the graphic representations of advance and retreat. Values along the base of the plot indicate the average rates of change for the designated sections of coast. Vertical lines indicate the approximate locations and shoreline change rates for Rollover Bayou, the Dewitt-Rollover project (ME-08) planting site, and Dewitt Canal. (from Byrnes et al. 1995).

DISCUSSION

Recent shoreline erosion studies, undertaken by the Coastal Studies Institute of Louisiana State University (Byrnes et al. 1995, McBride and Byrnes 1995), have yielded 100-yr shoreline erosion rates for the chenier plain of coastal Louisiana for the period 1884 to 1994. The studies show that the highest erosion rates on the chenier plain for this period occurred between Rutherford Beach near the Old Mermentau River and Dewitt Canal (figure 3), where shoreline retreat averaged 28.5 ft/yr (8.7 m/yr), with "hot spots" retreating at rates up to 41.0 ft/yr (12.5 m/yr). The average erosion rate of 15.3 ft/yr recorded for the project planting area during the 10-mo study period is consistent with the 100-yr rates of approximately 16.4 ft/yr (5.0 m/yr) to 26.2 ft/yr (8.0 m/yr) reported by Byrnes et al. (1995) for the project planting area, which is located on the eastern end of the high erosion zone (figure 3). This is in contrast to the shoreline east of Dewitt Canal, which according to Byrnes et al. (1995) has prograded an average of 9.2 ft/yr (2.8 m/yr) over the past 100-yr period.

By November 1994, the stands of smooth cordgrass and other marsh plants observed on the consolidated mudflats west of Dewitt Canal appeared to have successfully stabilized the mudflats for approximately 1 mi west of the canal. Many of the plants in these natural stands bore maturing seed heads, suggesting that natural colonization of any additional mudflats that develop seaward and west of the prograding shoreline in the vicinity of Dewitt Canal may be expected. Apparently, the extensive fluid mudflat along the shoreline at this site is buffering the shoreline from wave erosion by attenuating the height and energy of incoming waves. This allows the mudflat to consolidate landward as it progrades seaward, providing an excellent environment for rapid plant colonization through natural processes.

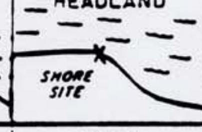
These observations suggest that the stabilized, vegetated mudflats in the vicinity of Dewitt Canal have reached the peak of their development, allowing for a localized reversal of shoreline erosion, as hypothesized by Wells and Kemp (1981, 1982), despite their contention that there is little evidence to suggest that large-scale stabilization of mudflats occurs by natural vegetation colonization under normal conditions (Wells and Kemp 1981). However, it must be noted that as a consequence of the tidal surge associated with Hurricane Chantal in early August 1989, a large deposit of mud appeared and literally plugged the mouth of Dewitt Canal at its confluence with the Gulf of Mexico (Edwards 1994). Subsequently, in March 1990, smooth cordgrass was planted on the mud deposit plugging the mouth of the canal and along the adjacent canal banks by the landowner, Vermilion Corporation. It is highly probable that the mud deposit left by Hurricane Chantal in the vicinity of Dewitt Canal provided the platform needed for further development of a stabilized mudflat, and that the smooth cordgrass plantings installed in March 1990 may have provided a seed source for the subsequent colonization of the developing mudflats along the adjacent shoreline between 1991 and 1994.

Moving westward, the wave-damping influence of this mudflat diminishes as the amount of sediment shoaling along the shoreline decreases and the mudflat becomes more fluid and less extensive, and is seasonally ephemeral. As a result, the rate of shoreline retreat increases as the extent of the fluid mudflat decreases. For this reason, the project planting area is subject to more intense wave energy than the originally proposed planting site located immediately to the east.

This attempt to establish plantings in this transitional zone of shoreline progradation and erosion offered an opportunity to test the limits of the existing planting standards and specifications for smooth cordgrass. Although the plantings did not establish successfully, the knowledge gained from the project may be used to revise vegetative planting specifications to avoid similar sites in the future, or to plan for the use of wave-damping structures in conjunction with vegetative plantings in high energy sites.

A number of recent publications have summarized planting specifications and guidelines for determining site suitability for the major salt marsh species being used for bank stabilization in the United States (Kadlec and Wentz 1974; Knutson 1977a, b; USACE 1977; Woodhouse 1979; Sharp et al 1980; Knutson et al. 1981, Knutson and Woodhouse 1983; Broome et al. 1982, 1988). The study by Knutson et al. (1981) lead to the development of a method to rank eroding shorelines in terms of their potential for stabilization with vegetation. Using three shoreline characteristics (sediment grain size, fetch, and shore configuration) that were verified statistically to be useful indicators of sites suitable for successful stabilization using vegetation, Knutson et al. (1981) developed a "Vegetative Stabilization Site Evaluation Form." Subsequently refined by Knutson and Woodhouse (1983), this form (figure 4) provides a quick and easy way to evaluate sites by visual inspection. Evaluation of the planting site chosen for the Dewitt-Rollover Plantings project using this form yields a potential success rate of 0% to 30%, depending on site-specific shoreline geometry. More recently, Knutson et al. (1990) produced a “Wave Climate Evaluation Form” (figure 5), which can be used to classify the wave energy environment at a particular site and determine the minimal acceptable options for stabilization using vegetation and/or hard structures. Using this form to evaluate the Dewitt-Rollover Plantings project yields moderate to high wave energy classifications for the planting site chosen, for which wave protection structures are recommended. These evaluations are fairly accurate, considering the monitoring results.

The LDNR/CRD and USDA/NRCS personnel who inspected the planting of the beach in July 1994, reported observing that plants were being washed from their planting holes by normal wave action before completion of planting, which took approximately two weeks. By the end of the first month, overall planting survival was estimated to be only 61.9% due to some mortality, but mainly because many of the plantings had been washed away, particularly on the west end. Most of the remaining plantings on the upper slope of the beach appeared chlorotic, while most of those remaining on the lower beach/mudflats appeared to be healthier, greener, and were apparently tillering. On a return trip in October 1994, only 3-mo postplanting, planting survival was roughly estimated to be no greater than 22%. By 10-mo postplanting, planting survival in all 19 sampling plots was 0%, and only 38 (0.7%) of the original 6,083 plantings could be found alive and growing in the project planting area outside of the sampling plots. Although they appeared to be healthy, and about half of them were tillering, they were not expected to survive very long in this environment. The main problem with establishing vegetative plantings along the project area shoreline appears to be beach erosion caused by high wave energy. Most of the plantings appear to have been washed away before they had a chance to establish themselves.

1. SHORE CHARACTERISTICS	2. DESCRIPTIVE CATEGORIES (SCORE WEIGHTED BY PERCENT SUCCESSFUL)				3. WEIGHTED SCORE
a. FETCH-AVERAGE AVERAGE DISTANCE IN KILOMETERS (MILES) OF OPEN WATER MEASURED PERPENDICULAR TO THE SHORE AND 45° EITHER SIDE OF PERPENDICULAR 	LESS THAN 1.0 (0.6)	1.1 (0.7) to 3.0 (1.9)	3.1 (1.9) to 9.0 (5.6)	GREATER THAN 9.0 (5.6)	
	(87)	(66)	(44)	(37)	
b. FETCH-LONGEST LONGEST DISTANCE IN KILOMETERS (MILES) OF OPEN WATER MEASURED PERPENDICULAR TO THE SHORE OR 45° EITHER SIDE OF PERPENDICULAR 	LESS THAN 2.0 (1.2)	2.1 (1.3) to 6.0 (3.7)	6.1 (3.8) to 18.0 (11.2)	GREATER THAN 18.0 (11.2)	
	(89)	(67)	(41)	(17)	
c. SHORELINE GEOMETRY GENERAL SHAPE OF THE SHORELINE AT THE POINT OF INTEREST PLUS 200 METERS (660 FT) ON EITHER SIDE	COVE 	MEANDER OR STRAIGHT 	HEADLAND 		
	(85)	(62)	(50)		
d. SEDIMENT[1] GRAIN SIZE OF SEDIMENTS IN SWASH ZONE (mm)	less than 0.4	0.4 – 0.8	greater than 0.8		
	(84)	(41)	(18)		
4. CUMULATIVE SCORE					

5. SCORE INTERPRETATION			
a. CUMULATIVE SCORE	122 – 200	201 – 300	300 – 345
b. POTENTIAL SUCCESS RATE	0 to 30%	30 to 80%	80 to 100%

[1]Grain-size scale for the Unified Soils Classification (Casagrande, 1948; U.S. Army Engineer Waterways Experiment Station, 1953):

Clay, silt, and find sand - 0.0024 to 0.42 millimeter
Medium sand - 0.42 to 2.0 millimeters
Coarse sand - 2.0 to 4.76 millimeters.

Figure 4. Vegetative Stabilization Site Evaluation Form. (from Knutson and Woodhouse 1983).

DESCRIPTIVE CATEGORIES SELECT APPROPRIATE DESCRIPTIVE CATEGORY FOR EACH SHORE CHARACTERISTIC (A & B) AND NOTE ASSOCIATED SCORE (1 - 3)			
A. AVERAGE FETCH AVERAGE DISTANCE IN KILOMETERS OF OPEN WATER MEASURED PERPENDICULAR TO THE SHORE AND 45 DEGREES TO EITHER SIDE OF PERPENDICULAR	LESS THAN 9.0 km	9.0 TO 18.0 km	GREATER THAN 18.0 km
	SCORE = 1	SCORE = 2	SCORE = 3
B. SHORELINE GEOMETRY GENERAL SHAPE OF THE SHORELINE AT THE POINT OF INTEREST AND 100 m TO EITHER SIDE OF POINT	COVE OR INDENTED	MEANDER OR STRAIGHT	ISLAND OR HEADLAND
	SCORE = 1	SCORE = 2	SCORE = 3

WAVE ENERGY CLASSIFICATION TOTAL SCORES OF SHORE CHARACTERISTICS (A & B)		
LOW WAVE ENERGY TOTAL SCORE 2 or 3	MODERATE ENERGY TOTAL SCORE 4	HIGH WAVE ENERGY TOTAL SCORE 5 or 6

VEGETATIVE STABILIZATION OPTIONS MINIMAL ACCEPTABLE OPTION FOR EACH WAVE ENVIRONMENT		
LOW WAVE ENERGY STANDARD PLANTING TECHNIQUES	MODERATE ENERGY ROOT-ANCHOR PLANTING TECHNIQUES OR WAVE PROTECTION STRUCTURE	HIGH WAVE ENERGY WAVE PROTECTION STRUCTURE

Figure 5. Wave Climate Evaluation Form for estimating wave climate severity and determining appropriate vegetative stabilization options. (from Knutson et al. 1990).

Associated with the high wave energy at the planting site was the presence of large amounts of debris being washed up on the beach by incoming tides. The planting area was littered with trash, lumber, pilings, and rope. In addition, in October 1994, rafts of debris and decaying water hyacinth (*Eichhornia crassipes* (Mart.) Solms) washed ashore from the east. The eastern half of the planting area was almost completely covered with a 1-ft-thick layer of this material, making it hard to locate any of the plantings. On the western half of the planting area, the raft material diminished to a band covering only about 25% of the width of the beach.

By January 1995, the planting area beach had been washed clean of debris, except for the area around sampling plot 10, which remained covered with reworked water hyacinth and beach material. Most of the soft sediment had also been washed away, leaving only hard mud deposits, sand, and shell fragments. The fluid, intertidal mudflats present along the shoreline on the eastern end of the planting area during the summer and fall were greatly reduced in width. In May 1995, at 10-mo postplanting, most of the planting area was visible, but rafts of water hyacinth and debris were again beginning to wash ashore from the east. The large, fluid mudflat on the east end of the planting area was no longer present, but a smaller fluid mudflat had formed adjacent to the west end of the planting area, suggesting that some of the mud that was seen accumulating along the shoreline on the east end of the planting area in 1994 had been transported westward by longshore drift.

The intense wave erosion of the planting area also made it difficult to maintain the 10-ft PVC pipe used as shoreline and sampling plot marker poles. On trips to the planting area in October and November 1994, and in January, April and May 1995, one or more of the plot marker poles had to be replaced. Some of the poles were missing, others were broken near ground level. It was possible to relocate and establish all of the plot markers that were found missing on these trips using field notes and additional markers placed in the planting area and along the beach rim. However, on the 10-mo postplanting monitoring trip on May 26, 1995, the three missing shoreline markers were not reestablished. The use of treated 4 x 4 in. wooden posts is to be recommended for monitoring other shoreline projects subject to such intense wave energy.

CONCLUSIONS

Based on field data collected by LDNR/CRD and USDA/NRCS personnel between April 1994 and May 1995, vegetative plantings alone do not appear to be a viable means of controlling erosion along the shoreline in the project planting area, which is experiencing high rates of retreat. In the absence of a substantial consolidated mudflat or a hard structure to buffer such shorelines from high wave energy, the majority of any plantings installed can be expected to be buried and smothered by incoming rafts of debris, and/or washed away through wave erosion, as observed for this project. More substantial measures will be needed to abate shoreline retreat along these rapidly eroding shorelines.

It is recommended that the selection of future planting sites be evaluated using the "Vegetative Stabilization Site Evaluation Form" (figure 4) developed by Knutson and Woodhouse (1983). This type of evaluation is an important step in the process of determining what type of shoreline protection is needed on a case–by–case basis. Sites that rank high may be recommended for stabilization using vegetation, and those that rank low may be recommended for stabilization using hard structures, such as rock breakwaters. It is further recommended that potential planting sites be evaluated using the "Wave Climate Evaluation Form" (figure 5) developed by Knutson et al. (1990), which provides specific recommendations for stabilizing shorelines with vegetation and hard structures, based on the wave energy environment. Since structural alternatives can easily be 10 times more costly than vegetative plantings, knowing the potential for successful stabilization using vegetation at a particular site is also useful in evaluating the cost-effectiveness of the available methods for shoreline stabilization.

Based on the monitoring results, the Dewitt-Rollover Plantings demonstration project was recommended for deauthorization on December 21, 1995, and officially deauthorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Task Force on February 28, 1996.

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