FINAL REPORT

MISSISSIPPI COASTAL GEOLOGY

AND

REGIONAL MARINE STUDY

1990 - 1994

VOLUME 1

Mississippi Office of Geology / U. S. Geological Survey
Cooperative Agreement No. 14-08-0001-A0827

Submitted to:

U. S. Geological Survey
Center for Coastal Geology and Regional Marine Studies
600 4th Avenue, South
St. Petersburg, Florida 33701

by

Office of Geology
Mississippi Department of Environmental Quality
P. O. Box 20307
Jackson, Mississippi 39289-1307

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"Historical Shoreline Analysis of the Mississippi Gulf Coast", Coastal Zone '93 reprint

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"Human-Environment Relationships Along the Mississippi Coast", Mississippi Journal for the Social Studies reprint

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EXECUTIVE SUMMARY

by

Stephen M. Oivanki

The Mississippi Coastal Geology and Regional Marine Study is a joint effort by the U. S. Geological Survey and the Mississippi Office of Geology during the period from October, 1990 to September, 1994 to understand coastal processes and their current and historical effects on the shoreline of Mississippi and the geologic framework of the coast. The shoreline of Mississippi encompasses numerous diverse environments with varying degrees of development and modification. Holocene geologic framework, shoreline evolution, natural resources processes, and storm event monitoring are the primary research objectives of the study.

This Final Report presents the results of this study in individual reports by the primary investigators involved in each separate research effort. Where appropriate, the research results and the raw data collected are presented in charts, tables, and maps. Digital data are included for those portions of this report where access would be facilitated by this medium. Numerous presentations of the data and results were made during the course of this study, and copies of the published abstracts, papers, and books are included as attachments to this Final Report. A video production illustrating coastal erosion and erosion control efforts in Mississippi is also included as an attachment to this report. Several of the research projects begun during this study are ongoing, and future reports to the USGS on these projects will be made as the data become available.

Shoreline Geomorphology and Storm Effects

A classification and inventory of the geomorphic characteristics of the Mississippi shoreline was developed to identify major shoreline types and define those parameters which could be used to gauge the effects of storm impacts on the shoreline. The video survey method developed by the Louisiana Geological Survey was modified and used to accomplish this. Thirty-seven geomorphic features are identified and related to natural and man-made processes, as well as inter-related to the progressive evolution from one geomorphic feature to another.

The barrier islands of Mississippi are preserved in their natural state as part of the Gulf Islands National Seashore, and provide an ideal platform on which to study geomorphic evolution. The islands show numerous geomorphic features resulting from previous storm and hurricane impacts. A hummocky dune terrace is the most common feature found on the islands, and it represents evolution from a previous storm washover terrace. All of the islands show erosional scarps along most of the shorelines as a result of normal seasonal erosion. Eolian features are prominent on the south and east shores of the islands due to the predominant southeast wind direction. The survey method developed for this study will be used to monitor future geomorphic evolution on the islands and to document changes in the event of a hurricane impact.

The mainland coast of Mississippi can be roughly divided into several geomorphic types based on man-made and natural influence and geographic position. Naturally eroding marsh shorelines are present at the western and eastern ends of the coast. Harrison County, in the center of the coast, as well as eastern Hancock County is dominated by an artificial beach placed in front of a continuous seawall. Central Jackson County contains a bare seawall and several highly industrialized ports. The only natural beach on the mainland coast is found in western Jackson County at Belle Fontaine, and a detailed analysis of this beach is presented in Mississippi Office of Geology Bulletin 130 attached to this report.

Beach and nearshore profiles are maintained along most of the mainland shoreline to monitor natural and man-made changes and provide a baseline for storm monitoring. The profiles recorded for several years are presented in this report.

A quick and economical method for bathymetric surveying developed during this study was used to update the bathymetry of the Mississippi Sound. Using two small boats, chart recorders, and GPS position equipment, the entire Mississippi Sound can be surveyed in approximately two weeks. The method does, however, require relatively quiet water conditions.

Historical Shoreline Change and Development

The history of the Mississippi coast and human development of the shoreline is summarized from archival research with numerous historical maps and photos. Major human modifications include the

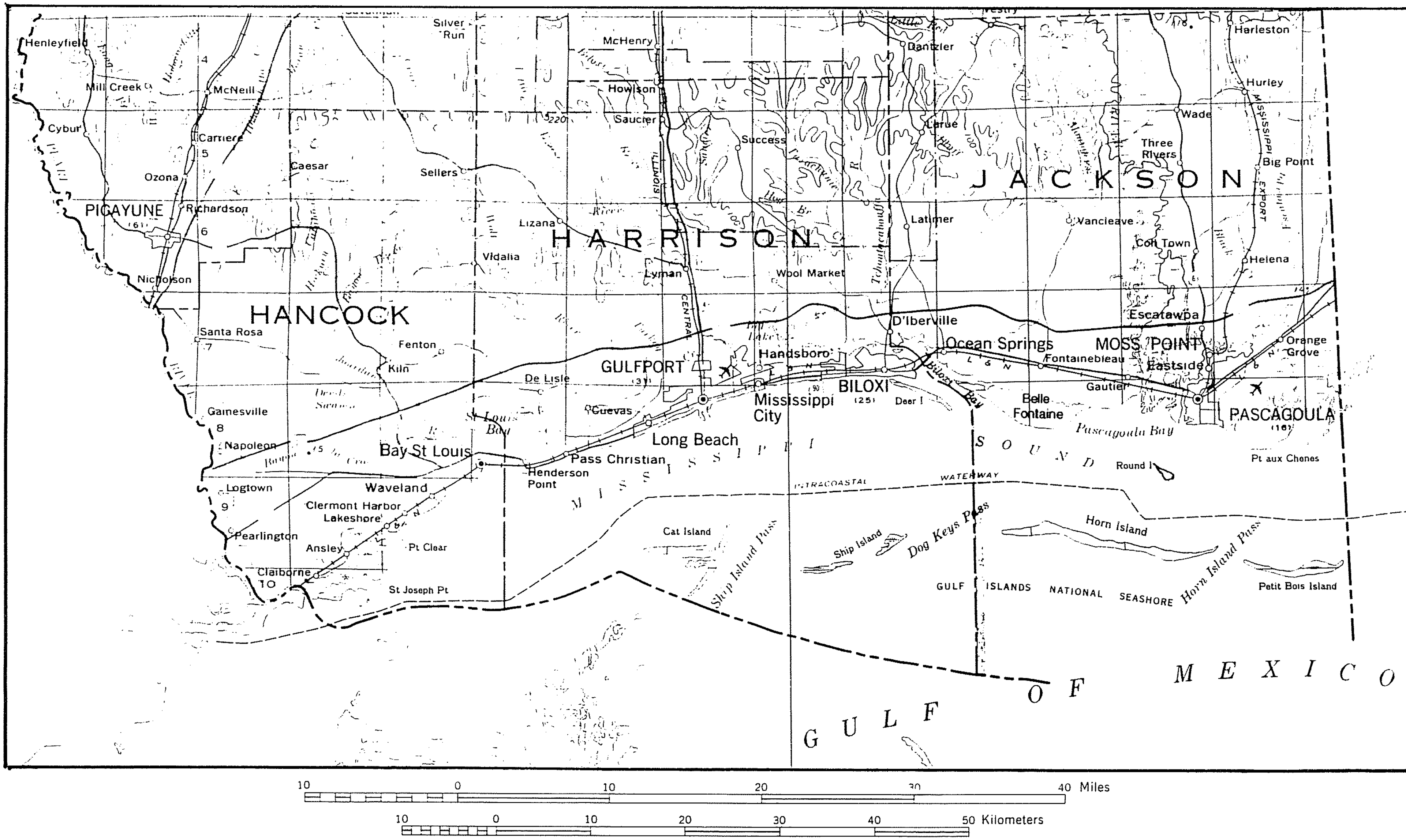


Figure 1. Mississippi coast index map.

seawall and artificial beach in Harrison County and Hancock County, expansion and development of the Biloxi waterfront, building and expansion of new land area at the ports of Gulfport and Pascagoula, and filling of wetlands as a result of residential and industrial development. Additions to the Harrison County shoreline are documented from official records and historical maps to better understand the sediment budget of this highly modified shoreline segment. Over 16 million cubic yards of documented fill have been added to the Harrison County shoreline, resulting in an areal expansion of approximately 1150 acres.

Historical shoreline changes in Mississippi were documented from U.S. Coast Survey and USGS T-sheets and aerial photo interpretations which were digitized, standardized, and compared in ARC/Info. Since the first official maps were made in the 1850s, the mainland coast of Mississippi has lost approximately 3148 acres to erosion up until 1986. Approximately 1725 acres have been reclaimed by various methods, primarily beach nourishment and subaerial dredge material disposal. The highest shoreline retreat rates on the mainland (1.5 - 2 meters/year) are found in the natural marsh areas at the east and west ends of the coast. The barrier islands are migrating from east to west, and have lost approximately 2655 acres due to erosion between the 1850s and 1986. The erosion rate on the islands shows a three-fold increase after the turn of the century when shipping channels were dredged and maintained between the islands for access to mainland ports. Reversal of this island erosion trend will require a change in channel maintenance practices and relocation of the channels.

Coastal Land Use/Land Cover Changes

Land use/land cover change trends in the Mississippi coastal zone (below the 15-foot contour) are documented from previous U.S. Fish and Wildlife Service studies in the 1950s and 1970s and compared with a new interpretation of 1991-92 aerial photos with an emphasis placed on wetland area changes. The Cowardin classification system was collapsed into 7 categories and applied to 19 USGS topographic quadrangles for each of the three time periods studied. Wetland/marsh loss is greatest in the eastern part of the coast due to erosion and in the western portion of the coast due to erosion and development. Developed land expansion is greatest in the Gulfport/Biloxi area and around Pascagoula and Bay St. Louis. Total marsh area in the Mississippi coastal zone decreased by 8587 acres between the 1950s and 1992. Developed area increased by 28,738 acres during the same time period.

Geologic Framework

Seismic data were collected during joint USGS/Office of Geology cruises during the study period to aid in interpreting the Holocene and uppermost Pleistocene geologic framework and depositional environments in the Mississippi Sound. The data quality proved insufficient to accomplish this task. An approximate channel pattern for a probable Neogene exposure horizon is mapped with examples of interpreted channel types recognized in the seismic data. Core information and descriptions from all previously known drill holes in the Mississippi coastal area were cataloged and collected in a digital database for future use. The digital database is delivered as an attachment to this Final Report. A bibliography of coastal Mississippi geologic literature is also delivered in both digital and published formats as an attachment to this report.

Specialized and Local Projects

Suspended Sediment Characterization from Light Reflection Data

An attempt was made to differentiate between the suspended sediment loads of the Pearl and Pascagoula rivers based on differences in light transmissibility in the two river outflow plumes. Ground-truth measurements of sediment load showed a correlation between suspended sediment load and light transmission for the whole Mississippi Sound, but no significant difference between the two river sources.

Hancock County Beach Project

Beach profiles and sediment distribution patterns were established in Hancock County prior to the placement of a new beach in front of the seawall there in the summer of 1994. The new beach will be monitored as it degrades due to natural wave action in an attempt to define more efficient beach nourishment methods for future use. The profile data for several years are presented in this report.

Round Island Project

Round Island, located offshore from Pascagoula, is partially owned by the City of Pascagoula, and is the site of a National Historic Lighthouse endangered by erosion of the island. Twenty-one vibracores were recovered around the island in a search for sand resources which might be used to restore the island. Approximately 1 million cubic yards of suitable sand were found near the island, and the Holocene/Pleistocene contact was mapped around the island from the core data. Sand isopach and Top of Pleistocene maps are included with this report, as well as descriptions of the cores.

Belle Fontaine Project

Belle Fontaine contains the only remaining natural beach on the Mississippi mainland shoreline. The Mississippi Office of Geology, funded by the USGS, and the Mississippi Bureau of Marine Resources, funded by the U.S. Environmental Protection Agency, sponsored a joint research project to define and model the processes acting on this section of coastline. The Shoreline Evolution Model developed in the project is used to predict future erosion rates and trends and to evaluate possible erosion control methods in the area. Mississippi Office of Geology Bulletin 130, included as an attachment to this report, describes in detail the results of this project. This project formed the basis for a grant from the EPA Gulf of Mexico Program to Jackson County to test the Shoreline Evolution Model with sand nourishment.

Mississippi DEQ GPS Base Station Network

Global Positioning System (GPS) equipment is used extensively by the Office of Geology to accurately measure shoreline positions and sample and core locations in the field. A GPS base station network was established in Mississippi to post-process GPS field data for maximum accuracy. The network was funded by a grant from the EPA and contributions from various DEQ agencies, and is maintained by the Office of Geology. Numerous state, federal, local and private users are now using the network on a daily basis to correct field GPS data.

PROJECT CHRONOLOGY

by

Stephen M. Oivanki

In 1990 the Mississippi Office of Geology and the U. S. Geological Survey entered into a co-operative agreement to jointly study the coastal geology and marine processes of the State of Mississippi. The four major topics designated to be covered by the research were geologic framework, shoreline evolution, natural resources processes, and storm event monitoring. At the time the agreement was signed the Office of Geology had no Coastal Section and no coastal research staff or capabilities.

OBJECTIVES AND SCOPE OF WORK

Year 1: October 1, 1990 - September 30, 1991

During the first year of the Mississippi Office of Geology/USGS Co-operative Coastal Geology and Regional Marine Study, the Office of Geology relied heavily on the expertise and assistance of the Louisiana Geological Survey Coastal Research Section (LGS), which had been participating in a similar cooperative agreement with the USGS for five years. Several projects for that first year were contracted out to LGS. In 1991 the Office of Geology began to assemble a Coastal Section staff to conduct the research involved in the co-operative agreement.

The first year of the study was dedicated to establishing a Coastal Section within the Office of Geology, and acquiring the personnel and equipment to carry forward the tasks started in Year 1. The Louisiana Geological Survey was contracted to digitize historical shoreline data from 1848, 1917, 1932, 1951, 1978, and 1989 for inclusion in the Geographic Information System (GIS) contemplated for purchase in Year 1. Aerial photography was also interpreted and digitized for 1986 coverage of the shoreline. Actual delivered products were digitized shorelines from 1848, 1917, 1951, and 1986. Dr. Klaus Meyer-Arendt with Mississippi State University was contracted to document historical human influences on the Mississippi coast from archival records. LGS also delivered aerial oblique video of the Mississippi coast for later geomorphic interpretation.

Geologic framework investigations included joint seismic cruises with the USGS and LGS in the Mississippi Sound, particularly Hancock County, to explore for sand resources. Dr. Ervin Otvos with the Gulf Coast Research Laboratory was contracted to locate and inventory all previous core and drillhole information pertaining to the Holocene and Pleistocene sediments on the Mississippi Gulf Coast, and to compile a comprehensive bibliography of all previously published material pertaining to Mississippi coastal geology.

Equipment purchases during the first year included the Sun Sparcstation and ARC/Info software needed to set up the GIS, a total station for shoreline and nearshore profile surveying, and a Boston Whaler workboat for offshore work in the waters of Mississippi. Stephen M. Oivanki was hired as principal investigator for the Coastal Section of the Office of Geology, and Barbara Yassin, a data-processing and GIS specialist, was hired to run the computer equipment purchased.

Year 2: October 1, 1991 - September 30, 1992

Year 2 saw a continued building of the Coastal Section of the Office of Geology with additional equipment and research capabilities. Additional personal computers and software were added, as well as video monitoring and soft-sediment vibracoring equipment and GPS receivers for field location measurements. A pontoon workboat was acquired to facilitate vibracoring in the Mississippi Sound and seismic acquisition in shallow water.

Shoreline change research involved incorporation of the digital products delivered by LGS in Year 1 into the Coastal Section GIS. Geomorphic analysis of the Mississippi barrier islands was begun with Dr. Mario Caputo from Mississippi State University using the aerial video acquired from LGS in 1991. Beach and nearshore profiles were established along the Mississippi coast to monitor normal shoreline changes and serve as a baseline for measuring storm event changes. Klaus Meyer-Arendt was contracted to begin a historical analysis of wetlands changes on the Mississippi coast, including an interpretation of 1991-92 aerial photography for wetlands distribution.

Geologic framework research included a contract with Dr. Otvos to gather and deliver to the Office of Geology all available core and drillhole data identified in Year 1 for standardization and digital entry into the Coastal Section GIS to facilitate future retrieval and use. Two joint Office of Geology/LGS/USGS seismic cruises were conducted in the Mississippi Sound.

Two special projects were begun in Year 2. Dr. Scott Dinnel with the University of Southern Mississippi was contracted to study satellite imagery light reflectance values of sediment plumes for the Pascagoula and Pearl rivers. Ground truthing of the plumes was performed by Coastal Section staff. A joint project with the Mississippi Bureau of Marine Resources was begun at Belle Fontaine in Jackson County to study and model erosion of the shoreline there.

There were two additions to the Coastal Section staff in Year 2. Peter Hutchins, geologist, was added as a co-investigator; and Philip White, a part-time student intern, was added as a lab technician for sediment analysis and data entry.

Year 3: October 1, 1992 - September 30, 1993

Shoreline change research included analysis and presentations of the digital data acquired previously. The wetlands maps completed in Year 2 by Klaus Meyer-Arendt were digitized and entered into the Coastal Section GIS. Interpretation and analysis of the mainland geomorphology was begun with Klaus Meyer-Arendt utilizing the 1991 video acquired from LGS. Beach and nearshore profiles established earlier were re-surveyed in Year 3 to record annual changes. Klaus Meyer-Arendt was contracted to research the historical sediment history of Harrison County, Mississippi, to document the changes which have occurred on this highly modified shoreline.

Geologic framework research was primarily concerned with interpretation of the seismic data acquired in previous years. Dr. Otvos was contracted to integrate the existing seismic data in Harrison County with the core data identified and collected previously. Additional seismic data were acquired utilizing the digital seismic equipment of the Marine Minerals Technology Center at the University of Mississippi deployed on the pontoon workboat owned by the Office of Geology. The bibliography previously begun by Ervin Otvos was expanded and published as Office of Geology Circular 5, included as an attachment to this report.

Field work and manuscript preparation for the Belle Fontaine project were completed, and publication preparations were begun for the Office of Geology Bulletin 130 which is included as an attachment to this report.

Michael Fayard, a recent geology graduate from Mississippi State University, was hired for the summer field season of Year 3 to assist with field work and data entry.

Year 4: October 1, 1993 - September 30, 1994

The Office of Geology was informed just prior to Year 4 that the co-operative study would not be continued for five years as previously planned. Year 4, therefore, was dedicated to finishing up the studies and projects already started and documenting the results for this final report.

Shoreline change research for this year included a re-survey of the beach profiles already established, detailed analysis of the new beach pumped in front of the seawall in Hancock County, and GPS shoreline surveys of the barrier islands and the mainland coast of Mississippi. The wetlands change project begun previously is being prepared for publication next year.

Vibracores and seismic collected around Round Island in Jackson County have been analyzed for possible sand resources to be used to rebuild the island and mitigate erosion there. The Belle Fontaine bulletin (130) was published this year. Video collected during the previous three years in Mississippi was edited into a coastal erosion video, which is included with this report.

The sections of this Final Report are composed of individual reports on the results of the various projects completed during the four years of the co-operative USGS/Office of Geology agreement. Numerous presentations of these results have been made during the four years, both published and unpublished, and the published abstracts and reports are included in Appendix D and Appendix E. Some of the work originally scheduled for this study could not be completed due to cancellation of the fifth year of the study. This work will be done in the future as additional time and funding are made available.

MISSISSIPPI SHORELINE GEOMORPHOLOGY

by

Stephen M. Oivanki

GEOMORPHOLOGIC CHARACTERISTICS AND INVENTORY

Introduction

In order to characterize the Mississippi shoreline as to shoreline type and to document changes as a result of natural and man-made influences, the entire shoreline was classified according to the geomorphologic features present. The method developed by the Louisiana Geological Survey (Debusschere et al., 1991) was used for this purpose. Oblique aerial video shot from a helicopter by LGS in 1991 was used as the base coverage for later comparisons. The geomorphic classification of the barrier islands was developed by Stephen Oivanki and Mario Caputo to reflect the features present in Mississippi. The geomorphologic classification of the mainland shoreline was developed by Stephen Oivanki and Klaus Meyer-Arendt using most of the features identified earlier on the barrier islands and including those man-made features found only on the mainland. The two classifications were consolidated to accommodate all of the natural and man-made features found on the Mississippi coast.

The Mississippi Automated Resource Information System (MARIS) was contracted to develop software in ARC/Info to catalog and display the geomorphologic mapping. The Mississippi Shoreline Geomorphology System developed by MARIS uses a fixed grid over the shoreline to spatially orient the video interpretation and reference it to the shoreline. A copy of the User Documentation for the Mississippi Shoreline Geomorphology System developed by MARIS is included as Appendix C of this section.

The system developed by MARIS also incorporates comparison and statistical functions to allow individual island, shoreline segment, year, and feature statistics to be queried. A comparison of shoreline change characteristics for the same shoreline for different years can also be accommodated and a statistical analysis done.

Acknowledgments

The geomorphologic classification used in this project was developed with assistance from Mario V. Caputo, Klaus J. Meyer-Arendt, and Shea Penland. The profile surveys on the barrier islands were done with assistance from Jack Moody, Peter Hutchins, Philip White, and Michael Fayard. Karen Westphal identified the plant types shown on the island profiles. Bobby Smith and Neal Smith at MARIS were especially helpful in developing the Mississippi Shoreline Geomorphlogy System which forms the basis for analysis and display of the data presented in this report.

Geomorphic Classification Development

The first geomorphic classification system developed in this study was done for the barrier islands. Only those features which were easily visible in the aerial video surveys were included. The predominant geomorphic character of the shoreline was the determining factor in identifying features where there was a proliferation of different features in one segment of shoreline. As the classification developed, it was clear that there was definite progression or evolution of features over time. Coppice dunes evolved into irregular dunes, which evolved into dune ridges and hummocky dune terraces. Washover flats and washover corridors were replaced by washover terraces and hummocky dune terraces. Features offshore, such as various bar types, were not included since they were not always visible in every video due to camera angles and reflections.

Actual mapping of the barrier island shorelines was done at a scale of 1:10,000 on mylar overlays over aerial photographs of the same scale taken in 1992. Geomorphic classification and mapping of the mainland shoreline was done at a scale of 1:10,000 on mylar maps with geographic and cultural features for location reference. Interpretation of the video is done by noting the linear extent of the geomorphic features present and entering codes for each feature on data sheets corresponding to the shoreline grid locations. The minimum shoreline length classified is 31 meters. Features smaller than 31 meters are classified as point features and indicated by symbols on the final output maps. The main features are indicated by color or hatch patterns in the center bar of a shore-parallel 3-bar set similar to that used by LGS. Foreshore and backshore modifiers are placed in the front or back bars of the set. Ground checking of individual feature classification is done where necessary, and ambiguous feature locations are verified in the field using GPS.

The barrier island classification contained primarily natural features. When the mainland classification was developed, a number of man-made features were added to complete the final classification system. The following is a listing of the geomorphic features identified and a brief description of each:

coppice dune - small singular dune on a flat surface.

coalesced coppice dune - several coppice dunes forming a ridge.

irregular dune - larger separate dunes with no particular orientation.

hummocky dune terrace - coalesced irregular low dunes which form an elevated terrace, usually with some form of continuous ground cover, generally above even storm tides.

degraded dune - a large mature dune which has been eroded by wind or wave action, usually topped with trees or mature vegetation.

dune ridge - a shore-parallel line of dunes.

precipitation dune - an interior feature where dunes have migrated into another geomorphic type, usually a maritime forest.

artificial beach - man-made beach, mainland feature.

uplands - stable, consolidated, higher shoreline with old-growth forest, usually Pleistocene in age.

perched beach - stranded beach deposit surrounded by new growth of marsh.

coastwise spit - shore-parallel spit reflecting longshore migration of sand, found on the Gulf shores of the barrier islands, used as a foreshore modifier.

bulkhead/seawall - man-made shore protection on the mainland; vertical, curved, or stepped design.

recurved spit - shore-parallel or terminal spit with end or ends curved toward the shore, used as a foreshore modifier.

washover flat - storm washover feature, low relief and bare of vegetation.

washover corridor - constrained storm washover feature wider than 31 meters, generally crosses the full width of an island, bare of vegetation.

washover terrace - storm washover feature which has been colonized by vegetation with a hummocky appearance, generally lower relief than the surrounding landscape.

maritime forest - pine forest, usually on a mature terrace or dune ridge.

marsh - wetland-type grass vegetation in water or in a depression.

tidal flat - low, flat area awash at normal high tide.

open marine water - open water at the ends of the islands and in bays.

pond/lake/lagoon - enclosed or semi-enclosed water body.

major tidal channel - tidal channel wider than 31 meters.

scarp - near-vertical erosion scarp, used as a foreshore modifier only.

riprap - rubble placed in the foreshore for erosion protection.

marina/harbor - man-made feature with visible dock facilities.

breakwater - offshore wave protection structure, used as a foreshore modifier or a primary feature.

dredge spoil - obvious land build-up utilizing dredged material.

The following are point features identified in the classification:

minor tidal channel - small tidal channel less than 31 meters wide.

tidal delta - sand delta in the foreshore resulting from ebb-tidal flow.

washover chute - small linear washover feature, usually crosses a narrow part of an island.

washover splay - interior storm washover delta.

man-made path/trail - obvious worn or built walkway, only found on the barrier islands.

pier - man-made structure built for access into the offshore.

access canal - dredged interior waterway.

groin - man-made, shore-normal structure built to trap migrating sand.

jetty - large, man-made, shore-normal structure, usually built of riprap.

storm outfall - open or closed storm water drainage structure extending into the foreshore, found only on the mainland.

These point features are coded separate from and in addition to the main geomorphic features, and they are represented by symbols adjacent to the geomorphic classification bars on the final maps.

DISCUSSION OF 1991 BARRIER ISLAND DATA

The geomorphic features of Mississippi's barrier islands are indicative of their evolutionary history. Since their formation about 3000-4000 years ago (Otvos, 1979), the islands have migrated westward and show a steady trend of erosion. Their emergence from sand shoals offshore is evident in the interior accretion ridge morphology of the older portions of the islands.

Because the Mississippi barrier islands are much wider than those in Louisiana, it was decided to incorporate a classification of the island interior into the system as well. To do this an additional shore-parallel bar set was constructed. Using the same grid system, the second bar set is coded to reflect the geomorphologic features in the interior of the islands as they are seen on the video. Features near the shore are placed in the bar farthest from the shore, those farther inland are placed in the middle bar, and the most distant features are placed in the bar nearest the shore, thus reflecting the view of the interior as seen by the interpreter's eye. Because the islands are classified from both the north and south shorelines in this manner, a cross-check for classification accuracy is provided. This additional interior inventory will be helpful in identifying changes on the islands as a result of hurricane events, which in the past have overwashed the islands, causing extensive interior modifications.

Typical cross-island profiles were surveyed with a total station on each barrier island. The profiles were geographically located with GPS, and vertical orientation was referenced to mean sea level on the date of each survey. Karen Westphal, with the Louisiana Geological Survey, identified plant and ground cover types along each profile in order to associate particular plants and plant groups with individual geomorphic features. These profiles are included in Appendix A at the end of this section along with the barrier island geomorphic interpretation maps.

Shoreline Features

Ship, Horn, and Petit Bois islands all show a similar trend of shoreline geomorphic features. The predominant shoreline type is a hummocky dune terrace. This reflects the mature nature of the geomorphology of these islands, since a hummocky dune terrace is the common end result of the evolution of other storm-produced features. It has been almost 10 years since the islands have felt the impact of a hurricane (Hurricanes Elena and Juan in 1985). Most of the scars from these events have long since healed. As an example, the area known as "the flats" on Horn island, just east of profile number 4, was almost completely washed out by Hurricane

Camille in 1969. It has evolved from a washover flat to a hummocky dune terrace, and shows signs of further evolution into an irregular dune surface as larger dunes are colonized by stable plant cover. All of the washover flats currently on the islands are located near the low-relief ends of the islands where winter and spring storms wash over them on a regular basis.

The only marsh shorelines on the islands are found on the protected north shores. Given the predominant south and southeast winds, there is little sand dune migration on the north shores of the islands to bury the marsh grasses. All of the tidal channels are also found on the north shores of the islands. Coppice dunes and dune ridges are only found on the south, windward sides of the islands due to the eolian evolutionary history of these features. Degraded dunes are found at the eastern ends of Petit Bois and Horn islands, reflecting erosion of the dune platforms at the eastern ends of the islands.

The shoreline features of all the islands show a pronounced erosional scarp near the high tide line. The scarp is more widespread on the north shores of the islands despite the larger waves on the south side, probably as a result of less eolian sand movement there which can obliterate and cover the scarp. Wherever a maritime forest appears on the shoreline, it is an erosional feature, usually on the north side of an island as the older, more stable island interior is eroded away.

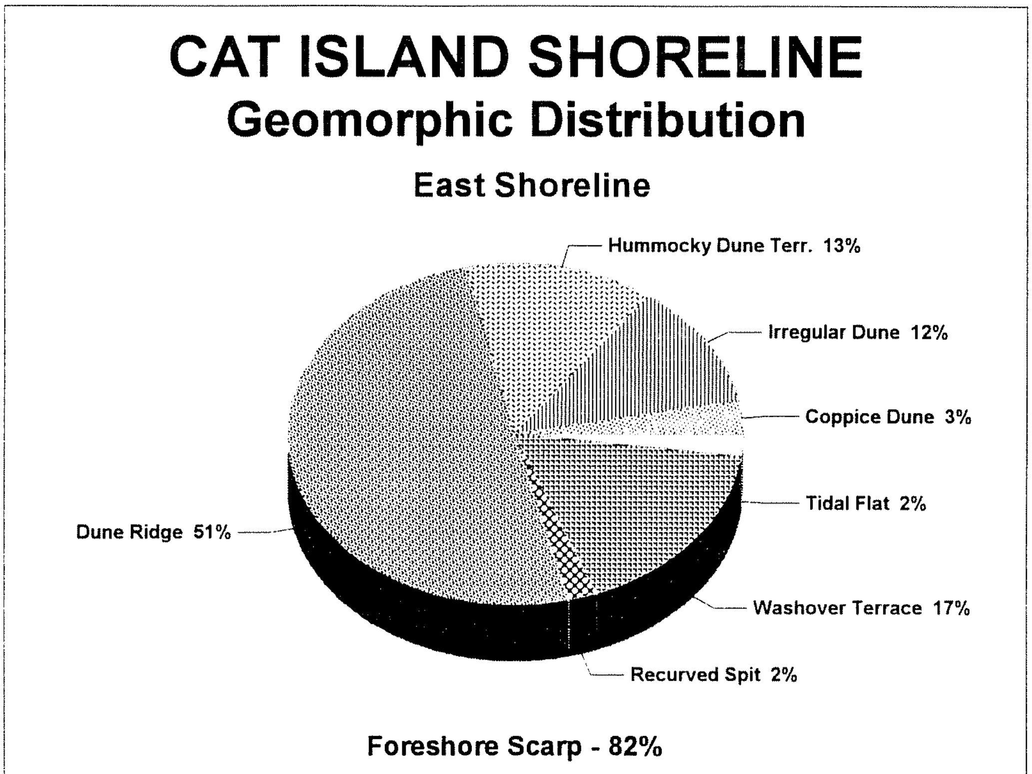
Ship Island has the lowest relief of the three migrating islands, and shows the greatest storm-induced geomorphic character. Camille Cut which separates East Ship and West Ship islands is the result of Hurricane Camille in 1969, which overwashed the island and established the present tidal pass. Ship Island has the greatest percentage of washover flat features along the shoreline as well as the highest percentage of shoreline dune ridges. The orientation of Ship Island is slightly different than Horn and Petit Bois. It trends more northeast-southwest, and thus is exposed to more direct onshore winds than Horn and Petit Bois. This lower shoreline angle of wind incidence produces a more pronounced dune ridge morphology and also explains the relatively low percentage of shoreline scarp on the island; the wind obliterates the scarp.

Cat Island has a different evolutionary history from the other barrier islands, and this is reflected in the range and distribution of geomorphic features found there. The island's original east-west orientation was altered about between 3000 and 1500 years ago by the emplacement of the Mississippi River St. Bernard delta. The east end of the island was eroded back by the changed north-south tidal currents into a northeast-southwest sand spit. This orientation of the eastern shore of the island subjects it to direct, on-shore wind action. The eastern shore of the island is dominated by an almost continuous shore-parallel dune ridge which is being scarped by erosion and is migrating slowly to the west, building precipitation dunes as it is thrown over the older, more stable portion of the island. Recurved spits commonly form at the north and south ends of this shoreline as storm and tidal currents move sand back and forth around and into the protected water behind it.

The western shores of Cat Island are protected from aggressive wind and wave action by the north-south orientation of the eastern shore. Geomorphic features there are dominated by marsh, maritime forest, and perched beaches. The maritime forest is an erosional feature reflecting both subsidence of the forested ridges of the island, as well as erosion due to wave action. The western shorelines show slightly greater scarp incidence due to reduced wind action and less available sand. The perched beaches occur mainly on the south side of the western end of the island, where previous storm washover features have been isolated by active marsh growth in the protected water there. Tidal channels are only found on the western end of the island where wave action is minimal. Graphic illustration of the distribution of shoreline features on the barrier islands is shown in Figures 1, 2, 3, and 4.

Interior Features

Whereas description and statistical analysis of the distribution of shoreline features on the islands yield fairly objective, accurate results, description and analysis of the interior features of the islands are very subjective at best. The coding of interior features is designed to give a general feel for the island interior as seen on the video, but it lacks the objective linear distribution of the shoreline coding scheme. The results shown in the pie charts in Figures 5, 6, 7, and 8 for interior feature distribution incorporate both interior bar series and therefore include duplication of some features. Prominent features such as maritime forest and marsh tend to obscure other


CAT ISLAND SHORELINE
Geomorphic Distribution
East Shoreline
Hummocky Dune Terr. 13%
Irregular Dune 12%
Coppice Dune 3%
Tidal Flat 2%
Washover Terrace 17%
Recurved Spit 2%
Dune Ridge 51%
Foreshore Scarp - 82%

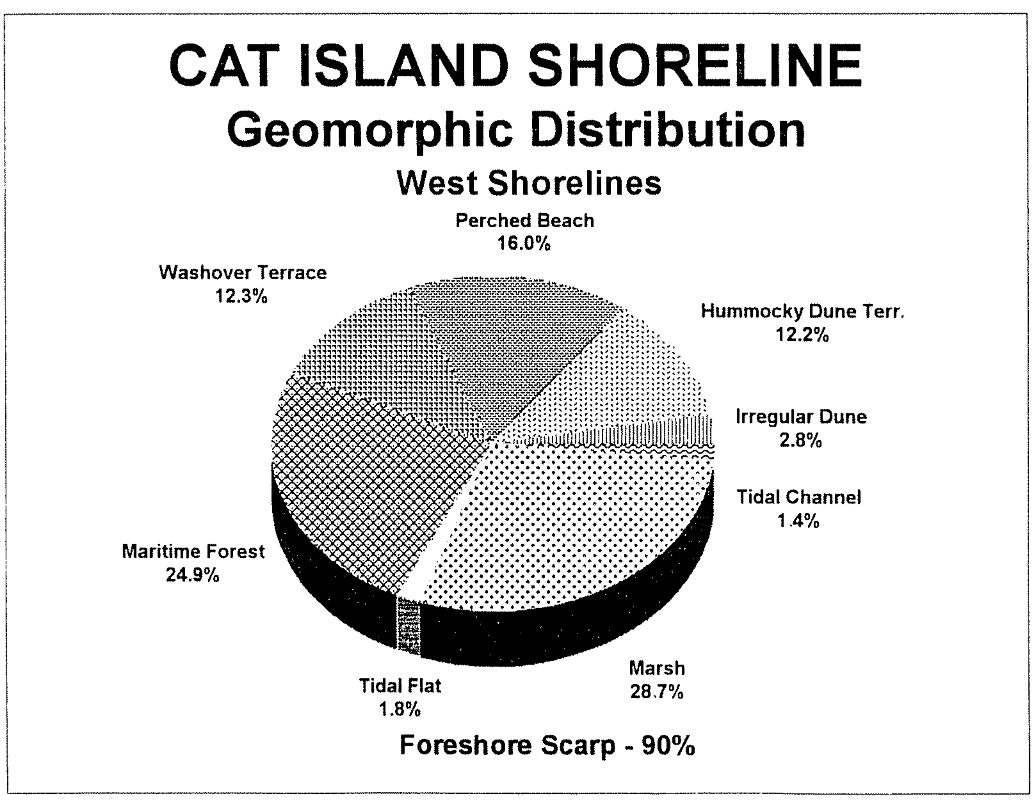

CAT ISLAND SHORELINE
Geomorphic Distribution
West Shorelines
Perched Beach
16.0%
Washover Terrace
12.3%
Hummocky Dune Terr.
12.2%
Irregular Dune
2.8%
Tidal Channel
1.4%
Maritime Forest
24.9%
Marsh
28.7%
Tidal Flat
1.8%
Foreshore Scarp - 90%

Figure 1

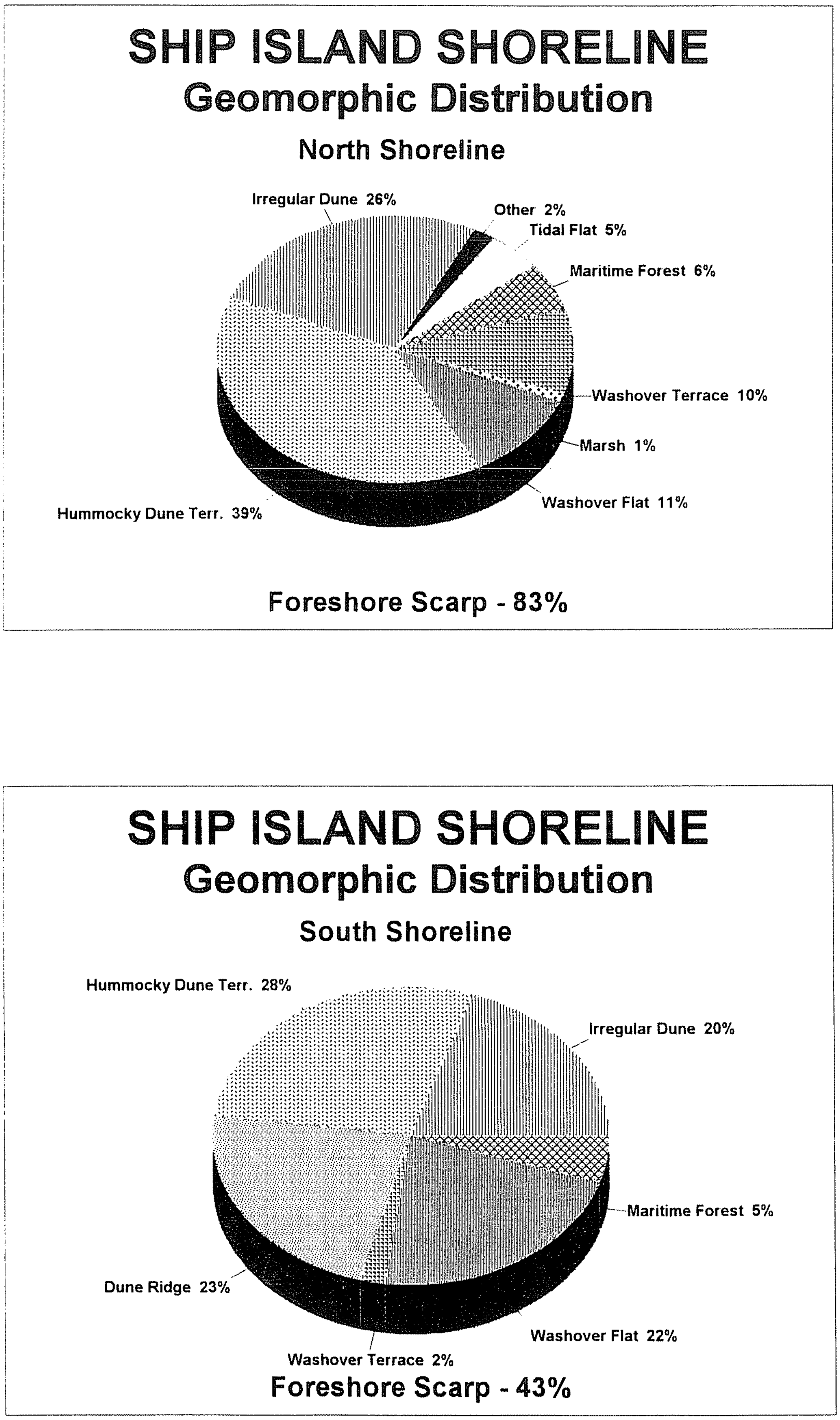
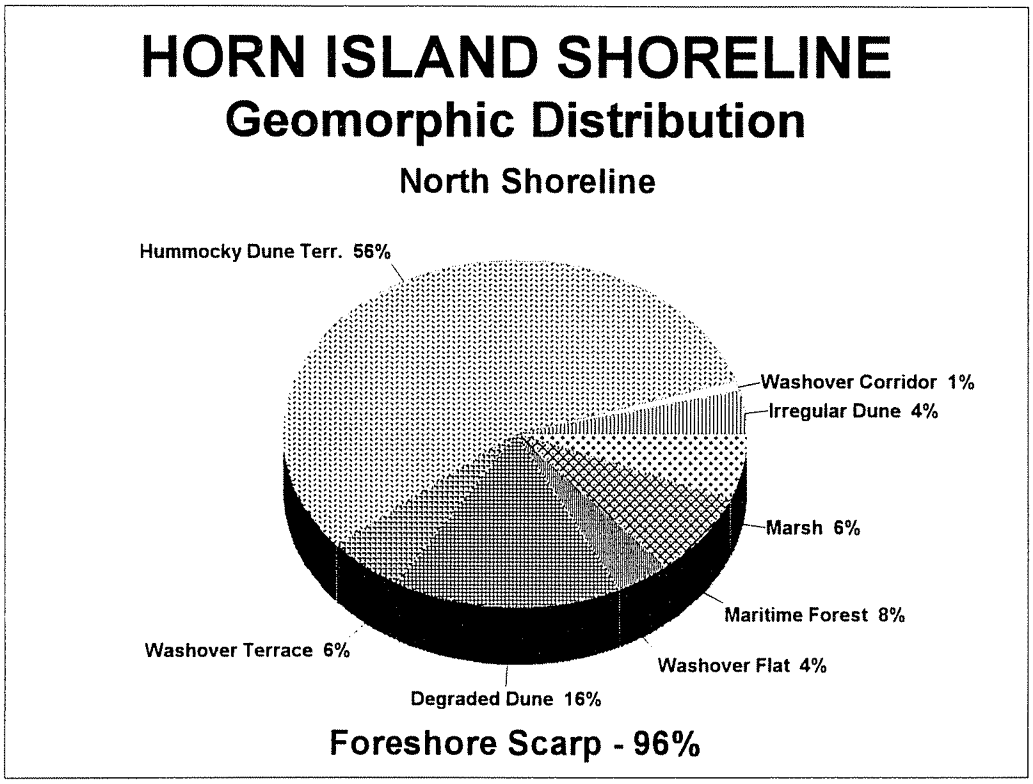

SHIP ISLAND SHORELINE
Geomorphic Distribution
North Shoreline
Irregular Dune 26%
Other 2%
Tidal Flat 5%
Maritime Forest 6%
Washover Terrace 10%
Marsh 1%
Washover Flat 11%
Hummocky Dune Terr. 39%
Foreshore Scarp - 83%
SHIP ISLAND SHORELINE
Geomorphic Distribution
South Shoreline
Hummocky Dune Terr. 28%
Irregular Dune 20%
Maritime Forest 5%
Dune Ridge 23%
Washover Flat 22%
Washover Terrace 2%
Foreshore Scarp - 43%

Figure 2


HORN ISLAND SHORELINE
Geomorphic Distribution
North Shoreline
Hummocky Dune Terr. 56%
Washover Corridor 1%
Irregular Dune 4%
Marsh 6%
Maritime Forest 8%
Washover Flat 4%
Degraded Dune 16%
Washover Terrace 6%
Foreshore Scarp - 96%

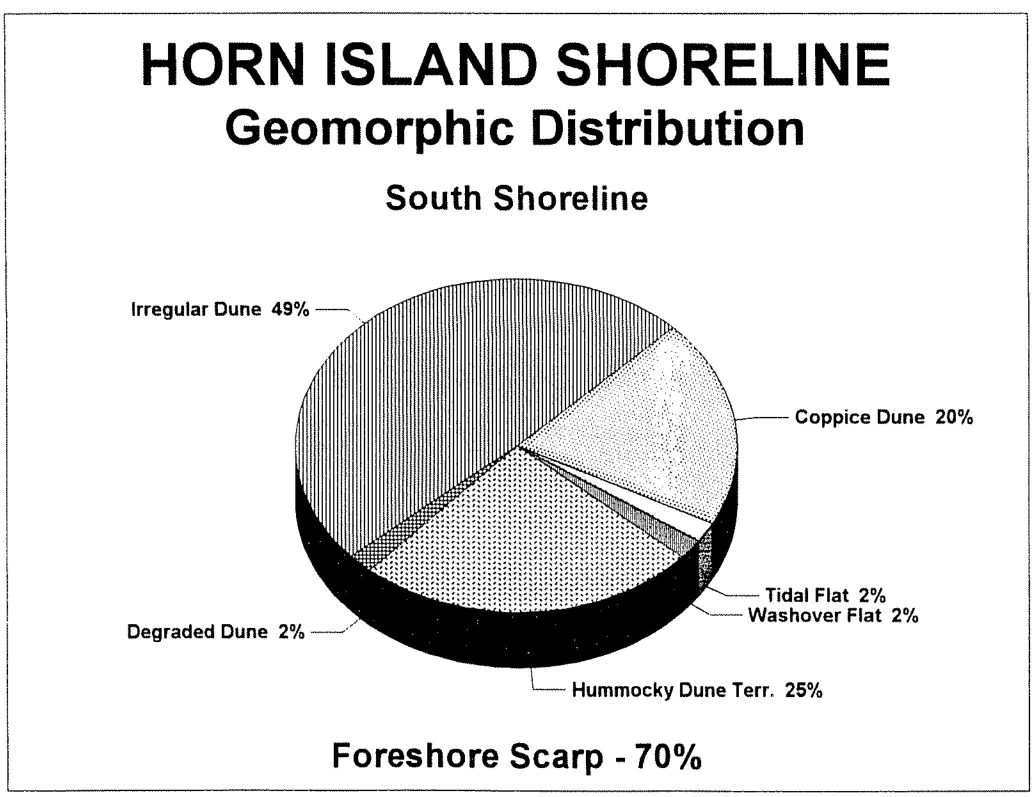
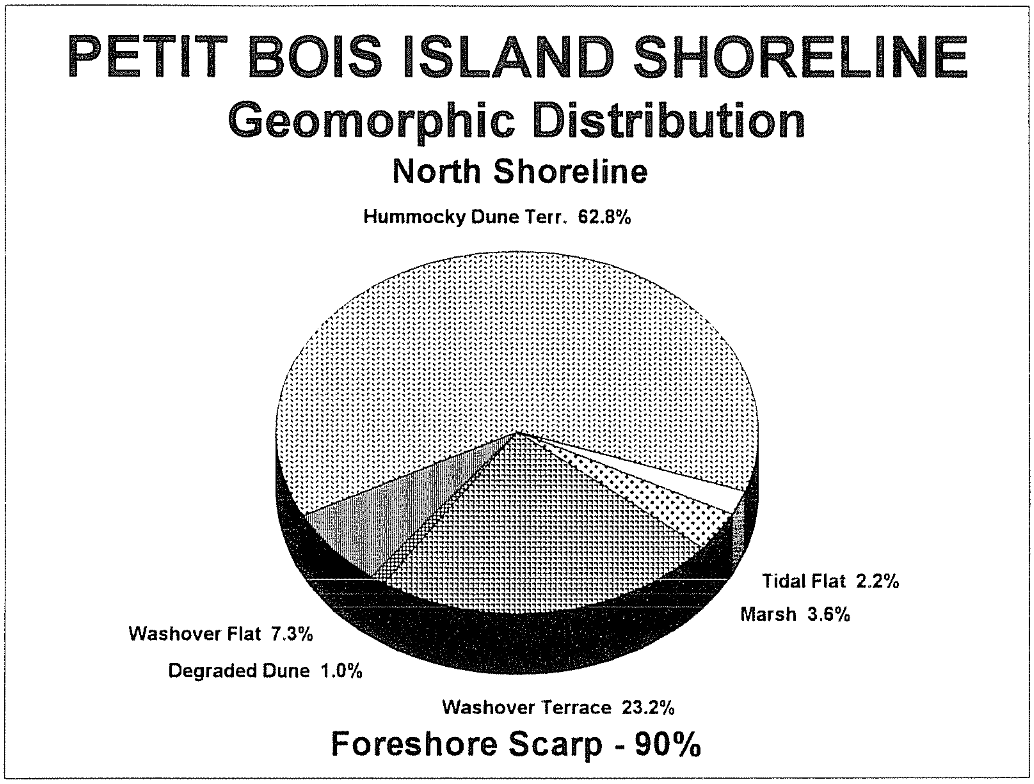

HORN ISLAND SHORELINE
Geomorphic Distribution
South Shoreline
Irregular Dune 49%
Coppice Dune 20%
Tidal Flat 2%
Washover Flat 2%
Hummocky Dune Terr. 25%
Degraded Dune 2%
Foreshore Scarp - 70%

Figure 3


PETIT BOIS ISLAND SHORELINE
Geomorphic Distribution
North Shoreline
Hummocky Dune Terr. 62.8%
Tidal Flat 2.2%
Marsh 3.6%
Washover Flat 7.3%
Degraded Dune 1.0%
Washover Terrace 23.2%
Foreshore Scarp - 90%

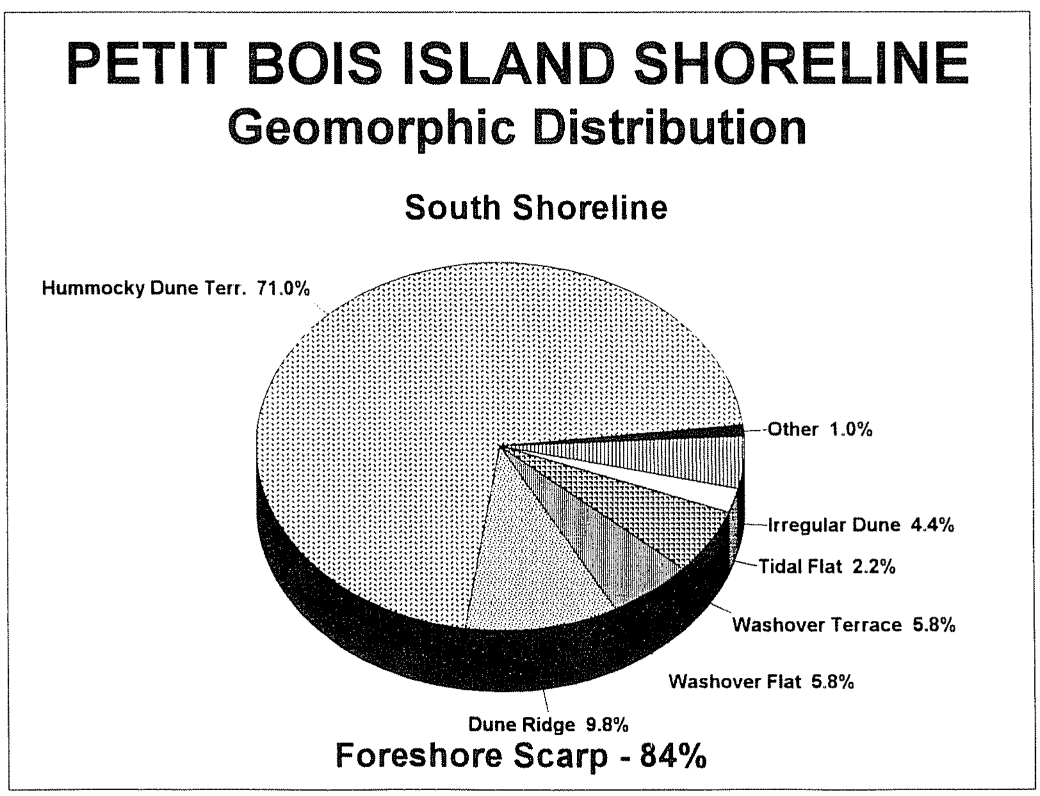

PETIT BOIS ISLAND SHORELINE
Geomorphic Distribution
South Shoreline
Hummocky Dune Terr. 71.0%
Other 1.0%
Irregular Dune 4.4%
Tidal Flat 2.2%
Washover Terrace 5.8%
Washover Flat 5.8%
Dune Ridge 9.8%
Foreshore Scarp - 84%

Figure 4

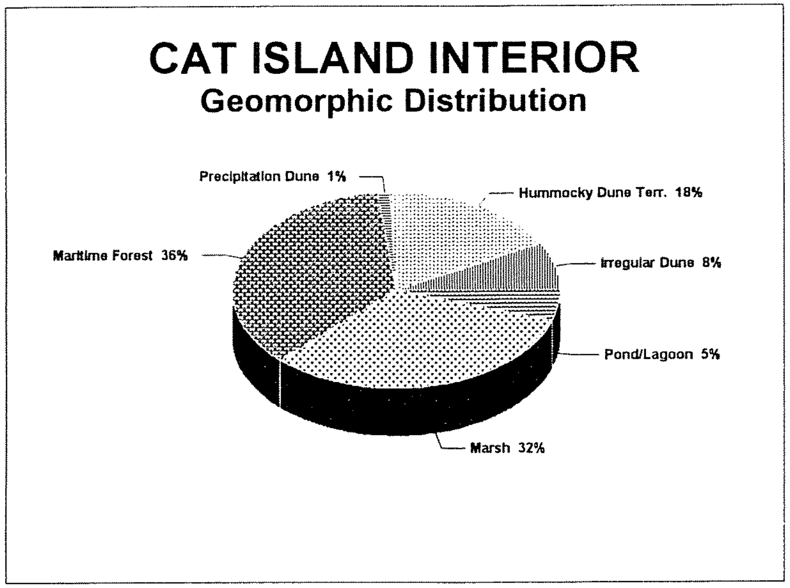


Figure 5

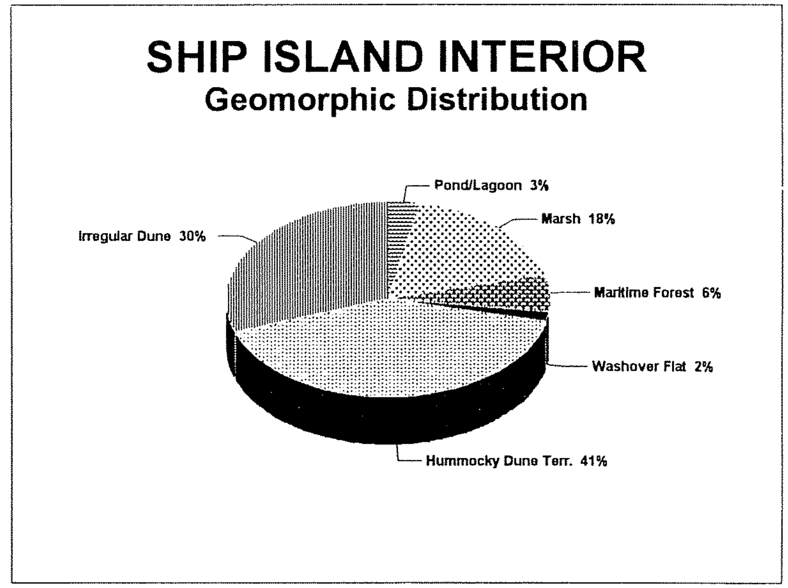


Figure 6

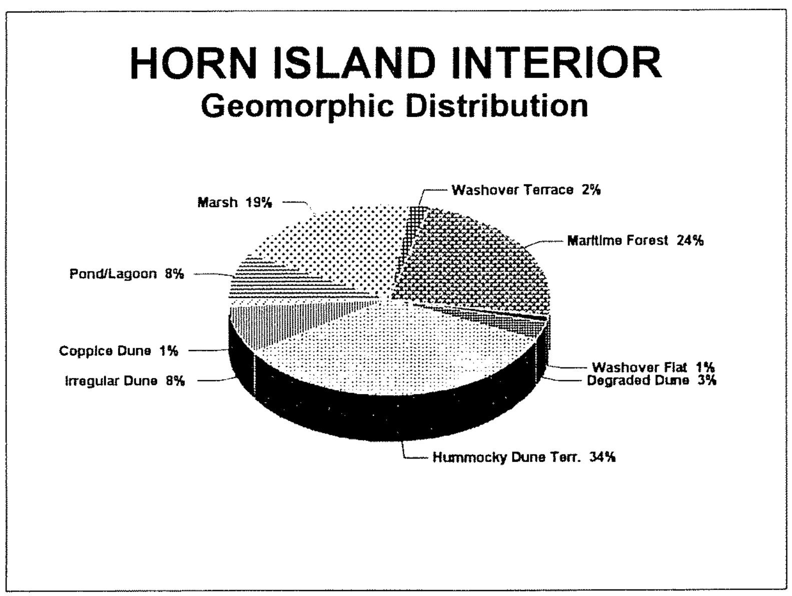


Figure 7

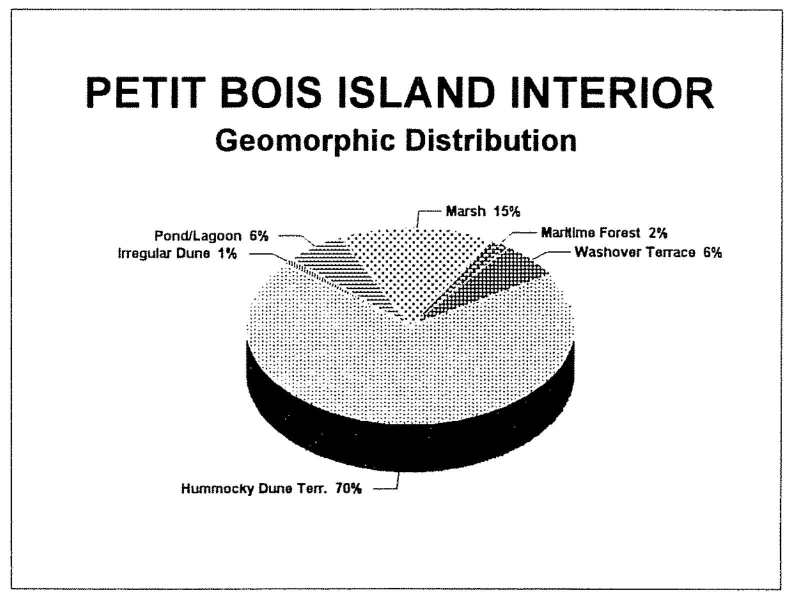


Figure 8

more subtle features, and thus are over-estimated. Ponds and lagoons are under-estimated due to their low relief. Hummocky dune terrace features are probably over-estimated by default, since their appearance from a distance resembles several of the other geomorphic features.

Cat and Horn islands are the largest and most stable of the barrier islands in Mississippi. Their interior is colonized by old growth maritime forest, and there has been relatively little storm overwash into the central portions of these islands. This is reflected in the geomorphic feature distribution charts. Ship Island shows a greater percentage of irregular dunes, reflecting the greater eolian influence discussed previously. Petit Bois Island is dominated by a hummocky dune terrace which covers most of the western portion of the island. This low-relief area was probably overwashed by the most recent hurricanes, and is showing the normal evolutionary recovery sequence from washover flat to washover terrace to hummocky dune terrace that we see on the other islands. The large ponds and interior lagoons on the islands are still in the same place they were when the islands were first mapped in the 1850s. There is active marsh accretion into these water bodies, and future surveys should show this, barring any major storm events.

DISCUSSION OF 1991 MAINLAND DATA

Interpretation Method

The mainland shoreline of Mississippi was also interpreted for geomorphic feature distribution using the 1991 video flyby conducted by LGS. The shoreline interpretation grid system was designed in segments in order to keep the grid as parallel as possible to the shoreline without creating too many segments and to avoid overlap. Only the shoreline is interpreted, since interior features are covered adequately by other mapping agencies. Round and Deer islands are included as part of the mainland system, since they are interior to the Mississippi Sound. Portions of Hancock, Harrison, and Jackson County shorelines have multiple man-made structures in the foreshore. Where this occurs the main feature is mapped as predominant, and the features shoreward or landward of this feature are mapped as modifiers. For example, a riprap revetment modifies the seaward edge of an artificial beach, which has a shoreward modifier in the form of a seawall. The interior portions of St. Louis Bay, Biloxi Bay, and the Pascagoula River were not mapped since there was not complete video coverage available. Shoreline interpretation was done only as far north as the U. S. Highway 90 bridges across the bays.

Shoreline Data Discussion

Data analysis discussed here will begin at the west end of the Mississippi shoreline and proceed to the east in the order that the shoreline maps are arranged in Appendix B at the end of this section.

Hancock County

The west Hancock County shoreline (Pearl River, Heron Bay, and Point Clear sets) is dominated by a marsh shoreline with erosional scarping along almost its entire length. Numerous tidal channels cut into the marsh and occasional perched pocket beaches of mixed shell and sand occur also. This shoreline has a high rate of erosion (see the Historical Shoreline section of this report), and this is evident in the scarp at the edge of the marsh. Several "islands" of pine tree growth occur in the interior of this area, the result of beach ridge deposition in the early Holocene, and they are exposed at two points along the shoreline of the Point Clear section. A single man-made canal (pipeline entry) is found on the Pearl River set.

The East Hancock section is entirely man-made. A seawall fronts this entire section with several man-made beach remnants from the 1967 beach nourishment here. Numerous piers, storm-water outfalls and groins extend into the water along this primarily residential part of the shoreline. The Pleistocene uplands are exposed at the eastern end of this section fronted by a discontinuous seawall. Geomorphic distribution in Hancock County is shown graphically in Figure 9.

Harrison County

The Harrison County shoreline (West Harrison, Gulfport West, Gulfport East, and Biloxi) is also entirely man-made. A seawall, constructed in the 1920s, fronts this entire section. The seawall is in turn fronted by an artificial beach for most of its length. The beach is mapped as the primary feature along this shoreline with the seawall as an interior modifier. In those portions where harbors are present the seawall is not mapped, since it is covered by harbor and road construction. The primary point modifers along this section are storm-water outfalls. The entire stretch of U. S. Highway 90 along this shoreline is drained under the beach to the outfalls exposed along the water line. These outfalls also act as groins, trapping the normally westward migrating sand of the beach. The eastern end of the Biloxi set is considerably more complicated than could be mapped at the scale of this method. The current casino-building boom in this area will simplify the interpretation in future mapping efforts. Harrison County geomorphic distribution is shown in Figure 10.

Jackson County

The Ocean Springs set contains a diverse range of geomorphic features, both man-made and natural. Most of the shoreline is fronted by a seawall with an artificial beach in front of it. Due to the protected nature of this section in the lee of Deer Island, natural marsh habitat has begun to colonize the beach shoreline. Upland Pleistocene is exposed just east of the Ocean Springs small craft harbor, and it exhibits a sharp erosional scarp along the shore. At the eastern end of this section the uplands are fronted by a marsh habitat where they are protected from wave action by the west end of Marsh Point to the south. Numerous piers and outfalls punctuate the shoreline in this section.

The West and East Belle Fontaine sets also show quite a diversity in geomorphologic types. West Belle Fontaine is primarily a washover terrace fronting an extensive marsh habitat. This washover terrace is actually a storm tide sand berm, the result of continual washover into the marsh of the narrow sand beach fronting this section. The beach is only exposed at very low tide, and at normal tide the erosional scarp of the underlying marsh substrate is exposed and mapped in this survey. Several actively prograding marsh sectors occur as a foreshore modifier in the western part of this section. The uplands mapped in the central part of the West Belle Fontaine set are Pleistocene Gulfport Formation sand deposits, which contribute sand to the narrow beach in the area (see Bulletin 130 attached to this report). Some of the uplands are bulkheaded to prevent further erosion. Numerous piers and groins are present along the occupied portion of this section.

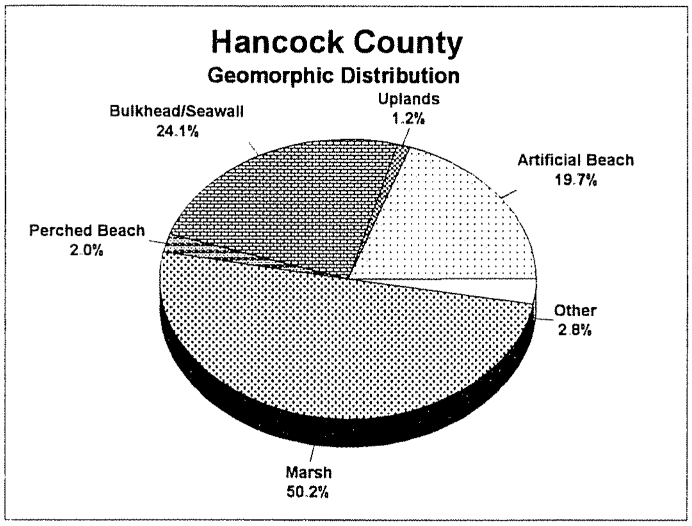


Figure 9

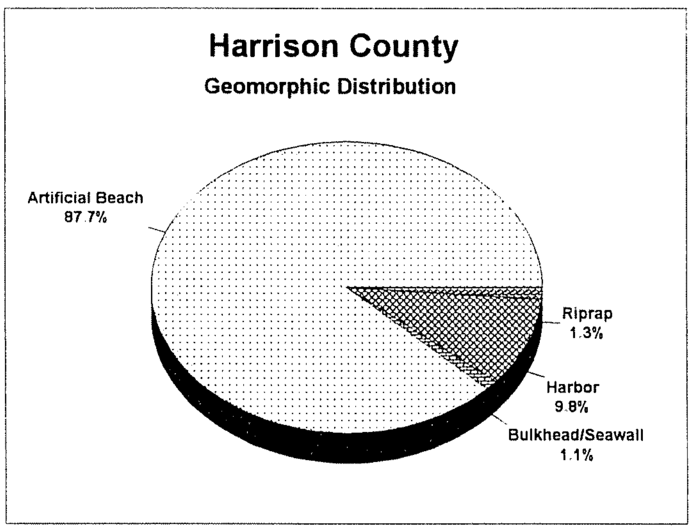


Figure 10

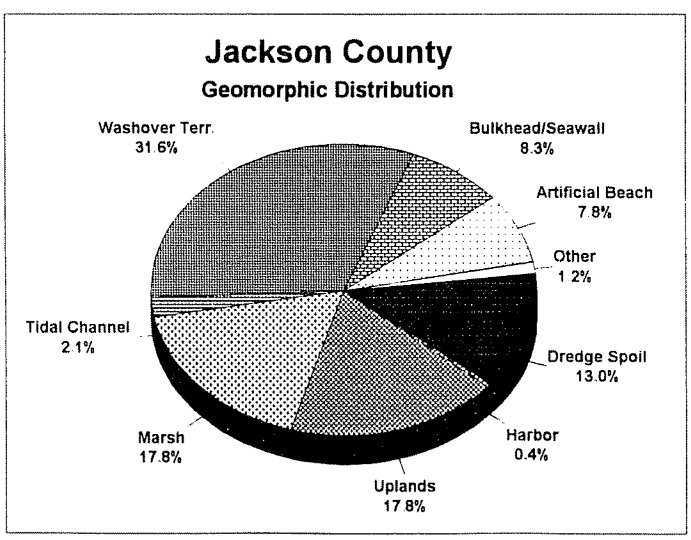


Figure 11

The East Belle Fontaine set contains the only natural beach on the Mississippi mainland in the western part of the section. This beach area is mapped as a hummocky dune terrace with an erosional foreshore scarp. The shoreline is entirely occupied by homesites, and numerous piers and groins are present. A number of homeowners have bulkheaded their property, as shown on the map. The uplands shown on the map are again Pleistocene Gulfport Formation, and the erosional scarp shown on the map is actually up to 12 feet (3.6 meters) high. The washover terrace shown in the central part of this section is similar to that described in the West Belle Fontaine set. Toward the east end of the East Belle Fontaine set the shoreline becomes more protected from southeast wave action by the Pascagoula River delta and Singing River and Round islands. This results in active marsh progradation in front of the uplands along that portion of the shore.

The Pascagoula River delta is composed of numerous small marsh islands in various stages of progradation or erosion. One data set is mapped in this area from video of the east bank of the river shot from the center of the river channel. The habitat is marsh with various tidal channels.

Singing River Island is a dredge spoil island built as the site of the Navy homeport of Pascagoula. It is mapped as dredge spoil, although vegetation has begun to transform the island into an upland habitat. The island shows erosional scarping on all sides exposed to wave action. The west side of the Ingalls Shipyard is shown on this set. This shipyard was built on dredge spoil and dirt fill placed in the area over the past 70 years. Some of the spoil is still evident with an active marsh growth in front of it, and the rest has been converted to uplands with industrial development.

The Pascagoula shoreline is entirely man-made. A curved-face seawall fronts most of the shore. The west end of this set contains dredge spoil with riprap protection at the entrance to the Port of Pascagoula. The artificial beach shown on this set is a protected beach surrounded by a concrete bulkhead in front of the seawall.

The Bayou Casotte set is a large industrial area. Greenwood Island at the west end of the set is an active dredge spoil disposal area. The large tidal channel in the center is Bayou

Casotte, which has been extensively dredged and modified into a port for the Chevron refinery. The washover terrace shown is a storm berm similar to that described for the West Belle Fontaine set. All of the exposed shoreline in this section shows an active erosional scarp.

The Pt. aux Chênes set consists of a washover terrace (storm berm) fronting an extensive marsh habitat inland. The marsh substrate shows continuous erosional scarping with occasional pocket beaches of shell and sand too small to map at this scale. Two dredged canals and numerous small tidal channels cut into the shoreline in this section.

The next two sets (Bangs Lake and Pt. aux Chênes Bay) are fronted by the shallow water (1-3 feet) of Pt. aux Chênes Bay. The interior marsh habitat of the previous set is also present here, but there has been no storm washover of sand to form a washover terrace berm. This area has the highest erosion rate in Mississippi (see the Historical Shoreline Change section of this report) as the exposed marsh is being rapidly undercut and washed away.

The last set (Grande Batture) again shows the washover terrace associated with storm washover of sand into the marsh. This exposed headland area was once a delta of the Escatawpa or the Pascagoula River, now abandoned (Gazzier, 1977; Otvos, 1985). It was once fronted by the Grande Batture Islands which have been completely eroded away, exposing the interior marshes to destructive wave action. The abundance of sand in the eroding substrate has resulted in the washover terrace extending farther into the interior than in previous examples. A washover flat exists at a narrow portion of this shore, and separation will probably occur at this point in the near future. The orange line shown cutting across the east end of the headland is the Mississippi/Alabama state line. Jackson County geomorphic distribution is shown in Figure 11.

Round Island

Round Island is also a relict Pleistocene remnant of the mainland. The uplands habitat mapped is under continuous wave attack, and the resulting erosional scarp is evident. A riprap barrier has been placed around the historic lighthouse at the

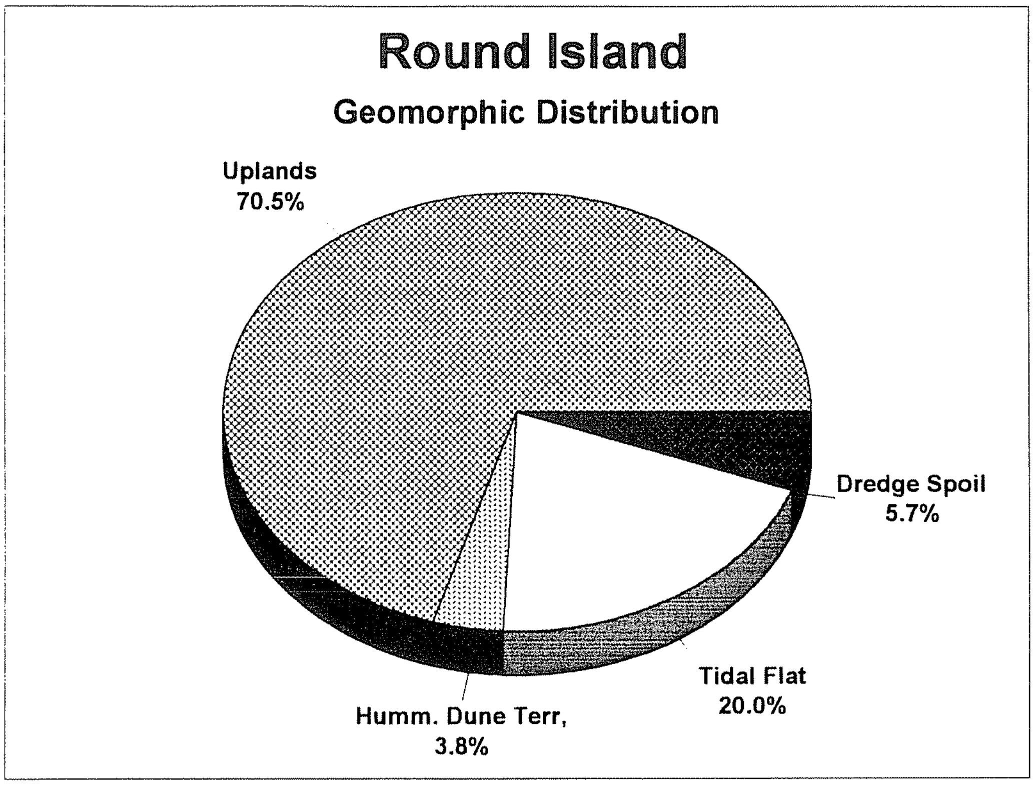


Figure 12

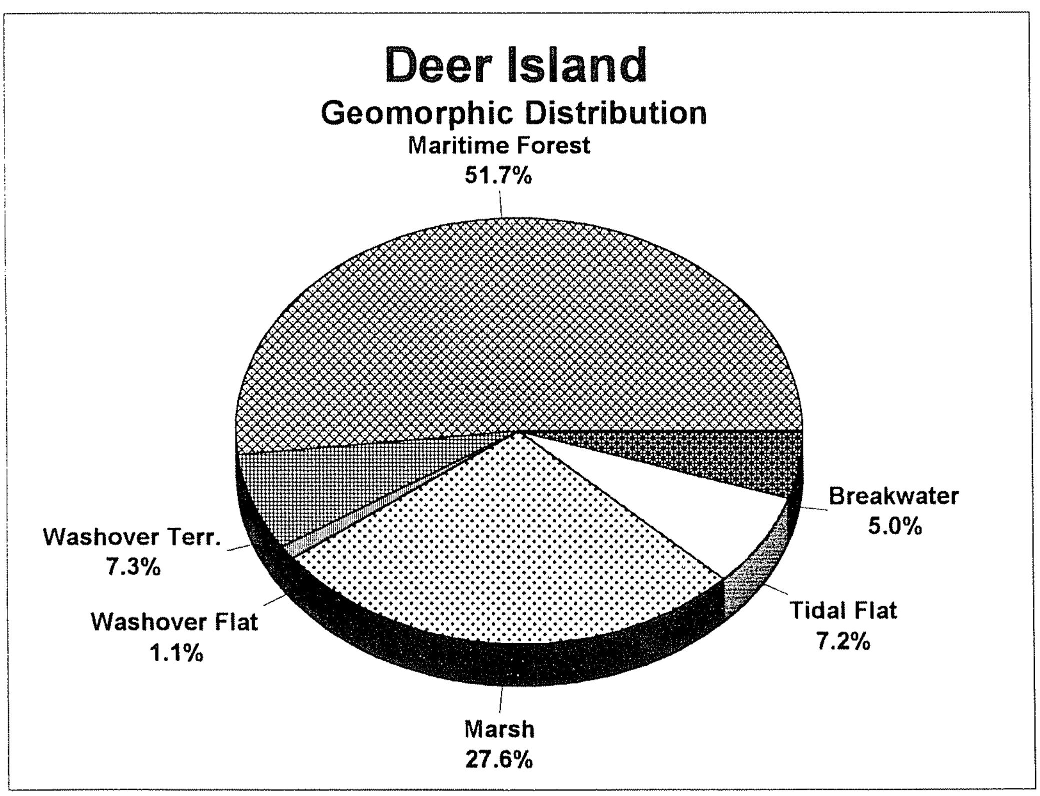


Figure 13

southwest tip of the island and filled with dredged sand. The northwest end of the island is a long sand spit, mapped as a tidal flat, which is formed by sand being eroded from the island and migrating to the northwest in response to the predominant southeast wind direction. Figure 12 shows the geomorphic distribution on Round Island.

Deer Island

Deer Island, located just offshore of the entrance to Biloxi Bay, is a remnant portion of the mainland. It is primarily composed of a relict Pleistocene beach ridge with a mature maritime forest of pine trees established on it. The west end of the island has been extended with dredge spoil and riprap to protect Biloxi Harbor from wave action. The breakwater shown at the east end of the set is built of riprap. The island shows an erosional scarp along all of the south shore and most of the north shore. The east end of the island is mostly marsh which is rapidly retreating under wave attack. Figure 13 shows the geomorphic distribution on Deer Island.

CONCLUSIONS

The Mississippi Shoreline Geomorphology System presented here will serve as a rapid method for evaluating changes to the Mississippi shoreline should a hurricane strike the coast. It can also serve as a convenient tool to help coastal planners and managers keep up with the shoreline changes which occur as a result of continued development of the Mississippi coast.

The mainland coast of Mississippi, according to the current geomorphic inventory, is composed of 56.8% man-made features and 43.2% natural shoreline. Continued development of the coast will undoubtedly increase the percentage of man-made features in the future.

The geomorphic classification and inventory presented here was developed primarily to evaluate storm changes on the islands and development changes on the mainland. A cursory look at non-storm-related shoreline changes which occurred on the barrier islands between the 1989 and 1991 surveys was done by Mario Caputo and Stephen Oivanki (1992), and the results were presented at the Mississippi Academy of Sciences. The Office of Geology plans to do a detailed comparison of the 1989 and 1991 data in the future using the statistical functions of the system as time allows. Future video flights will also be conducted to update the 1991 coverage.

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Debusschere, K., S. Penland, K. A. Westphal, P. D. Reimer, and R. A. McBride, 1991, Aerial videotape mapping of coastal geomorphic changes: Coastal Zone '91, Seventh Symposium on Coastal & Ocean Management, Proceedings, p. 370-390.

Gazzier, C. A., 1977, Holocene stratigraphy of the Bayou Cumbest fluvial system: southeastern Mississippi: M. S. thesis, University of Mississippi, 72 p.

Otvos, E. G., 1979, Barrier island evolution and history of migration, north-central Gulf Coast, *in* S. P. Leatherman, ed., Barrier Islands: New York, Academic Press, p. 291-319.

Otvos, E. G., 1985, Coastal evolution, Louisiana to northwest Florida: American Assoc. of Petroleum Geologists Annual Meeting Guidebook, New Orleans Geological Society, 91 p.

A P P E N D I X   A

BARRIER ISLAND GEOMORPHOLOGY MAPS AND PROFILES

INDEX MAP

1. Pearl River
2. Heron Bay
3. Point Clear
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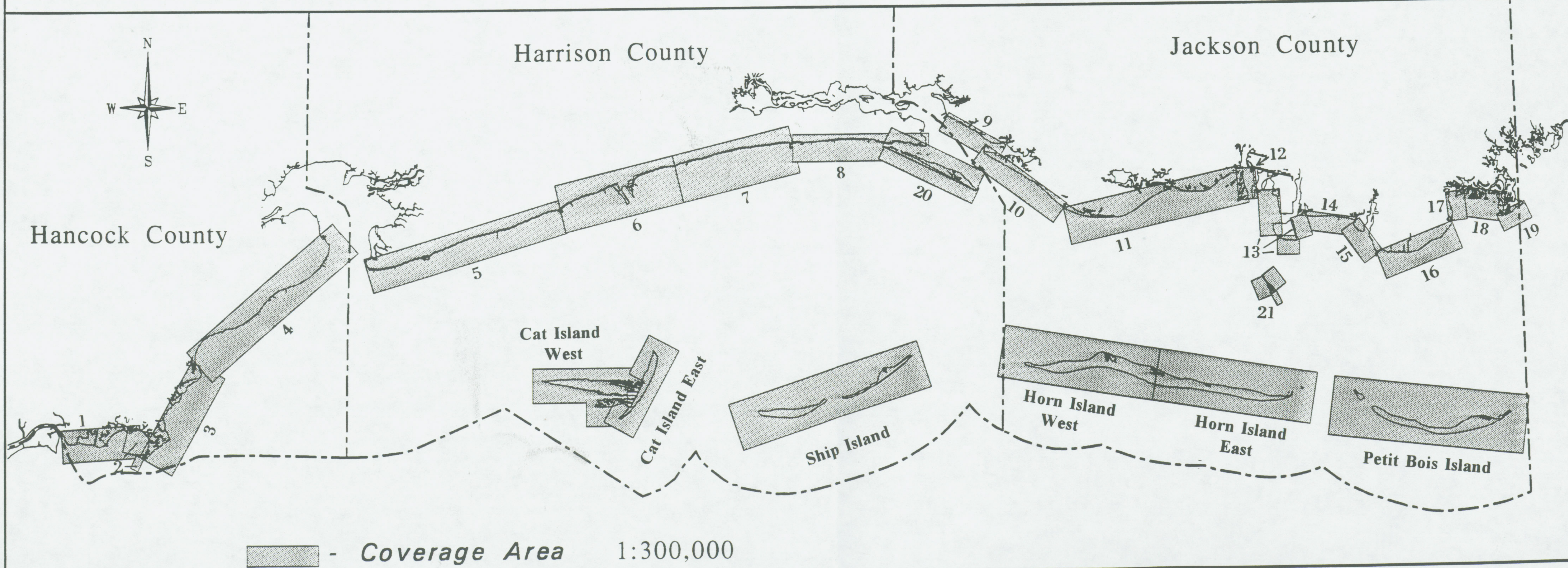
7. Gulfport East
8. Biloxi
9. Ocean Springs
10. West Belle Fontaine
11. East Belle Fontaine
12. Pascagoula River
13. Singing River Island
14. Pascagoula
15. Bayou Casotte
16. Pt. Aux Chênes
17. Bangs Lake
18. Pt. Aux Chênes Bay
19. Grande Batture
20. Deer Island
21. Round Island



MISSISSIPPI SHORELINE GEOMORPHOLOGY SYSTEM

Map Legend

Geomorphic Features

Primaries

- Coppice Dune
- Coalesced Coppice Dune
- Irregular Dune
- Hummocky Dune Terrace
- Degraded Dune
- Dune Ridge
- Precipitation Dune
- Artificial Beach
- Uplands
- Perched Beach
- Coastwise Spit
- Bulkhead / Seawall
- Recurved Spit
- Washover Flat
- Washover Corridor
- Washover Terrace
- Maritime Forest
- Marsh
- Tidal Flat
- Open Marine Water
- Pond / Lake / Lagoon
- Major Tidal Channel
- Erosional Scarp
- Riprap
- Marina / Harbor
- Breakwater
- Dredge Spoil

Modifiers

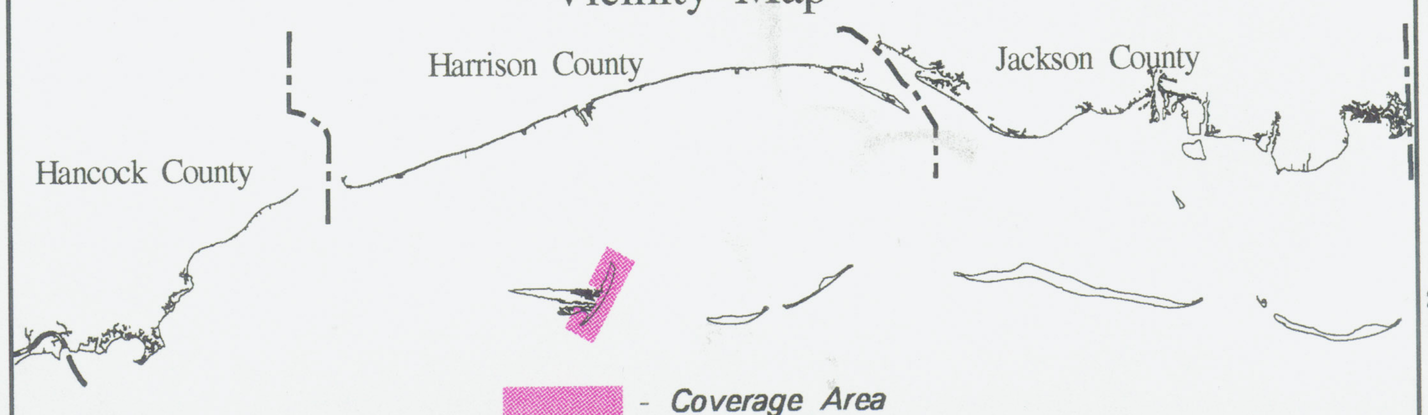
- Minor Tidal Channel
- Tidal Delta
- Washover Chute
- Washover Splay
- Manmade Path / Trail
- Pier
- Access Canal
- Groin
- Jetty
- Storm Outfall

Reference Features

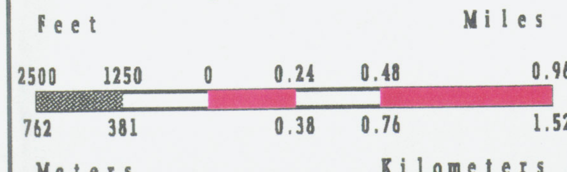
- Coastline
- Manmade Coastal Features
- Primary Highways
- Other Roads
- Railroads
- Rivers
- County Boundaries

Mississippi Shoreline Geomorphology System

Vicinity Map



Map Scale

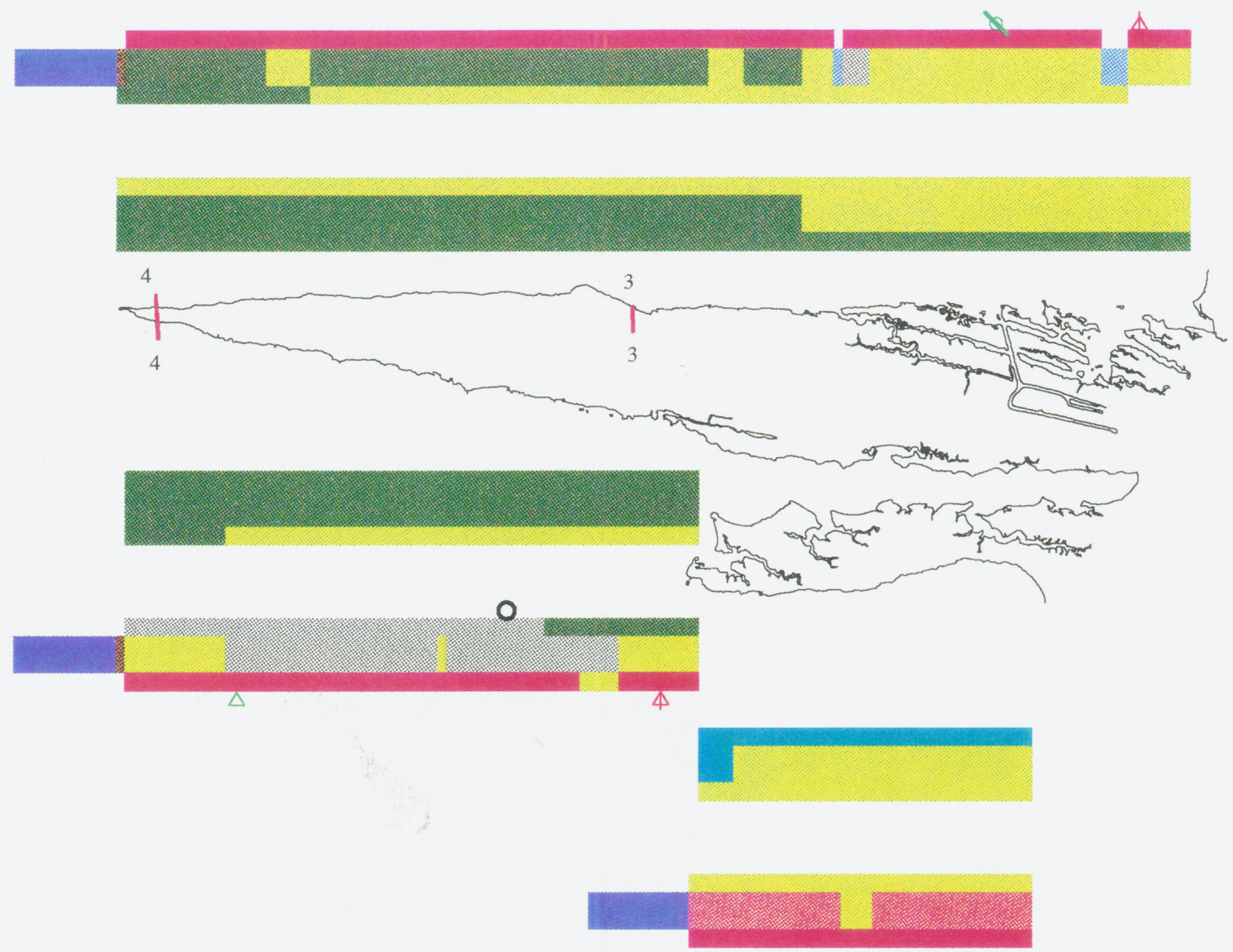


CAT ISLAND EAST

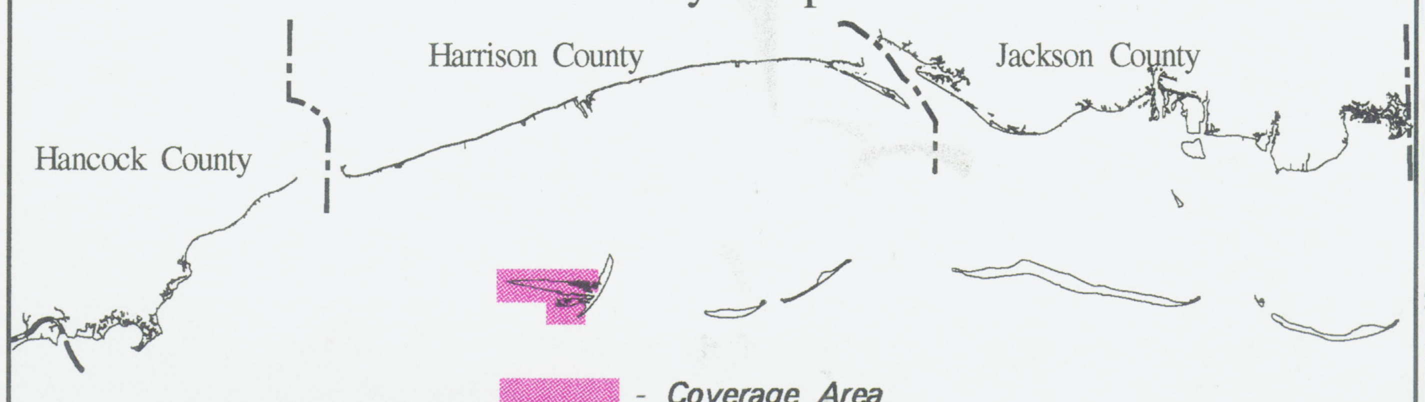
Geomorphology: 1991

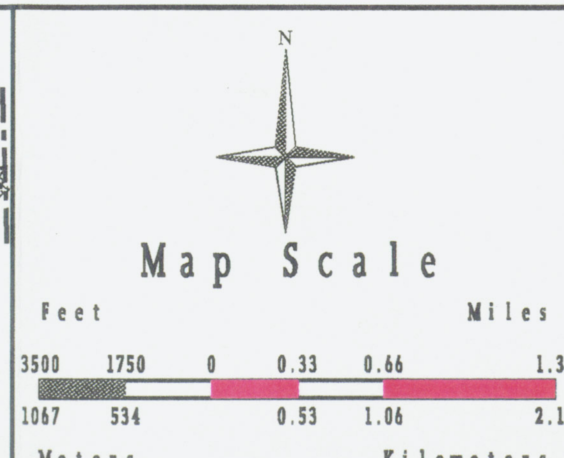
Shoreline: 1986

Mississippi Shoreline Geomorphology System



Vicinity Map





CAT ISLAND WEST

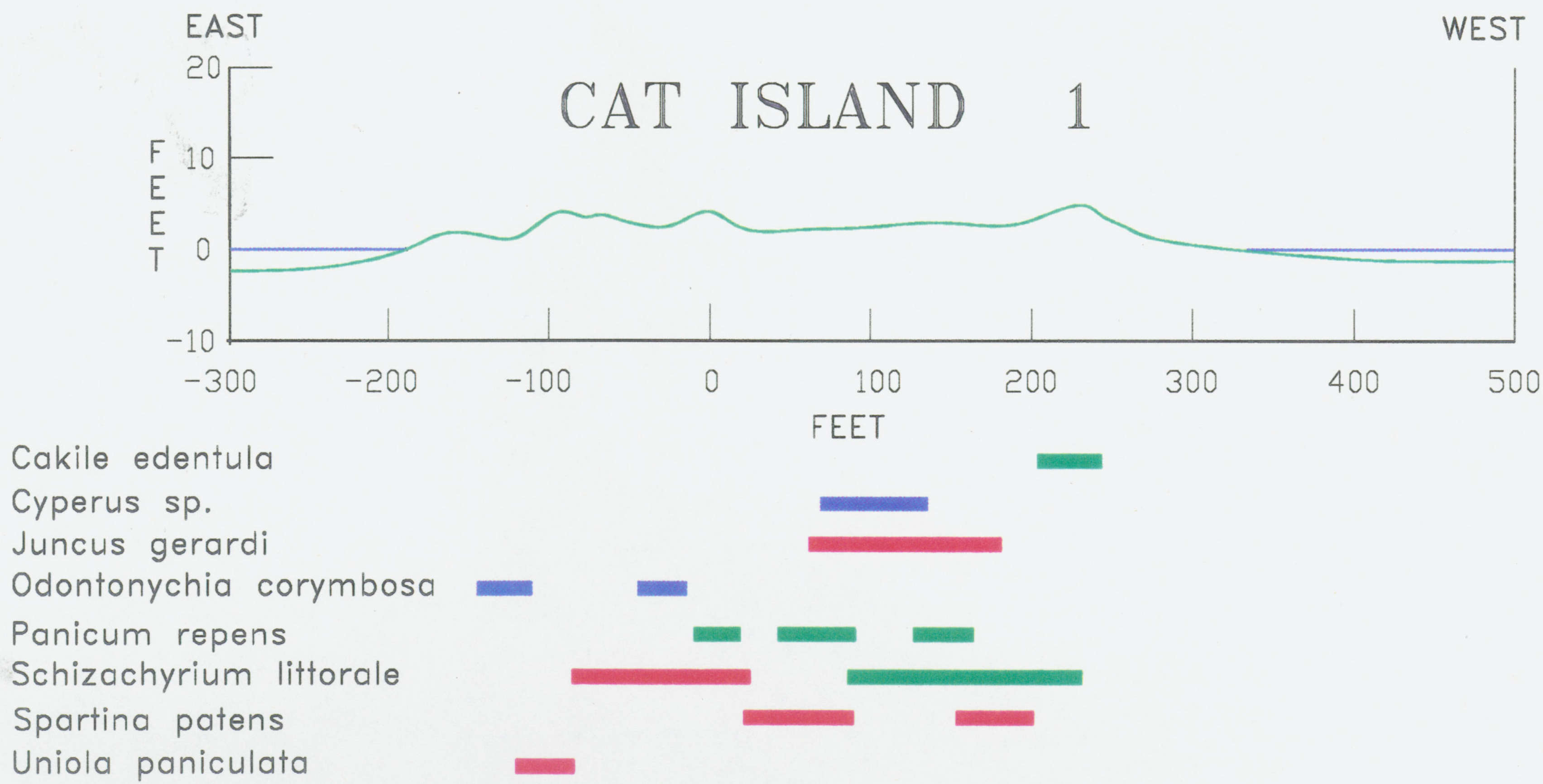
Geomorphology: 1991

Shoreline: 1986

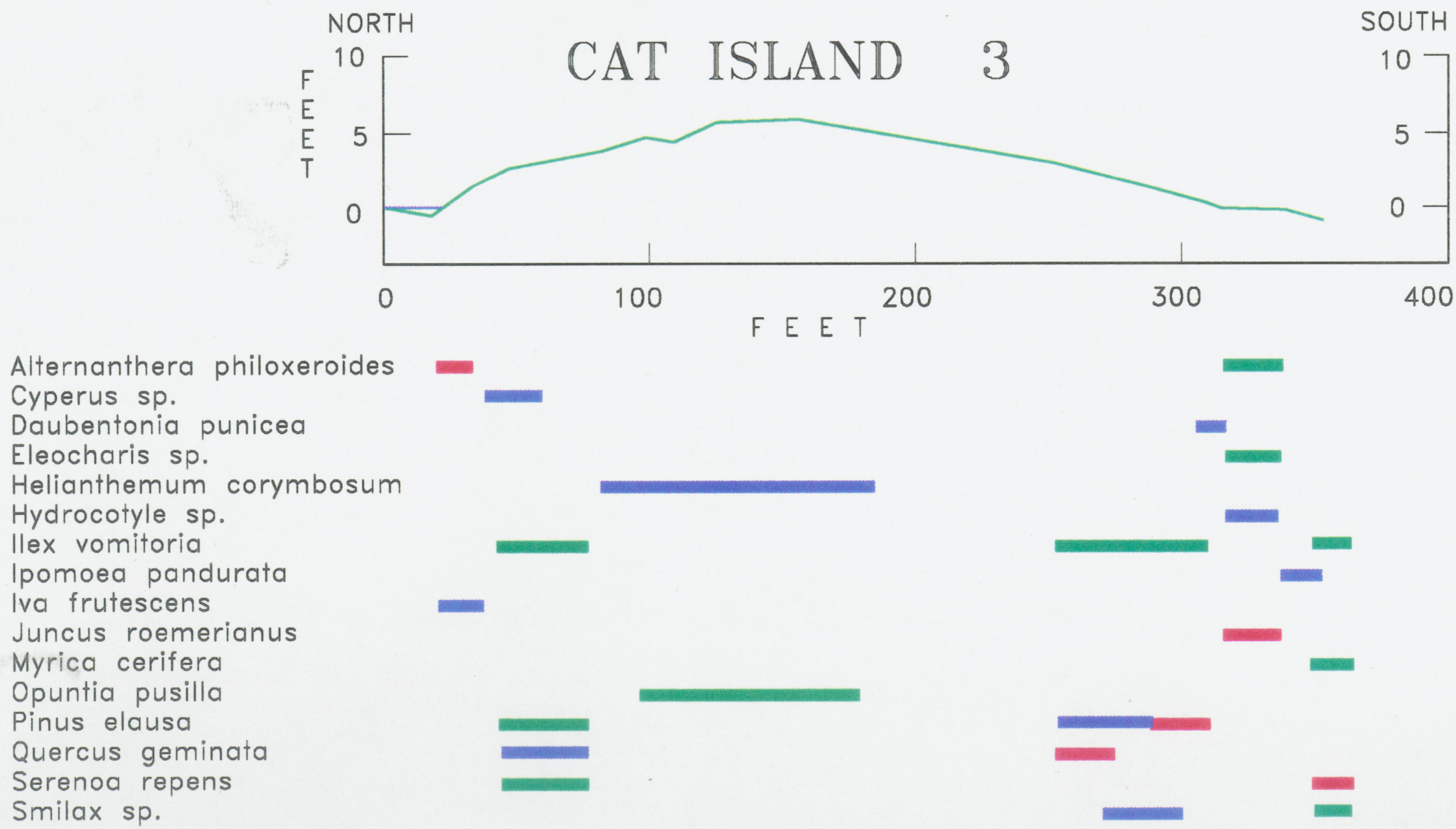
LEGEND

PLANT DISTRIBUTION PROFILES

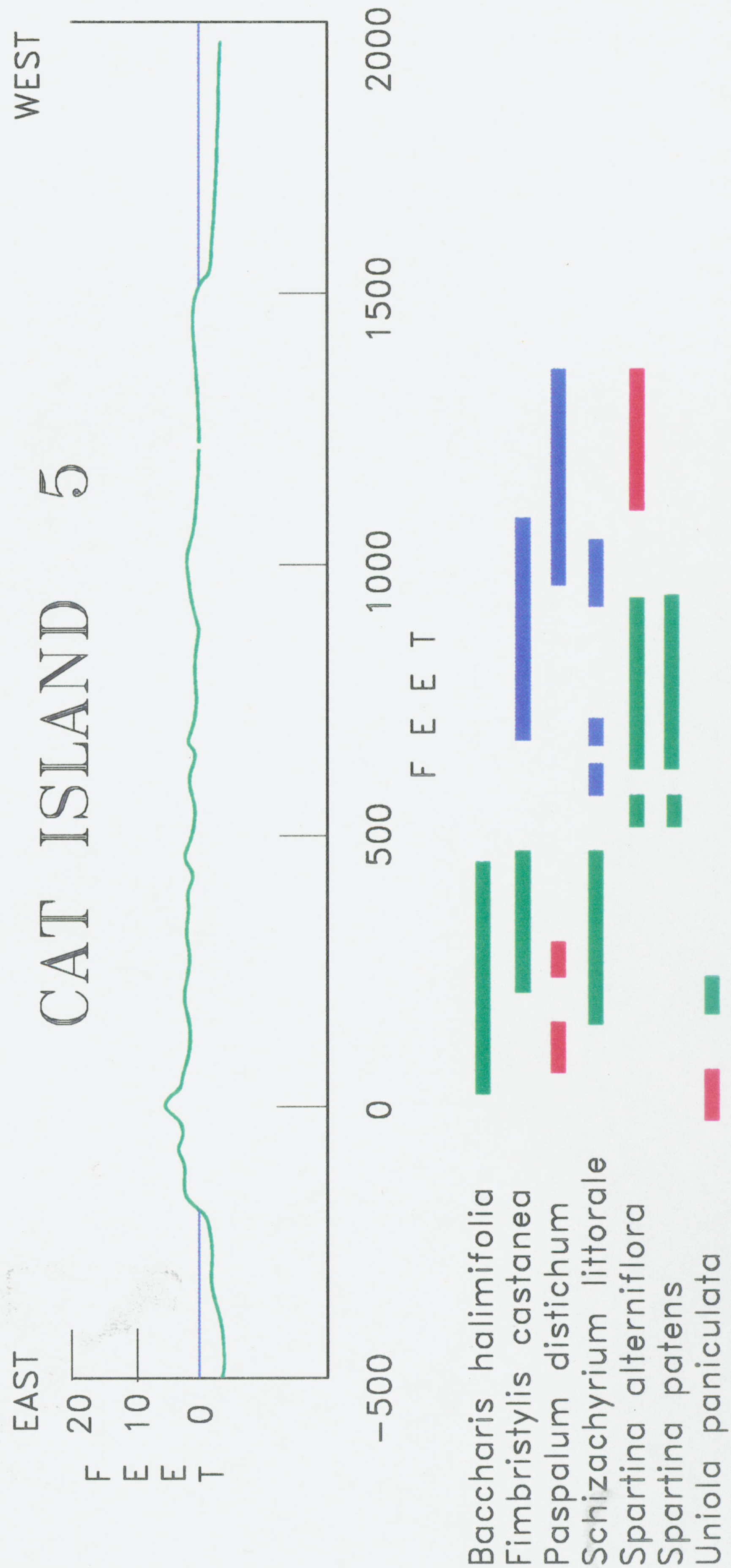
MAJOR OCCURRENCE	red
MIXED OCCURRENCE	green
MINOR OCCURRENCE	blue


CAT ISLAND 1
EAST
WEST
FEET
20
10
0
-10
-300
-200
-100
0
100
200
300
400
500
FEET
Cakile edentula
Cyperus sp.
Juncus gerardi
Odontonychia corymbosa
Panicum repens
Schizachyrium littorale
Spartina patens
Uniola paniculata


CAT ISLAND 2
EAST
WEST
FEET
0
10
20
0
100
200
300
400
500
600
FEET
Baccharis halimifolia
Cakile edentula
Cyperus strigosus
Eleocharis sp.
Helianthemum corymbosum
Ilex vomitoria
Juncus roemerianus
Myrica cerifera
Panicum repens
Pinus elausa
Quercus geminata
Rubus trivialis
Schizachyrium littorale
Serenoa repens
Teucrium canadense
Uniola paniculata


CAT ISLAND 3
NORTH
SOUTH
FEET
10
5
0
0
100
200
300
400
F E E T
Alternanthera philoxeroides
Cyperus sp.
Daubentonia punicea
Eleocharis sp.
Helianthemum corymbosum
Hydrocotyle sp.
Ilex vomitoria
Ipomoea pandurata
Iva frutescens
Juncus roemerianus
Myrica cerifera
Opuntia pusilla
Pinus elausa
Quercus geminata
Serenoa repens
Smilax sp.

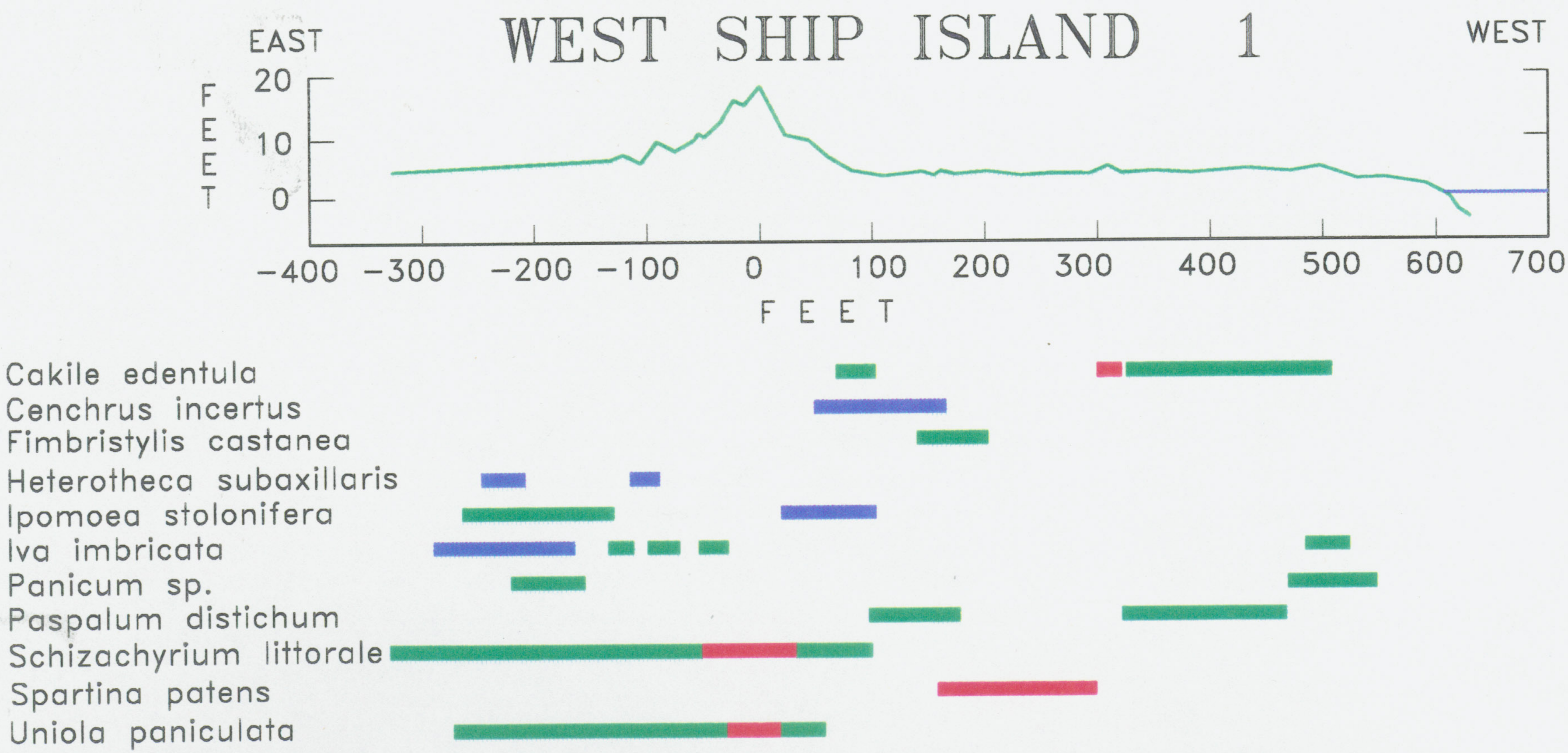

CAT ISLAND 4
SOUTH
NORTH
FEET
10
0
-10
-400
-300
-200
-100
0
100
FEET
Baccharis halimifolia
Erythrina herbacea
Iva frutescens
Lepidium virginicum
Physalis augustifolia
Pinus elausa
Rubus trivialis
Serenoa repens
Spartina alterniflora
Uniola paniculata


CAT ISLAND 5
EAST
WEST
FEET
20
10
0
-500
0
500
1000
1500
2000
FEET
Baccharis halimifolia
Fimbristylis castanea
Paspalum distichum
Schizachyrium littorale
Spartina alterniflora
Spartina patens
Uniola paniculata

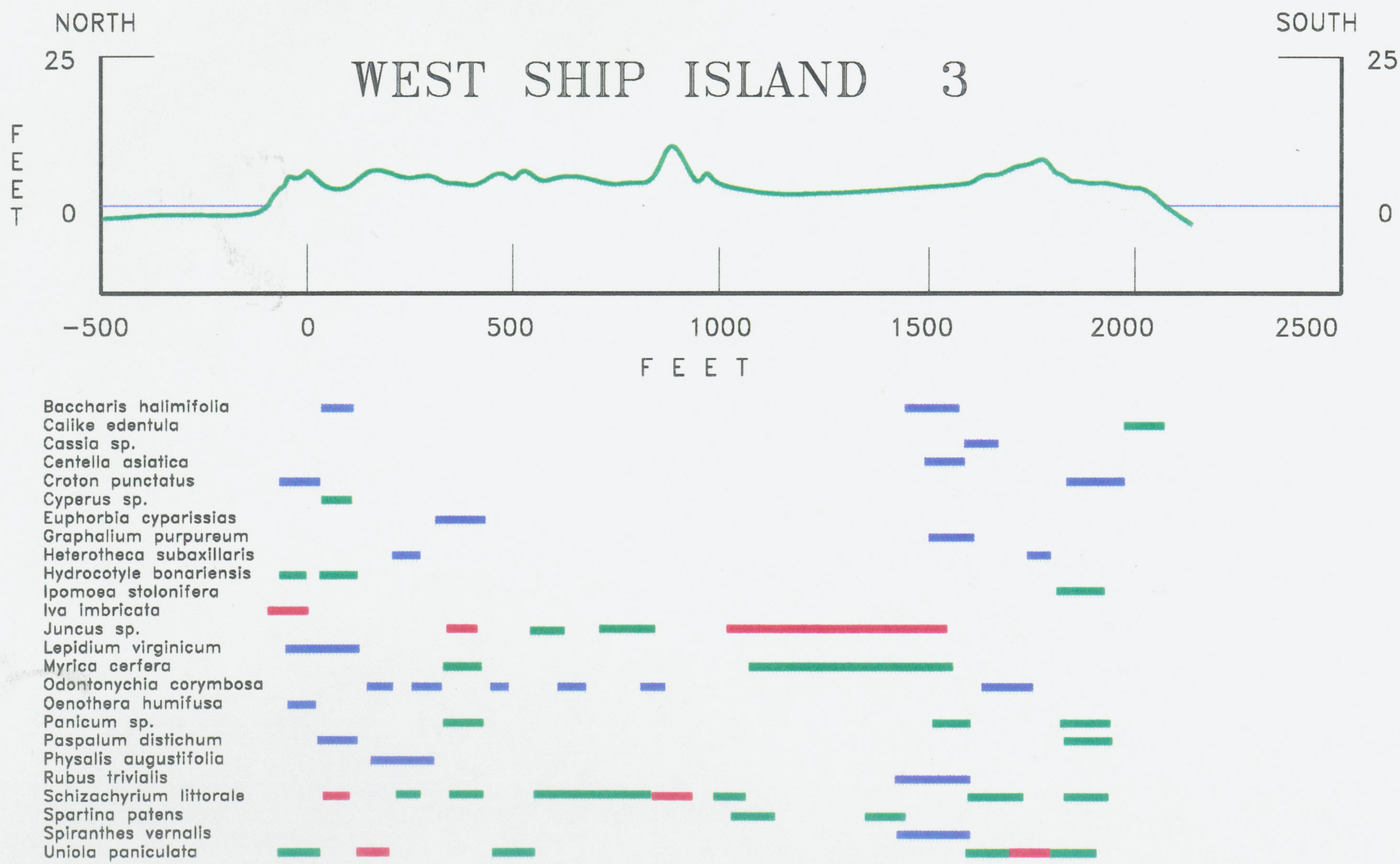
LEGEND

PLANT DISTRIBUTION PROFILES

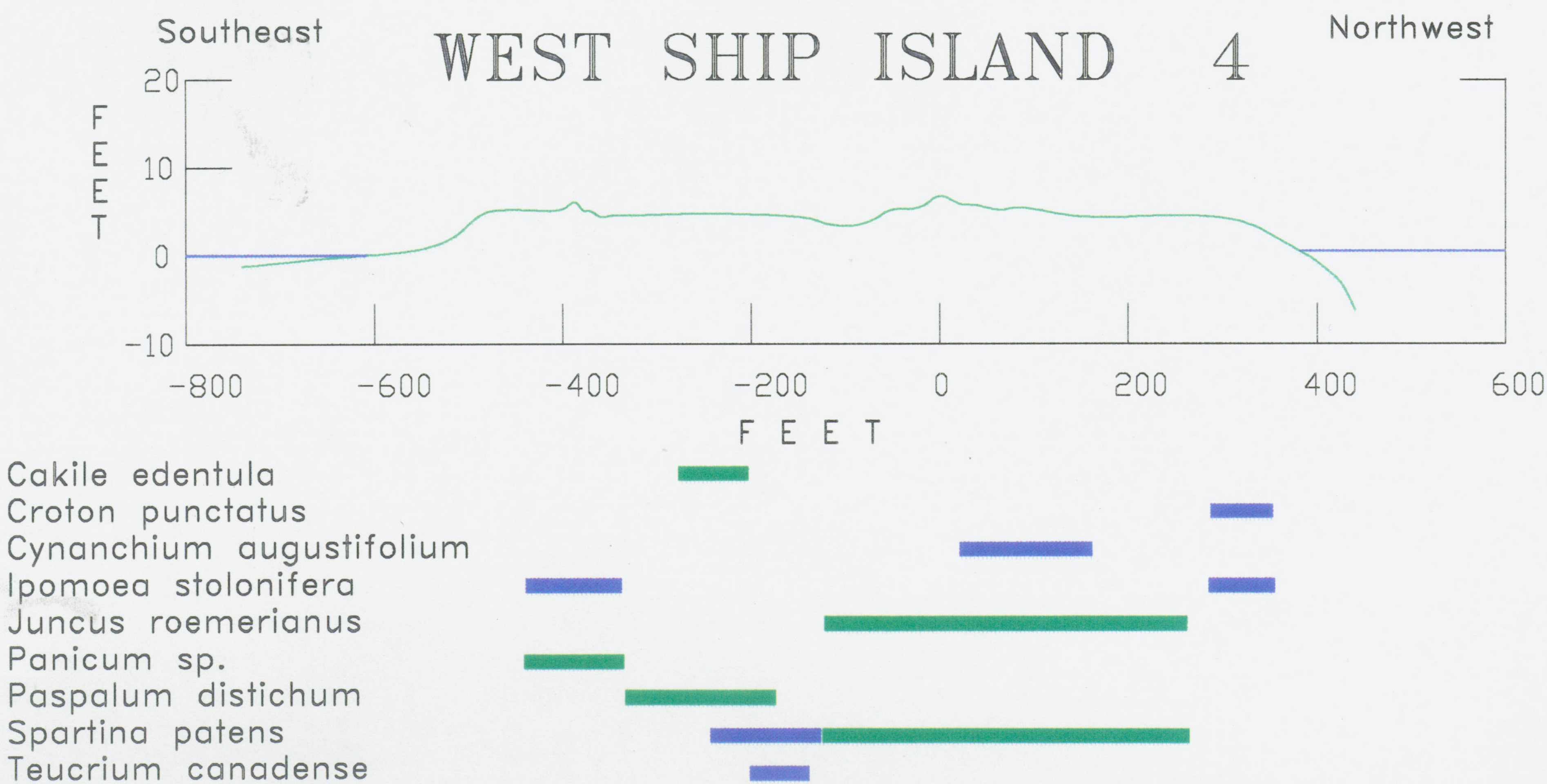
MAJOR OCCURRENCE	red
MIXED OCCURRENCE	green
MINOR OCCURRENCE	blue


WEST SHIP ISLAND 1
EAST
WEST
FEET
20
10
0
-400
-300
-200
-100
0
100
200
300
400
500
600
700
FEET
Cakile edentula
Cenchrus incertus
Fimbristylis castanea
Heterotheca subaxillaris
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Paspalum distichum
Schizachyrium littorale
Spartina patens
Uniola paniculata

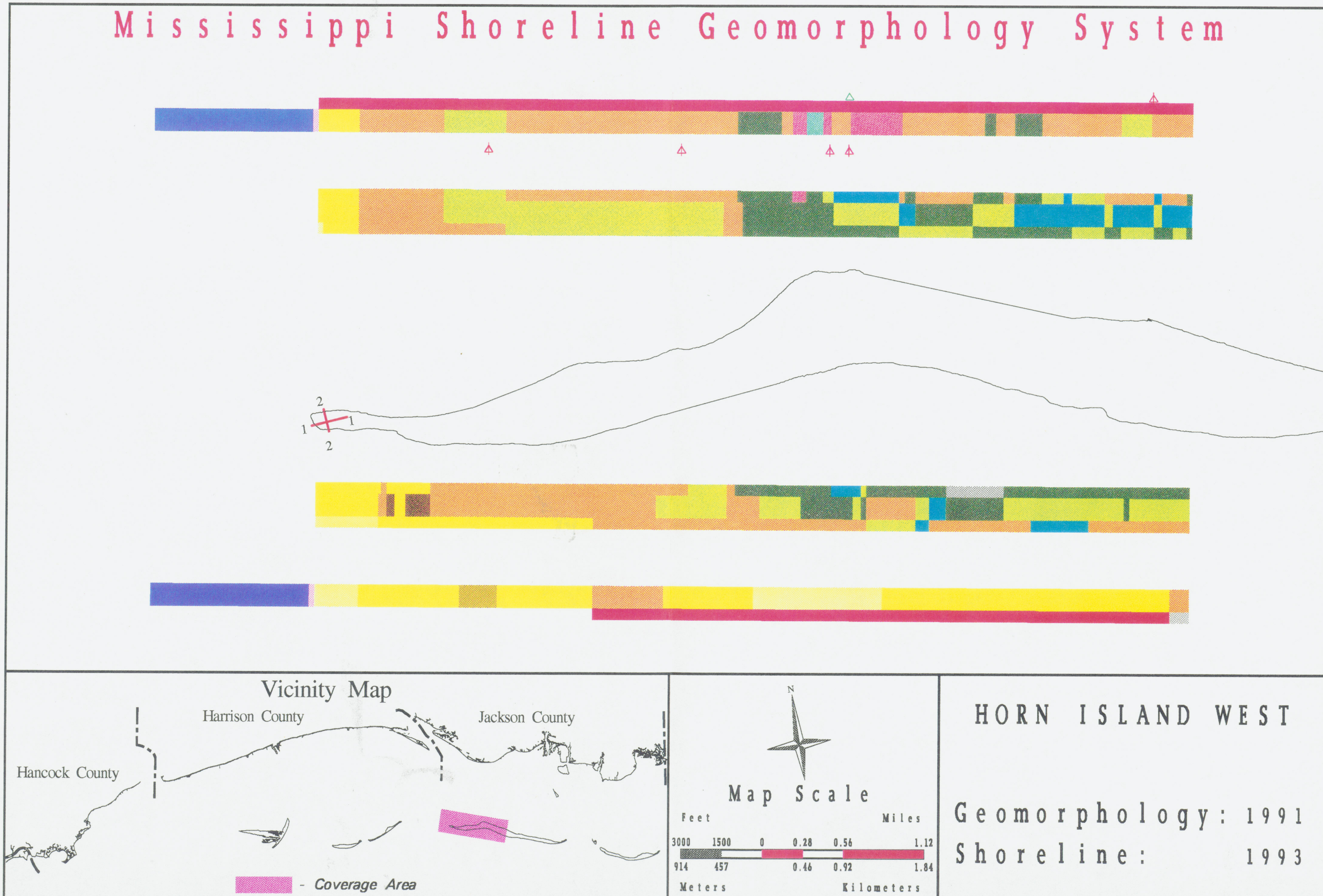

WEST SHIP ISLAND 2
NORTH
SOUTH
FEET
20
0
-600
-400
-200
0
200
400
600
800
FEET
Cakile edentula
Cenchrus incertus
Croton punctatus
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Paspalum distichum
Schizachyrium littorale
Uniola paniculata



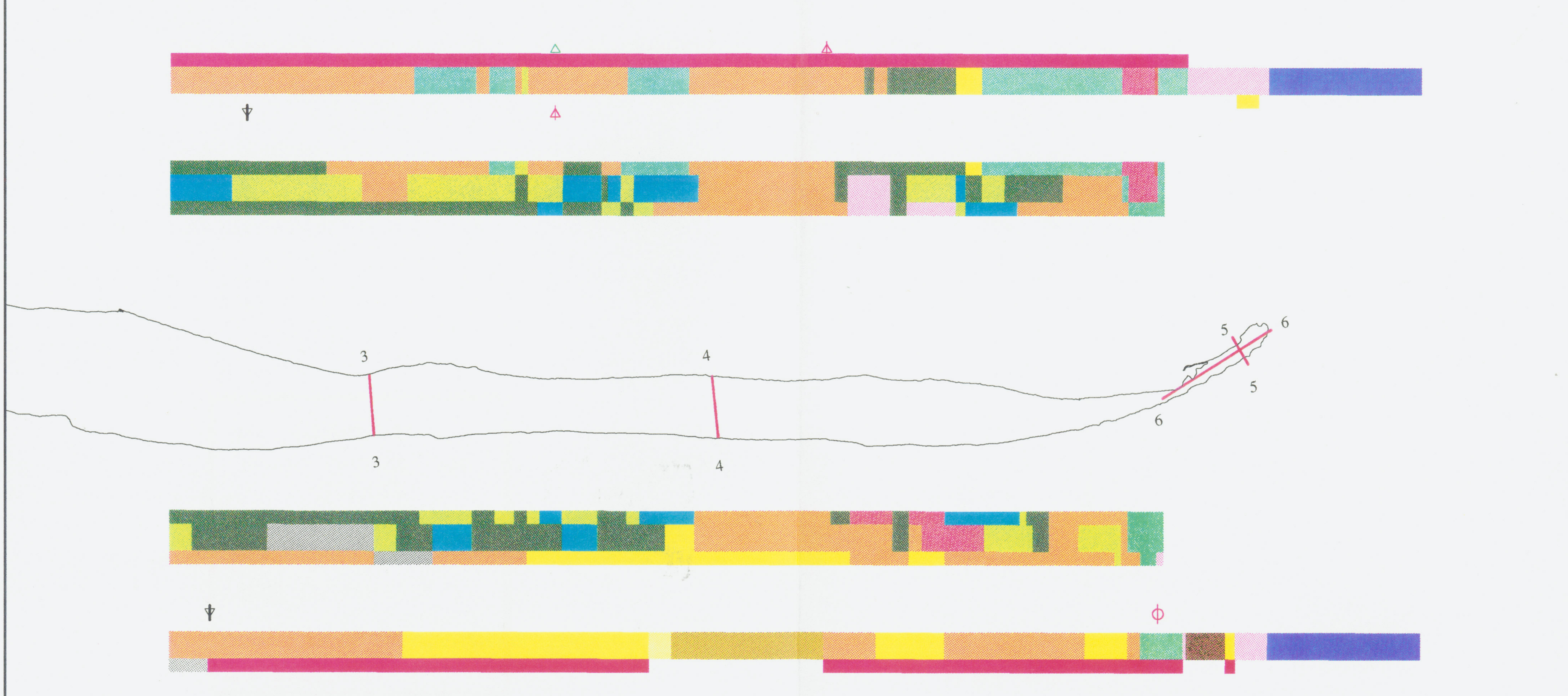
WEST SHIP ISLAND 3
NORTH
SOUTH
25
0
25
0
FEET
-500
0
500
1000
1500
2000
2500
FEET
Baccharis halimifolia
Calike edentula
Cassia sp.
Centella asiatica
Croton punctatus
Cyperus sp.
Euphorbia cyparissias
Graphalium purpureum
Heterotheca subaxillaris
Hydrocotyle bonariensis
Ipomoea stolonifera
Iva imbricata
Juncus sp.
Lepidium virginicum
Myrica cerfera
Odontonychia corymbosa
Oenothera humifusa
Panicum sp.
Paspalum distichum
Physalis augustifolia
Rubus trivialis
Schizachyrium littorale
Spartina patens
Spiranthes vernalis
Uniola paniculata

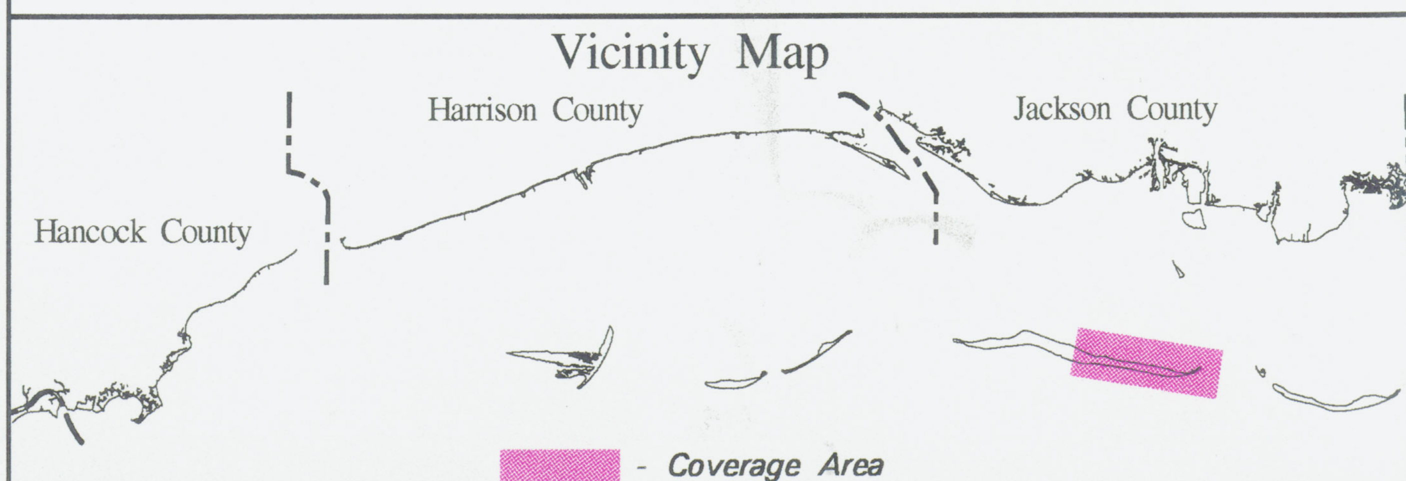


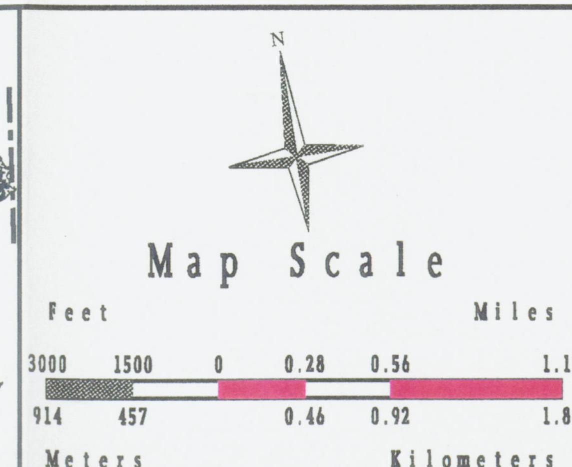
WEST SHIP ISLAND 4
Southeast
Northwest
FEET
20
10
0
-10
-800
-600
-400
-200
0
200
400
600
FEET
Cakile edentula
Croton punctatus
Cynanchium augustifolium
Ipomoea stolonifera
Juncus roemerianus
Panicum sp.
Paspalum distichum
Spartina patens
Teucrium canadense


Mississippi Shoreline Geomorphology System
2
1
1
2
Vicinity Map
Harrison County
Jackson County
Hancock County
- Coverage Area
N
Map Scale
Feet
Miles
3000
1500
0
0.28
0.56
1.12
914
457
0.46
0.92
1.84
Meters
Kilometers
HORN ISLAND WEST
Geomorphology: 1991
Shoreline: 1993

Mississippi Shoreline Geomorphology System







HORN ISLAND EAST

Geomorphology: 1991

Shoreline: 1993

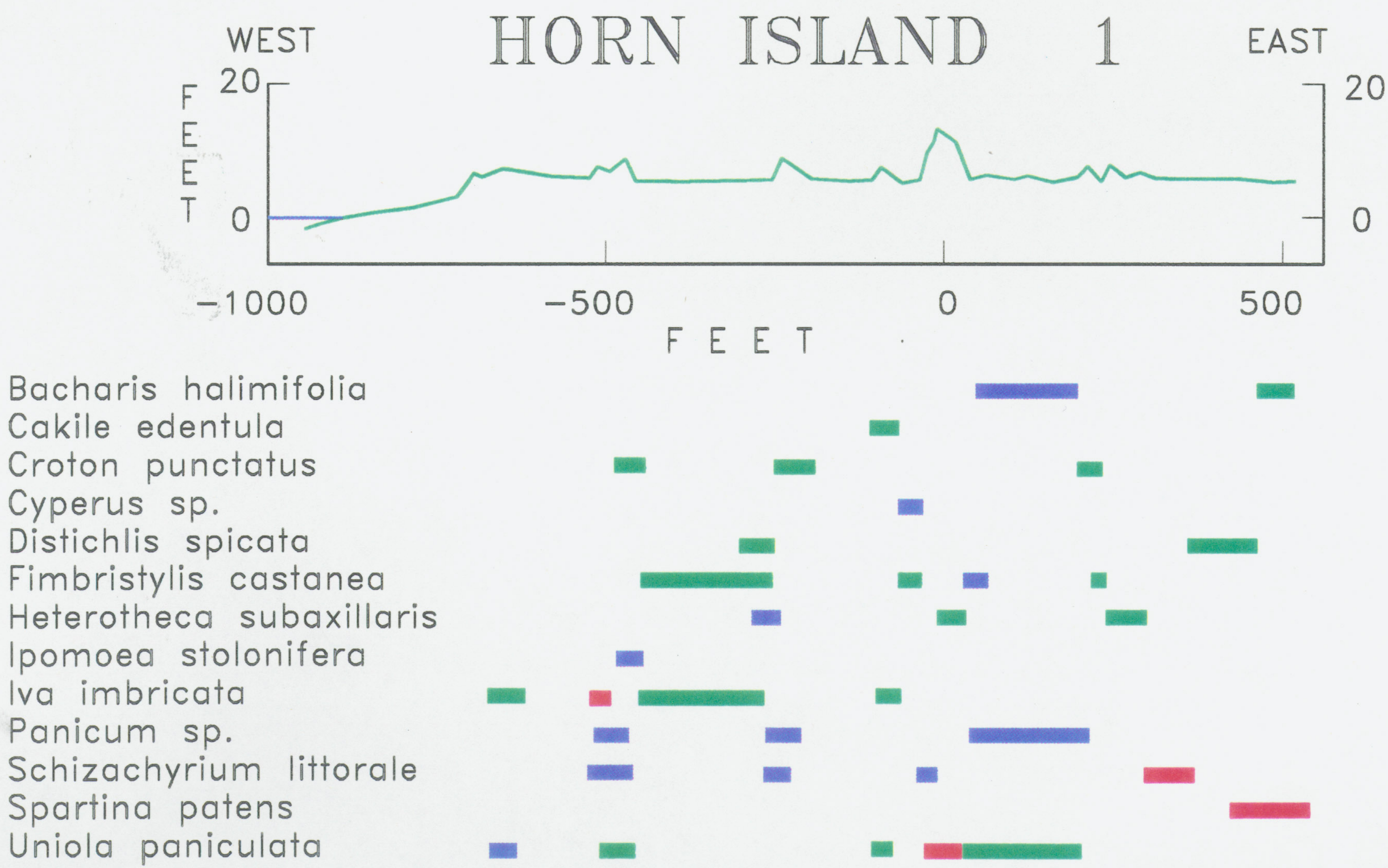
LEGEND

PLANT DISTRIBUTION PROFILES

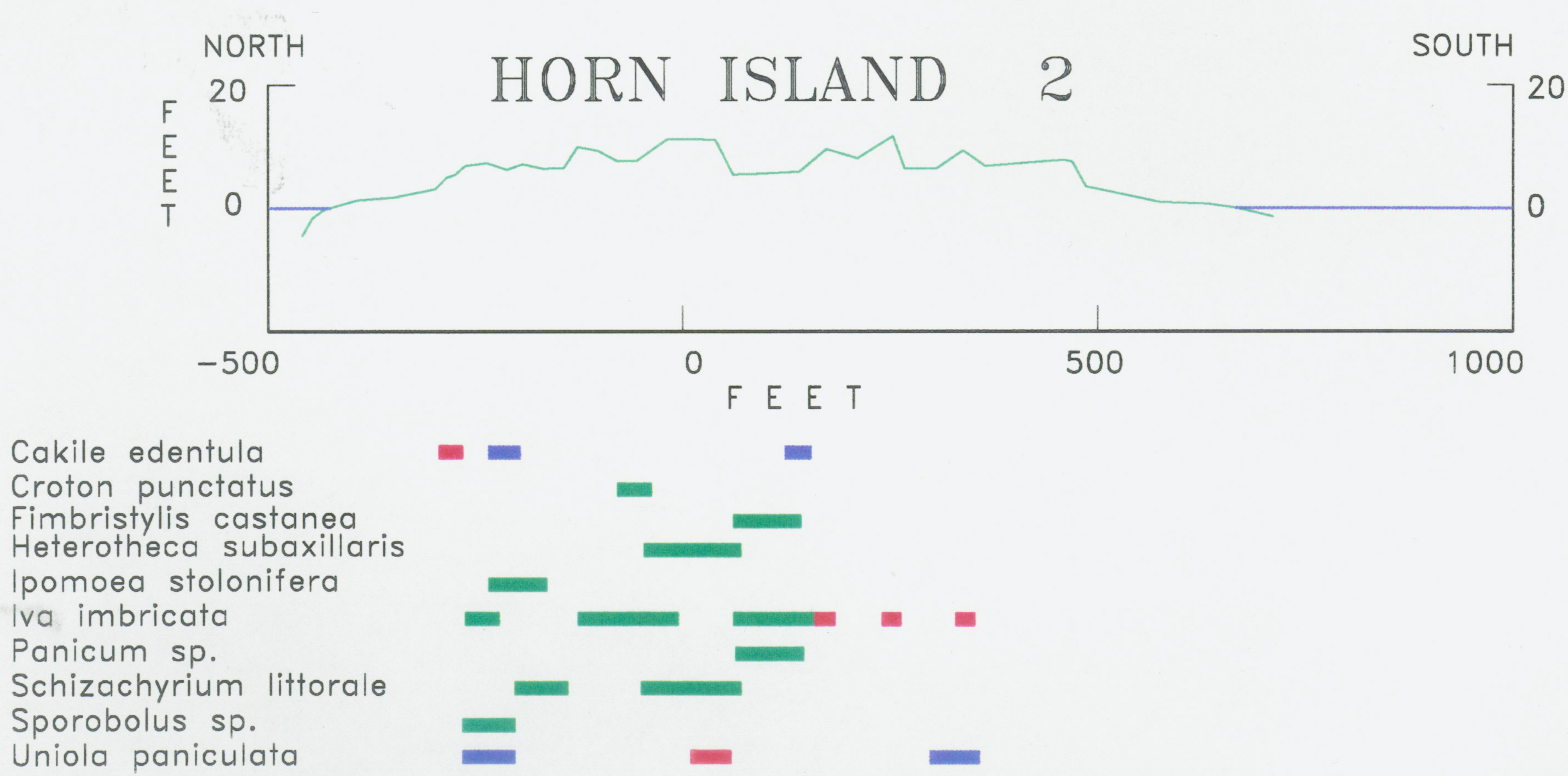
MAJOR OCCURRENCE

MIXED OCCURRENCE

MINOR OCCURRENCE

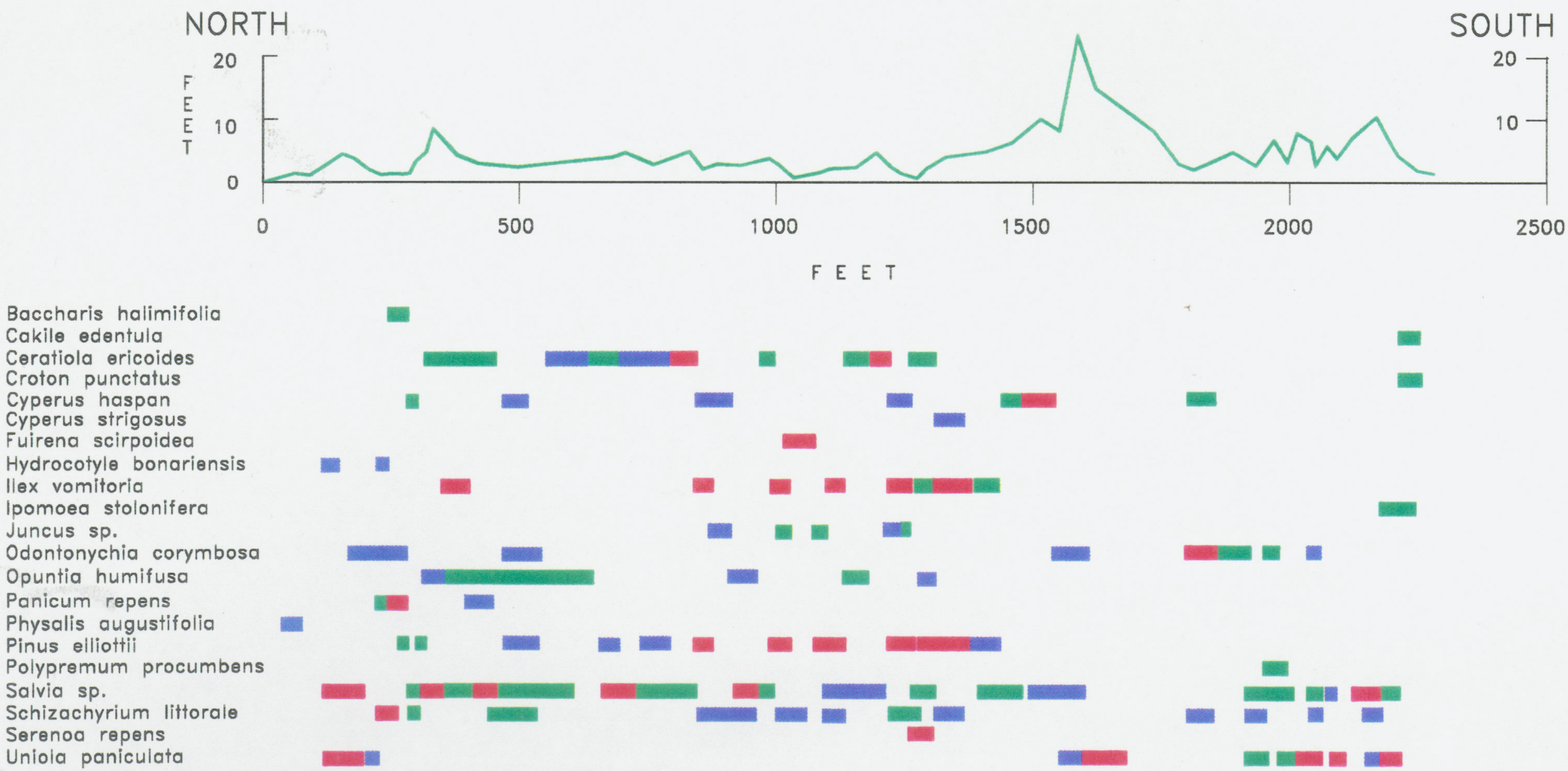


HORN ISLAND 1
WEST
EAST
FEET
20
0
20
0
-1000
-500
0
500
FEET
Bacharis halimifolia
Cakile edentula
Croton punctatus
Cyperus sp.
Distichlis spicata
Fimbristylis castanea
Heterotheca subaxillaris
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Schizachyrium littorale
Spartina patens
Uniola paniculata

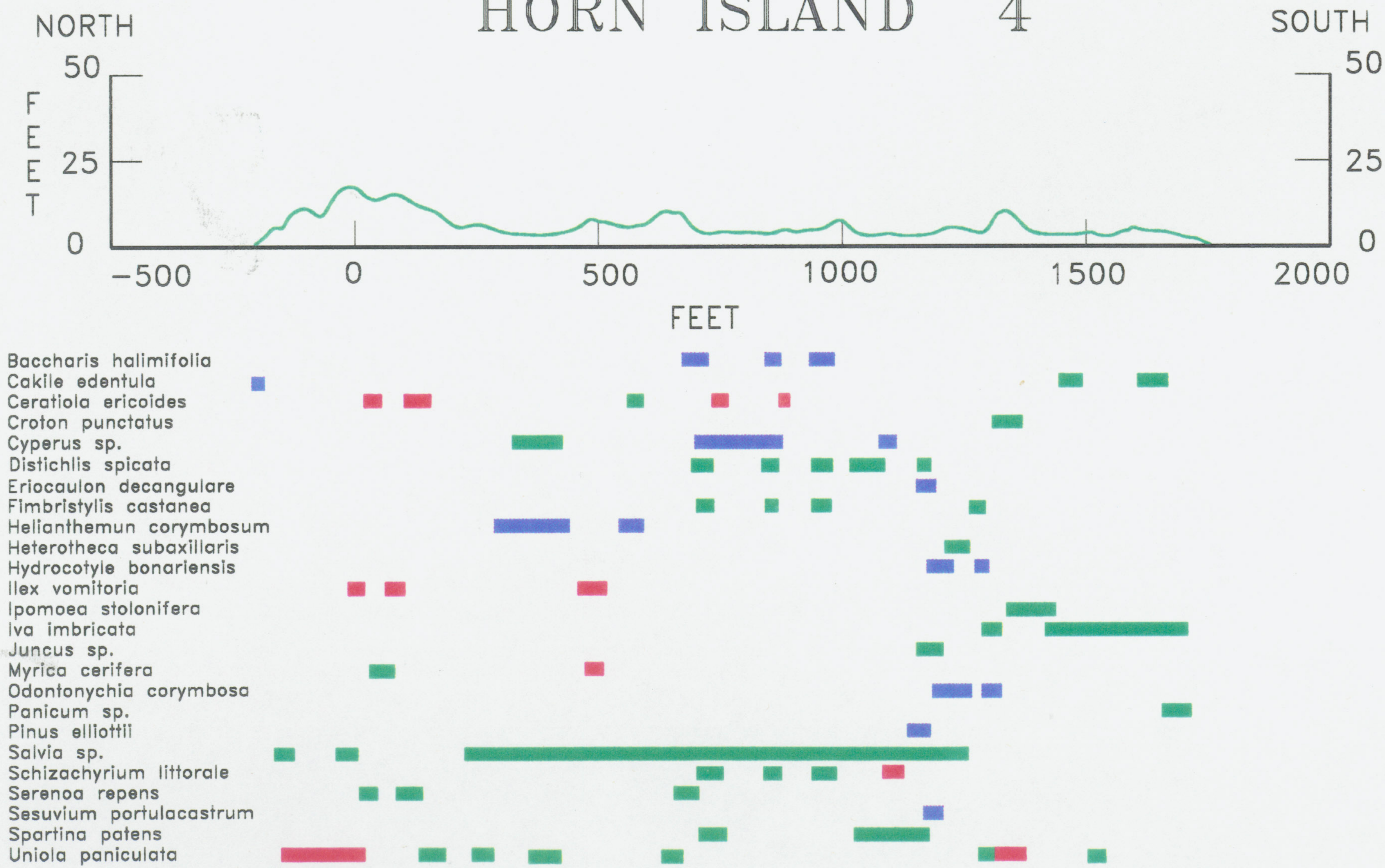


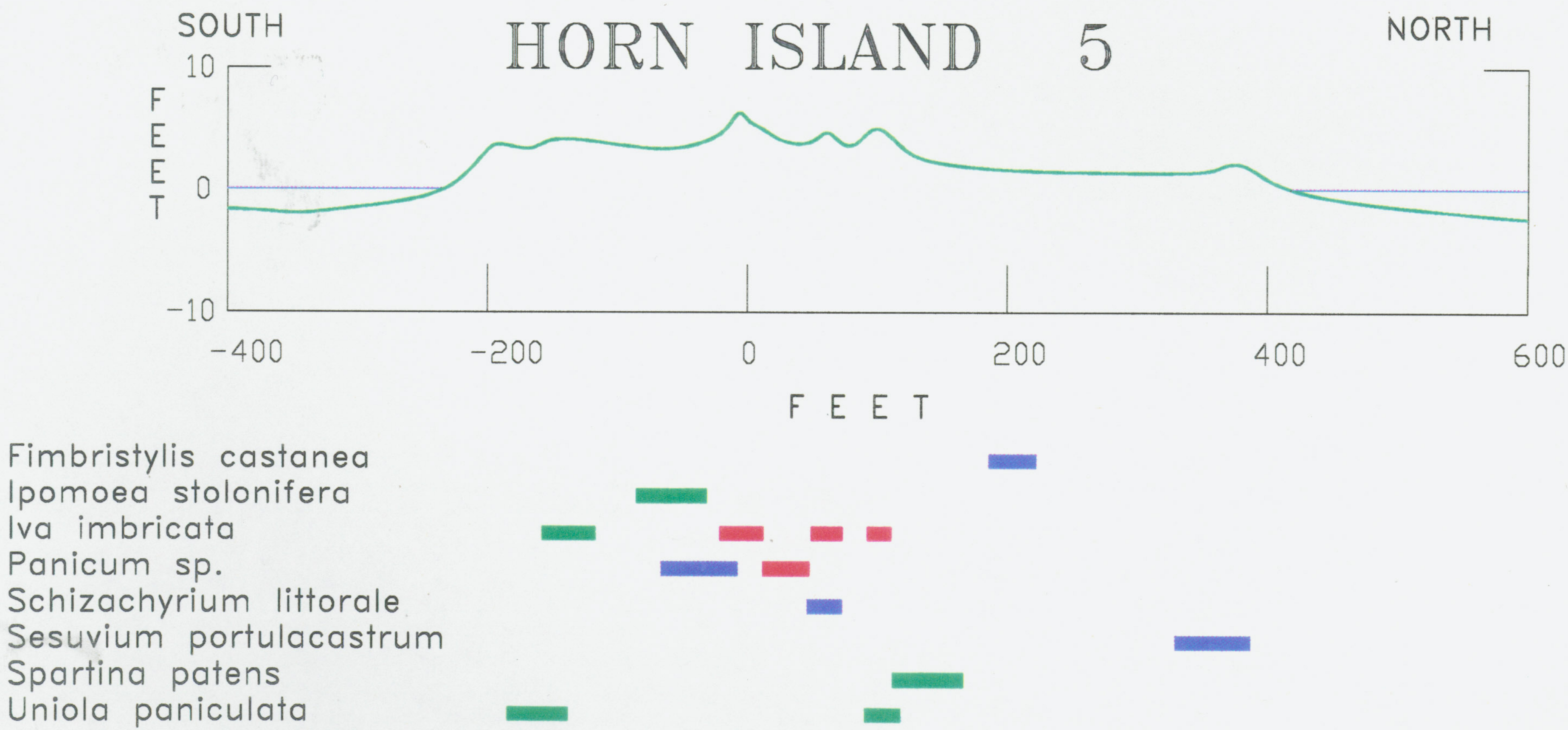
HORN ISLAND 2
NORTH
SOUTH
FEET
20
0
-500
0
500
1000
FEET
Cakile edentula
Croton punctatus
Fimbristylis castanea
Heterotheca subaxillaris
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Schizachyrium littorale
Sporobolus sp.
Uniola paniculata

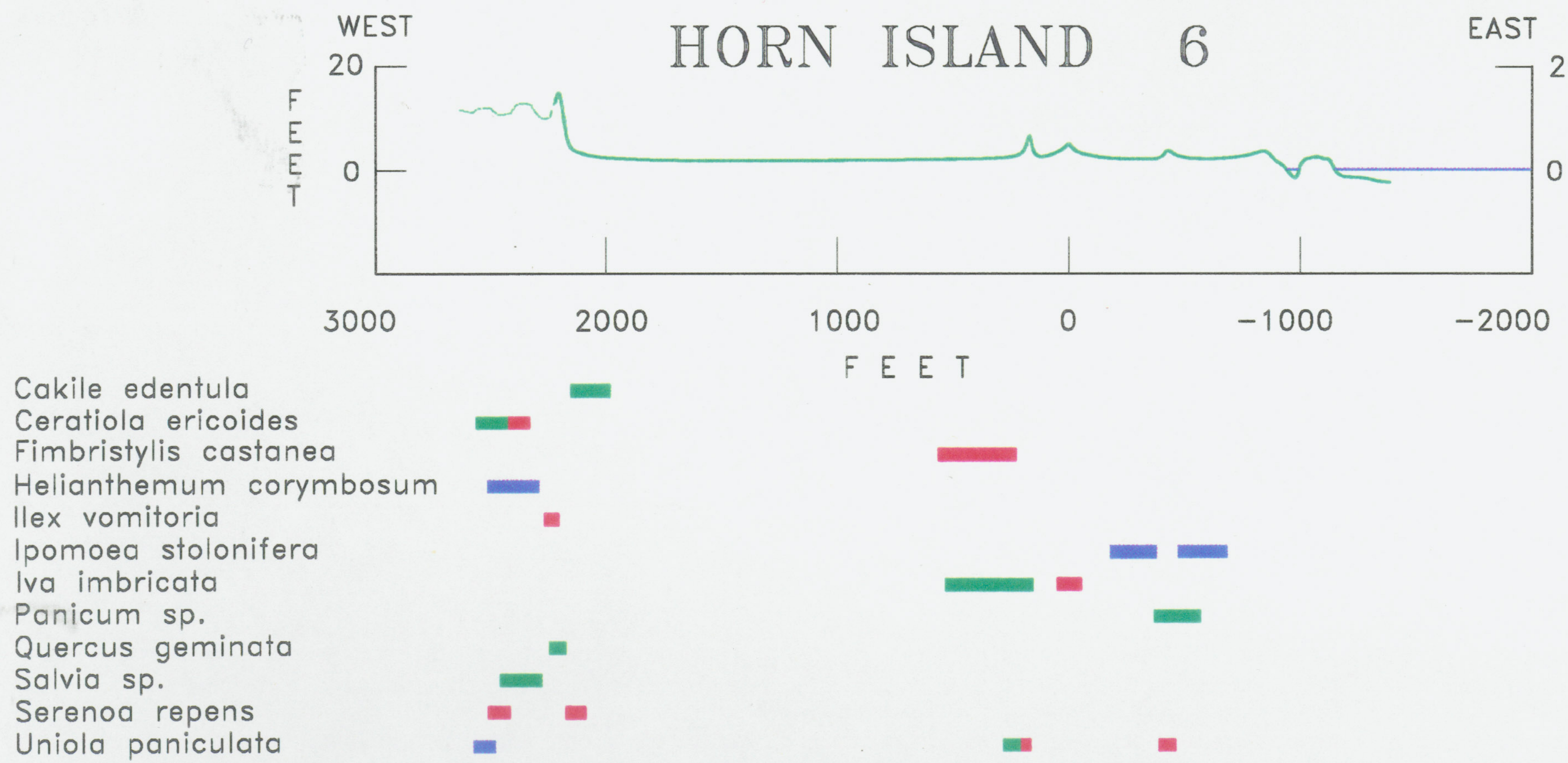
HORN ISLAND 3



HORN ISLAND 4

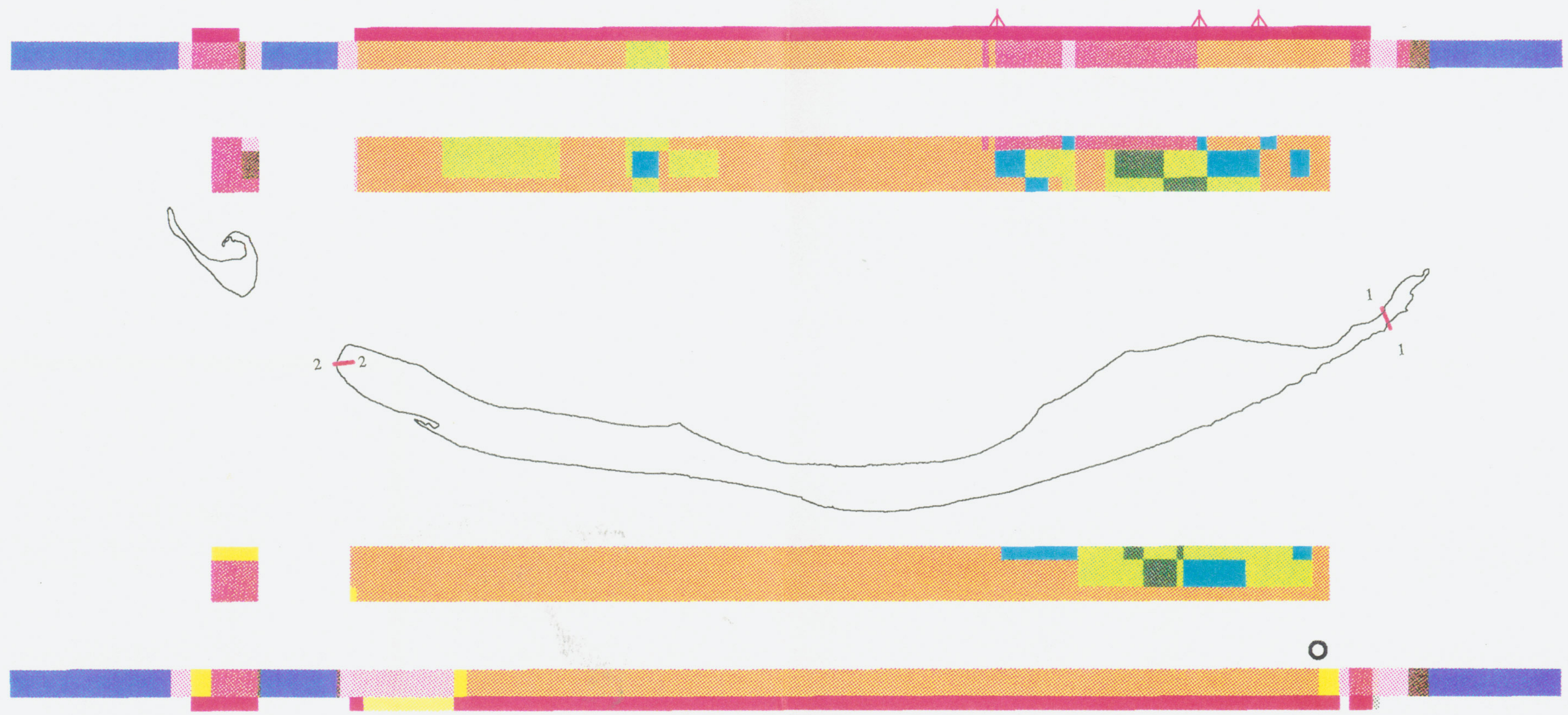


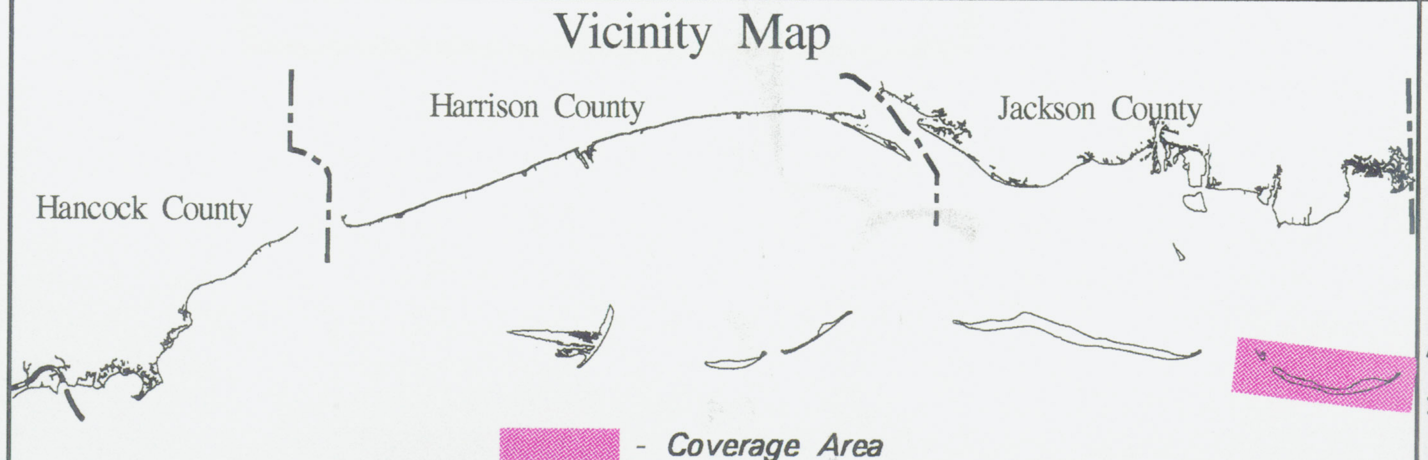

SOUTH
HORN ISLAND 5
NORTH
FEET
10
0
-10
-400
-200
0
200
400
600
F E E T
Fimbristylis castanea
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Schizachyrium littorale
Sesuvium portulacastrum
Spartina patens
Uniola paniculata



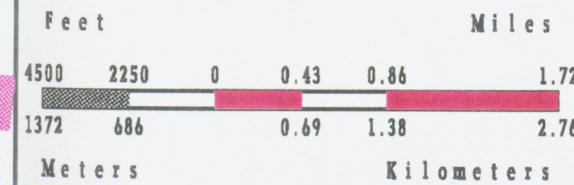
HORN ISLAND 6
WEST
EAST
20
0
FEET
3000
2000
1000
0
-1000
-2000
F E E T
Cakile edentula
Ceratiola ericoides
Fimbristylis castanea
Helianthemum corymbosum
Ilex vomitoria
Ipomoea stolonifera
Iva imbricata
Panicum sp.
Quercus geminata
Salvia sp.
Serenoa repens
Uniola paniculata

Mississippi Shoreline Geomorphology System





Map Scale



PETIT BOIS ISLAND

Geomorphology: 1991

Shoreline: 1993

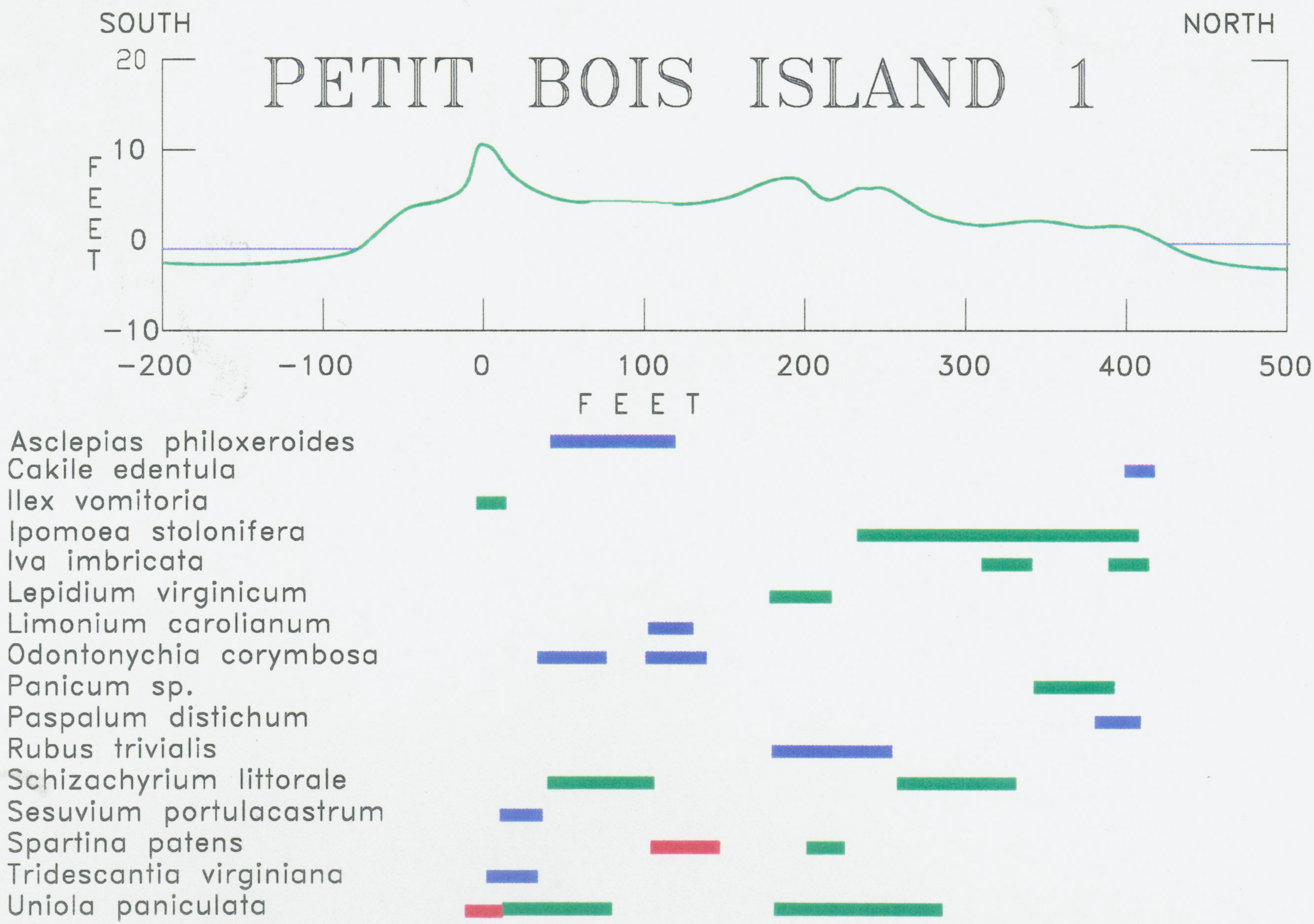
LEGEND

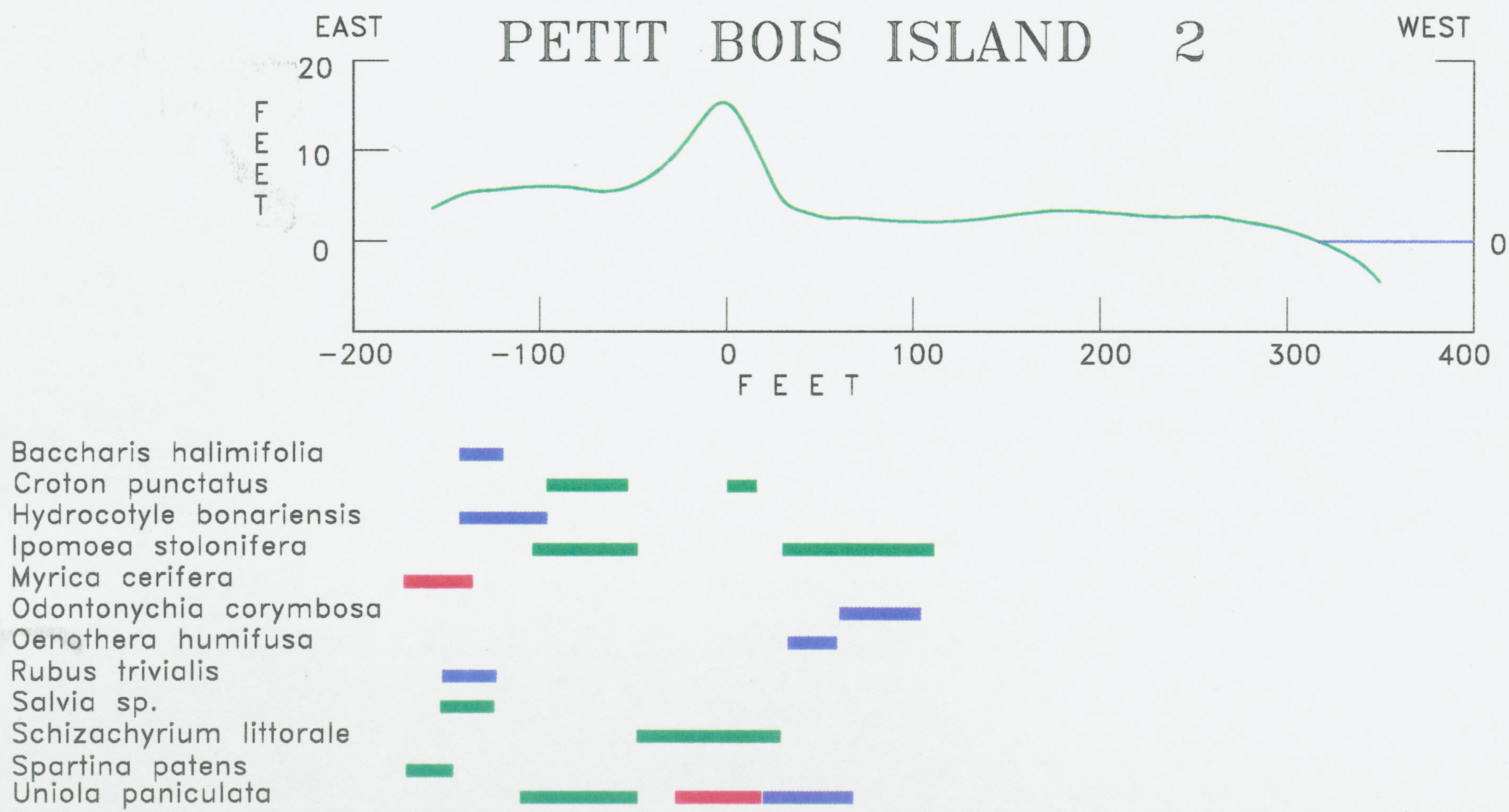
PLANT DISTRIBUTION PROFILES

MAJOR OCCURRENCE — red

MIXED OCCURRENCE — green

MINOR OCCURRENCE — blue


SOUTH
NORTH
PETIT BOIS ISLAND 1
20
10
0
−10
FEET
−200
−100
0
100
200
300
400
500
FEET
Asclepias philoxeroides
Cakile edentula
Ilex vomitoria
Ipomoea stolonifera
Iva imbricata
Lepidium virginicum
Limonium carolianum
Odontonychia corymbosa
Panicum sp.
Paspalum distichum
Rubus trivialis
Schizachyrium littorale
Sesuvium portulacastrum
Spartina patens
Tridescantia virginiana
Uniola paniculata



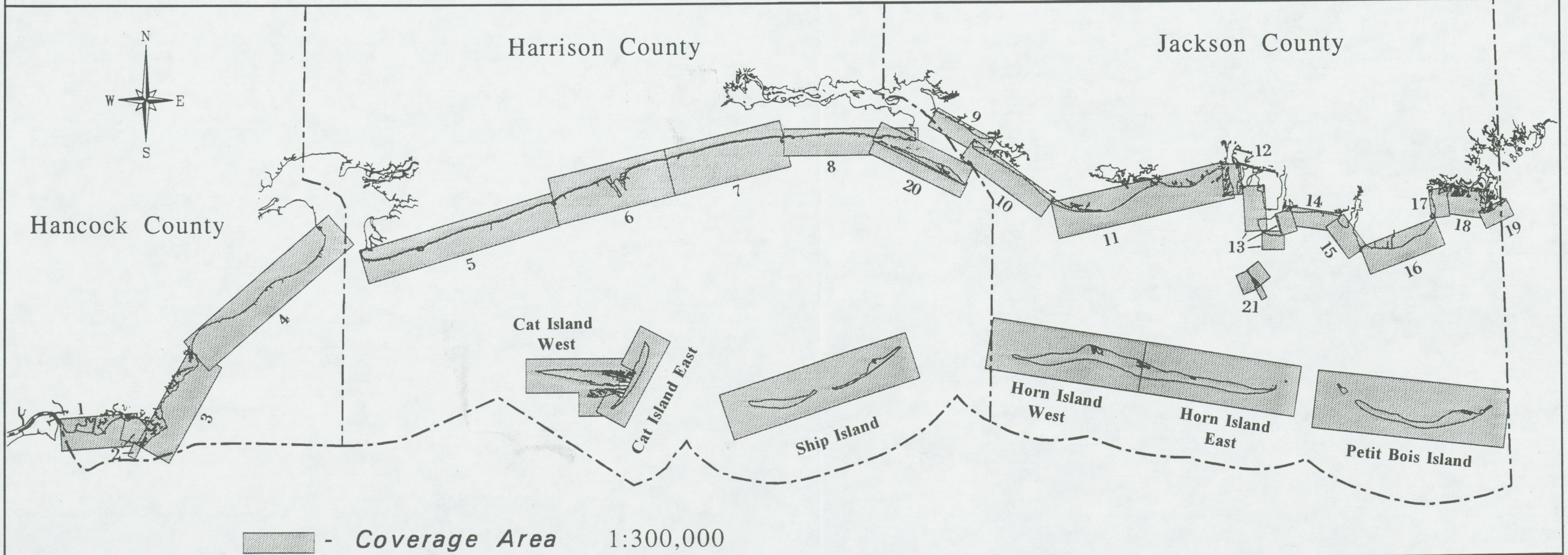
PETIT BOIS ISLAND 2
EAST
WEST
FEET
20
10
0
0
-200
-100
0
100
200
300
400
FEET
Baccharis halimifolia
Croton punctatus
Hydrocotyle bonariensis
Ipomoea stolonifera
Myrica cerifera
Odontonychia corymbosa
Oenothera humifusa
Rubus trivialis
Salvia sp.
Schizachyrium littorale
Spartina patens
Uniola paniculata

APPENDIX B

Mainland Geomorphology Maps

INDEX MAP

1. Pearl River
2. Heron Bay
3. Point Clear
4. East Hancock
5. West Harrison
6. Gulfport West
7. Gulfport East
8. Biloxi
9. Ocean Springs
10. West Belle Fontaine
11. East Belle Fontaine
12. Pascagoula River
13. Singing River Island
14. Pascagoula
15. Bayou Casotte
16. Pt. Aux Chênes
17. Bangs Lake
18. Pt. Aux Chênes Bay
19. Grande Batture
20. Deer Island
21. Round Island



MISSISSIPPI SHORELINE GEOMORPHOLOGY SYSTEM

Map Legend

Geomorphic Features

Primaries

- Coppice Dune
- Coalesced Coppice Dune
- Irregular Dune
- Hummocky Dune Terrace
- Degraded Dune
- Dune Ridge
- Precipitation Dune
- Artificial Beach
- Uplands
- Perched Beach
- Coastwise Spit
- Bulkhead / Seawall
- Recurved Spit
- Washover Flat
- Washover Corridor
- Washover Terrace
- Maritime Forest
- Marsh
- Tidal Flat
- Open Marine Water
- Pond / Lake / Lagoon
- Major Tidal Channel
- Erosional Scarp
- Riprap
- Marina / Harbor
- Breakwater
- Dredge Spoil

Modifiers

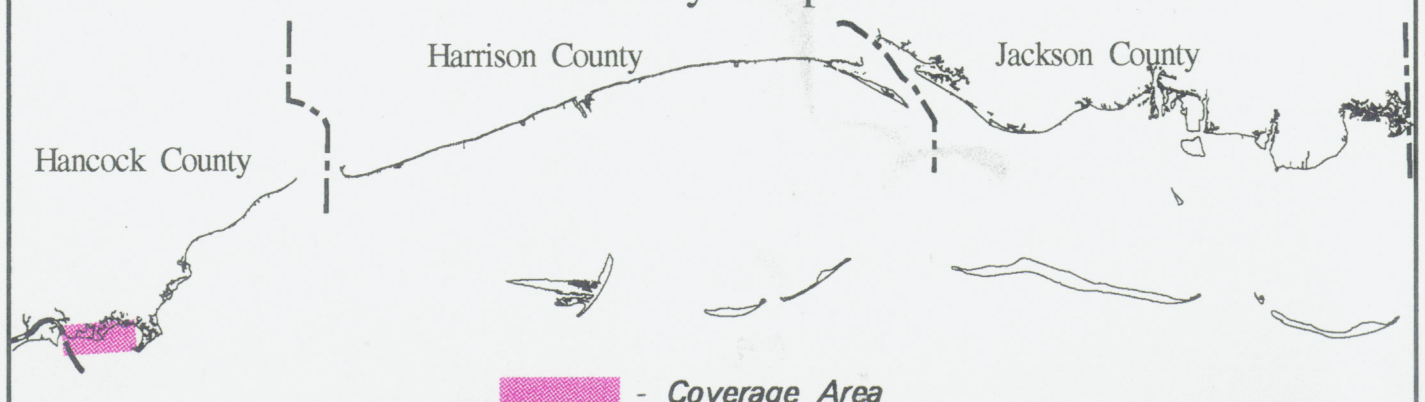
- Minor Tidal Channel
- Tidal Delta
- Washover Chute
- Washover Splay
- Manmade Path / Trail
- Pier
- Access Canal
- Groin
- Jetty
- Storm Outfall

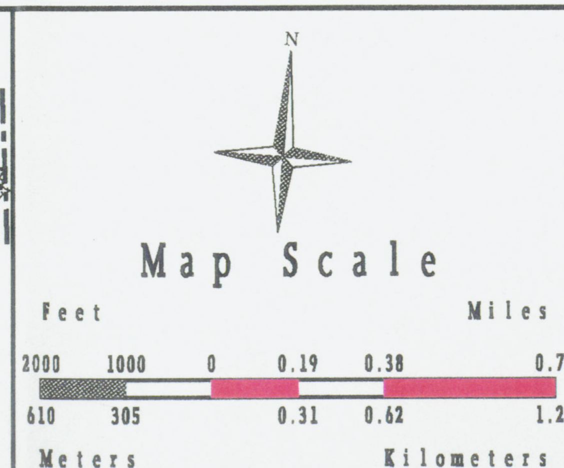
Reference Features

- Coastline
- Manmade Coastal Features
- Primary Highways
- Other Roads
- Railroads
- Rivers
- County Boundaries

Mississippi Shoreline Geomorphology System

Vicinity Map





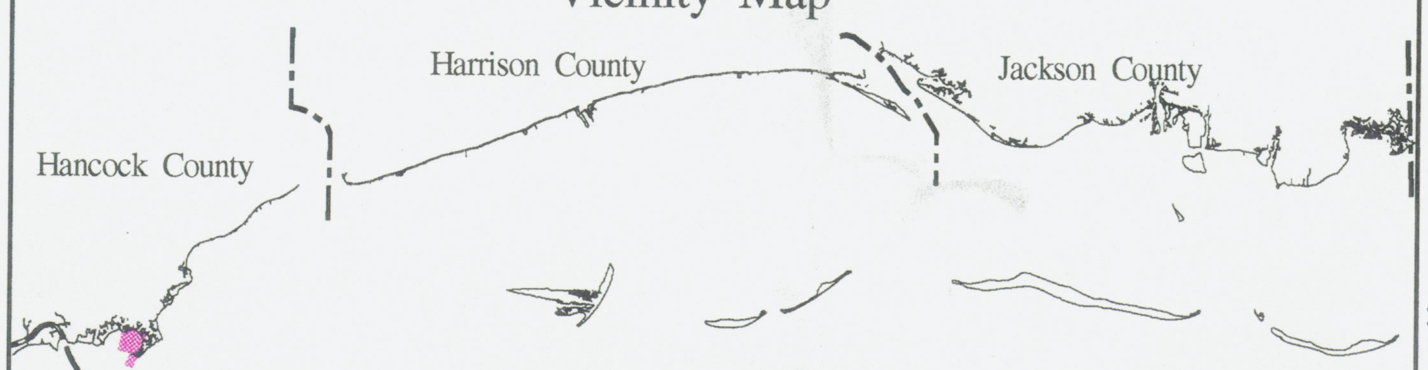
PEARL RIVER
SET 1

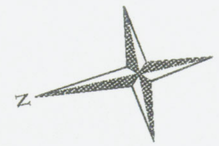
Geomorphology: 1991

Shoreline: 1986

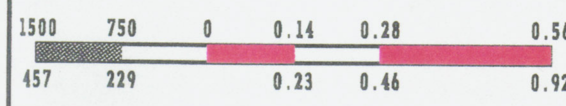
Mississippi Shoreline Geomorphology System

Vicinity Map





Map Scale

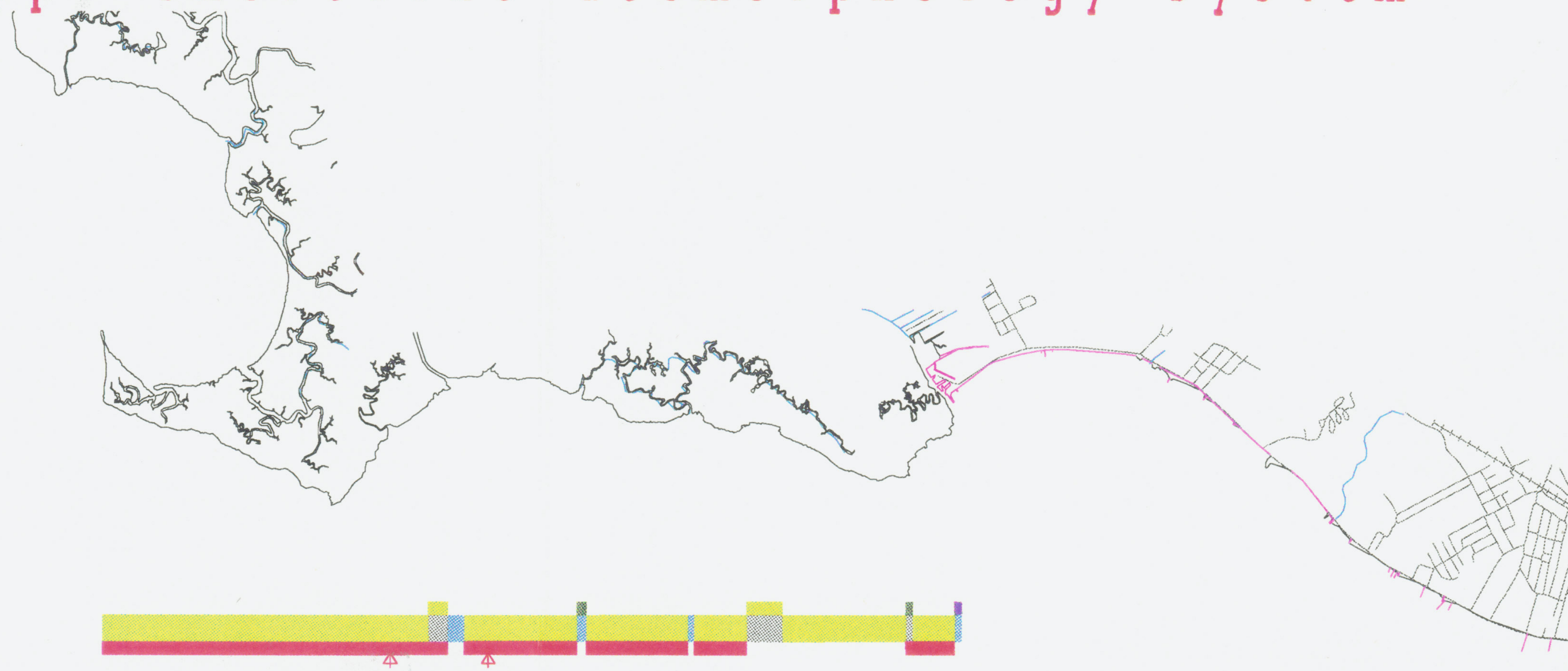


HERON BAY

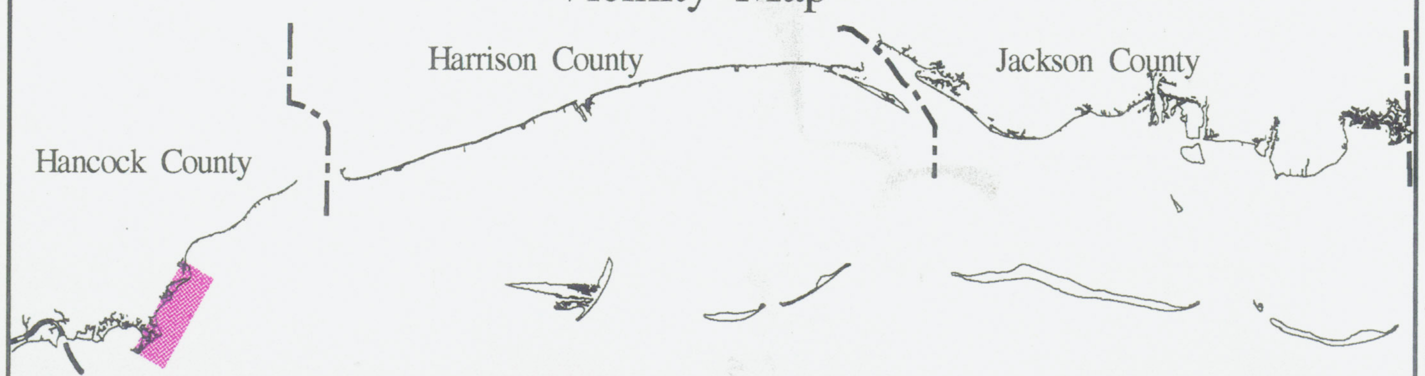
Geomorphology: 1991

Shoreline: 1986

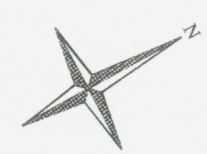
Mississippi Shoreline Geomorphology System



Vicinity Map



- Coverage Area



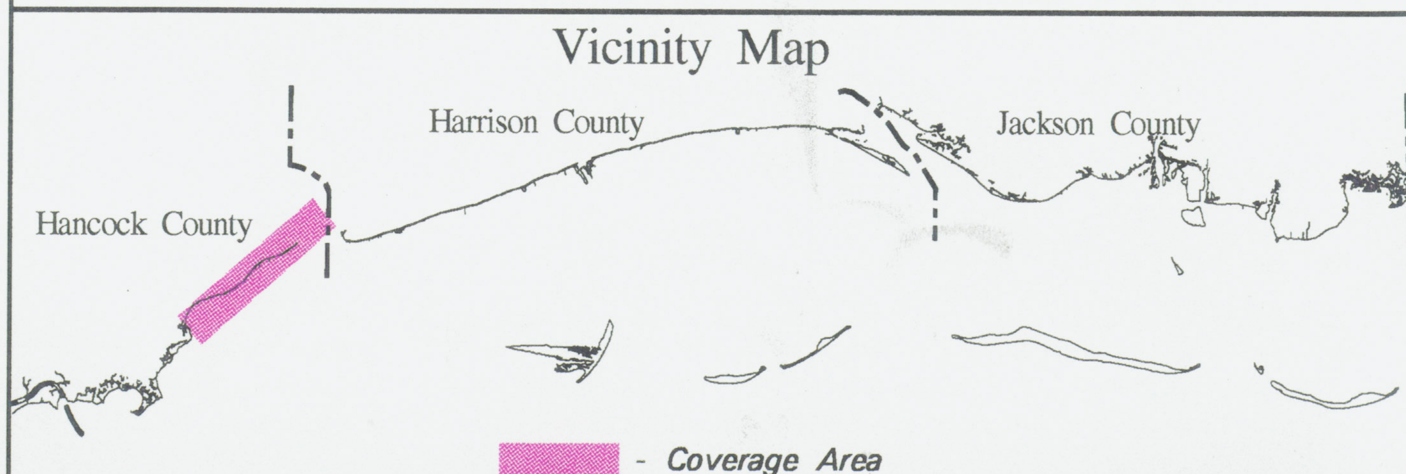
Map Scale

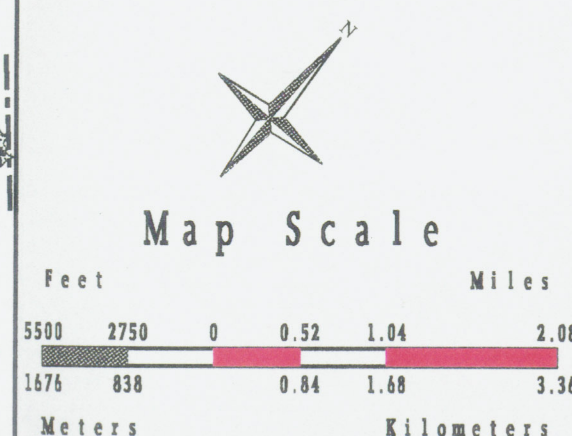
Feet					Miles
4000	2000	0	0.38	0.76	1.52
1219	610		0.61	1.22	2.44
Meters					Kilometers

POINT CLEAR
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System

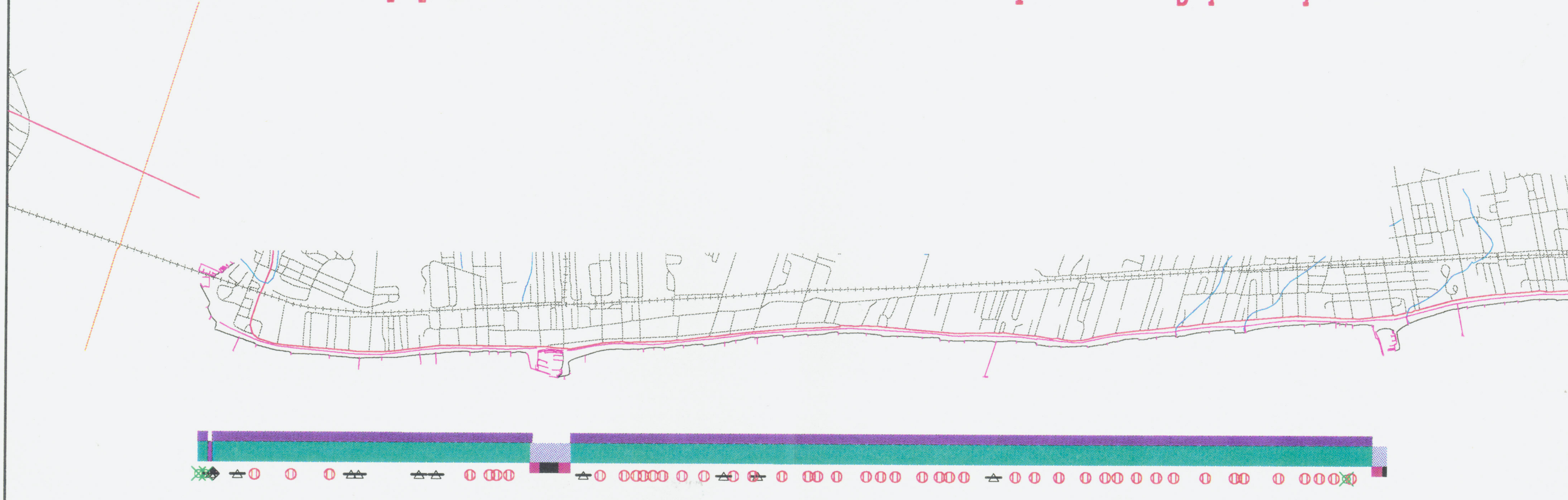




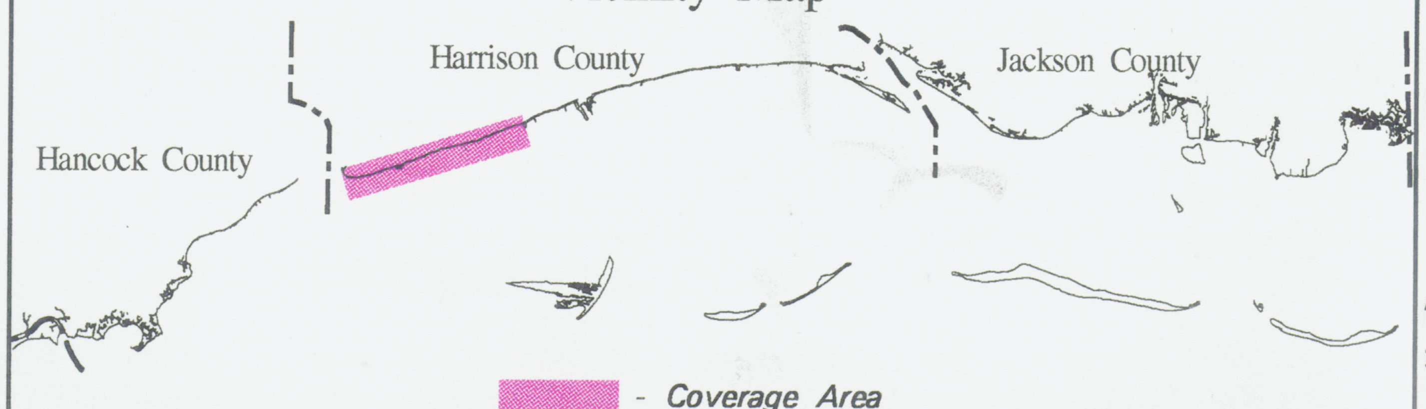
EAST HANCOCK
SET 1

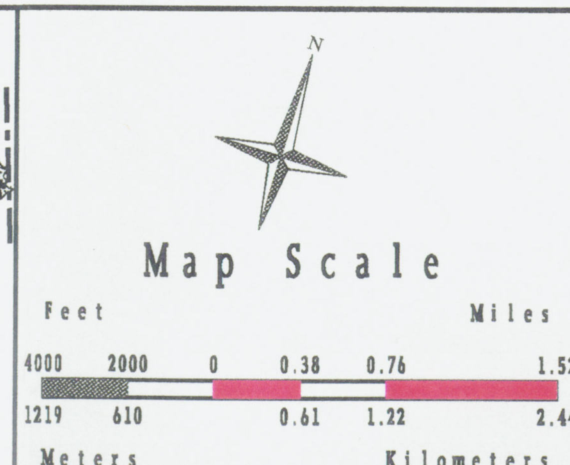
Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System



Vicinity Map

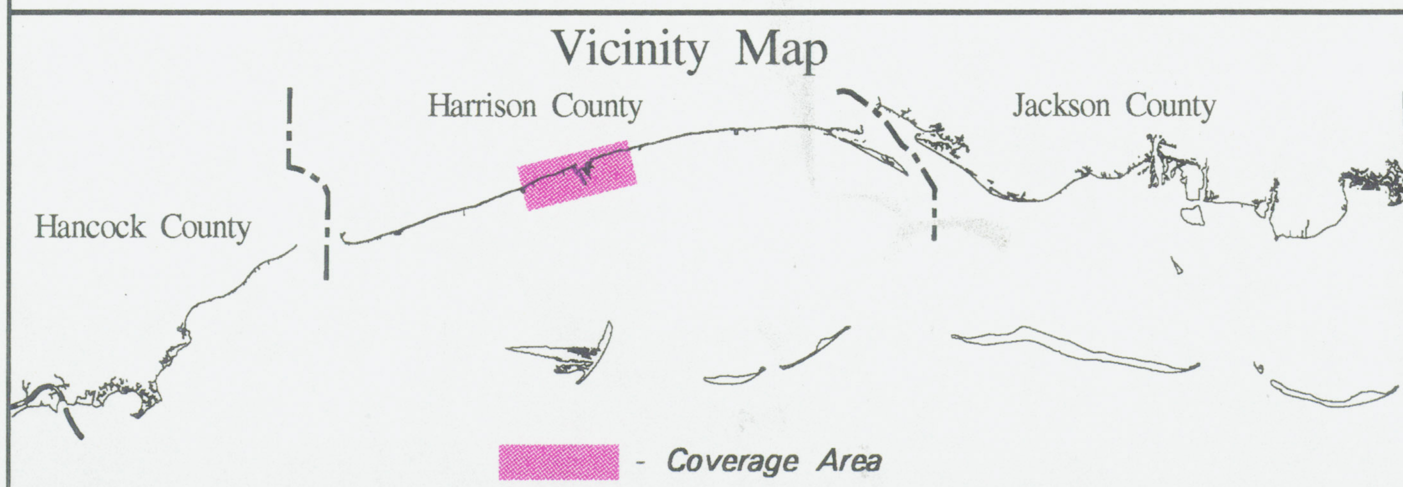


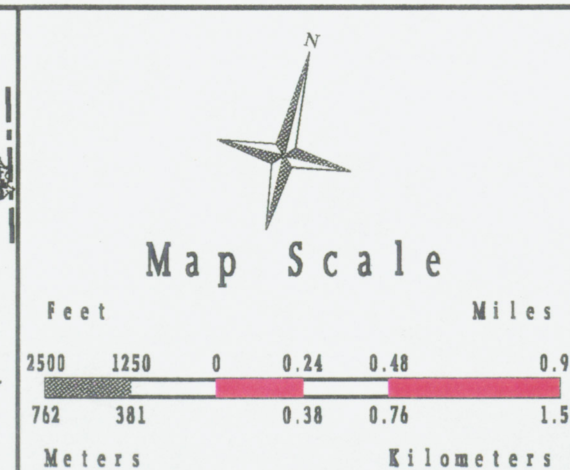


WEST HARRISON
SET 1

Geomorphology: 1991
Shoreline: 1986

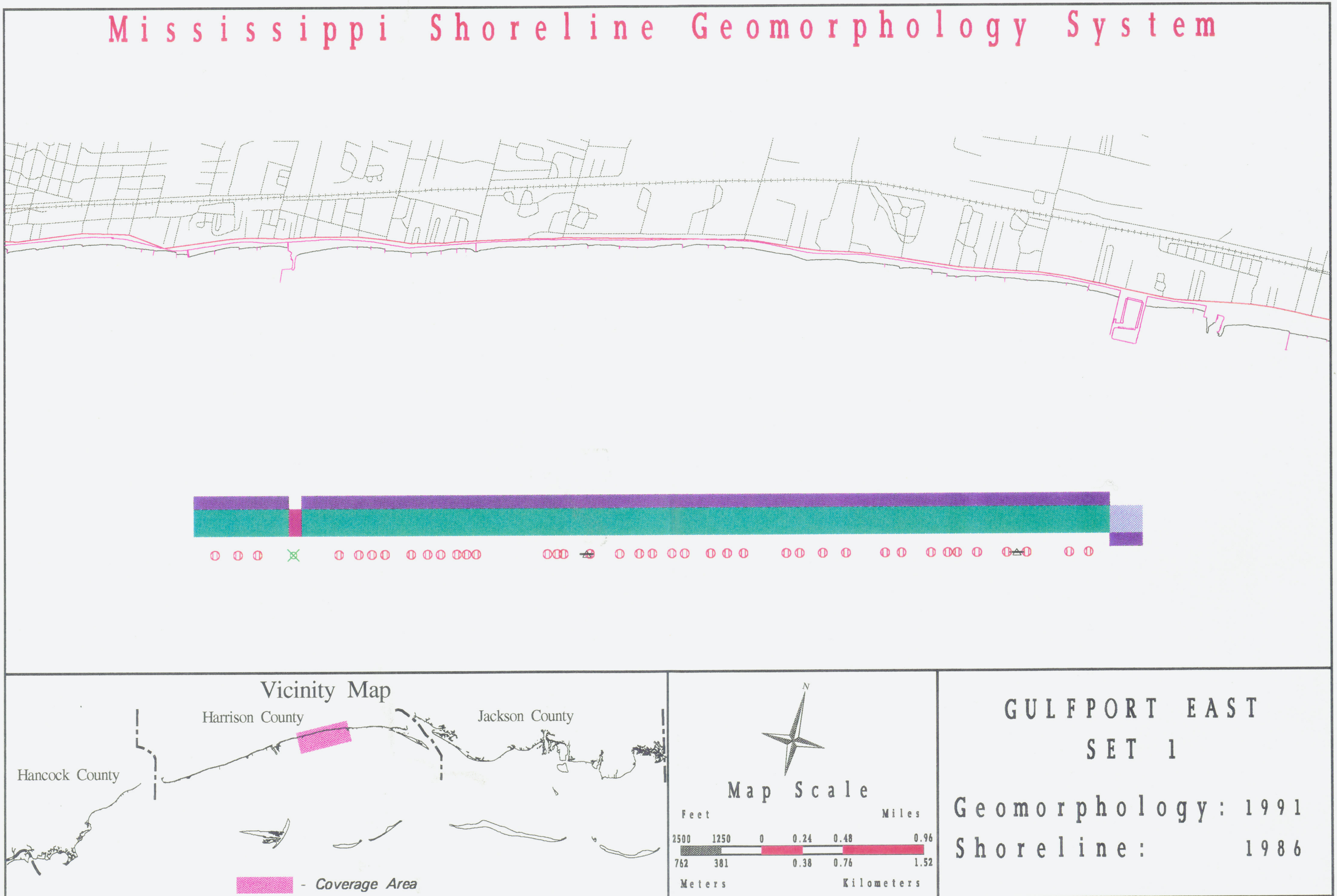
Mississippi Shoreline Geomorphology System



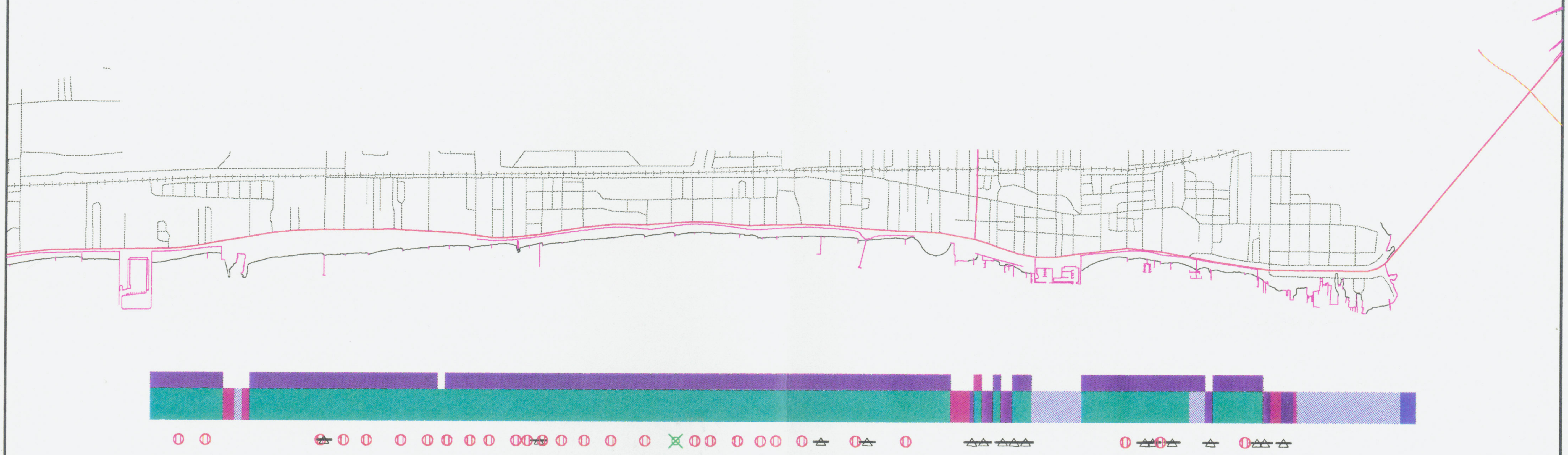


GULFPORT WEST
SET 1

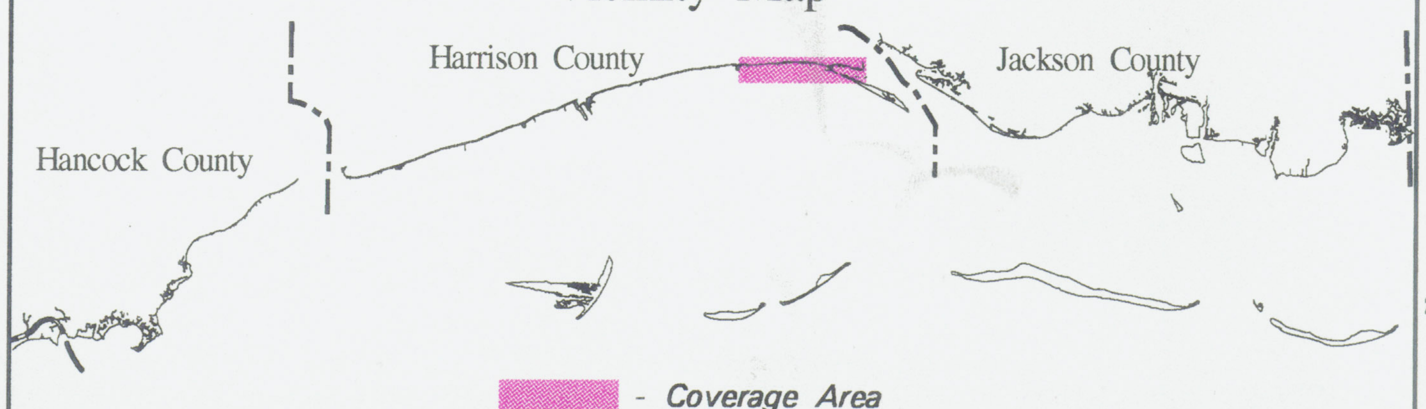
Geomorphology: 1991
Shoreline: 1986

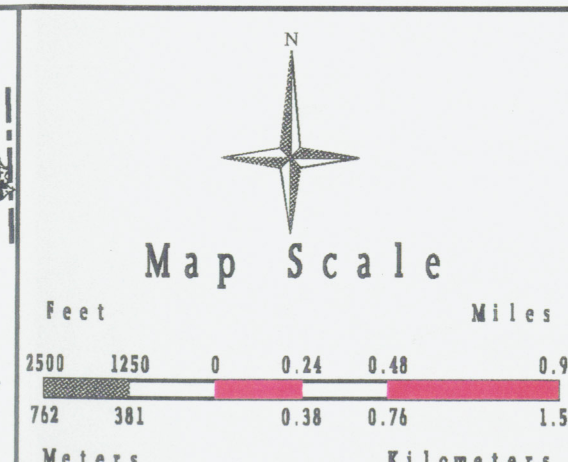

Mississippi Shoreline Geomorphology System
Vicinity Map
Hancock County
Harrison County
Jackson County
- Coverage Area
N
Map Scale
Feet
Miles
2500 1250 0 0.24 0.48 0.96
762 381 0.38 0.76 1.52
Meters
Kilometers
GULFPORT EAST
SET 1
Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System



Vicinity Map





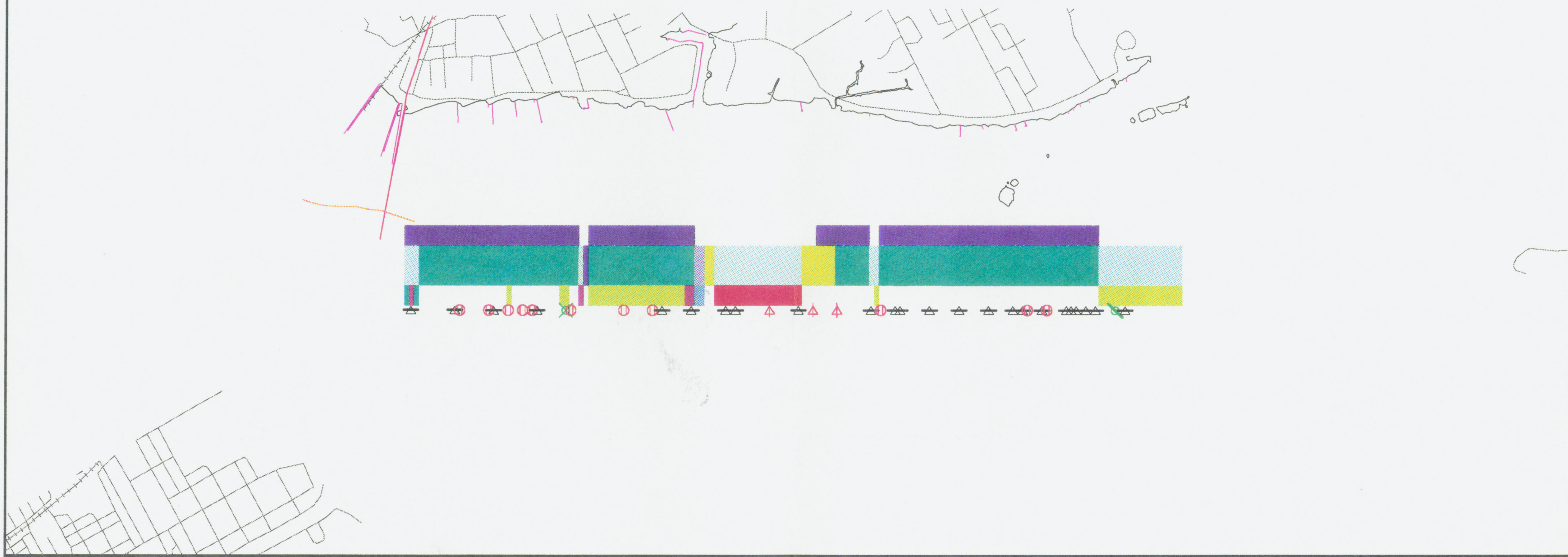
BILOXI

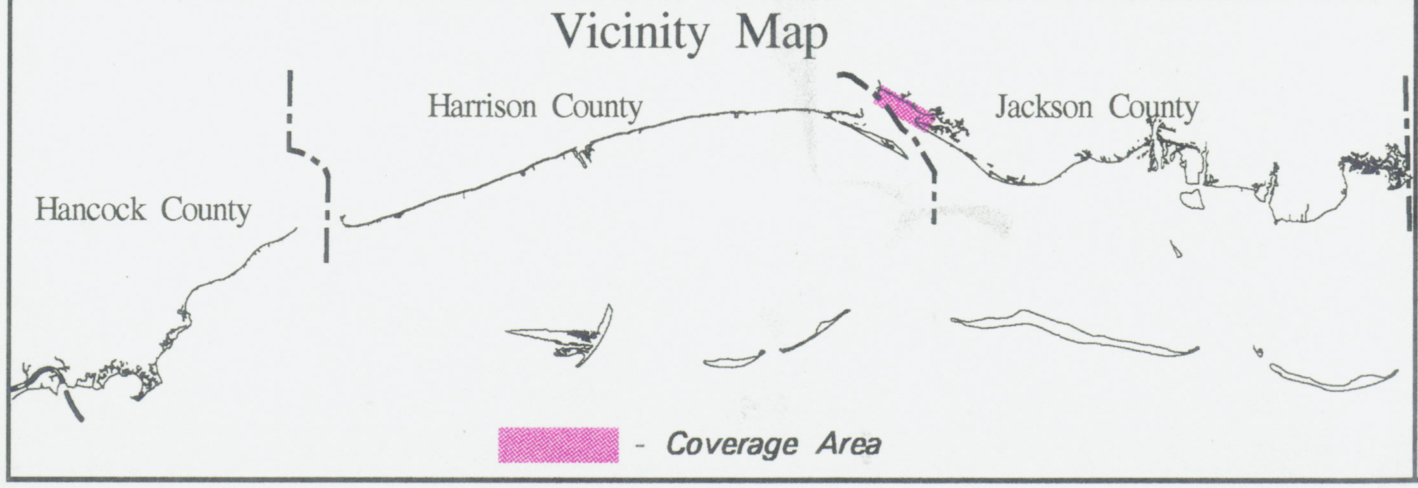
SET 1

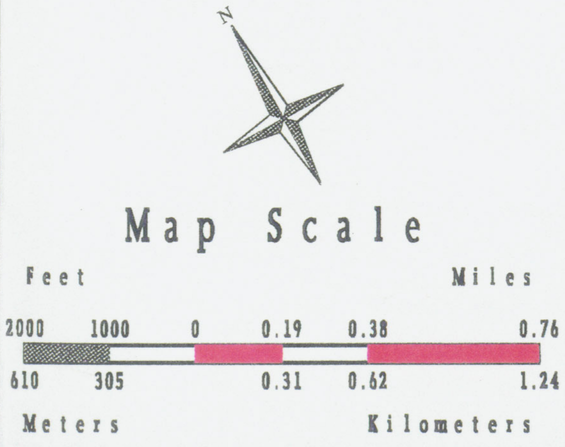
Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System



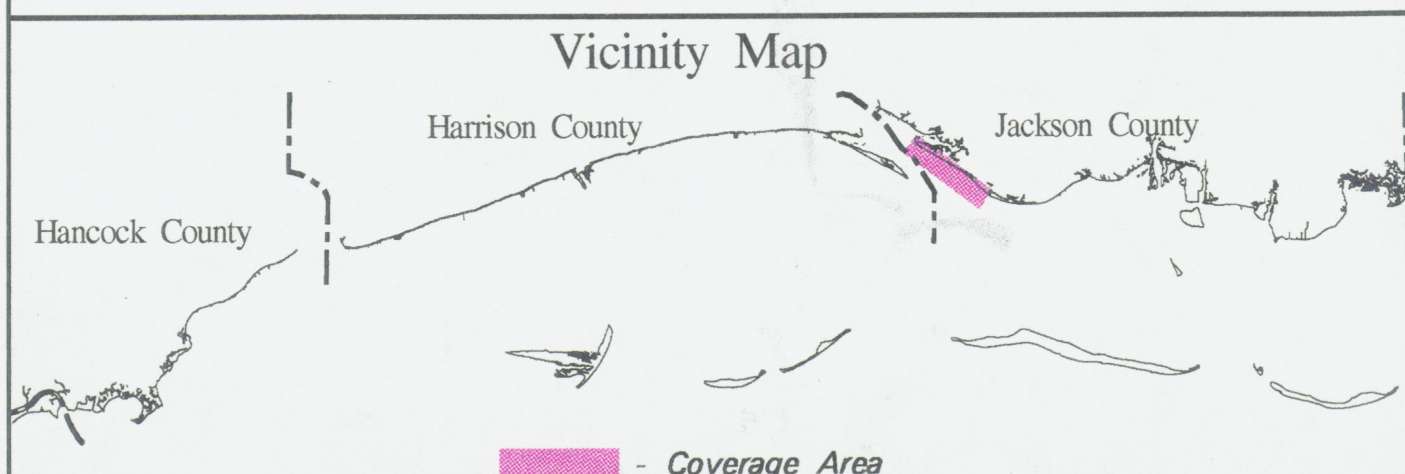


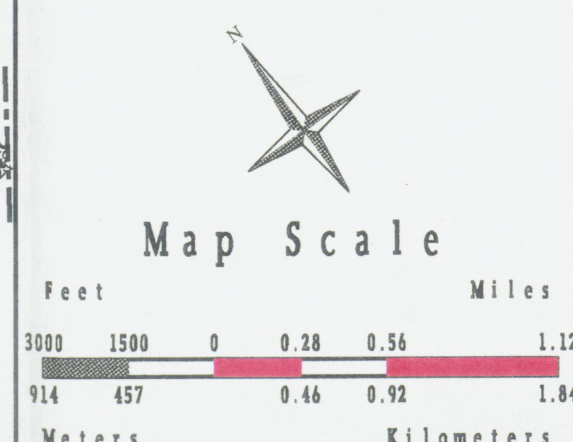


OCEAN SPRINGS
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System





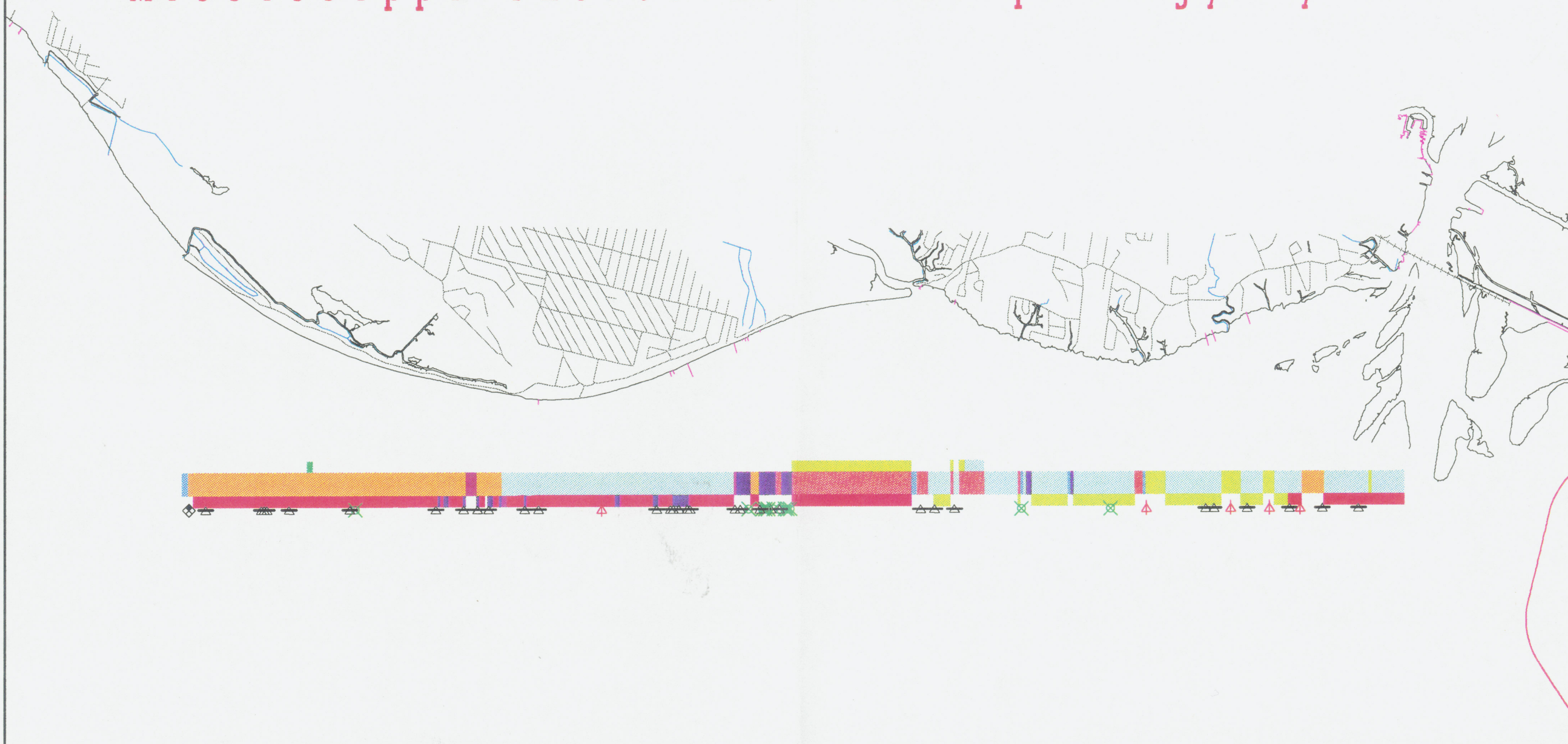
W BELLE FONTAINE

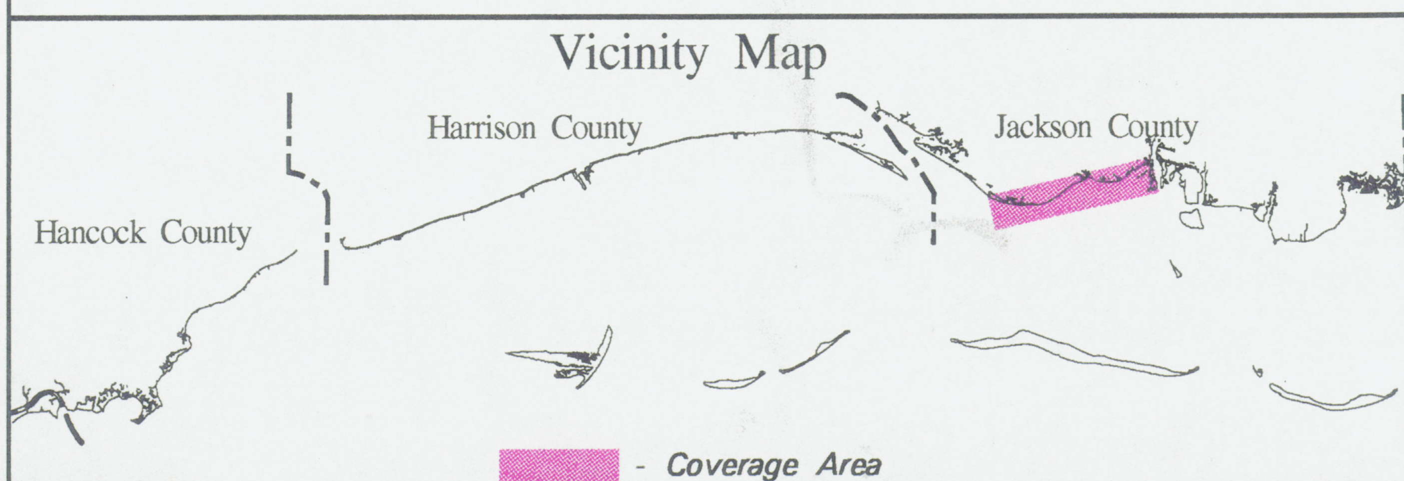
SET 1

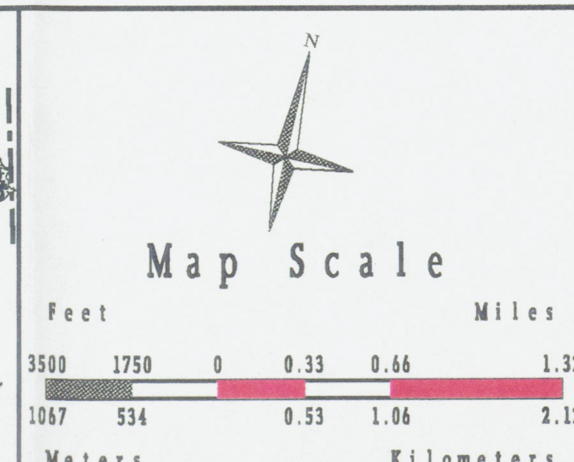
Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System





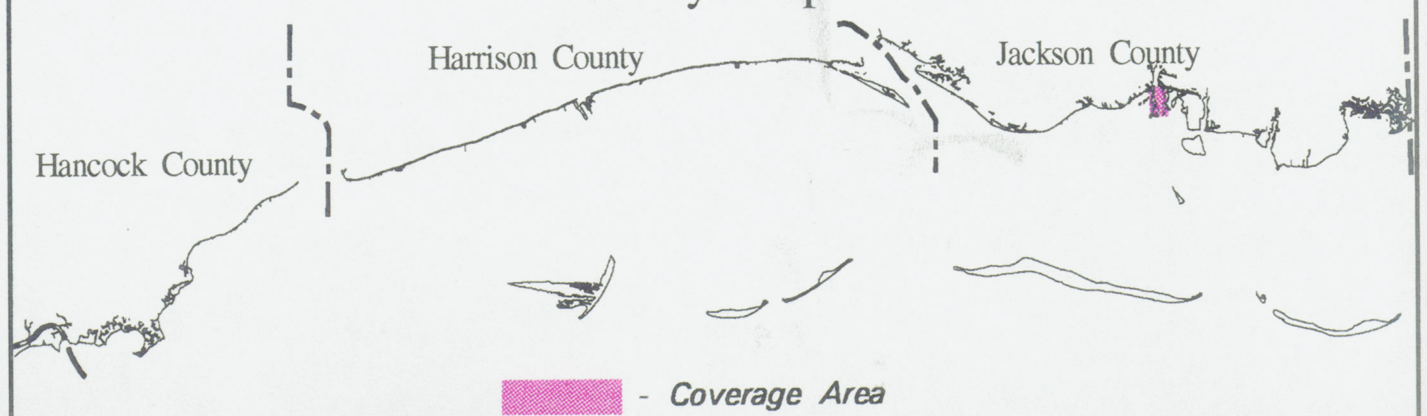


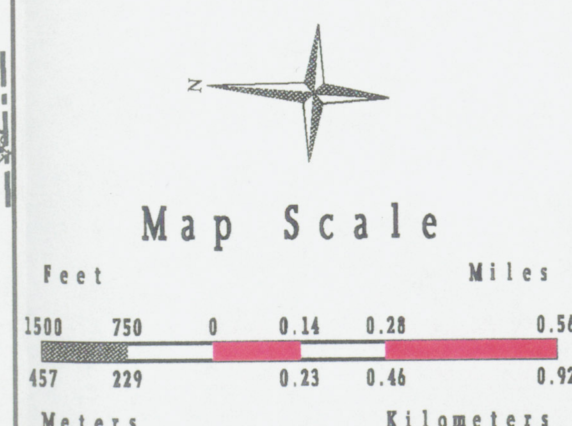
E BELLE FONTAINE
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System

Vicinity Map



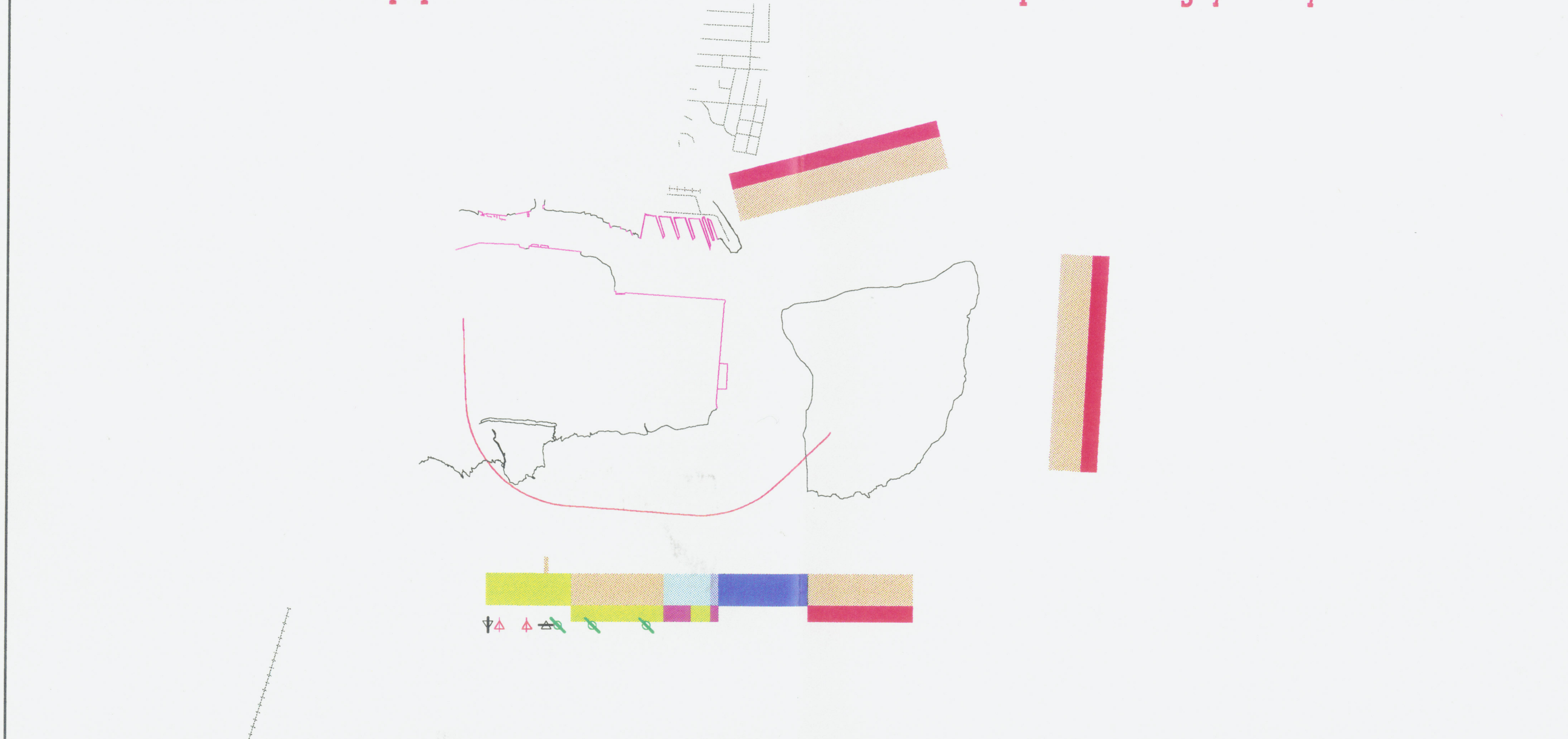


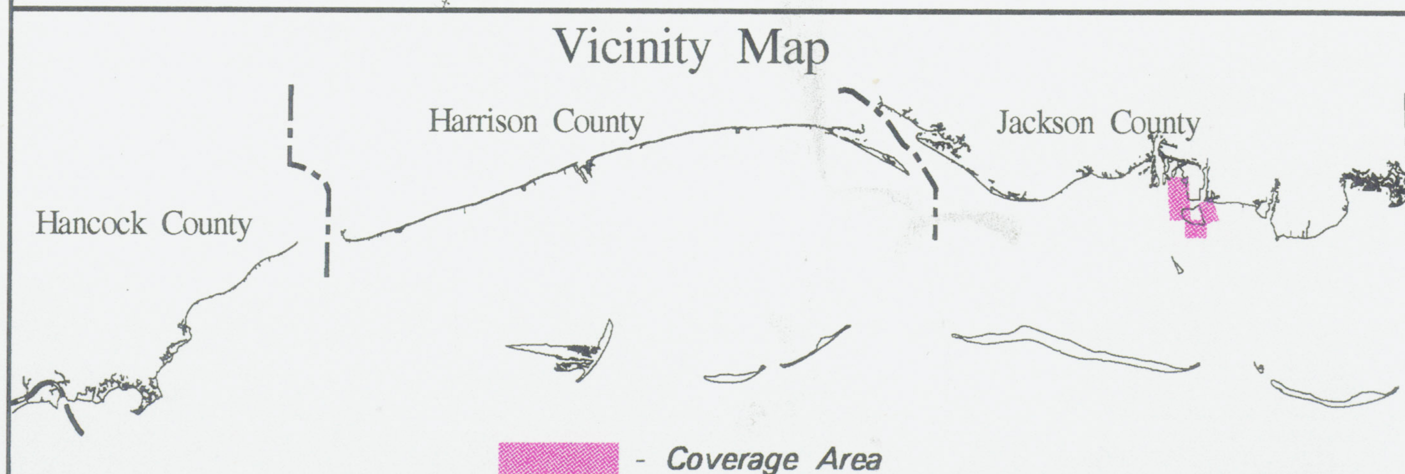
PASCAGOULA RIVER
SET 1

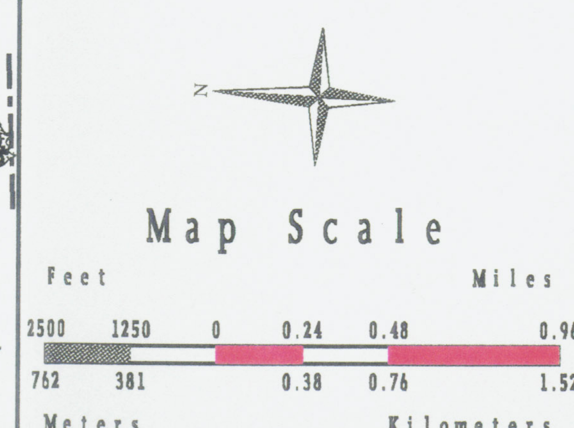
Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System





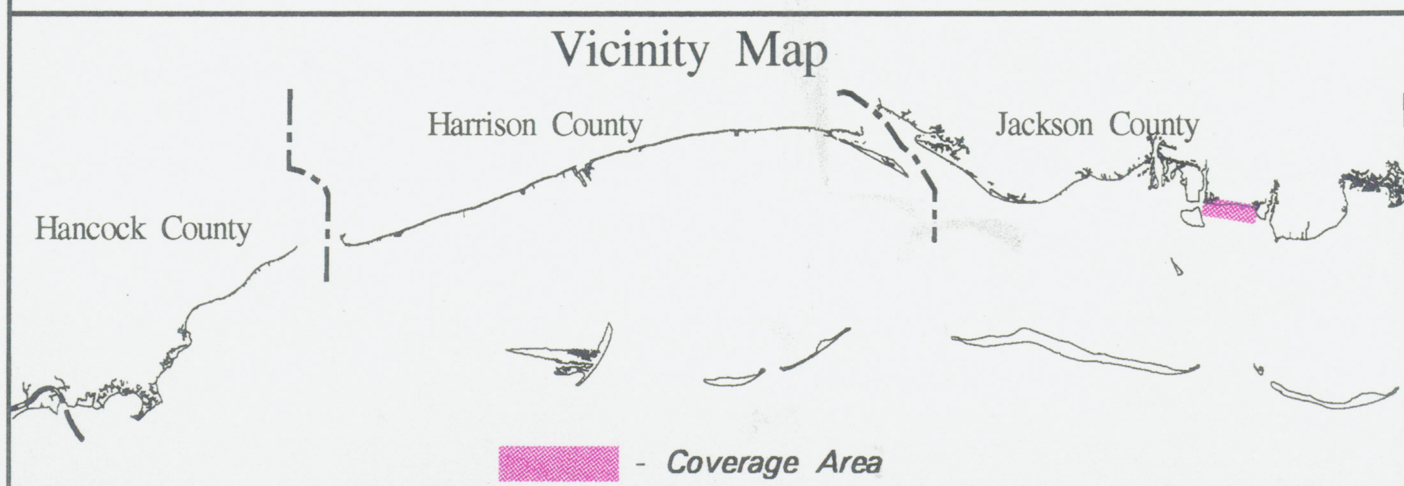


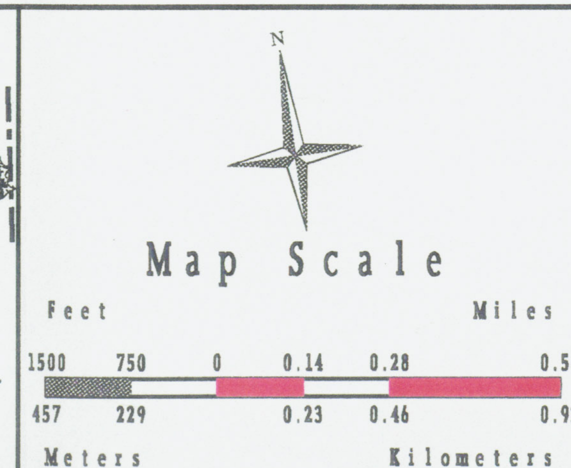
SINGING RIVER ISL.

Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System

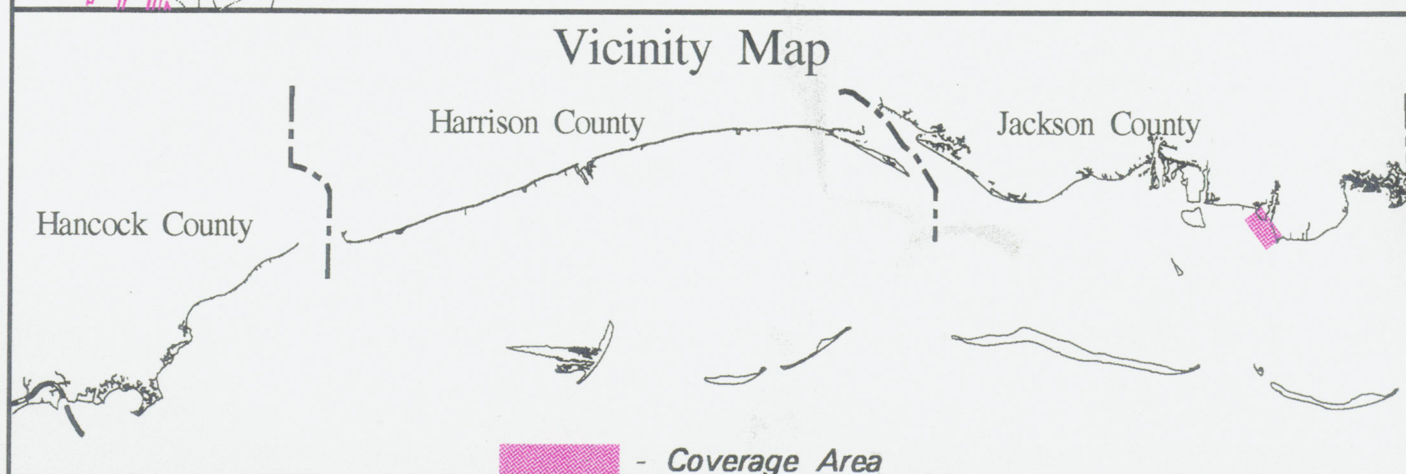


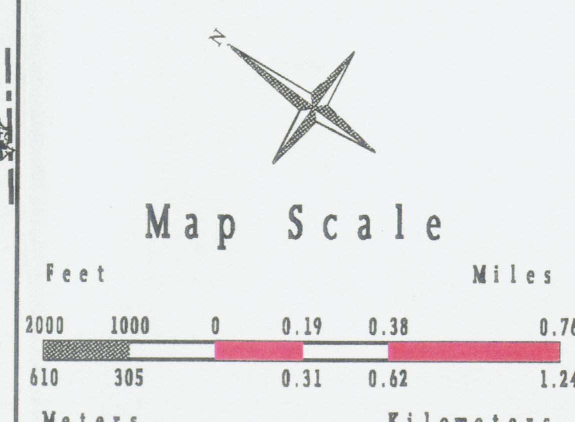


PASCAGOULA
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System





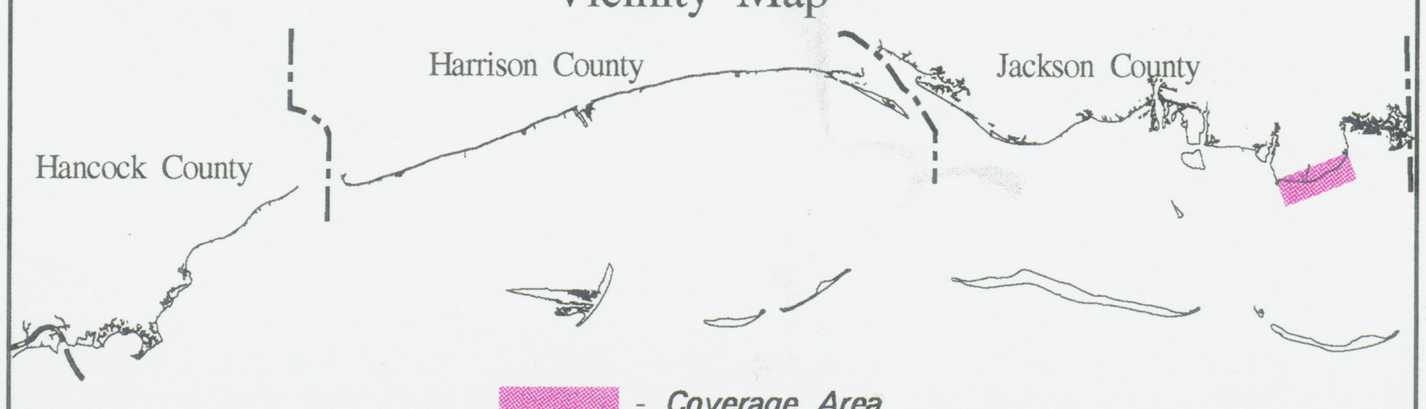
BAYOU CASOTTE

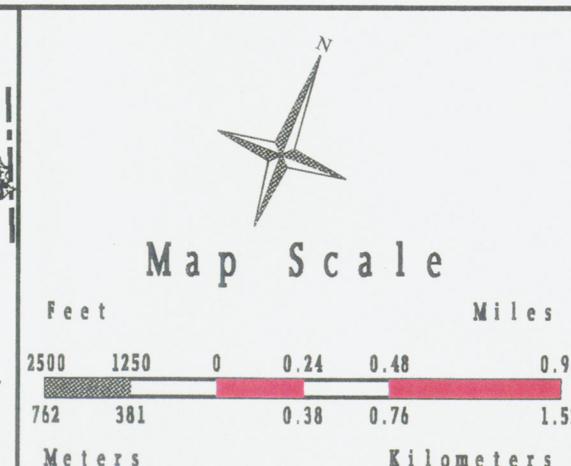
Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System

Vicinity Map





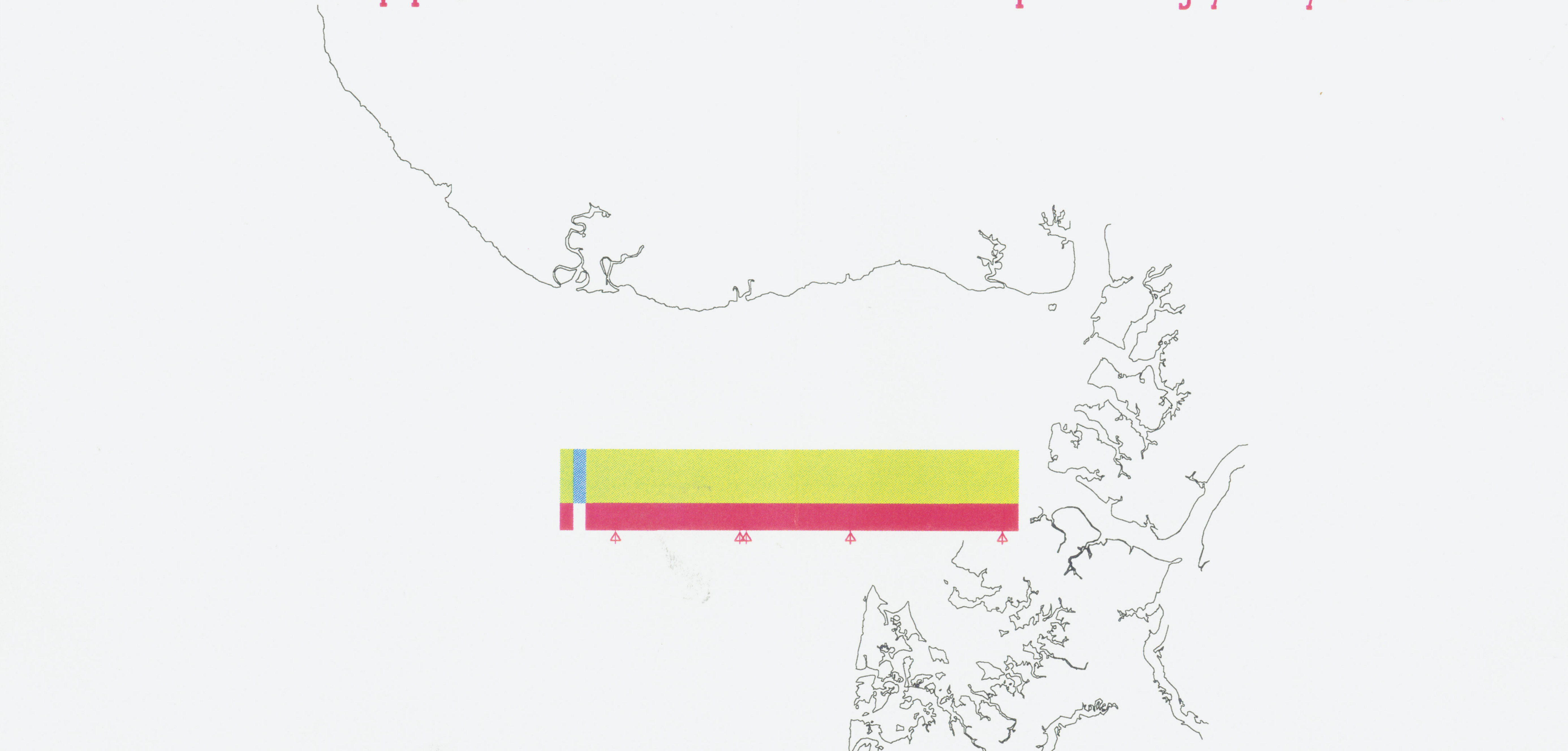
PT AUX CHENES

SET 1

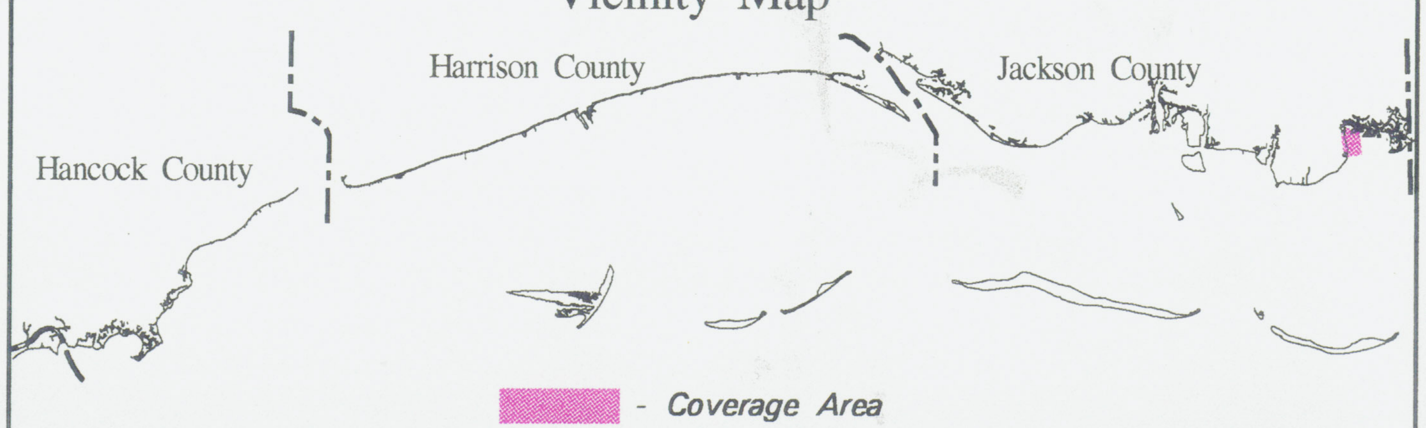
Geomorphology: 1991

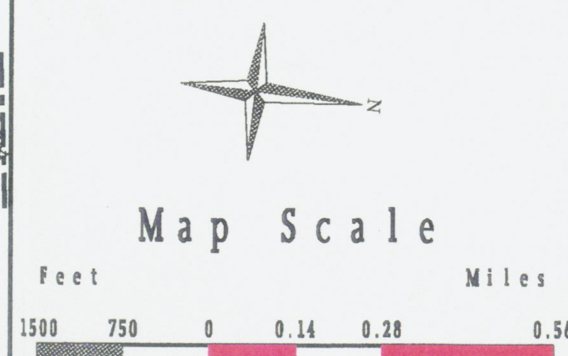
Shoreline: 1986

Mississippi Shoreline Geomorphology System



Vicinity Map





Map Scale

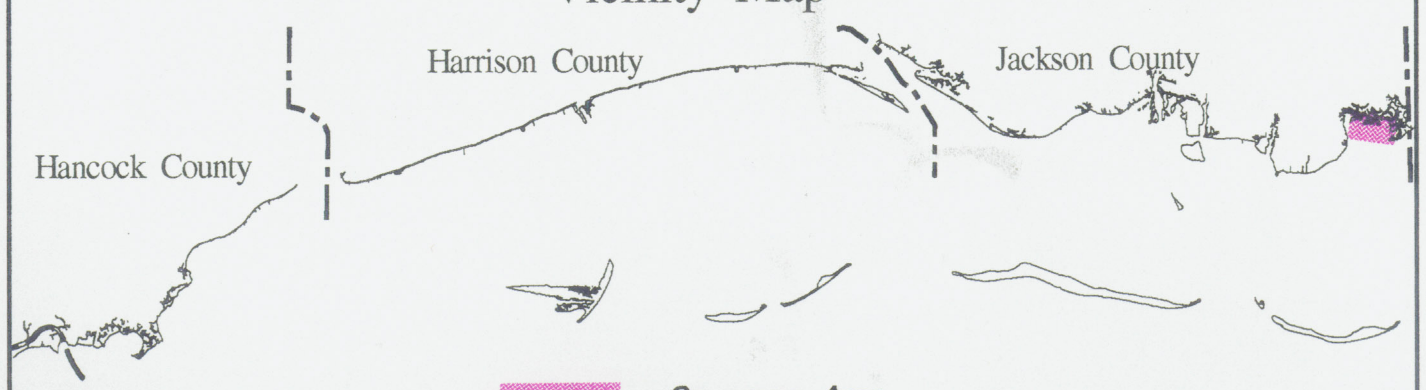
Feet						Miles
1500	750	0	0.14	0.28		0.56
457	229		0.23	0.46		0.92
Meters						Kilometers

BANGS LAKE
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System

Vicinity Map



- Coverage Area

Map Scale

Feet: 1500, 750, 0 — Miles: 0.14, 0.28, 0.56

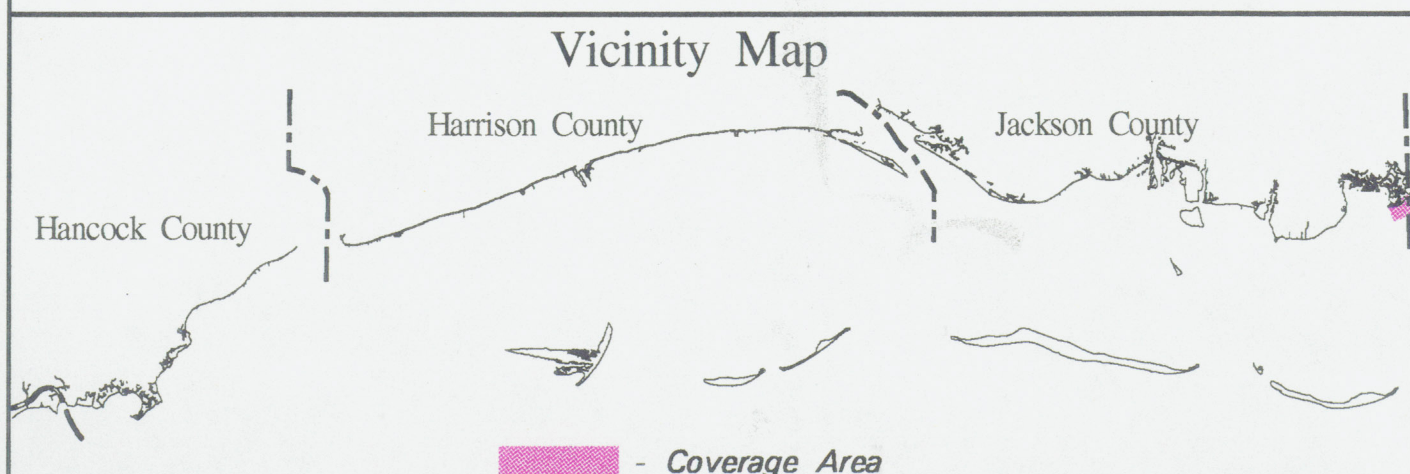
Meters: 457, 229 — Kilometers: 0.23, 0.46, 0.92

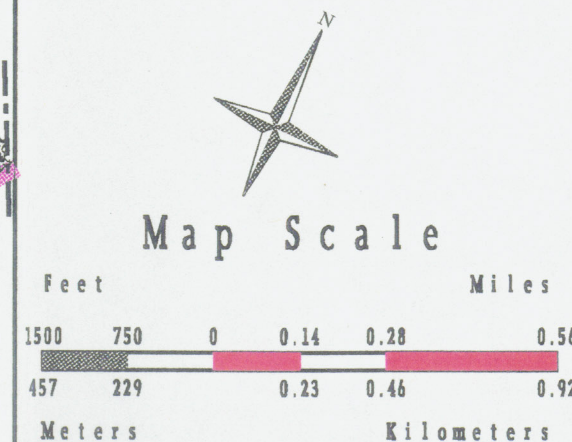
PT AUX CHENES BAY
SET 1

Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System



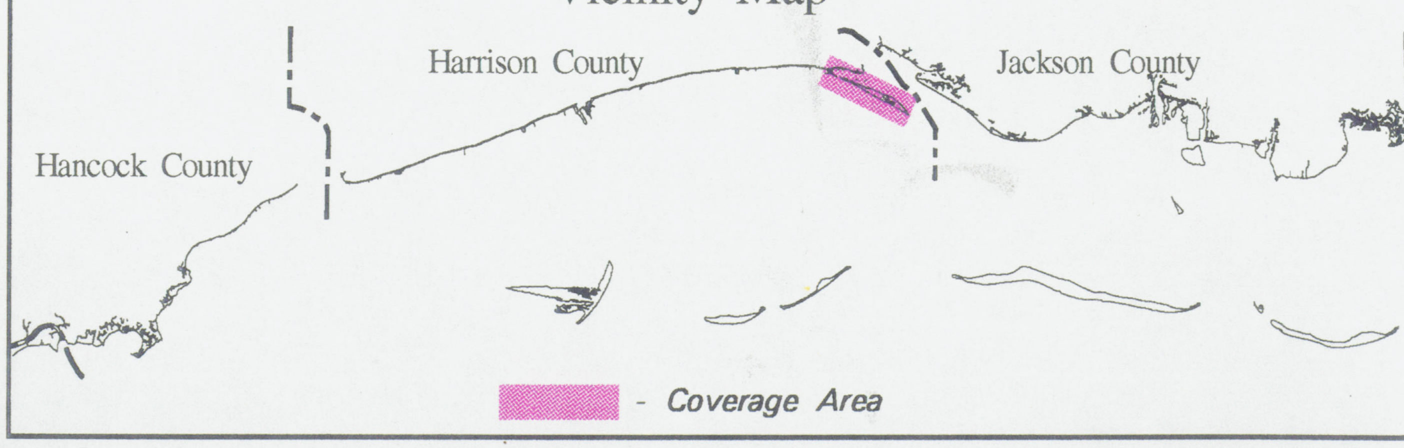


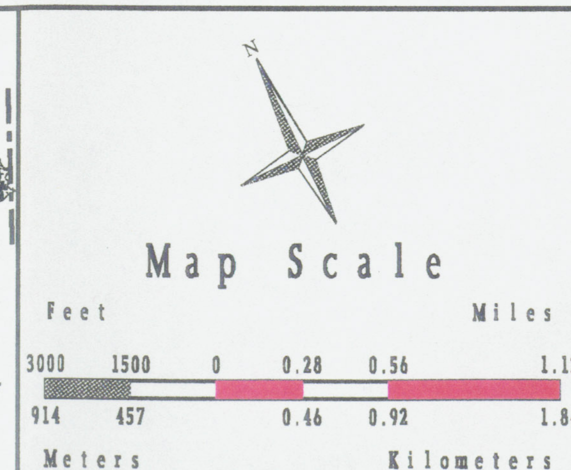
GRANDE BATTURE
SET 1

Geomorphology: 1991
Shoreline: 1986

Mississippi Shoreline Geomorphology System

Vicinity Map



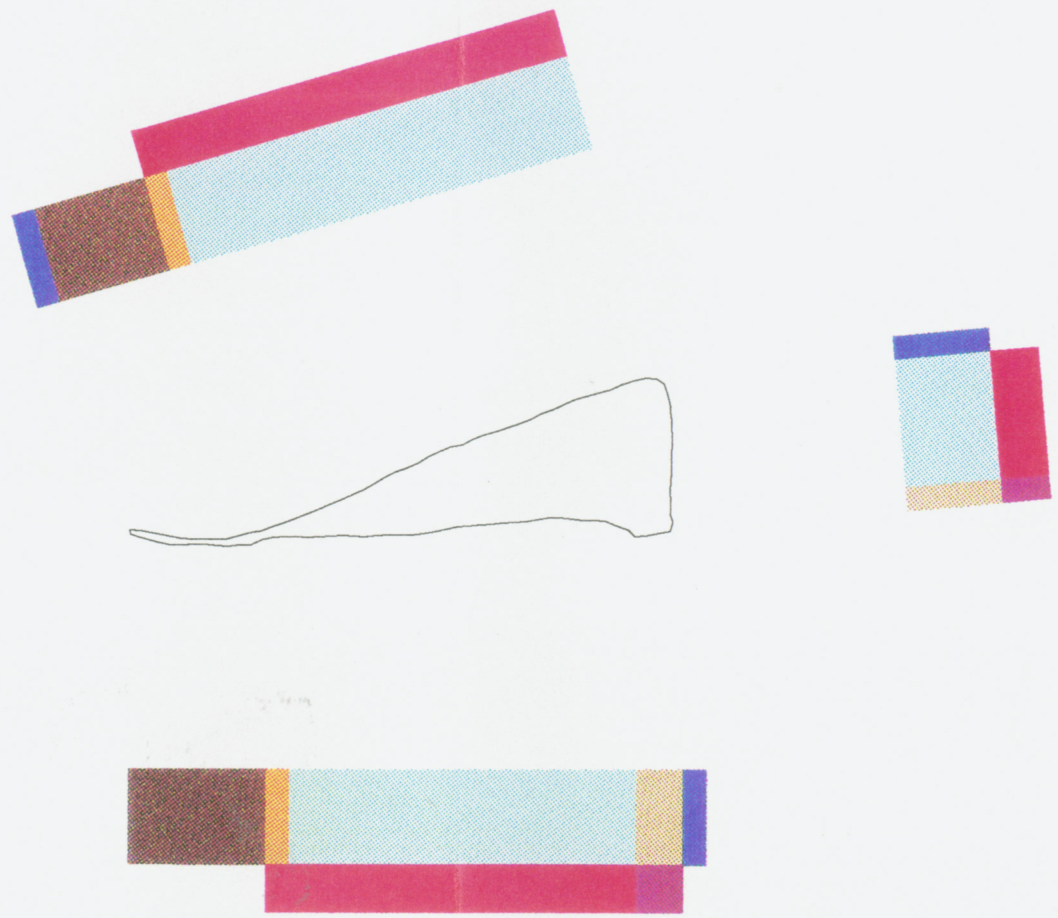


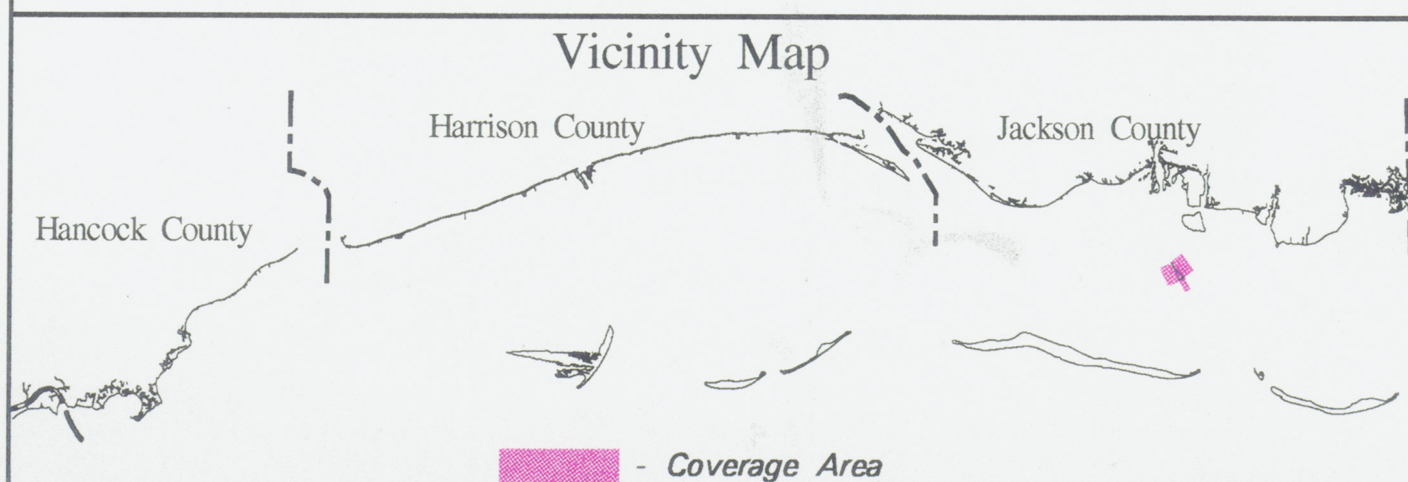
DEER ISLAND

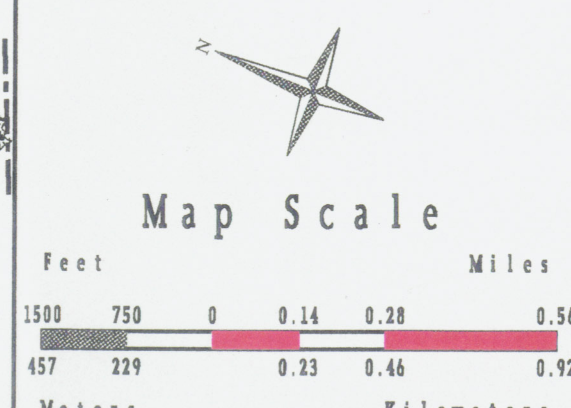
Geomorphology: 1991

Shoreline: 1986

Mississippi Shoreline Geomorphology System







ROUND ISLAND

Geomorphology: 1991
Shoreline: 1993

APPENDIX C

MISSISSIPPI SHORELINE GEOMORPHOLOGY SYSTEM DOCUMENTATION

OVERVIEW

The Mississippi Department of Environmental Quality (DEQ), Office of Geology contracted with the Mississippi Institutions of Higher Learning, Mississippi Automated Resource Information System (MARIS) via DEQ Contract Number GE-V-175041-B-92-PB to develop an Arc/INFO format database and application software system to assist in Coastal Geomorphology studies. The Mississippi Shoreline Geomorphology System (MSG) is the final product of this contract.

It is an integrated database and application software interface system using Arc/INFO geographic information system (GIS) software. MSG was developed on MARIS's Digital Equipment Corporation VAX 6420 mini-computer using Arc/INFO version 5.0.1 software. It was then ported to DEQ Office of Geology's SUN Microsystems, Inc. SUN Sparc II workstation with Arc/INFO version 6.0.1 software.

The objective of MSG is to produce graphics and related statistical data to support geomorphology studies of the Mississippi barrier islands, including Cat Island, Ship Island, Horn Island, and Petit Bois Island. The system was designed with a user friendly set of menus which prompt for data input, produce graphic screen displays, and generate statistical reports. MSG is a flexible system to which new options may be added and/or other geographic areas may be addressed.

To illustrate the geomorphology of the four islands, MARIS constructed bar graphs adjacent and parallel to each island. The graphs consist of six rows of 31 meter wide 'cells' . The rows are divided into two groups of three rows each. An individual group of three rows is called a bar while the entire six rows or two bars comprise one set. Each island, except Cat Island, has two sets, one generally on the north side and one generally on the south side. The sets were constructed by visually identifying a central axis for each island, except Cat. The sets were then constructed parallel on either side of this axis. Each bar is designed with the following dimensions; central row height is 254.1 meters, the two outside rows height is 127.05 meters. The cell width for each row is 31 meters. The number of cells per row varies for each island depending on linear extent. The two bars of a set are separated from each other by a distance of 508.2 meters. The exceptional shape of Cat Island necessitated the creation of six sets.

For a given set, the individual bar which is closest to the island shore is tagged as bar type '1' and is designed to represent the nature of the island interior. The other bar is tagged bar type '2' and represents the island shoreline. Within bar type '1', the row closest to the island is labeled row '1', the central row is row '2', and the third row is row '3'. Rows are numbered identically for bar type '2', with the closest row to the island labeled row '1', the central row is tagged '2', and the outside row is referred to as row '3'. To uniquely identify a row, a user must specify the island name, set number, bar type, and row number. Cells within rows are numbered in ascending order beginning with 1 to coincide with the direction of the reconnaissance flights as per maps provided by DEQ, Office of Geology.

For geomorphic interpretation of the mainland shoreline a similar set of bar graphs was constructed parallel to the mainland shoreline. Because the orientation of the mainland shoreline varies along its length, separate graphs were constructed for each section of shoreline having the same general orientation. A total of 26 bar graphs were necessary to completely cover the shoreline as well as Deer and Round islands in the Mississippi Sound. Each graph consists of three rows similar to those used on the barrier islands. No interior bar set was constructed for the mainland shoreline. In order to minimize the number of maps needed to display the bar sets, individual sets were combined where possible on single maps.

The remainder of this manual is divided into two main portions: 1. **User documentation**, and 2. **Program documentation.** The User Documentation section explains how each menu option functions and is supported with graphic replicas of all system menus. The final section, Program Documentation, contains listings of all interface software developed, arranged as it is accessed by the main menu. At the end of this section, a sub-section is included which lists the data dictionary and use of some special INFO files which were developed and are used by various system programs.

USER DOCUMENTATION

System Start-Up and Control

A user session in the Mississippi Shoreline Geomorphology System is begun by typing MSG <cr> from the ARC: prompt. This initial macro sets necessary pathnames, terminal settings, and dates. The user is transferred to the correct workspace, the ARCPLOT module is initiated, and the MSG-Main menu is displayed. All system functions are accessed through this menu. The user must point and click with a mouse or move the highlight box with the cursor arrow keys and hit <cr> on the desired option to execute it. Upon completion of execution of a selected option the MSF-Main menu is redisplayed.

Data Input

Input data represent geomorphic classes. There are two types, polygon classes (P) and point classes (M). Two coverages were constructed for each island or shoreline segment (except Cat Island where four coverages were created and Round Island where three coverages were created). One coverage is a polygon coverage, where each row of each bar of each set is divided into a finite number of cells (polygons). The polygon classes are stored as attributes of cells in an item in the polygon attribute table of the appropriate island polygon coverage. The item is identified by naming convention as to the survey year represented.

The other coverage is a point coverage that has an individual point to represent each cell of each row of each bar of each set. The point classes are stored as attributes of points in an item in the point attribute table of the appropriate island point coverage. The item is identified by naming convention as to the survey year represented.

Note that only one set of data may be input for an individual calendar year.

All data input is done through the **MODIFY** option under the **DATABASE** heading of the MSG-MAIN menu. Upon selecting the **MODIFY** option, the user is prompted for the island name or set name, survey year, set number, bar type, row number, and feature type through another menu. After filling in the appropriate information and clicking the End Input option, a data input menu is displayed. The specific menu depends on the feature type entered, P or M. In the case of polygon data (feature type P), the data input menu displays the island name, set, bar, and row numbers, and number of cells per row, and prompts the user for beginning and ending cell numbers of a cell range and the polygon class number. The beginning and ending numbers of the range are inclusive. A single cell can be specified by giving the same beginning and ending cell number. In the case of point data (feature type M), the data input menu displays the same information, but prompts the user for only a cell number and class number. Cell ranges cannot be specified.

At any time the user may view the appropriate class list by clicking on the **View Class List** option. When the user has entered the certain cell number (s) and a class number, the **End Input** option must be selected. Input data are then checked for logic and input to the data base. The user is queried about more data entry for the same island, set, bar, and row. A positive response will result in the appropriate menu being redisplayed to repeat the data input process. Erroneous data entry may be edited by simply re-entering the data, as the program always overwrites any data that may already be in the data base. The data input process can be halted at any time by clicking on the **Cancel Input** option.

The following pages are graphic representations of the screen menus the user will view during the data entry process. The first is the **MSG** main menu. Selecting the **MODIFY** option displays the next menu. Supplying the appropriate information will cause display of either the polygon input menu or point input menu. The final two pages are the class lists that would be displayed by clicking on the **View Class List** option on either of the data input menus.

*** Menu file name: MSG-MAIN.MENU**
*** Sub-menu of: This is the main menu of the system.**

```
           ****Mississippi Shoreline Geomorphology System****

                              MAIN MENU

Thursday
September 24, 1992

*****************************************************************
DATABASE        DISPLAY             REPORTS            MAP GEN.
*****************************************************************

MODIFY         ISLAND             EDIT REPORTS        ISLAND
INITIALIZE     SINGLE SET         ONE YEAR            SUB-ISLAND
                                  COMPARISON
                                  SUMMARY COMP.

*****************************************************************

                             End Session
```

```
* Menu file name: GETBAR.MENU
* sub-menu of: [DATABASE/MODIFY]
```

```
          Enter the Following Information

    Thursday
    September 24, 1992

    *****************************************

     Island Name:            Survey Year:

      Set#:         Bar#:        Row#:

              Feature Type: P

    *****************************************

                    End Input

                  CANCEL Input
```

*** Menu File Name: DATAINP.MENU**
*** Sub-menu of: [DATABASE/MODIFY]**

```
        Enter the beginning and ending cell number
                 and geomorphic class


        Thursday
        September 24, 1992

                     Island : SHIP

               Set#        Bar#        Row#
                1           1           1

                    Cells per Row: 480
      *********************************************

                  Beginning cell#: 1

                     Ending cell#: 0

                           Class#: 0

      *********************************************

                      View Class List

              End Input            CANCEL Input
```

```
* Menu File Name: DATAINM.MENU
* Sub-menu of: [DATABASE/MODIFY]
```

```
                    Enter the cell number
                    and geomorphic class

         Thursday
         September 24, 1992

                         Island : SHIP

              Set#         Bar#         Row#
               1            1            1

                    Cells per Row: 480
        ********************************************

                         Cell#: 1

                        Class#: 0

        ********************************************

                      View Class List

             End Input             CANCEL Input
```

*** Text file name: PCLASSES.TXT**

Mississippi Shoreline Geomorphology System

Polygon Class List

****

Class Number	Geomorphic Type
1	Coppice Dune
2	Coalesced Coppice Dune
3	Irregular Dune
4	Hummocky Dune Terrace
5	Degraded Dune
6	Dune Ridge
7	Precipitation Dune
8	Artificial Beach
9	Uplands
10	Perched Beach
11	Coastwise Spit
12	Bulkhead/Seawall
13	Recurved Spit
14	Washover Flat
15	Washover Corridor
16	Washover Terrace
17	Maritime Forest
18	Marsh
19	Tidal Flat
20	Open Marine Water
21	Pond/Lake/Lagoon
22	Major Tidal Channel
23	Scarp
24	Riprap
25	Marina/Harbor
26	Breakwater
27	Dredge Spoil

PREV END FULL OK

Text file name: PTCLASSES.TXT

Mississippi Shoreline Geomorphology System

Point Class List

****

Class Number	Geomorphic Type
1	Minor Tidal Channel
2	Tidal Delta
3	Washover Chute
4	Washover Splay
5	Man-made Path or Trail
6	Pier
7	Access Canal
8	Groin
9	Jetty
10	Storm Outfall

PREV END FULL OK

Other Data Editing

In case the user wishes to completely eliminate data entered for a specific island, set, bar, row, and survey year the **INITIALIZE** option is available. This program will input a zero class value for all cells on a user specified island, set, bar, row, survey year, and feature type.

Upon selection of the **INITIALIZE** option, the user is prompted for the specific island, survey year, set number, bar type, row number, and feature type. After supplying this information and clicking the **End Input** button, logic checks are performed and the appropriate class item is given a zero value. The same effect could be obtained by entering the entire range of cells for a row and a zero class value on the polygon input menu. However, for point data this is the only method to zero all values on a selected row.

The following two pages illustrate the sequence of initializing the class values for a given island, survey year, set, bar, row, and feature type. The first is the **MSG** main menu. Selecting the **INITIALIZE** option results in the display of the next menu, which prompts the user for the necessary information about the cells to initialize.

```
* Menu file name: MSG-MAIN.MENU
* Sub-menu of: This is the main menu of the system.
```

```
         ****Mississippi Shoreline Geomorphology System****

                            MAIN MENU

Thursday
September 24, 1992

******************************************************************
DATABASE         DISPLAY                REPORTS           MAP GEN.
******************************************************************

MODIFY          ISLAND                EDIT REPORTS       ISLAND
INITIALIZE      SINGLE SET            ONE YEAR           SUB-ISLAND
                                      COMPARISON
                                      SUMMARY COMP.

******************************************************************

                            End Session
```

*** Menu file name: GETBAR.MENU**
*** sub-menu of: [DATABASE/INITIALIZE]**

```
                Enter the Following Information

           Thursday
           September 24, 1992

           *****************************************

            Island Name:              Survey Year:

             Set#:          Bar#:         Row#:

                      Feature Type: P

           *****************************************

                           End Input

                         CANCEL Input
```

Screen Display

Two screen display options are available for viewing data input to the Mississippi Shoreline Geomorphology System. The only difference is that one option displays all sets for a selected island/shoreline segment and survey year, and the other option displays a selected set for a selected island/shoreline segment and survey year. Polygon classes are shaded in various colors and point class are drawn with marker symbols. The display is complete with a legend and north arrow. The individual selected island or shoreline segment is rotated so that the bars are displayed horizontally.

The following pages represent the menus that will be displayed if either of the two options are chosen. The first menu is the **MSG** main menu from which the **ISLAND** option under **DISPLAY** may be chosen. The next menu is then displayed prompting the user to identify the island and survey year to display. After entry of this information, the **End Input** button must be clicked. The appropriate island the bar data are then drawn to the screen. When the user is finished viewing, a <cr> will re-display the **MSG** main menu.

The next page is again the **MSG** main menu from which the other option, **SINGLE SET**, under the **DISPLAY** heading may be chosen. The final page of this group is the succeeding menu to prompt the user for the Island name, survey year, and set number for display. After entry of this information, proceed as above.

*** Menu file name: MSG-MAIN.MENU**
*** Sub-menu of: This is the main menu of the system.**

```
****Mississippi Shoreline Geomorphology System****

                     MAIN MENU

Thursday
September 24, 1992

*******************************************************************
DATABASE        DISPLAY             REPORTS            MAP GEN.
*******************************************************************

MODIFY          ISLAND            EDIT REPORTS       ISLAND
INITIALIZE      SINGLE SET        ONE YEAR           SUB-ISLAND
                                  COMPARISON
                                  SUMMARY COMP.

*******************************************************************

                    End Session
```

```
* Menu file name: GETISLAND.MENU
* Sub-menu of: [DISPLAY/ISLAND]
```

```
              Enter the Following Information

        Thursday
        September 24, 1992

        *****************************************

                  Island Name:

                 Display Year:

        *****************************************

                       End Input

                     CANCEL Input
```

*** Menu file name: MSG-MAIN.MENU**
*** Sub-menu of: This is the main menu of the system.**

```
                ****Mississippi Shoreline Geomorphology System****

                                   MAIN MENU

Thursday
September 24, 1992

*****************************************************************
DATABASE        DISPLAY                 REPORTS              MAP GEN.
*****************************************************************

MODIFY          ISLAND                EDIT REPORTS         ISLAND
INITIALIZE      SINGLE SET            ONE YEAR             SUB-ISLAND
                                      COMPARISON
                                      SUMMARY COMP.

*****************************************************************

                                   End Session
```

```
* Menu file name: GETSET.MENU
* Sub-menu of: [DISPLAY/SINGLE ISLAND]
```

```
        Enter the Following Information

  Thursday
  September 24, 1992

  *****************************************

           Island Name:

          Display Year:

            Set Number:

  *****************************************

                End Input

                CANCEL Input
```

Reports

Four statistical report options are available on the **MSG** main menu. The first two - **EDIT REPORTS** and **ONE YEAR** - report on a single survey year, while the last two report options - **COMPARISON** and **SUMMARY COMP**. - cross tabulate survey data from two selected years.

The **EDIT REPORTS** option generates a simple tabular list of class number for each cell of a selected set, bar, row, and feature type for a selected island and survey year. This report is intended for the user to use to check data entry accuracy. When the **EDIT REPORTS** option is selected from the **MSG** main menu, a secondary menu is displayed prompting the user for the island name, survey year, set number, bar type, row number, and feature type. After the user has supplied this information and clicked the **END INPUT** button, the report is generated and displayed to the screen. The user can pause the report, and then optionally print it. Clicking the **CANCEL INPUT** button will halt the report and return the user to the **MSG** main menu.

An inventory report for a selected set or all sets of a selected island for a selected survey year can be prepared with the **ONE YEAR** option under the **REPORTS** heading of the **MSG** main menu. When this button is clicked, the user is prompted for the name of the island, the survey year, and the set number. By entering a '99' in the set number field, the report will contain information for all sets for the specified island for the specified survey year. The report is structured with a separate page for each row of each bar of each specified set. For each class, the total number of cells is given and the percent of the row occupied by the class. Also, linear distance is calculated for polygon classes for all rows on bar type '2', the shoreline bar.

The **COMPARISON** report generates a matrix table comparing class numbers by row for two survey years, for a selected island and a selected set. When this option is chosen from the **MSG** main menu, a subsequent menu is displayed to prompt the user for the island name, base report year (y-axis of the matrix table) , comparison year (x-axis of the matrix table), and the set number. A '99' entered in the set number field will cause the report to include all sets for the specified island. This report is structured to produce a separate page for each row reported on. The subject rows included in this report are: 1. bar type 1, row 2 (Central Interior); 2. bar type 2, row 2 (Shoreline); and 3. bar type 2, row 3 (Fore Shore). The y-axis or rows of the matrix table are the classes from the base survey year and the x-axis or columns of the matrix table are the classes from the comparison survey year. The table is populated with the number of cells occurring at the class intersections. Separate tables are generated for the polygon and point classes.

The **SUMMARY COMP**. report under the **REPORTS** heading of the **MSG** main menu generates a gross comparison of class occurrence for a selected set of a selected island for two survey years. Initiating this report is identical to the **COMPARISON** report described above. Structurally, this report generates a separate page for each row of each set included in the report. For each class, the report lists the total number of cells, percent of the row, and linear distance (for polygon classes on the shoreline rows) for the base report year and the comparison year.