U.S. Army Corps of Engineers - New Orleans District
Louisiana State University - Coastal Studies Institute

BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1996 ANNUAL REPORT

Part 9: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel

Base Year 1985 through Fiscal Year 1996

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INTRODUCTION

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel (Atchafalaya Bay and Bar) is located 20 miles south of Morgan City, Louisiana. This area is dominated by the growth of the Atchafalaya River delta over the last 50 years. The U.S. Army Corps of Engineers - New Orleans District (USACE-NOD) maintains this navigation channel through the prograding Atchafalaya delta complex (Figure 1).

The Beneficial Use of dredged material Monitoring Program (BUMP) at Louisiana State University - Coastal Studies Institute (LSU-CSI) is documenting the disposal and beneficial use of dredged material using aerial photography, geographical information system (GIS) analysis, and field surveys through the sponsorship of the USACE-NOD. BUMP results are provided in map series, annual reports, and scientific literature.

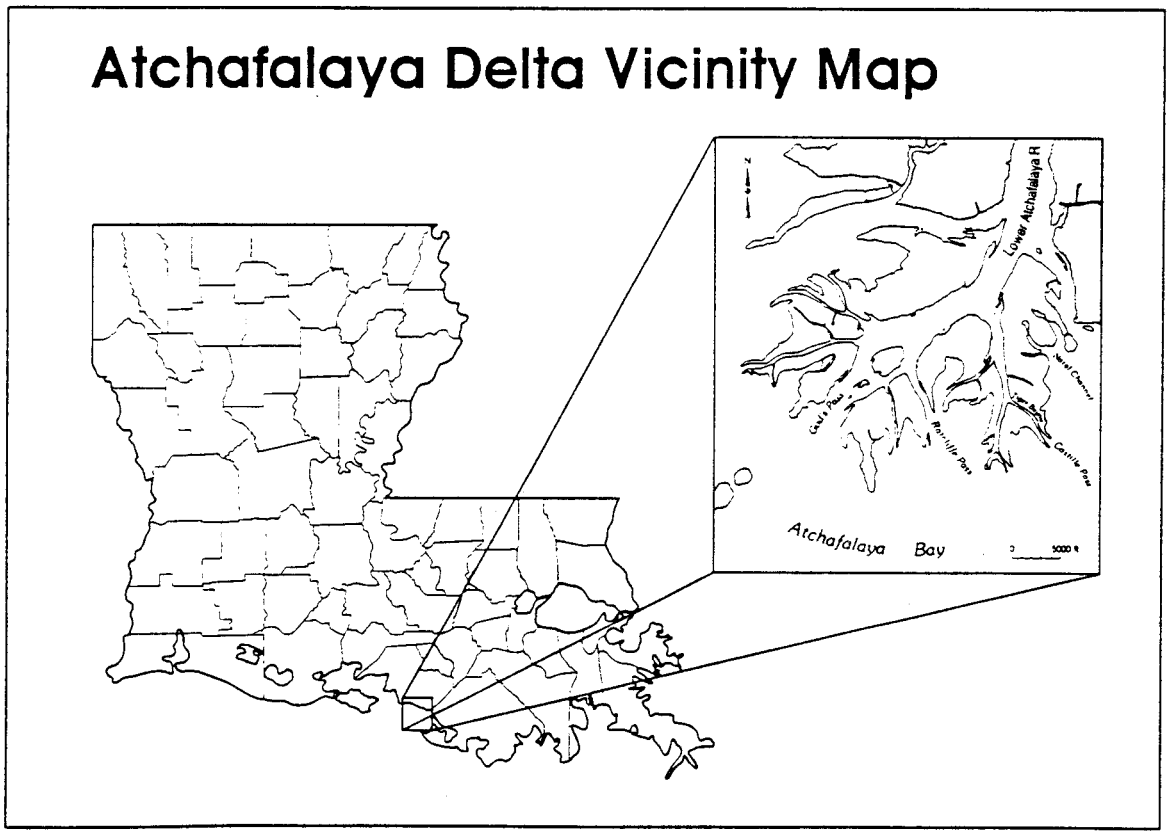


Figure 1. The location of the Atchafalaya Bay and Bar navigation channel in Louisiana.

In this report, LSU presents the new results of the BUMP analysis at the Lower Atchafalaya River Bay and Bar navigation channel. This is the ninth part of the nine part Beneficial Use of dredged material Monitoring Program (BUMP), 1996 Final Report, representing monitoring results through the USACE-NOD Fiscal Year 1996. The nine parts are:

Part 1: Introduction and Methodology
Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Mile 47-59
Part 3: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Jetties
Part 4: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Breton Island
Part 5: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Outlet, Venice, Louisiana - Baptiste Collette Bayou
Part 6: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass
Part 7: Results of Monitoring the Beneficial Use of Dredged Material at the Houma Navigation Channel, Louisiana - Bay Chaland
Part 8: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River Horseshoe
Part 9: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel

Using aerial photography, LSU classified the natural and man-made habitats in the study area for December 1985, November 1994, October 1995, and November 1996 including the Fiscal Year 1994, 1995, and 1996 maintenance events. Through the GIS analysis, these areas were calculated and changes documented for 1985, and 1996. Field surveys were conducted in April 1995 on artificial delta lobes named Andrew Island and Horseshoe Island created/constructed through the beneficial use of the dredged material during routine maintenance operations in 1994. In October 1996, transects were revisited at Andrew Island and Horseshoe Island. In addition, in October 1996 new transects were established on Ibis Island which was created during routine maintenance dredging operations in 1995. Habitats were ground truthed and survey transects were established to document vegetation species, stacking elevations, and compaction/subsidence. Figure 2 shows the area of minimum aerial photo-mosaic coverage and the limit of the digitized area.

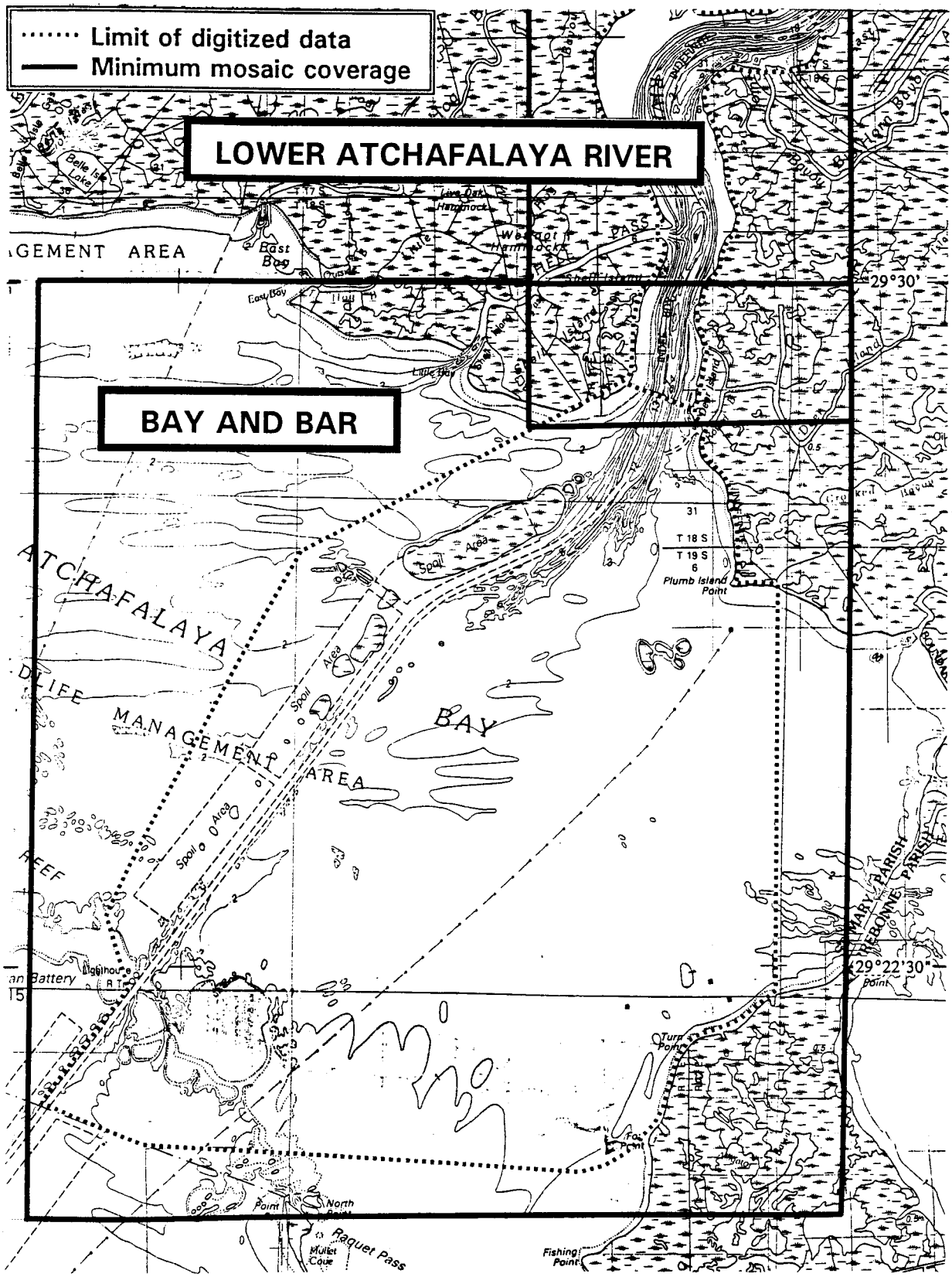


Figure 2. The Lower Atchafalaya River Bay and Bar BUMP study area showing the minimum coverage of the aerial photo-mosaic and limits of the area digitized.

DREDGED MATERIAL DISPOSAL HISTORY

The Rivers and Harbors Act of 25 June 1910 authorized the USACE-NOD to construct and maintain the Atchafalaya River, Morgan City to the Gulf of Mexico, Louisiana, project which provided a navigation channel 20 feet deep, 200 feet wide and 15.75 miles long from the 20 foot contour in the Atchafalaya Bay, approximately 4 miles beyond the mouth of the Atchafalaya River, to the 20 foot contour in the Gulf of Mexico. Traffic sufficient to warrant maintenance of the authorized navigation channel to full project dimensions did not immediately develop. The channel was progressively enlarged during maintenance events from 10 by 100-feet in 1939 to 20 by 200-feet in 1974.

The Rivers and Harbors Act of 1968 authorized construction and maintenance of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana, project which incorporated the existing project and provided an increase in channel width of the navigation channel in Atchafalaya Bay and Bar to 400 feet. Construction of the channel in the bay and Gulf was initiated in April, 1974 and was complete in December of the same year.

Dredged material disposal history prior to construction of the enlarged channel in 1974 is sketchy. Dredging records dating back to 1957 indicate that maintenance of *discontinuous* reaches of the bay and/or bar channels occurred on an annual basis from 1957 until 1974 except for 1958. It is likely that dredged material was placed unconfined in open water on either side of the navigation channel.

Dredged material removed during new work dredging associated with construction of the 400 foot navigation channel in 1974 was placed in open water and on subaerial levees of existing delta lobes on the west side of the navigation channel. During maintenance events beginning in 1979 and continuing on an annual basis through 1985, this practice continued. During this period, Big Island was created; dredged material was used to construct a campground at the Louisiana Department of Wildlife and Fisheries Camp; dredged material was used to construct islands for colonial nesting seabirds; and some wetlands were created on the western side of Big Island (Figure 3).

In 1987, at the request of the Louisiana Department of Wildlife and Fisheries (LDWF) and the U.S. Fish and Wildlife Service (FWS), the New Orleans District began placement of dredged material on the east side of the navigation channel in an effort to stimulate growth of the east side of the delta. Disposal plans developed in coordination with the LDWF, FWS, and other state and Federal natural resources agencies, were designed to direct sediment-laden water through existing natural channels, i.e., God's Pass, East Pass, Ratcliffe Pass, to the east side of the delta. In general, dredged material was to be placed as a series of mounds on the eroding subaerial levees of existing delta lobes and on the heads of islands at existing channel bifurcations. The maximum initial height of the dredged material mounds was +5.0 feet Mean Low Gulf (+4.2 Mean Sea Level). The mounds of dredged material would re-furbish the subaerial levees which would direct flows into the desired locations within the developing delta. During high flow events, the re-furbished levees would be over-topped and sediment-laden waters would drop sediment behind them at elevations suitable for the establishment of fresh marsh (+2.3 feet Mean Low Gulf) and/or submerged aquatic vegetation. The re-furbished levees also would protect the developing wetlands from wave-induced erosion.

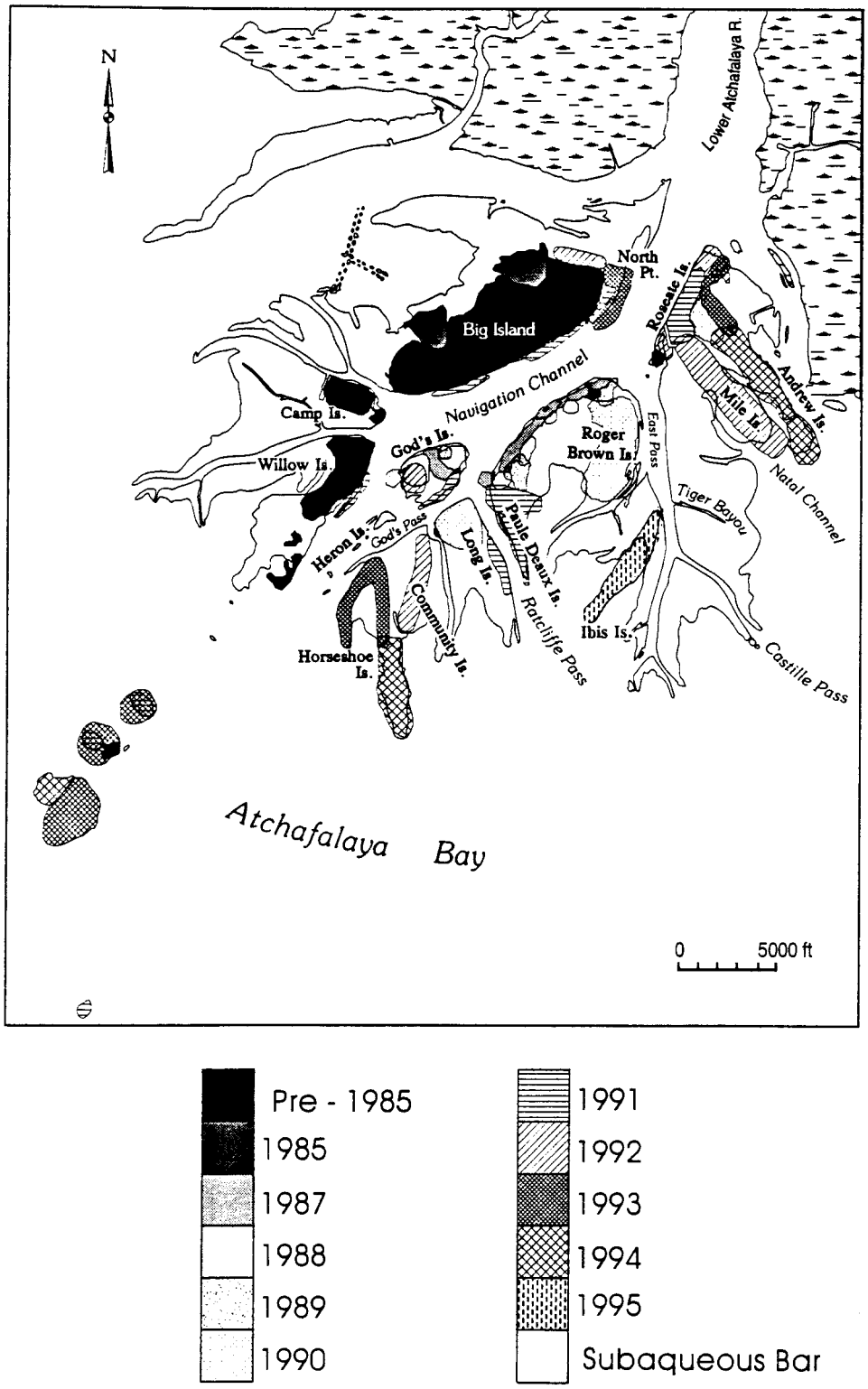


Figure 3. Dredged material disposal history for the Lower Atchafalaya River Bay and Bar navigation channel through 1996. 1985 to 1990 data from Van Heerden, 1994; 1991 to 1996 data from USACE -NOD *as-builts*.

In accordance with the plan during maintenance events in 1987, 1988, 1989, and 1990, in the upper bay/delta, dredged material was placed on the eroded subaerial levees of Roger Brown Island, Paule Deaux Island, and Roseate Island and on the heads of God's Island and Long Island. In the lower bay/delta, dredged material was used to maintain and construct islands for colonial nesting seabirds on the west side of the navigation channel. The initial height of the dredged material for bird island creation was +6.0 feet Mean Low Gulf (+5.2 Mean Sea Level).

By 1991 it became obvious that the re-furbished levees were not being over-topped during high flow events. At the request of the LDWF, the maximum initial height of the dredged material was changed to +3.78 feet Mean Low Gulf (+3.0 Feet Mean Sea Level). Dredged material from the 1991 maintenance event was placed along the banks of the navigation channel on the east side of Big Island, on both sides of God's Island and Heron Island and on the banks of East Pass and Ratcliffe Pass. Dredged material also was placed behind previously re-furbished levees on Paule Deaux and Roger Brown Islands, Long Island, and Roseate Island at an initial elevation of +2.78 feet Mean Low Gulf (+2.0 feet Mean Sea Level). Islands for colonial nesting seabirds were constructed and/or maintained with dredged material from the lower bay/delta.

Beginning with the 1992 maintenance event and in coordination with LDWF, FWS and other natural resources agencies, the dredged material disposal plan was modified to incorporate use of dredged material from the upper bay/delta to construct artificial delta lobes. The disposal plan developed was designed to direct flows between the lobes and to provide protected, shallow, open water areas within the lobes for the development of fresh marsh and submerged aquatic vegetation. During the 1992 maintenance event, the maximum initial height of the dredged material in that portion of the artificial delta lobes paralleling the channel was +4.0 feet Mean Sea Level/National Geodetic Vertical Datum (+4.78 feet Mean Low Gulf); the maximum initial height of the dredged material in that portion of the delta lobes perpendicular to the channel was +3.0 feet Mean Sea Level/National Geodetic Vertical Datum (+3.78 feet Mean Low Gulf). Both Mile Island and Community Island were constructed during the 1992 maintenance event. Islands for colonial nesting seabirds were constructed with dredged material from the lower bay/delta.

During the 1993 maintenance event, the maximum initial height of the dredged material for creation of the artificial delta lobes was +4.0 feet Mean Sea Level/National Geodetic Vertical Datum (+4.78 feet Mean Low Gulf) for all portions of the lobes. Construction of Andrew Island and Horseshoe Island commenced during the 1993 maintenance event and continued during the 1994 maintenance event. Dredged material also was placed at North Point and on God's Island during the 1993 maintenance event. Islands for colonial nesting seabirds were constructed with dredged material from the lower bay/delta during both 1993 and 1994, and were enlarged in 1995 and 1996. In 1995, a new delta lobe was created on the east side of the delta off of East Pass. Named Ibis Island, the bare, sandy formation was quickly claimed by nesting birds.

In the bar channel between 1974 and 1991, all of the dredged material removed during routine maintenance was placed in an interim designated ocean dredged material disposal site (ODMDS) located on the east side of the navigation channel. Beginning with the 1991 maintenance event, dredged material suitable for stacking from the upper reach of the bar channel has been placed into an open water disposal area on the east side of the channel in a manner conducive to bird island construction and the material not suitable for stacking has been placed into the ODMDS.

FIELD SURVEY RESULTS

Methodology

Elevation Profile Surveys

Andrew Island, Horseshoe Island, and Ibis Island were selected for the long-term field monitoring sites in the Atchafalaya River bay and bar (Figure 4). Both Andrew Island and the eastern lobe of Horseshoe Island were constructed during the 1994 maintenance event. Ibis Island was constructed during the 1995 maintenance event.

The collection of survey profiles were made in two phases. Phase-I involved assessing the characteristics of each site to determine the most applicable position to setup a long-term monitoring program that would best document habitat evolution. This was accomplished using vertical aerial photography, reviewing dredging schedules and history, ground truthing each site, and defining varying vegetation and site morphology. Based on these factors, three series of stakes (two groups of four stakes, and a single southern most stake) were positioned along the longitudinal axis (crest) of Andrew Island, eastern Horseshoe Island, and Ibis Island. Permanent 1-inch diameter by 6-foot galvanized stakes were driven approximately 3.5-feet into the ground and secured with concrete. The stakes in each group at Horseshoe and Andrew islands were positioned 200-feet apart, and at Ibis Island 1000 feet apart, and were defined spatially using a Global Positioning System (GPS).

Phase-II involved the actual collection of profile datum. Survey datum were collected using a Topcon GTS-300_{DPG} Total-Station, tri-prism, and TDS48 Data Collection System. The horizontal accuracy of the GTS-300 is 0.25 ft $\pm$ 0.0125 ft., and has a vertical accuracy of 0.45 ft $\pm$ 0.0125 ft. The maximum horizontal range with tri-prism is 3,525 ft. A Pathfinder Professional MC-5 global positioning system (GPS) device was used to record the horizontal positions of each stake, instrument location, and the position and exact orientation of each transect line. The transect datum collected were processed, referenced to local benchmarks (Figure 4) or tide gage at Point au Fer, and entered into a graphic software program to produce topographic profiles.

In April of 1995, nine lateral (perpendicular to island crest) profile transects were collected from both Andrew and Horseshoe islands. In October 1996, the transects at Andrew Island and Horseshoe Island were re-surveyed to determine change since 1995, and a new transect network was established at Ibis Island. Ibis Island was constructed during the 1995 maintenance dredging event and provided a new opportunity to document geomorphic and vegetative processes controlling landscape development.

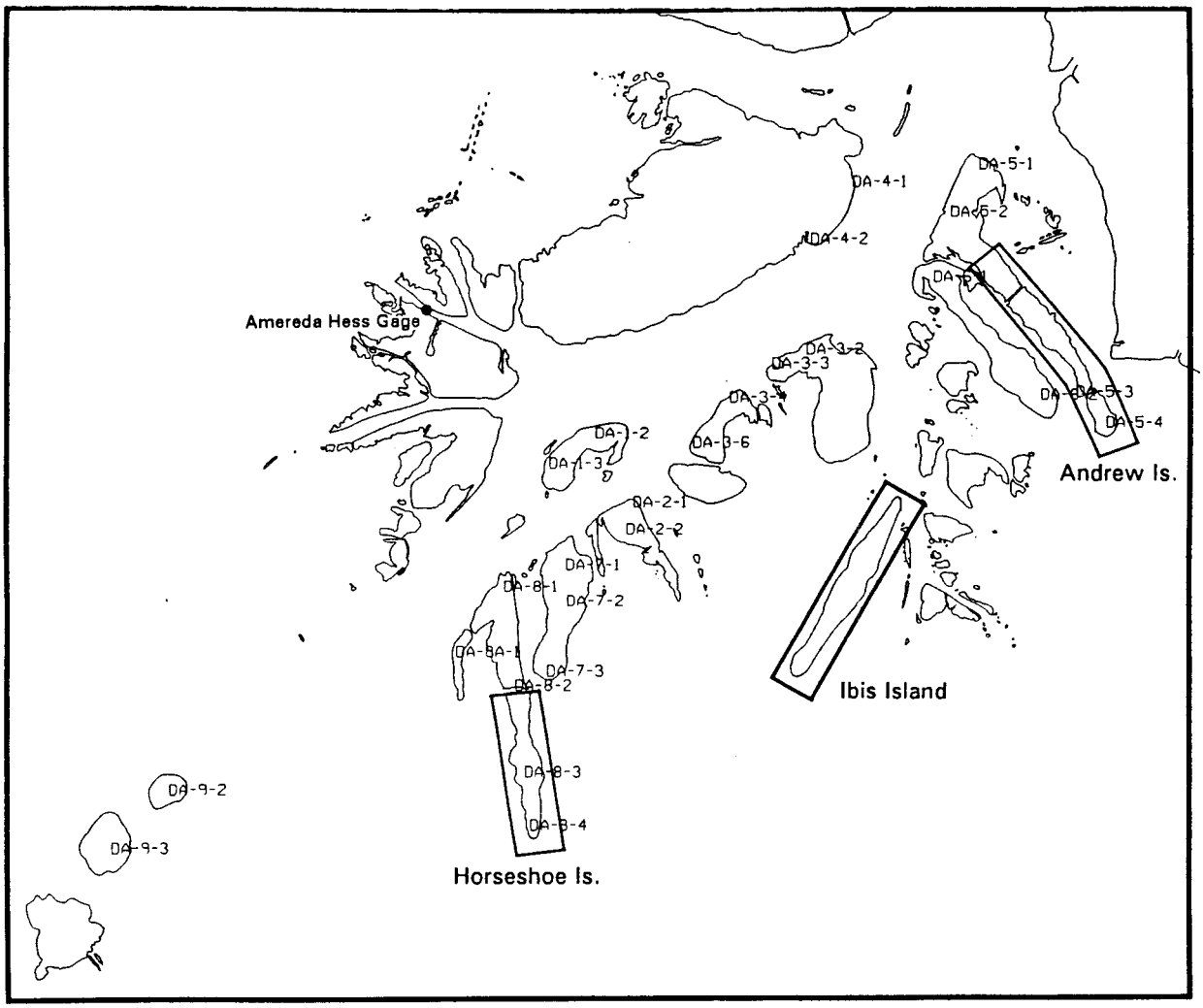


Figure 4. Location of Andrew Island, Horseshoe Island, and Ibis Island BUMP study sites, and the benchmarks available to reference the elevation data at the Atchafalaya River Bay and Bar delta.

Vegetation Surveys

Ground truthing for vegetative species composition and habitat verification of Andrew Island and eastern Horseshoe Island was done in April of 1995 and October 1996. Ground truthing for vegetative species composition and habitat verification of Ibis Island was done in July 1996. Species composition was determined within an approximate six- foot swath along each profile, and boundaries between vegetative communities were entered as points on the elevation profile. No submerged aquatic species were considered for this report. Plants were identified in the field with only representative specimens taken for confirmation by taxonomic keys and/or verification by the LSU Department of Plant Biology. The better specimens, and uncommon specimens were entered into the LSU herbarium collection; all others were archived by the author. The percent composition of each species was visually estimated in order to determine the relative abundance and dominance of species for habitat determinations. These percentages were not intended to provide scientific ratios or statistics. The *list of vegetative species* was compiled of all species observed and/or collected along the study and includes habitat preferences of each (Appendix 9A). This list is not complete; it reflects only those species that were readily observed and identified during the profiling period. Some plants can only be identified during a short flowering period which may not have occurred at the time of the profile, and therefore can not be included in the list other than by a broad classification.

Detailed plant identification was performed on the initial set of profiles for a new area to establish plant community/habitat types for ground truthing. Thereafter, plant identification is more for updating the vegetation list. Therefore, detailed vegetation data was collected for Andrew and Horseshoe islands in 1995 and was reported in the 1995 Final Report. Ibis Island was new for 1996 and detailed vegetation data was collected in 1996 and is included in this report.

Profiles

The field monitoring area included three very long spits created by dredged material deposition; Andrew Island at the north end of the Atchafalaya delta, Ibis Island at the central area, and the eastern lobe of Horseshoe Island at the south end. Initially, a matrix of 10 elevation profiles was established at each spit, and vegetation was recorded for each profile. The profile matrix at each island consists of three sections each, labeled 3-0 to 3-3 for the channel section, 2-0 to 2-3 for the middle section, and 1-0 to 1-1 for the distal end. Sample profiles were selected to show the general distribution of the vegetation or habitats in relation to the elevation profiles. The profile elevations were taken during a period of high water for the Atchafalaya delta.

Andrew Island

Andrew Island is located along the northeastern side of the Atchafalaya River delta (Figure 4). Figure 5 is a schematic diagram of the arrangement of profile transects. Five of the ten topographic profiles for Andrew Island were selected to be representative of the area based on the data collected in 1995 and were repeated in 1996. A comparison of the data collected in 1995 and 1996 shown in Figure 6 reveals an interesting pattern of compaction, aeolian transport, sediment accretion and overwash processes for Andrew Island in cross section.

Profiles here range in lateral length from 790 to 1450 feet. The first series of stakes (I) located at the southern tip of Andrew Island has a maximum relief of 4.47 feet, with an average relief of 2.33 feet. The 2nd series of stakes (E-H) along the crest has a maximum average relief of 4.23 feet, with an average relief of 2.20 feet. The 3rd series of stakes (D-D') has a maximum average relief of 4.27 feet, with an average relief of 3.08 feet.

The profiles were typically more vegetated at the lateral ends (intertidal zone) of each profile, and generally decrease in density with an increase in elevation. Vegetation increased in density since the date of the last profile, some bare areas have been colonized, and habitats have become more established or shifted as the elevation has varied over time. Sample profiles selected to show the general distribution of the habitats in relation to elevation in 1995 and 1996 are shown for comparison in figures 7 and 8. The island crest was generally composed of bar aeolian type sand features (ripples and dunes).

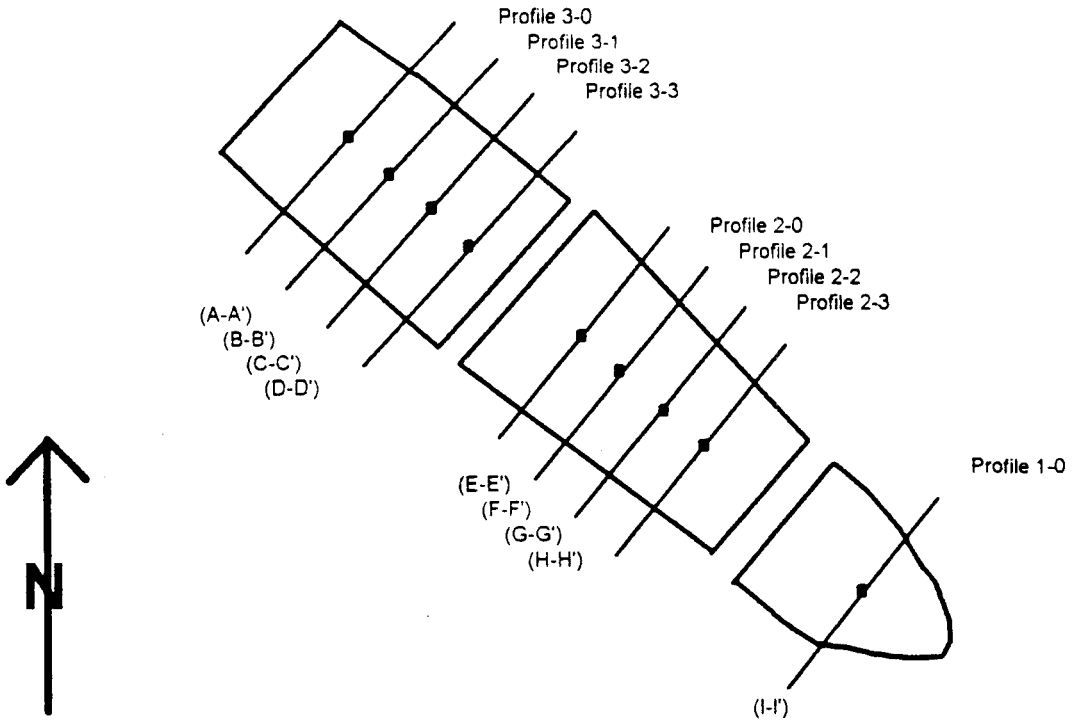


Figure 5. A schematic diagram of the BUMP profile locations and configurations for Andrew Island in the Atchafalaya River delta.

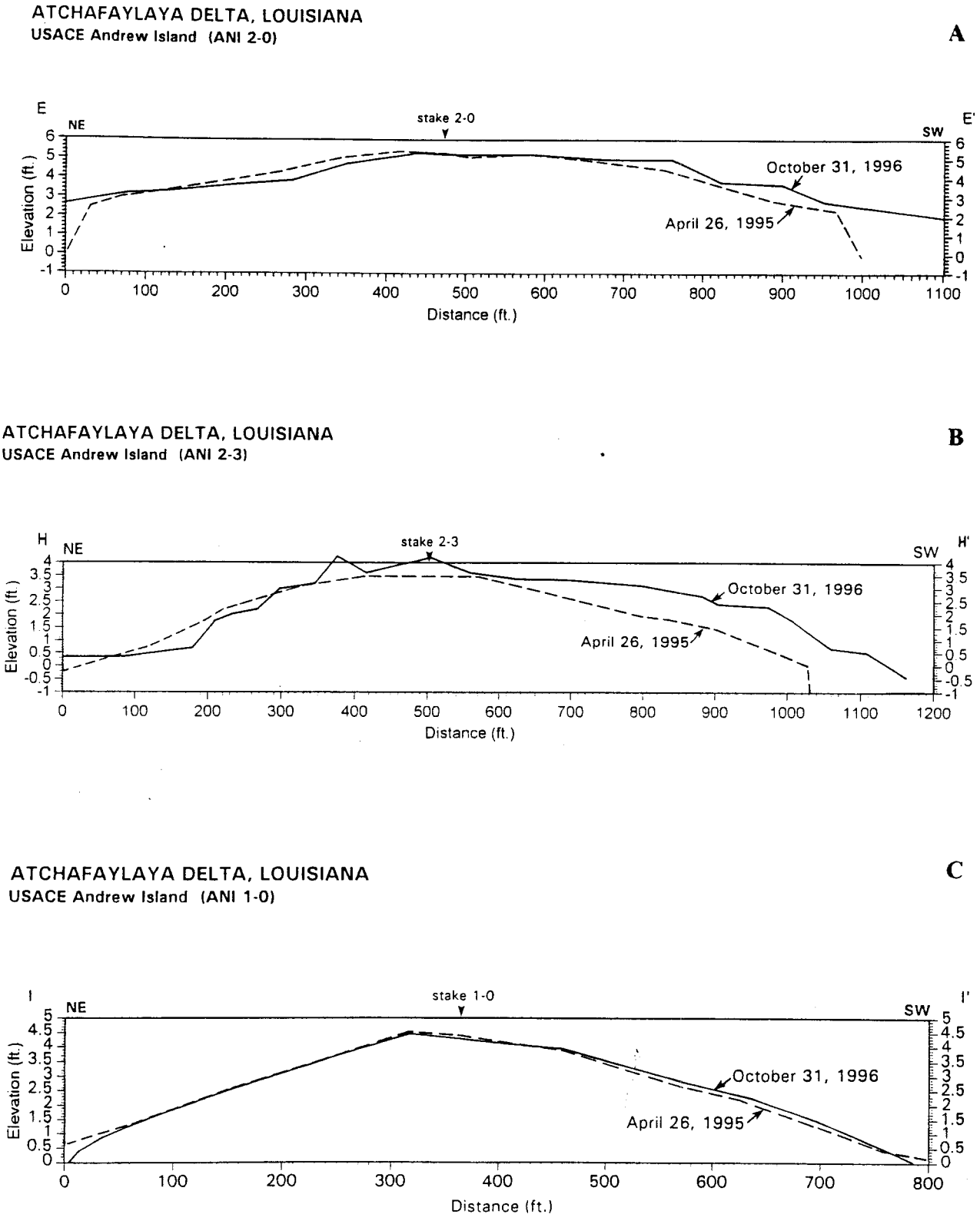
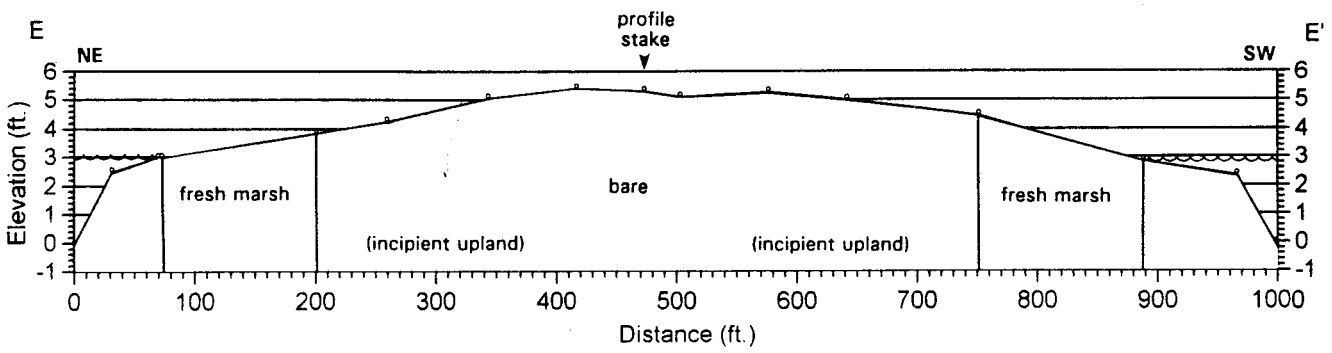


Figure 6. A comparison of 1995 and 1996 elevation data at Andrew Island in the Atchafalaya River delta. A) Profile E-E' at stake 2-0.B) Profile H-H' at stake 2-3. C) Profile I-I' at stake 1-0.

A



B

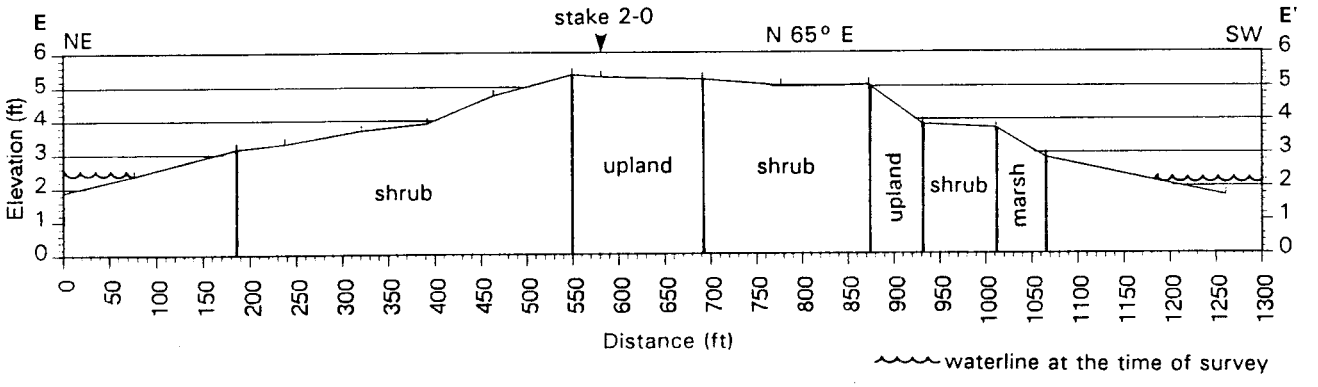
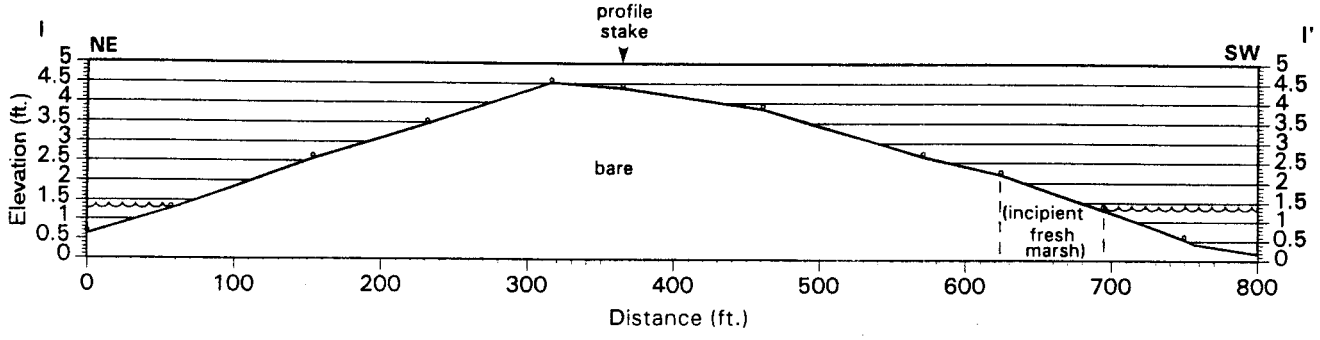


Figure 7. Elevation profile ANI 2-0 from Andrew Island in the Atchafalaya River delta showing habitat distribution change. A) 1995 data. B) 1996 data.

A

ATCHAFAYLAYA DELTA, LOUISIANA
USACE Andrew Island (ANI 1-0)
April 26, 1995



B

ATCHAFAYLAYA DELTA, LOUISIANA
USACE Site, Andrew Island (ANI-1-0)
October 31, 1996

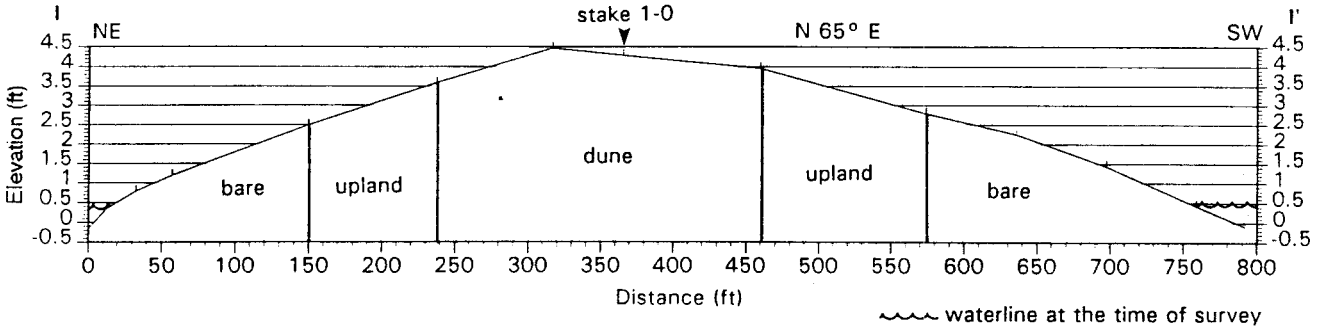


Figure 8. Profile ANI 1-0 from Andrew Island in the Atchafalaya River delta showing habitat distribution changes. A) 1995 data. B)1996 data.

Horseshoe Island

Horseshoe Island is located along the southeastern side of the Atchafalaya River delta and is composed of two lobes (Figure 4). Figure 9 is a schematic diagram of the arrangement of profile transects. These nine topographic profiles were constructed from the data collected in reference to the U. S. Army Corps of Engineers benchmarks #DA-8-3 and #DA-8-4. A comparison of the data collected in 1995 and 1996 shown in Figure 10 reveals a pattern of compaction, aeolian transport, sediment accretion and overwash processes for Horseshoe Island in cross section.

Profiles here range in lateral length from 1045 to 1445 feet. The first series of stakes (I-J) located at the southern tip of eastern Horseshoe Island has a maximum average relief of 3.09 feet, with an average relief of 2.17-feet. The 2nd series of stakes (E-H) along the crest has a maximum average relief of 3.41 feet, with an average relief of 1.78 feet. The 3rd series of stakes (A-D) has a maximum average relief of 3.76 feet, with an average relief of 2.60 feet.

The profiles were typically vegetated at the lateral ends (intertidal zone) of each profile, and generally decrease in density with an increase in elevation. Sample profiles selected to show the general distribution of the habitats in relation to elevation in 1995 and 1996 are shown for comparison in figures 11 and 12. The island crest was generally composed of bar aeolian type sand features (ripples and dunes).

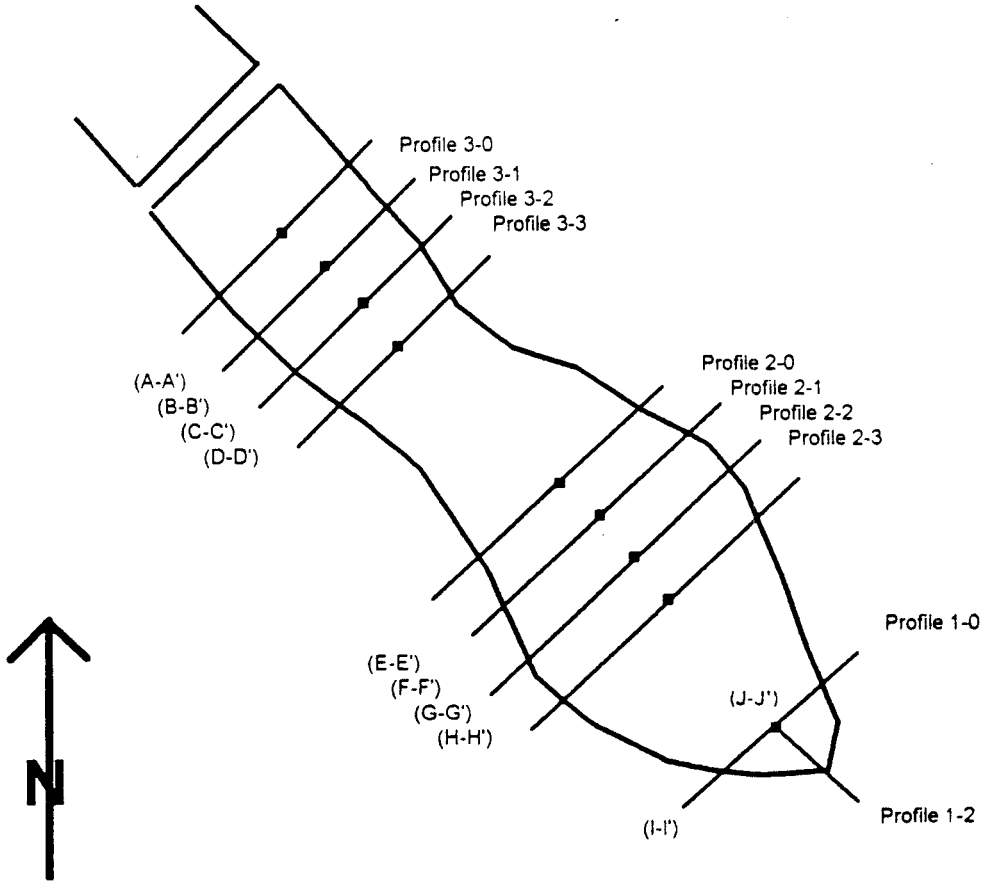


Figure 9. Schematic diagram of the BUMP profile locations and configurations for the eastern lobe of Horseshoe Island in the Atchafalaya River delta.

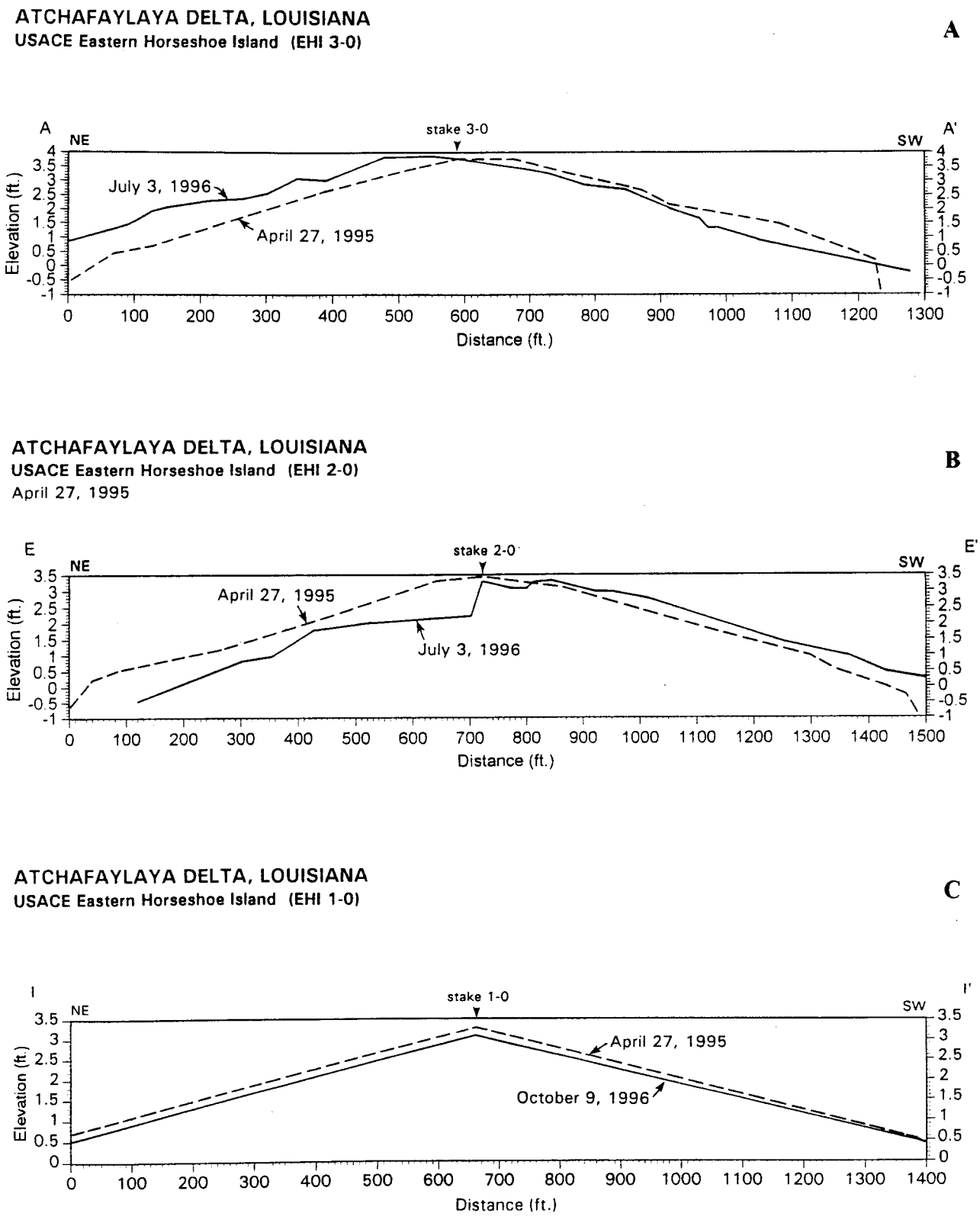
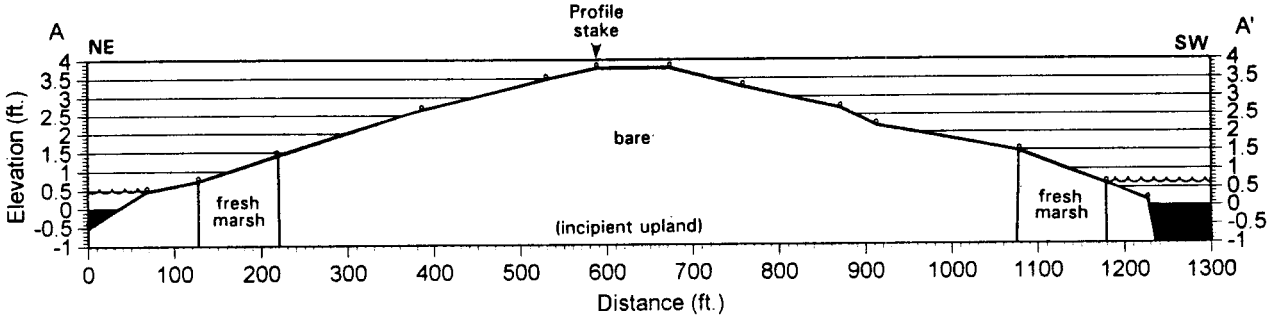


Figure 10. A comparison of 1995 and 1996 elevation data at Horseshoe Island in the Atchafalaya River delta. A) Profile A-A' at stake 3-0. B) Profile E-E' at stake 2-0. C) Profile I-I' at stake 1-0.

A

ATCHAFAYLAYA DELTA, LOUISIANA
USACE Eastern Horseshoe Island (EHI 3-0)
April 27, 1995



B

ATCHAFALAYA DELTA, LOUISIANA
USACE Site, Eastern Horseshoe Island (EHI-3-0)
July 3, 1996

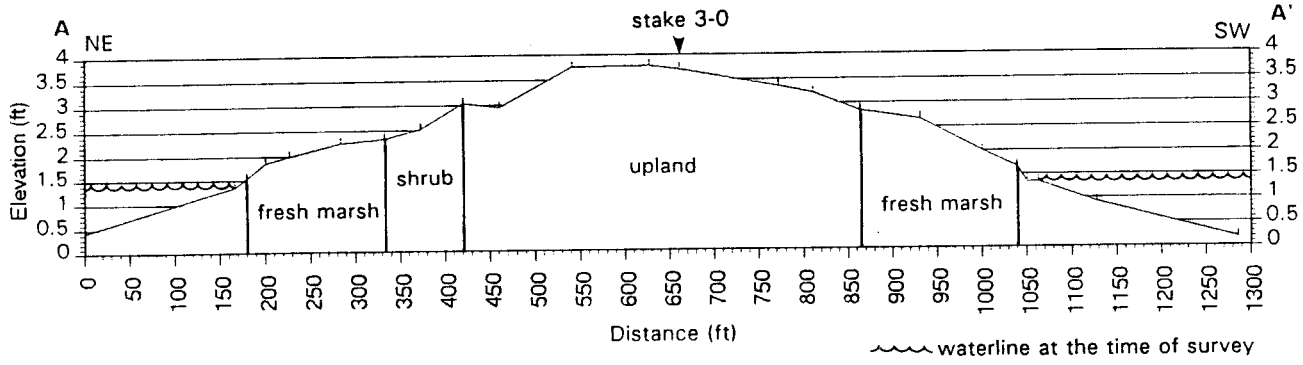
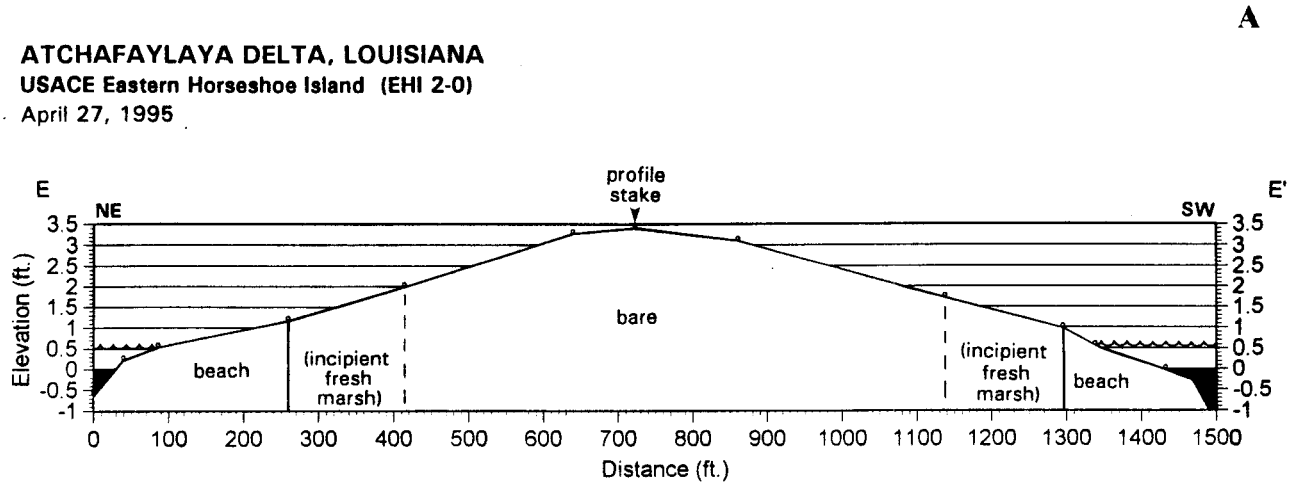


Figure 11. Elevation profile EHI 3-0 from Horseshoe Island in the Atchafalaya River delta showing habitat distribution changes. A) 1995 data. B) 1996 data.

A



B

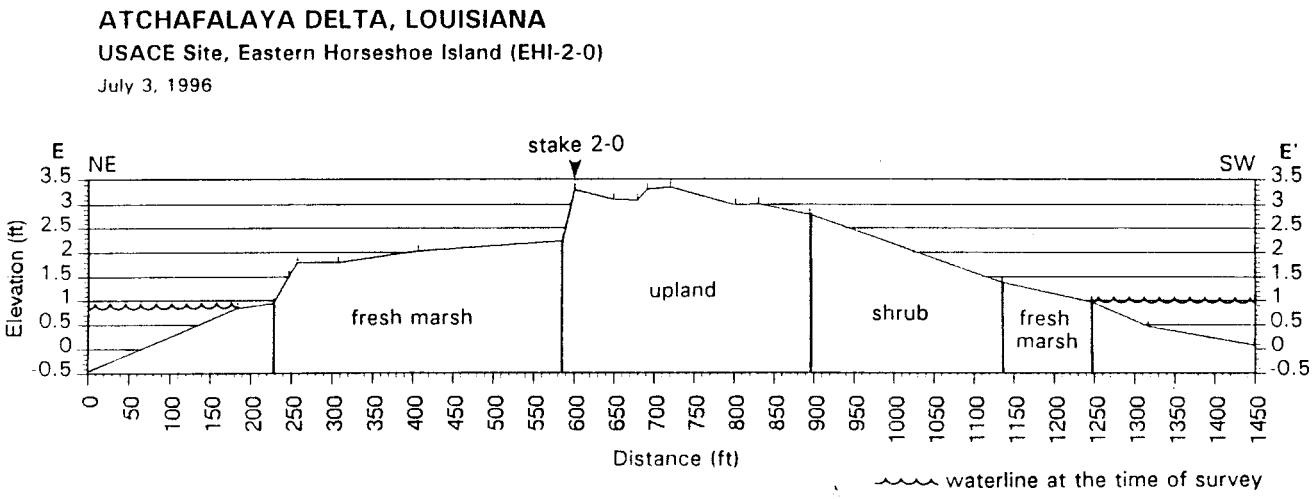


Figure 12. Elevation profile EHI 2-0 from Horseshoe Island in the Atchafalaya River delta showing habitat distribution changes. A) 1995 data. B) 1996 data.

Ibis Island

Ibis Island is located along the east-central side of the Atchafalaya River Bay and Bar delta (Figure 4). This artificial delta lobe was constructed during the USACE-NOD FY1995 maintenance event.

Nine topographic profiles were constructed from the data collected in reference to the tide gage for Point Au Fer, Louisiana. Figure 13 is a schematic diagram of the arrangement of profile transects. Profiles here range in lateral length from 921 to 1237 feet. The first series of stakes (A-B) located at the southern tip of eastern Ibis Island has a maximum average relief of 3.89 feet, with an average relief of 2.14 feet. The 2nd series of stakes (C-E) along the central portion of the island has a maximum average relief of 4.09 feet, with an average relief of 2.42 feet. The 3rd series of stakes (E-H) on the portion of the island near East Pass has a maximum average relief of 2.89 feet, with an average relief of 2.08 feet.

The island was created approximately one year before the survey profile elevation and vegetation data was collected and vegetation ccolonization was well under way. The profiles were typically vegetated at the lateral ends (intertidal zone) of each profile, and generally decrease in density with an increase in elevation. Sample profiles selected to show the general distribution of the vegetation in relation to the elevation profiles are shown in figures 14, 15, and 16. The majority of the island was generally composed of extensive bar aeolian type sand features (ripples and dunes).

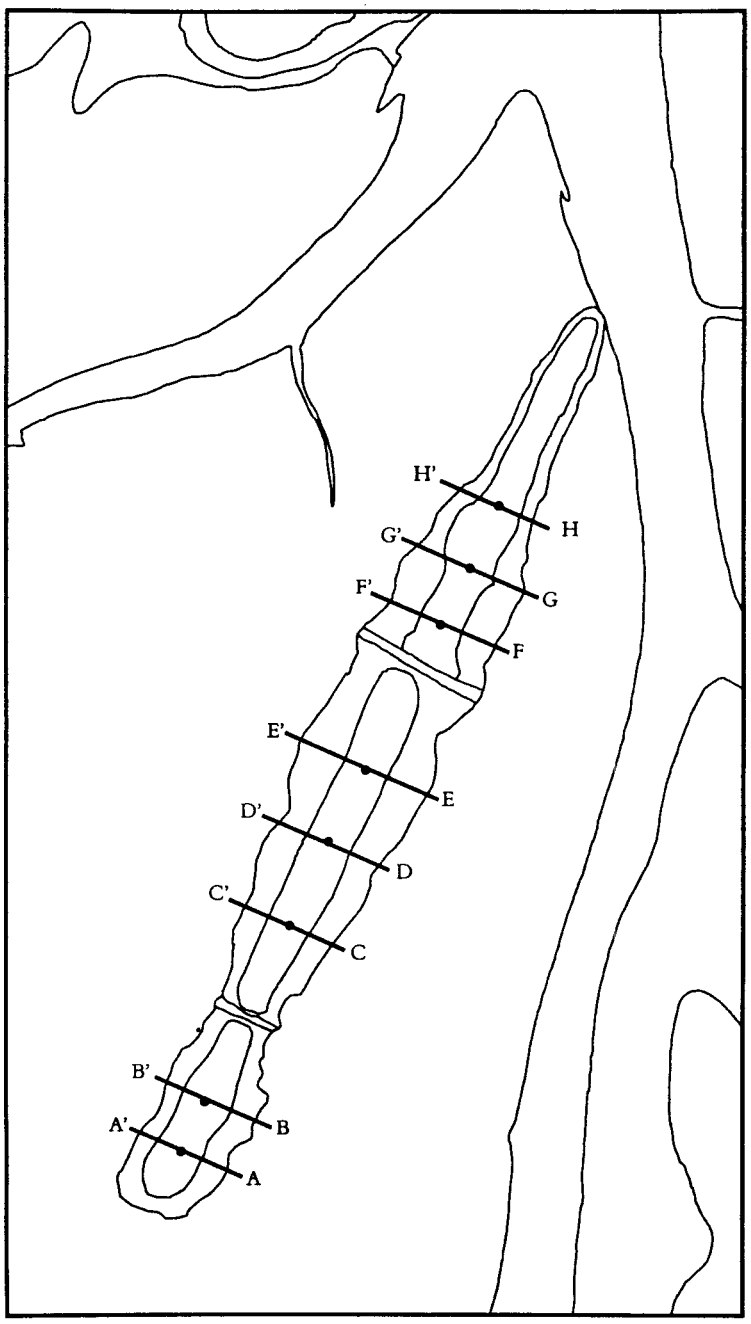


Figure 13. Schematic diagram of the BUMP profile locations and configurations for Ibis Island in the Atchafalaya River Bay and Bar delta.

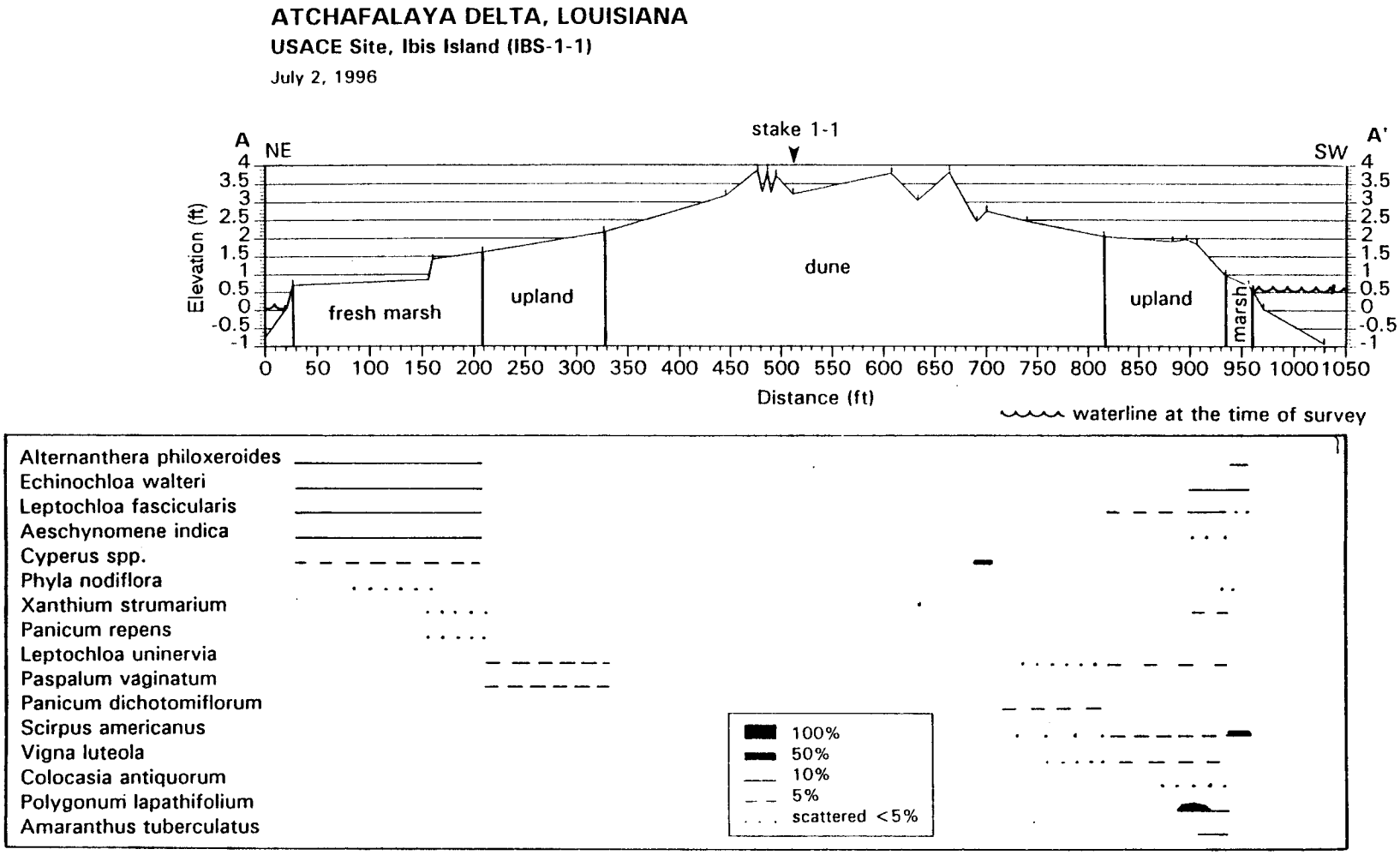


Figure 14. Profile IBS 1-1 from Ibis Island in the Atchafalaya River delta.

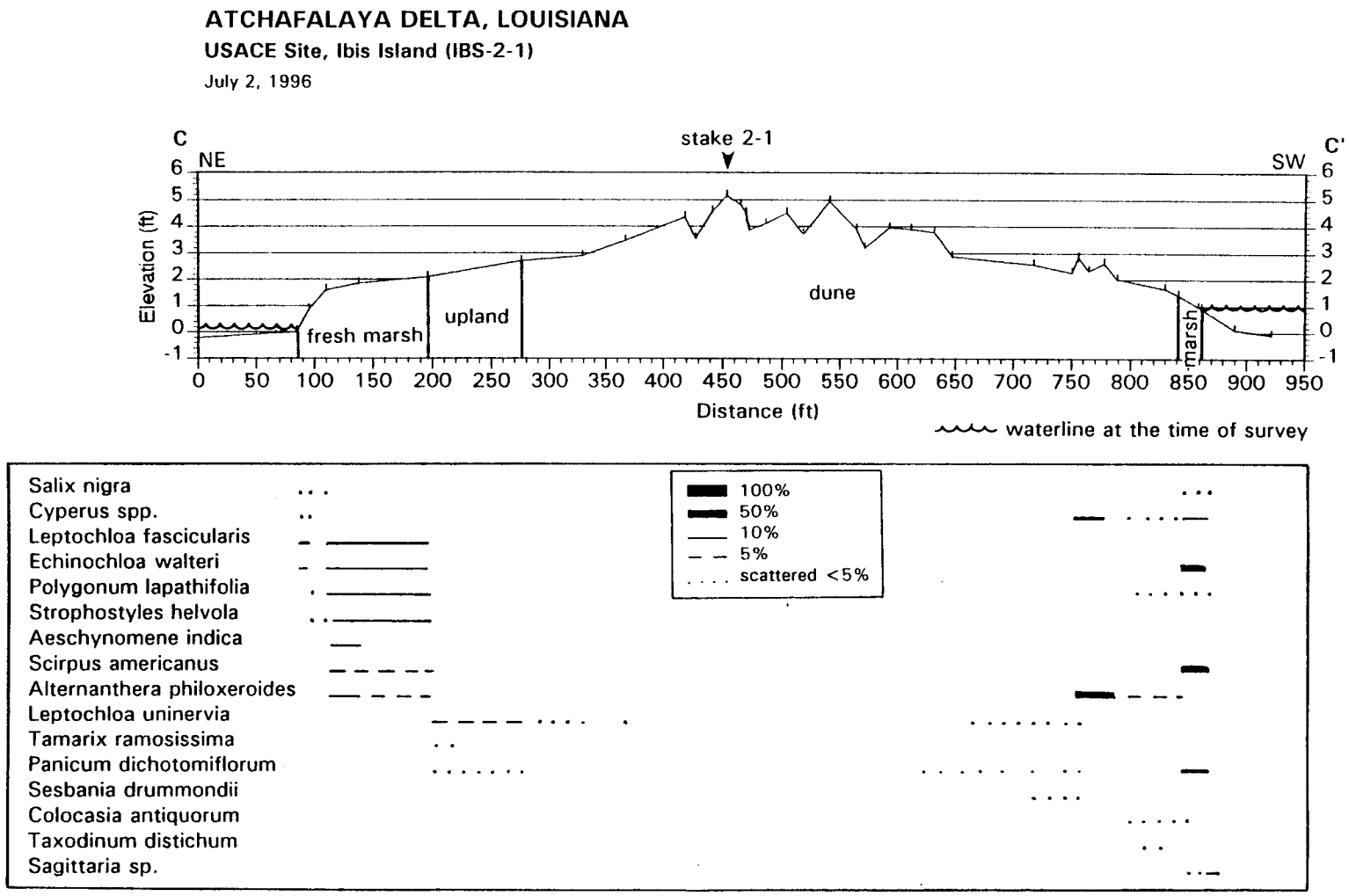


Figure 15. Profile IBS 2-1from Ibis Island in the Atchafalaya River delta.

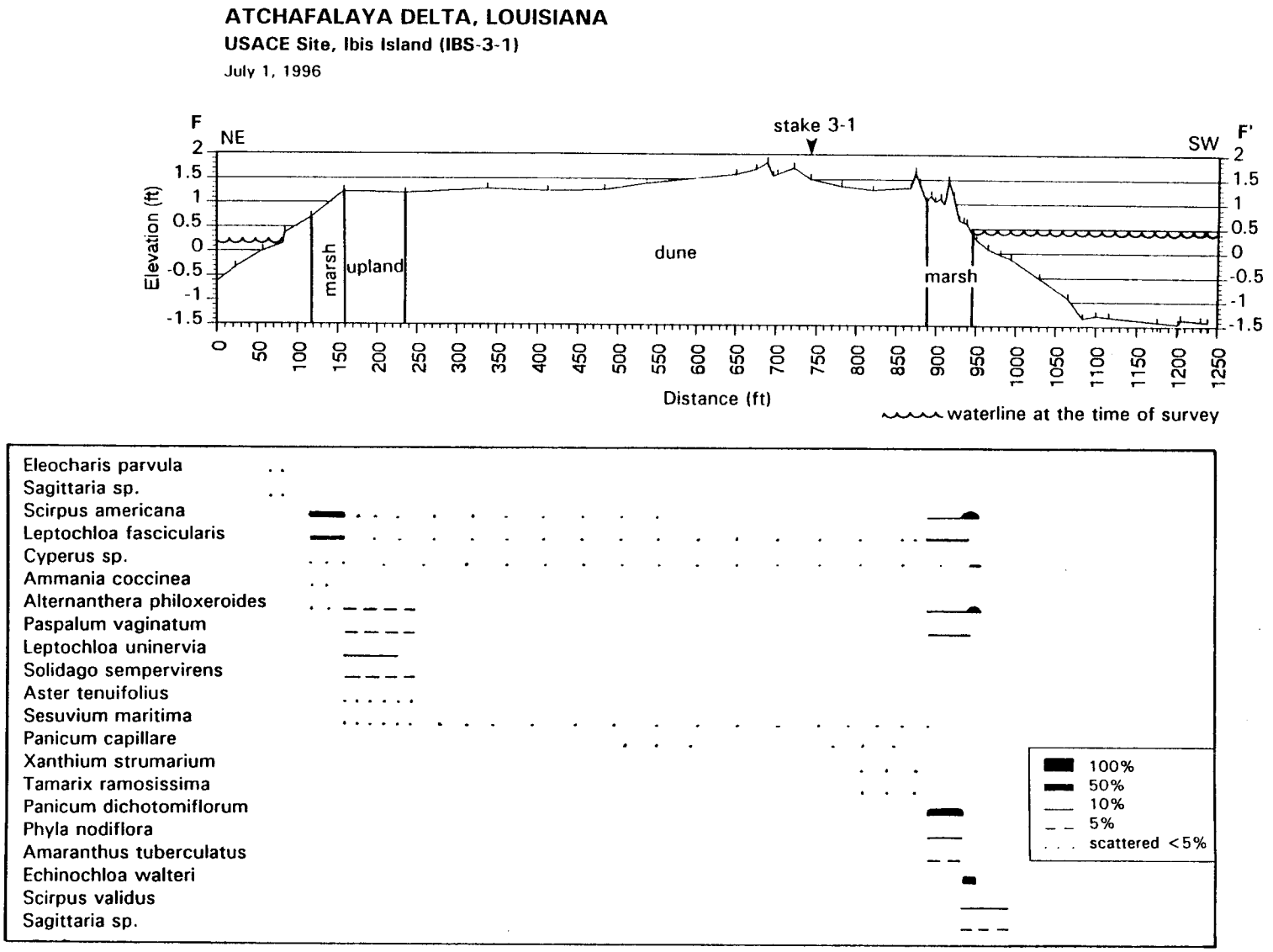


Figure 16. Profile IBS 3-1 from Ibis Island in the Atchafalaya River delta.

Vegetative Character

General Description

The delta within the Atchafalaya River Bay and Bar supports a freshwater dependant vegetation system. This is predominately fresh marsh, batture communities dominated by black willow, and upland/grassland habitats. The delta area is exposed to the daily tides as well as to elevated water levels during high river conditions. Source material for colonization is predominantly from the extensive Atchafalaya River swamp system that lies upstream from the dredged material disposal sites. Longshore drift or aeolian transport of some vegetative material could be expected from other nearby areas.

Each plant species has a habitat preference, and when taken as a community, the type of vegetation present is an indication of habitat type. Major changes in plant communities delineate boundaries between habitats. The study sites exhibited well-zoned colonization of vegetation with distinct wet areas and distinct dry/aeolian areas. A large, bare, central area flanked by grassland, shrubs, and then outlined with a marsh fringe was the common arrangement of habitats.

Vegetative Community Types in the Atchafalaya Delta

Most of the plants observed within the study sites at Andrew Island and Horseshoe Island are of riparian or wetland habits (See habitat descriptions in Appendix 9A). Other species are listed as occupying "disturbed" or "waste" places and are species that take advantage of newly created or exposed ground with rapid growth and can withstand some inundation by fresh water. Opportunistic species will occupy a new area quickly, but will eventually be replaced by plants most suited for long term survival in a specific habitat.

Marsh species within the study sites at Andrew Island and Horseshoe Island occurred most commonly at an elevation below 2 feet MSL. The fresh marsh was represented by predominantly high marsh or marsh-margin species *Scirpus* spp., *Cyperus* sp., *Ranunculus sceleratus*, *Polygonum lapathifolium*, *Rorippa palustris*, and *Senecio glabellus*. Fresh marsh dependent species such as *Sagittaria* sp. that compose low fresh marsh was insignificant or not present along the profiles in the study area. Young willow trees (*Salix nigra*) were present throughout, scattered in many areas of the marsh, along low energy beaches, or within the grasslands. Water hyacinth (*Eichhornia crassipes)* was found along the shore, rafted against the windward side and stranded thickly by a previous high water event.

Upland areas along the profiles within the study sites were represented by grasslands, embryonic dune terraces, and potential shrub/scrub. Grasses establish quickly on well-drained, freshly deposited materials and form grasslands that help to quickly stabilize the new material. *Leptochloa uninervia*, *Panicum repens*, and *Cynodon dactylon* tend to be the most common grass species, with *Cyperus elegans*, *Acnida tamariscina*, *Conyza bonariensis* as common herbaceous plants. Older deposits support additional species and the beginnings of shrub habitats with an understory of grasses.

Shrub communities usually indicate older, more stable, elevated areas. In the Atchafalaya area, this is almost exclusively *Salix nigra* or black willow. Since willows also forms a forested wetland habitat, shrub/scrub is not a good indicator of elevation in the delta, but does indicate stable areas. Young willows were profusely represented along most of the survey transects at Andrew and Horseshoe islands. *Baccharis halimifolia* was the only other significant shrub species found along the study profiles.

Willows (*Salix nigra*) at greater than 20 ft tall also constitutes the forested wetland habitat found on other areas of the delta. Willow establishes and grows rapidly in frequently inundated sandy areas, most often along riverbanks and battures. This habitat sometimes includes an understory of *Iris virginicus*, *Hymenocallis occidentalis*, *Colocasia antiquorum*, and *Senecio glabellus*.

Low wet areas within the upland areas of the study sites at Andrew and Horseshoe islands are being colonized by *Bacopa monnieri*, *Polygonum lapathifolium*, and tiny *Eleocharis parvula*.

GIS ANALYSIS RESULTS

Shoreline Changes: 1985-1996

Figure 17 graphs the spatial history of the Atchafalaya delta between 1970 and 1996. The area of the Atchafalaya delta in 1985 was measured at 1339.0 acres. The area of the Atchafalaya delta in 1996 was measured at 4445.2 acres. This is an area increase of +3106.2 acres or an increase in area of 232 percent. Figure 18 shows the shoreline change history of the Atchafalaya delta between 1985 and 1996. Between 1972 and 1985, the rate of area gain was about 100 acres per year. Since the shift of dredged material placement to the east side of the navigation channel with concomitant changes in placement techniques, the rate of growth has accelerated to about 350 acres per year.

The areas of greatest shoreline progradation are found east of the navigation channel. The shoreline has been pushed seaward up to 2 miles in some areas and averages about 1 mile. These measurements yield rates of shoreline progradation of 500 feet per year. These high rates of shoreline progradation are found mainly in areas of dredged material placement. West of the navigation channel in natural deltaic areas, the rate of progradation is much less and averages 0.5 miles. This yields a progradation rate of about 300 feet per year in areas of natural deltaic processes.

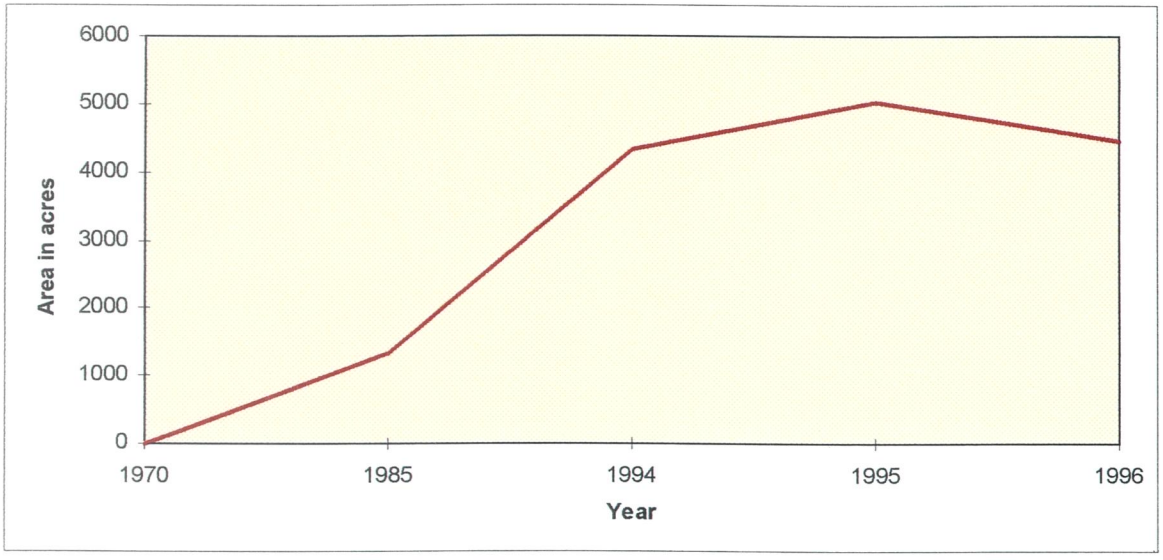


Figure 17. Graph of the area of the Atchafalaya delta over time.

ATCHAFALAYA DELTA 1985 - 1996

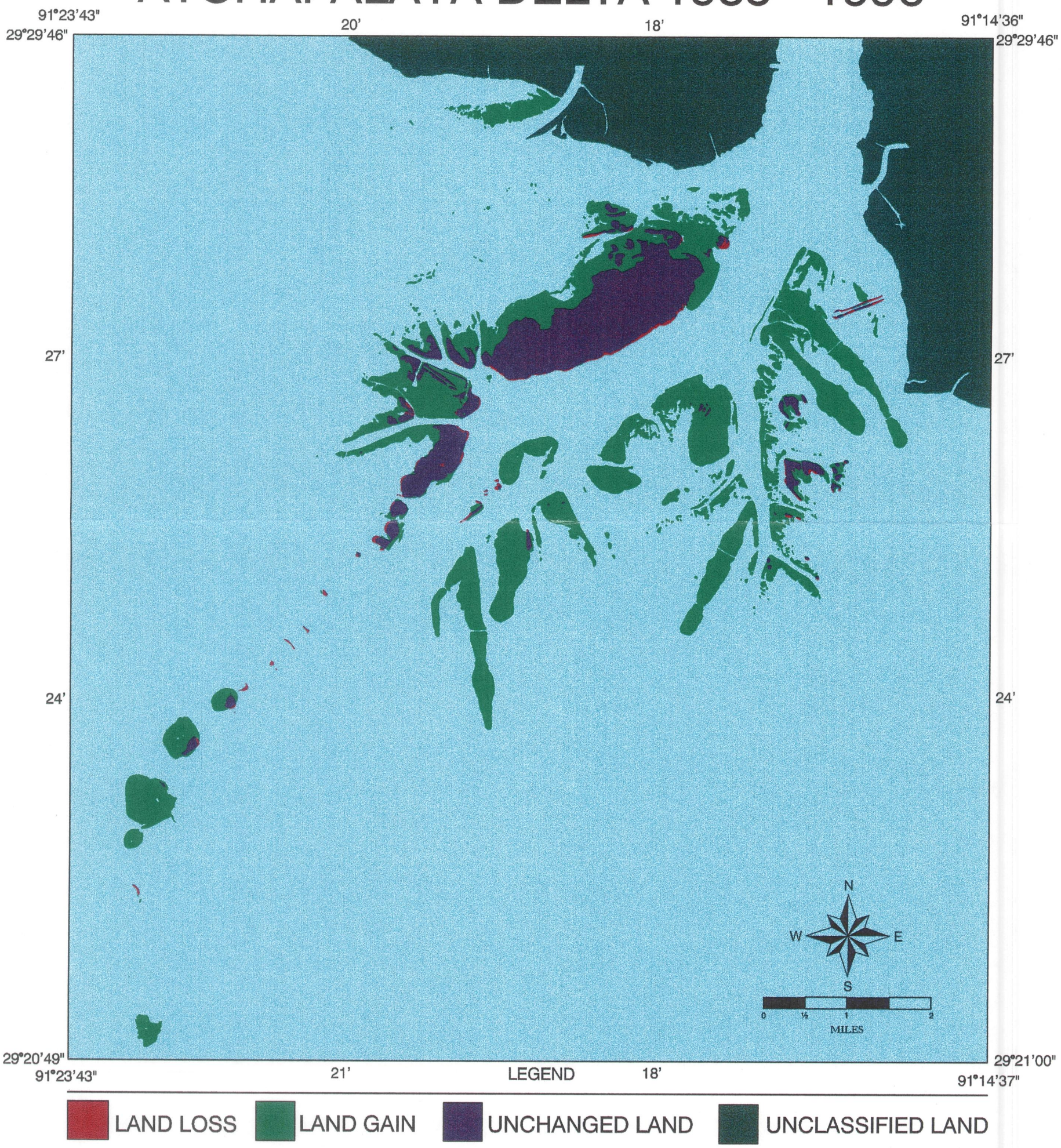


Figure 18. Land loss/gain map of the Atchafalaya River delta between December 1985 and November 1996.

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified seven major habitat types in the Atchafalaya delta. These habitats are further classified as natural, BUMP man-made and non-BUMP man-made. The natural class identifies habitats created by natural deltaic processes. The BUMP man-made class (BUMP-made) identifies the habitats created by placement of dredged material. The Non-BUMP man-made class (other-made) separates areas created that were not part of the BUMP effort, such as areas created in association with the oil industry access and pipeline canals. Areas created indirectly by the beneficial use of dredged materials being re-worked by natural processes are included as natural. On the habitat maps presented in this report, an intertidal class is included to indicate nearshore topography. Because the seaward extent of these areas is not clearly defined, the area of this class is not calculated or included in the inventory.

Table 1 lists the areas of the four habitat types found in the Atchafalaya River delta in December 1985. The location and arrangement of these habitats are presented in figure 19. The total area of the Atchafalaya delta was 1339.0 acres. Of this total, 231.9 acres were natural, 1064.5 acres were BUMP-related, and 4.26 acres were other man-made. In terms of habitat totals, shrub/scrub (613.5 acres) and fresh marsh (549.7 acres) dominated the landscape. Under natural conditions, the normal deltaic processes creates a greater percentage of fresh marsh than shrub/scrub. In contrast, under man-made conditions the dredged material disposal process created more shrub/scrub than fresh marsh. This was due to the intent and design of the man-made areas that were placed at a height and orientation to influence natural sedimentation and habitat development rather than directly create a specific habitat.

TABLE 1
December 1985 Habitat Inventory of the Atchafalaya Delta

HABITAT	TOTAL	NATURAL	BUMP MAN-MADE	OTHER MAN-MADE
Fresh Marsh	549.70	174.9	363.8	11.0
Shrub/Scrub	413.50	56.7	535.8	21.3
Bare Land	150.80	0.0	140.2	10.6
Beach	25.80	0.3	24.7	0.0
Habitat Total	1,339.00	231.9	1064.5	42.6

ATCHAFALAYA DELTA 1985

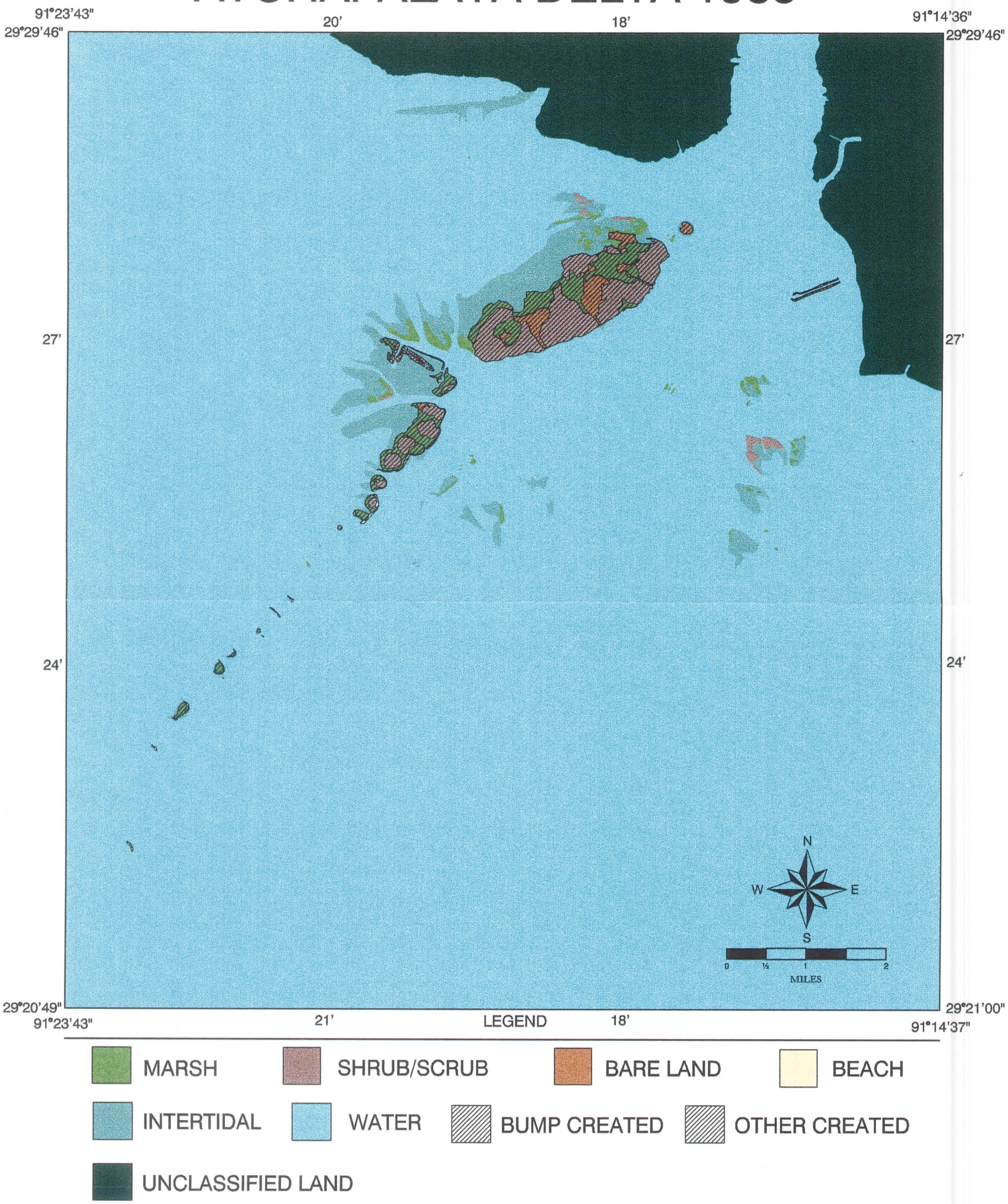


Figure 19. Habitat inventory map of the Atchafalaya delta in December 1985.

Table 2 lists the areas of the five habitats found in the Atchafalaya River delta in November 1994. The location and arrangement of these habitats is presented in figure 20. In 1994, the total area of the Atchafalaya delta was calculated at 4337.2 acres. Of this total, 1303.0 acres were natural, 2911.8 acres were BUMP-made, and 122.4 acres were other man-made. In terms of total area, fresh marsh (1864.0 acres) and forested wetland (954.7 acres), shrub/scrub (897.3 acres), and bare land (596.4 acres) dominated the landscape of the Atchafalaya delta. These areas were designed not to directly create marsh, but to direct sediment-laden water through existing natural channels to augment the natural delta-building process. Under natural conditions, the normal deltaic processes tend to create a greater percentage of fresh marsh than shrub/scrub.

TABLE 2
November 1994 Habitat Inventory of the Atchafalaya Delta

HABITAT	TOTAL	NATURAL	BUMP MAN-MADE	OTHER MAN-MADE
Marsh	1864.0	1218.9	623.0	22.1
Shrub/Scrub	897.3	79.6	788.9	28.8
Forested Wetland	954.7	0.0	883.2	71.5
Bare Land	596.4	0.0	596.4	--
Beach	24.8	4.5	20.3	--
Habitat Total	4337.2	1303.0	2911.8	122.4

ATCHAFALAYA DELTA 1994

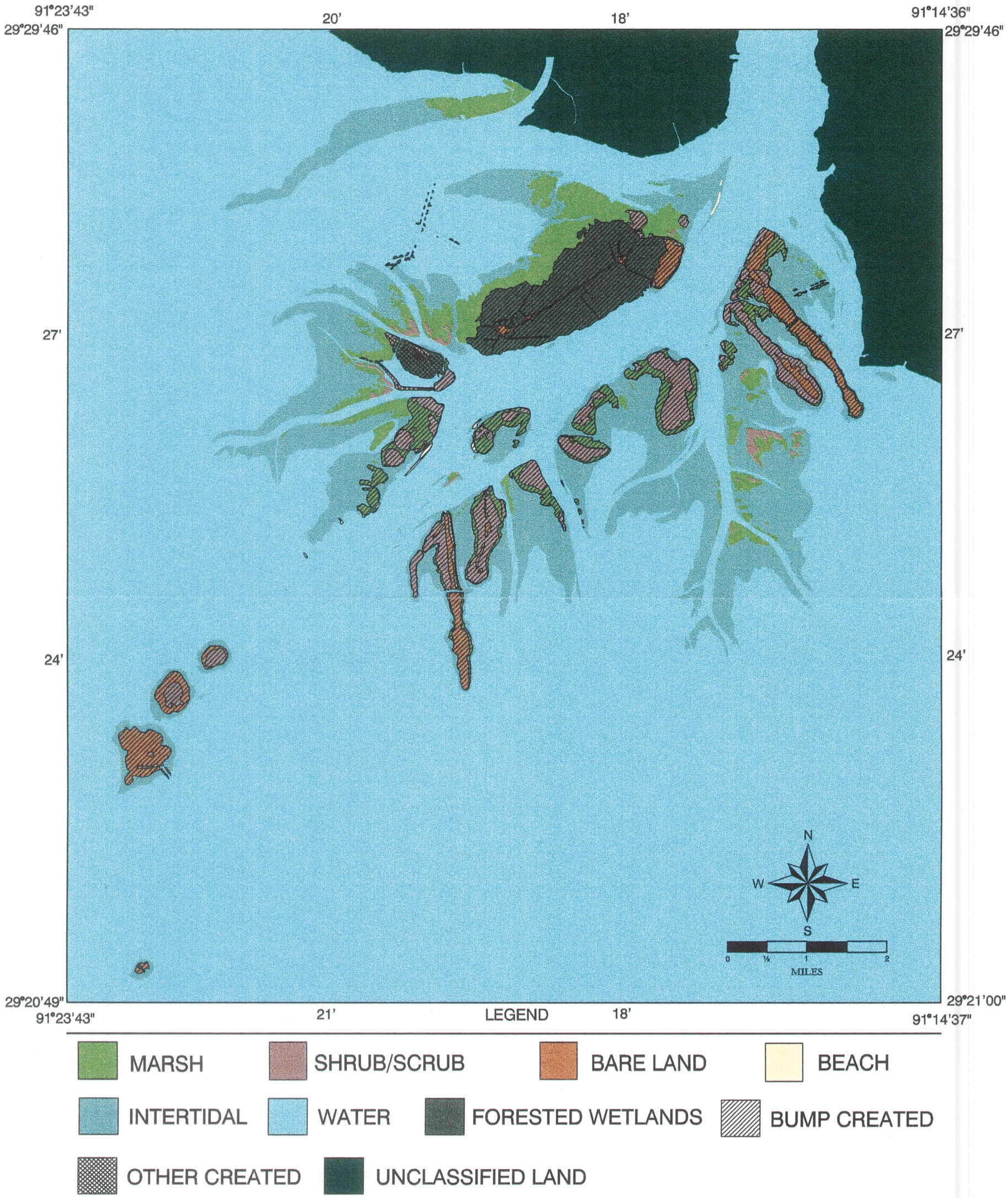


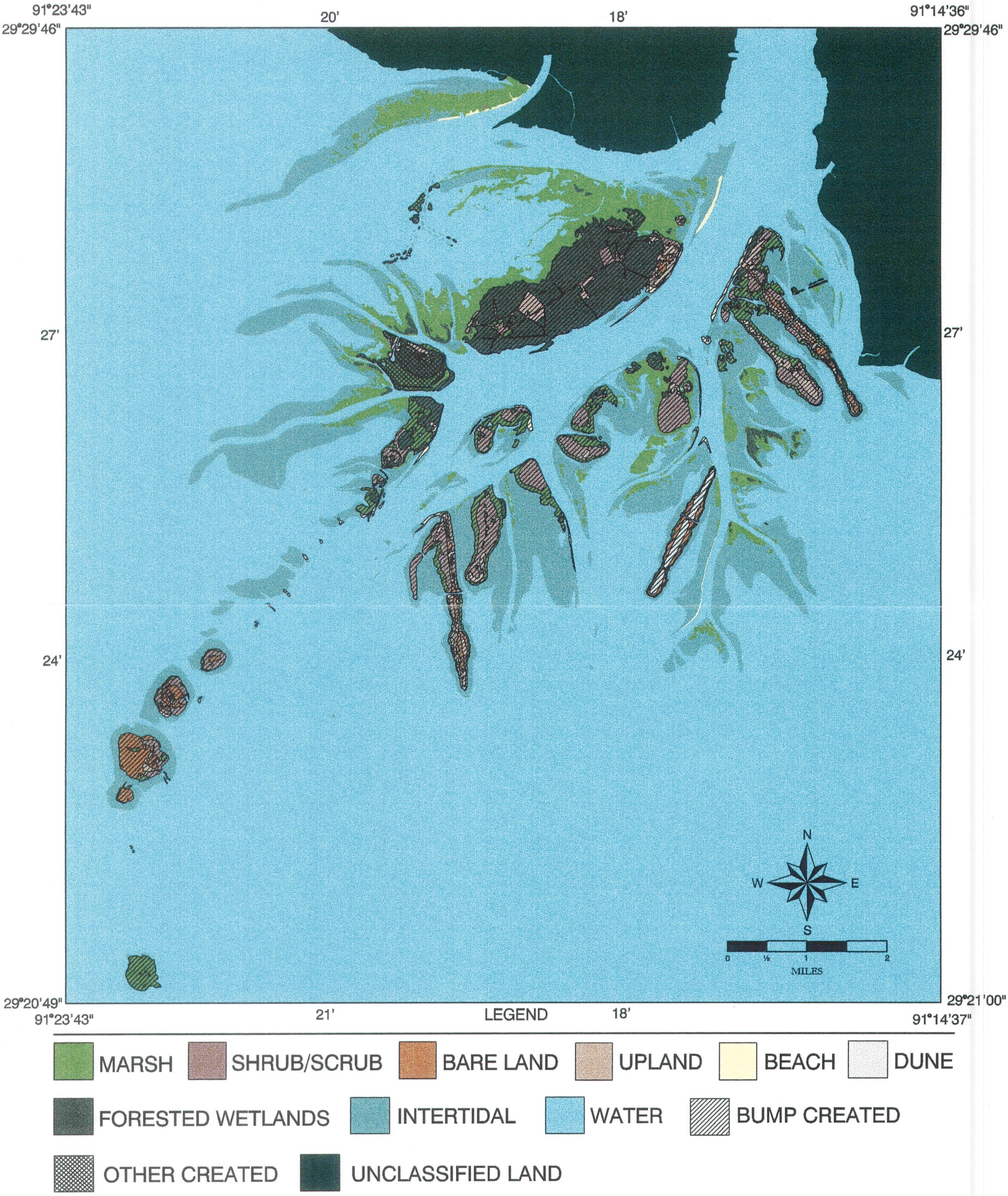
Figure 20. Habitat inventory map of the Atchafalaya delta in November 1994.

Table3 4 lists the areas of the seven habitats found in the Atchafalaya River delta in November 1995. The location and arrangement of these habitats is presented in figure 21. In 1995, the total area of the Atchafalaya delta was calculated at 5027.3 acres. Of this total, 1820.2 acres were natural, 3029.4 acres were BUMP-made, and 177.7 acres were other man-made. In terms of total area, fresh marsh (2412.7 acres) and forested wetland (1172.5 acres), shrub/scrub (760.3 acres), and bare land (269.0 acres) dominated the landscape of the Atchafalaya delta. These areas were designed not to directly create marsh, but to direct sediment-laden water through existing natural channels to augment the natural delta-building process. Under natural conditions, the normal deltaic processes tend to create a greater percentage of fresh marsh than shrub/scrub.

TABLE 34
November 1995 Habitat Inventory of the Atchafalaya Delta

HABITAT	TOTAL	NATURAL	BUMP MAN-MADE	OTHER MAN-MADE
Marsh	2412.7	1703.8	629.9	79.0
Upland	245.4	0.5	243.6	1.3
Shrub/Scrub	760.8	2.6	752.9	5.3
Forested Wetland	1172.5	79.6	1001.5	91.4
Bare Land	260.0	0.0	259.3	0.7
Dune	57.2	0.0	57.2	--
Beach	118.7	33.7	85.0	--
Habitat Total	5027.3	1820.0	3029.4	177.7

ATCHAFALAYA DELTA 1995



LEGEND

MARSH
SHRUB/SCRUB
BARE LAND
UPLAND
BEACH
DUNE
FORESTED WETLANDS
INTERTIDAL
WATER
BUMP CREATED
OTHER CREATED
UNCLASSIFIED LAND

Figure 21. Habitat inventory map of the Atchafalaya delta in November 1995.

Table 4 lists the areas of the seven habitats found in the Atchafalaya River delta in November 1996. The location and arrangement of these habitats is presented in figure 22. In 1996, the total area of the Atchafalaya delta was calculated at 4445.2 acres. Of this total, 1222.9 acres were natural, 3035 acres were BUMP-made, and 186.5 acres were other man-made. In terms of total area, fresh marsh (1864.4 acres) and forested wetland (1230.2 acres), shrub/scrub (711.9 acres), and bare land (247.5 acres) dominated the landscape of the Atchafalaya delta. These areas were designed not to directly create marsh, but to direct sediment-laden water through existing natural channels to augment the natural delta-building process. Under natural conditions, the normal deltaic processes tend to create a greater percentage of fresh marsh than shrub/scrub.

TABLE 4
November 1996 Habitat Inventory of the Atchafalaya Delta

HABITAT	TOTAL	NATURAL	BUMP MAN-MADE	OTHER MAN-MADE
Marsh	1864.4	1120.0	671.8	72.6
Upland	331.0	0.0	317.8	13.0
Shrub/Scrub	711.9	18.0	689.5	4.4
Forested Wetland	1230.2	81.4	1052.7	96.1
Bare Land	247.5	3.5	243.7	0.3
Dune	39.5	0.0	39.5	--
Beach	20.7	0.0	20.7	--
Habitat Total	4445.2	1222.9	3035.8	186.5

ATCHAFALAYA DELTA 1996

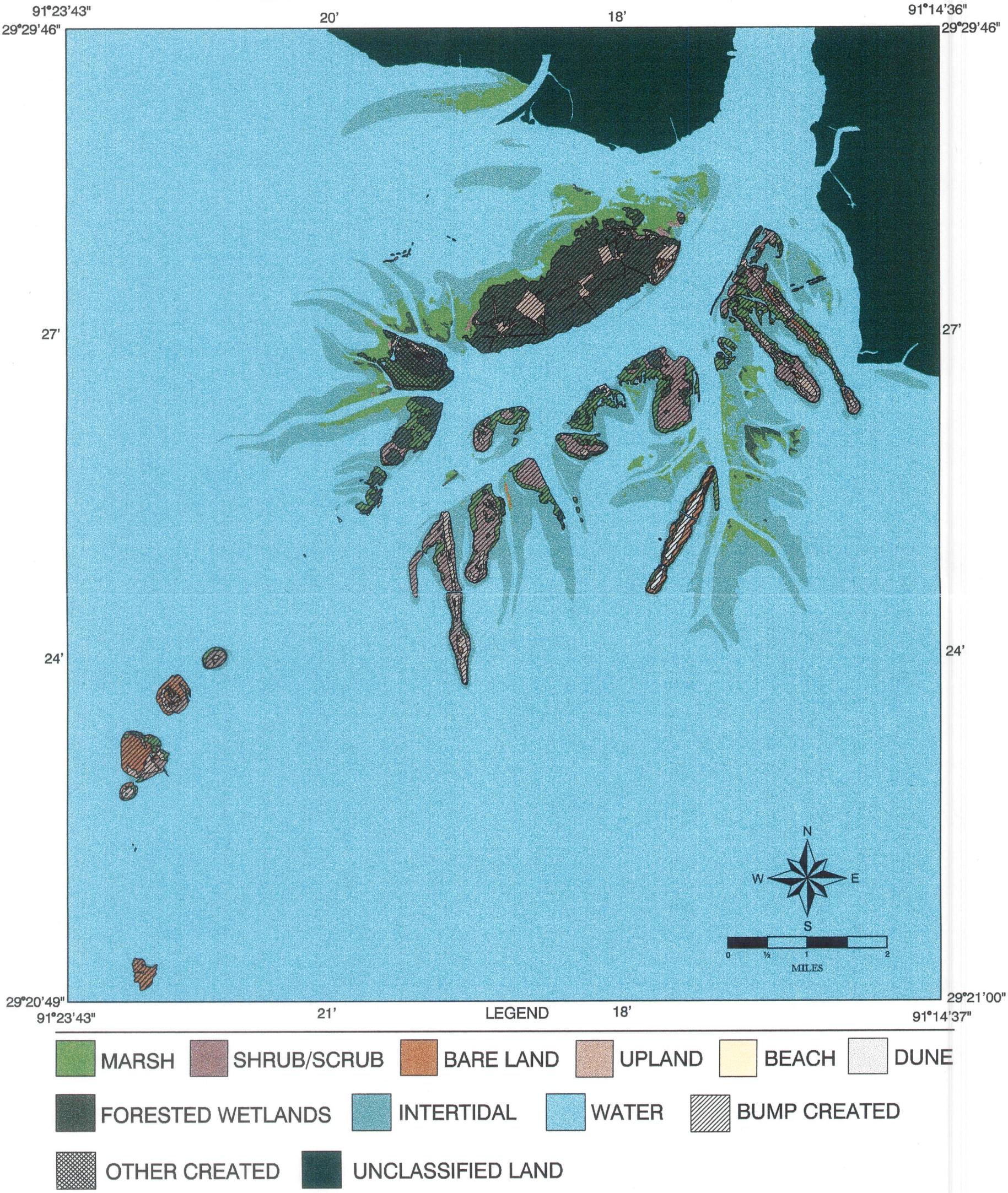
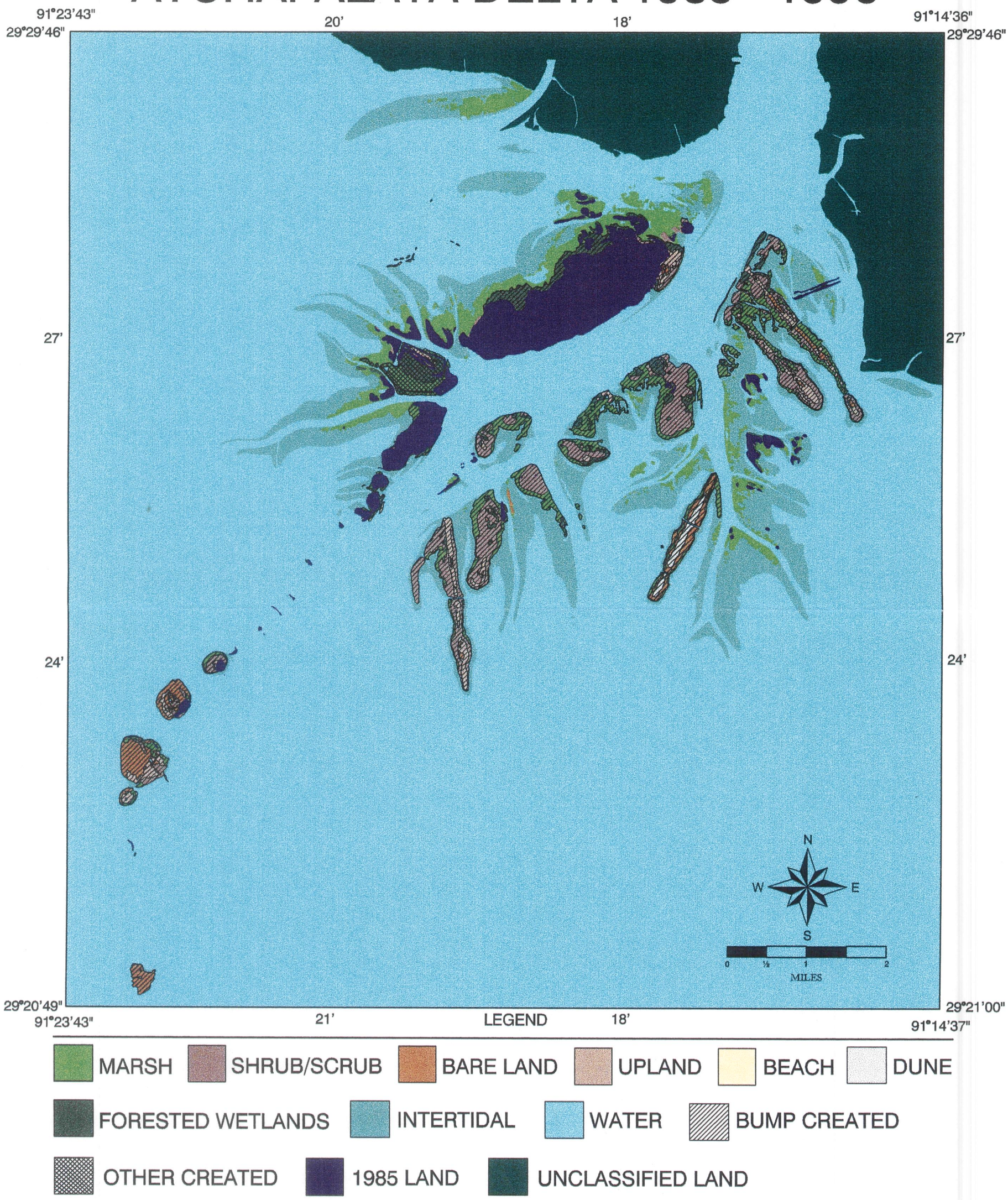


Figure 22. Habitat inventory map of the Atchafalaya delta in November 1996.

Habitat Change

Figure 22 shows the creation of new habitat, both natural and man-made, in the Atchafalaya delta by comparing December 1985 and November 1996. The total area increased by +2987.76 acres which represents a 230 percent increase in area between 1985 and 1996. Of this increase in area, 1134.55 acres were natural and 1853.21 acres were man-made by the placement of dredged material. Table 5 lists the major habitat changes. The major habitat-increase by natural processes was the increase in natural fresh marsh (+1061.83 acres). Other large increases occurred in the man-made habitats, include forested wetland (+960.23 acres), bare land (+450.75 acres), fresh marsh (+331.83 acres), and shrub/scrub (+128.40 acres). Figure 23 shows a time series of habitat changes in the Atchafalaya delta. In terms of dredged material placement, the greatest areas of new habitat creation include man-made forested wetland (+960.23), man-made bare land (+450.75 acres), and man-made shrub/scrub (+128.40 acres). Figure 23A graphs the natural habitat changes over time. Natural marsh development dominates the natural habitat class. Figure 23B graphs the man-made habitat changes over time. Forested wetland, man-made fresh marsh, man-made shrub/scrub and man-made bare land dominate the man-made class.

ATCHAFALAYA DELTA 1985 - 1996



LEGEND

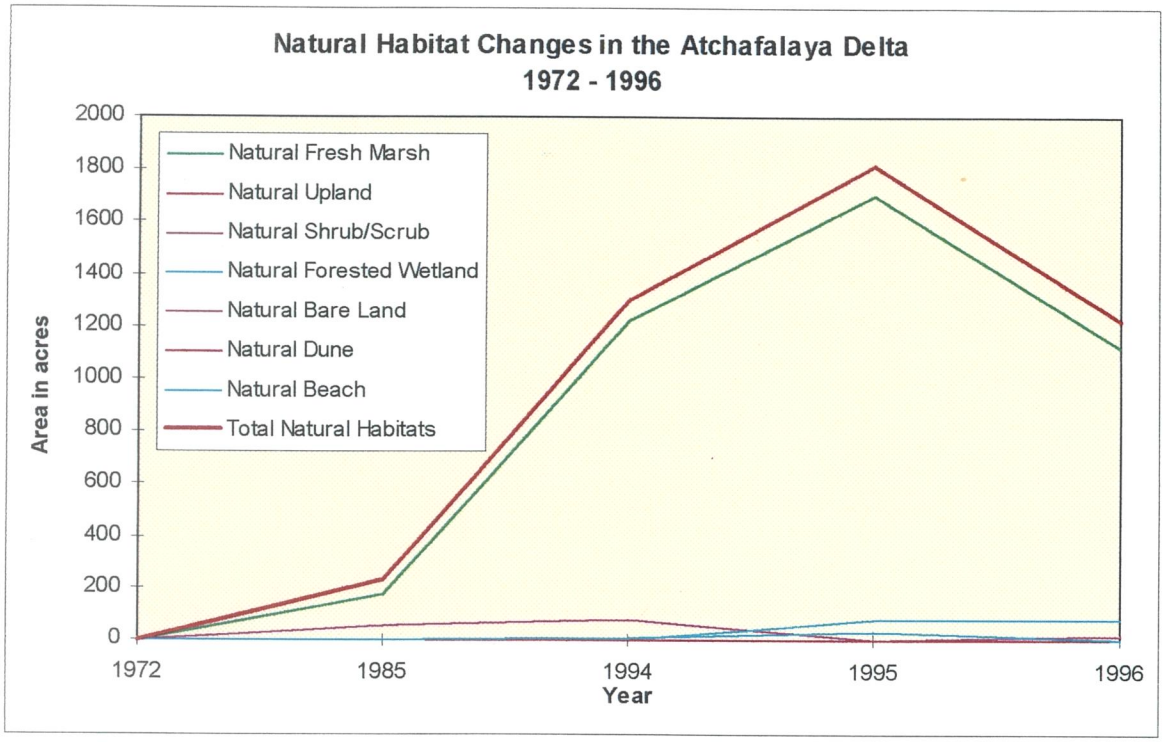
MARSH
SHRUB/SCRUB
BARE LAND
UPLAND
BEACH
DUNE
FORESTED WETLANDS
INTERTIDAL
WATER
BUMP CREATED
OTHER CREATED
1985 LAND
UNCLASSIFIED LAND

Figure 23. Map of the Atchafalaya delta showing the new habitats that developed between December 1985 and November 1996.

TABLE 5
Changes in Total Acres of Each Habitat in the Atchafalaya Delta between December 1985 and November 1996

HABITAT	1985[1]	1996[1]	AREA CHANGE[1]
Natural Marsh	174.9	1120.0	+945.1
Natural Upland	0.0	0.0	0.0
Natural Shrub/Scrub	56.7	18.0	-38.7
Natural Forested Wetland	0.0	81.4	+81.4
Natural Bare Land	0.0	3.5	+3.5
Natural Dune	0.0	0.0	0.0
Natural Beach	0.3	0.0	-0.3
Total Natural Habitats	231.9	1222.9	+991.0
BUMP-made Marsh	363.8	671.8	+308.0
BUMP-made Upland	0.0	317.9	+317.9
BUMP-made Shrub/Scrub	535.8	689.5	+153.7
BUMP-made Forested Wetland	0.0	1052.7	+1052.7
BUMP-made Bare Land	140.2	243.7	+103.5
BUMP-made Dune	0.0	39.5	+39.5
BUMP-made Beach	24.7	20.7	+1052.7
Total BUMP-made Habitats	1064.5	3035.8	+1971.3
Other man-made Marsh	11.0	72.6	+61.6
Other man-made Upland	0.0	13.1	+13.1
Other man-made Shrub/Scrub	21.0	4.4	-16.6
Other man-made Forested Wetland	0.0	96.1	+96.1
Other man-made Bare Land	10.6	0.3	-10.3
Other man-made Dune	0.0	0.0	0.0
Other man-made Beach	0.0	0.0	0.0
Total Man-made Habitats	42.6	186.5	+143.9
Habitat Total	1339.0	4445.2	+3106.2

[1]Acres



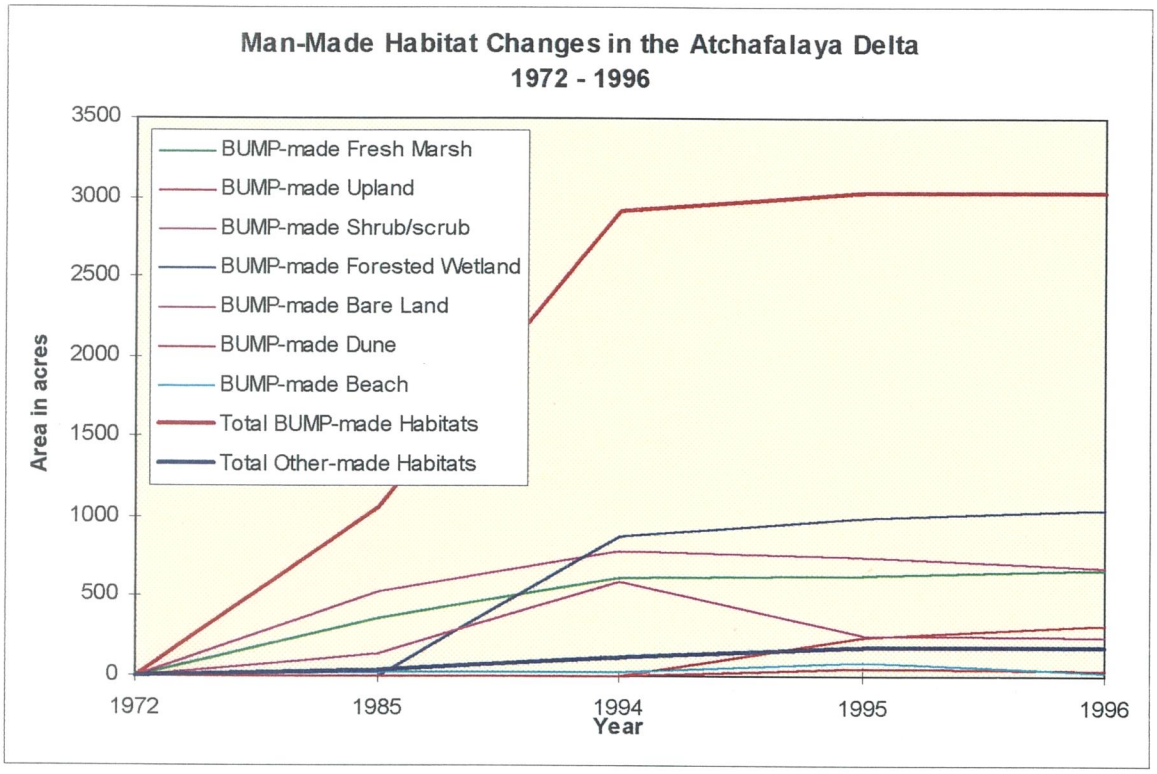


Figure 24. Time series showing the changes in total area of each habitat in the Atchafalaya River delta between 1972 and 1996. A) natural habitat changes. B) man-made habitat changes.

CONCLUSIONS

1. The total area of the Atchafalaya River delta in December 1985 was 1339.0 acres. Natural processes accounted for 231.9 acres or 17 percent of the total area. BUMP-made processes related to placement of dredged material accounted for 1064.5 acres or 79 percent of the total area. Other man-made processes accounted for 42.6 acres or 4 percent of the total areas.

2. The total area of the Atchafalaya River delta in November 1996 was 4445.2 acres. Natural processes accounted for +1222.9 acres or 28 percent of the total area. Man-made processes related to the beneficial use of dredged material accounted for +3035.8 acres or 68 percent of the total area. Other man-made processes accounted for 186.5 acres or 4 percent of the total area.

3. The Atchafalaya River delta increased by +3106.2 acres between December 1985 and November 1996. Natural processes were responsible for +991.0 acres of increase and the beneficial placement of dredged material was responsible for +1971.3 acres of this increase. Other man-made processes accounted for +143.9 acres of this increase.

4. Natural processes appear to be effective in creating marsh. Beneficial use of dredged material appears to be effective in creating a variety of habitats, including forested wetland, shrub/scrub, bare land, and fresh marsh.

5. The field surveys indicate the current stacking heights are optimal for establishing forested wetland and shrub/scrub habitats and to a lesser extent fringing marshes. The optimal elevation for marsh creation appears to be less than +2 feet MSL. The average elevation of Andrew Island is +3.02 feet. The average elevation of eastern Horseshoe Island is +2.25 feet. The average elevation of Ibis Island is +2.21 feet.

6. The greatest rates of shoreline progradation in the Atchafalaya River delta are associated with the placement of dredged material. Natural processes prograde the Atchafalaya River delta at a rate of about +300 feet per year and man-made processes prograde the shoreline at a rate of about +500 feet per year.

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Penland, S. and Westphal, K.A., 1997. 1996 beneficial use monitoring program annual report; Part 1: Methodology. Report to the US Army Corps of Engineers - NOD. 16 pp.

APPENDIX 9A

LIST OF VEGETATIVE SPECIES IN THE ATCHAFALAYA DELTA

LIST OF VEGETATIVE SPECIES IN THE ATCHAFALAYA DELTA

An alphabetical list of observed and collected plant species follows. This list is not complete, but is meant to establish vegetative character and indicate dominant species observed. The list includes the species name, alternate scientific names, common names, and general habitat description for each plant. The habitat information was taken from the Manual of the Vascular Flora of the Carolinas or The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts. Common names were from a variety of sources.

Acmella oppositifolia (Lam.) R.K. Jansen var. **repens** ..... creeping Spotflower
(Spilanthes americana)
colonial perennial; wet pastures, swamp forests, river banks

Acnida tamariscina (Nutt.) Wood. ..... water-hemp
(Amaranthus tamariscinus) annual; brackish marshes

Aeschynomene indica L. ..... joint-vetch shrub
annual; swamps, marshes, and ditches

Alternanthera philoxeroides (Mart.) Griseb. ..... alligator-weed
perennial; fresh or intermediate aquatic or very wet habitats

Asclepsis sp. ..... milkweed
perennial herbs

Aster subulatus Michx ..... annual saltmarsh aster
annual; fresh to brackish marsh

Baccharis halimifolia L. ..... groundselbush
shrub or small tree; elevated sites in fresh to saline marshes

Bacopa caroliniana (Walter) Robinson ..... blue water-hyssop
succulent creeping herb; sandy, shallow pond and marsh or moist stream margins

Bacopa monnieri (L.) Pennell ..... coastal water-hyssop
succulent creeping herb; sandy margins of fresh or brackish marshes, streams, ponds

Boehmeria cylindrica (L.) Sw. ..... False-nettle
perennial; moist or wet soil under shrubs or trees or in open, flats, marshes

Callibrachoa parviflora (Juss.) D'Arcy ..... wild petunia
(Petunia parviflora)
perennial; roadsides and waste places

Chamaesyce maculata (L.) Small ..... prostrate spurge
erect or prostrate annual; along paths, crevices and sides of sidewalks and roads, waste places

Colocasia antiquorum ..... elephantsear
perennial; freshwater marsh, pond and stream margins

Conyza bonariensis (L.) Cronq. ..... hairy fleabane
(Erigeron bonariensis)
winter annual; fields and waste places

Conyza canadensis (L.) Cronq ..... horseweed
annual; fields, roadsides, pastures and waste places

Cynodon dactylon (L.) Pers. ..... Bermuda grass
rhizomatous perennial; fields, roadsides, waste places

Cyperus aristatus Rottb. .....
Annual; sandy fields

Cyperus elegans L. ..... nut sedge
fresh to intermediate marsh, sand lake and bayshore

Cyperus esculentus L. ..... yellow nutgrass
perennial; sandy fields, roadsides, and waste places

Cyperus oxylepis Steud. .....

Cyperus surinamensis Rottb. .....
Rhizomatous perennial; disturbed clay-sand beds

Digitaria ciliaris (Retz.) Koel. ..... crab grass
annual; sandy fields, roadsides, waste places

Echinochloa crusgalli (L.) Beauv. ..... barnyard grass
coarse annual; low fields, marshes and waste places

Echinochloa walteri (Pursh) Heller ..... Walter's millet
coarse annual; fresh and intermediate marshes and low waste places

Eclipta prostrata (L.) L. (Eclipta alba) ..... Yerba de Tajo
annual herb; pond shores, alluvial meadows, marshes, low woods and bogs

Eichhornia crassipes Kunth ..... water hyacinth
floating aquatic; freshwater ponds and waterways

Eleocharis parvula (R. & S.) Link ..... dwarf spikerush
perennial; brackish marshes, rarely fresh-water marshes

Equisetum hyemale L. var. **affine** (Engelm.) A.A.Eaton ..... scouring rush
rhizomatous; railroad embankments, roadsides and stream banks

Erigeron philadelphicus L. ..... daisy fleabane
perennial herb; old fields, meadows and waste ground

Eupatorium capillifolium (Lam.) Small ..... yankee weed, dog fennel
annual; fields, meadows, pastures and disturbed woods

Galium tinctorium L. ..... dye bedstraw
annual; swamps, meadows, marshes and wet ditches

Heliotropium curassavicum L. ..... seaside heliotrope
annual succulent; seashores and borders of fresh to saline marsh

Heliotropium procumbens Mill. ..... marsh heliotrope
annual succulent

Hydrocotyle bonariensis Lam. ..... sand pennywort
creeping perennial; among beach dunes, moist open sandy areas

Hydrocotyle ranunculoides L.f. ..... pennywort
aquatic or semi-aquatic perennial; seepage areas, pools, stream margins and swamps

Hydrocotyle umbellata L. ..... marsh pennywort
creeping perennial; low or moist areas

Hymenocallis crassifolia Herbert. ..... spider lily
perennial bulb; brackish marshes, low woods and swamp forest borders

Iris giganticaerulea ..... giant blue flag
rhizomatous perennial; fresh marshes, swamps, and stream margins

Iva annua L.
Erect annual herb; fields and waste places

Juncus effusus L. ..... soft rush
perennial; moist soil, edges of swamps and ponds, low pastures

Juncus tenuis Wiild. ..... path rush
perennial; dry or moist soil along roadsides and paths

Leptochloa fascicularis (Lam.) Gray ..... bearded sprangletop
tufted annual; lakebed, fresh to brackish marsh,
best in intermediate marsh subject to drying

Leptochloa uninervia (Presl) Hitchc. & Chase ..... Mexican sprangletop
tufted annual; waste places

Medicago polymorpha L. ..... bur clover
annual; fields, roadsides and waste places

Mikania scandens (L.) Willd. ..... climbing hempweed
perennial vine; woods, thickets, marshes and bogs, usually very wet habitats

Modiola caroliniana(L.) G.Don ..... Carolina mallow
creeping perennial; lawns, gardens, pastures, roadsides and seepage slopes in woods

Panicum dichotomiflorum Michx. ..... fall panicum,
tufted annual; fresh and intermediate marsh, ditches, low woods zig-zag grass

Panicum repens L. ..... dogtooth grass
perennial grass; fresh and intermediate marsh , slightly elevated sites torpedo grass

Paspalum distichum L. ..... "red-stem paspalum"
mat-forming perennial; brackish and freshwater marshes

Paspalum urvillei Steud. ..... Vasey grass
perennial grass; roadsides, fields and waste places

Phyla nodiflora (L.) Greene ..... frog-fruits
decumbent perennial; sandy open habitats,usually moist, swales, ditches, pond margins

Polygonum lapathifolium L. ..... willow-weed
annual; alluvial fields, river banks, disturbed habitats

Polypogon monspeliensis (L.) Desf. ..... rabbitfoot grass
annual; brackish marshes

Ranunculus sceleratus L. ..... buttercup
succulent annual; marshes and ditches

Rorippa palustris (L.) Besser ..... yellow cress
biennial or perennial herbs; wet habitats about ponds, lakes, and streams

Sacciolepis striata (L.) Nash ..... cupscale
creeping perennial; marshes, swales, sloughs, ditches, pond margins, depressions

Salix nigra Marshall ..... black willow
tree; streambeds and low moist areas

Samolus valerandii L. subsp. **parviflorus** (Raf.) Hulten ..... water pimpernel
annual or perennial; wet habitats, fresh or brackish

Scirpus americanus Pers. ..... American bulrush,
perennial; fresh to intermediate marsh, sandy lake and bayshore freshwater three-square

Scirpus validus Vahl. ..... softstem bulrush
creeping perennial; (S. tabernaemontani K.G. Gmel)
marshes and rocky streambeds

Senecio glabellus Poir. ..... butterweed
annual; alluvial woods, swamp forests and wet pastures

Sesbania drummondii (Rydb) Cory. ..... yellow rattlebox
(Daubentonia longifolia (Cav.) DC.)
shrub; elevated areas in fresh to saline marsh

Sesbania exaltata (Raf.) Rydb. .....
Annual shrub to 4m; ditches, edge of brackish and fresh marshes, swales, edge of sloughs, fields, alluvial soils

Sibara virginica (L.) Rollins ..... winter cress
winter annual; disturbed soils, mostly in low fields

Solanum americanum P. Mill. (or **S. ptychanthum** Dunal) ..... nightshade
annual; woodland margins, fields, roadsides and waste places

Solidago sp. ..... goldenrod
perennial herbs

Solidago sempervirens L. ..... seaside goldenrod
perennial; brackish marsh or saline sand

Spergularia echinosperma Celak (or **S.marina** (L.) Griseb. ..... sand spurrey
tufted annual; salt marshes and tidal flats

Tamarix gallica L. ..... sea-side cedar, tamarisk
shrub or small tree; escaped to sandy roadsides and waste places

Trifolium dubium Sibthorp ..... low hop clover
annual; lawns, fields, roadsides and waste places

Trifolium hybridum L. ..... Alsike clover
perennial; lawns, fields, roadsides, swales between stable dunes

Urtica chamaedryoides Pursh ..... stinging nettle
stinging annual; rich woods over circumneutral soil, rare

Zizaniopsis miliacea (Michx.) Doell & Asch. ..... southern wild rice, water millet
rhizomatous perennial; brackish and freshwater marshes