Biological Services Program

FWS/OBS-81/16
October 1982

Mississippi Deltaic Plain Region Ecological Characterization: An Ecological Atlas

Map Narratives

Bureau of Land Management
Fish and Wildlife Service

U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.

- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.

- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

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MISSISSIPPI DELTAIC PLAIN REGION ECOLOGICAL CHARACTERIZATION: AN ECOLOGICAL ATLAS

MAP NARRATIVES

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U.S. Department of the Interior
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PREFACE

The purpose of the Mississippi Deltaic Plain Region (MDPR) Characterization study is to compile existing information about the biological, physical, and social sciences for coastal Louisiana and Mississippi from Vermilion Bay, Louisiana, to the Mississippi-Alabama state line (see map of the study area that follows). The MDPR Ecological Atlas consists of composited overlay topic information with thirteen base maps, to produce a total of 78 maps, and a volume of map narratives. Federal and State decisionmakers, among others, may use these maps and narratives for coastal planning and management, and in planning for Outer Continental Shelf oil and gas development. This study is one of a series of characterizations of coastal ecosystems being produced by the U.S. Fish and Wildlife Service. Additional studies include the Chenier Plain of Louisiana and Texas, the sea islands of Georgia and South Carolina, the rocky coast of Maine, the coast of northern and central California, the Pacific Northwest (Oregon and Washington), and the Texas barrier islands.

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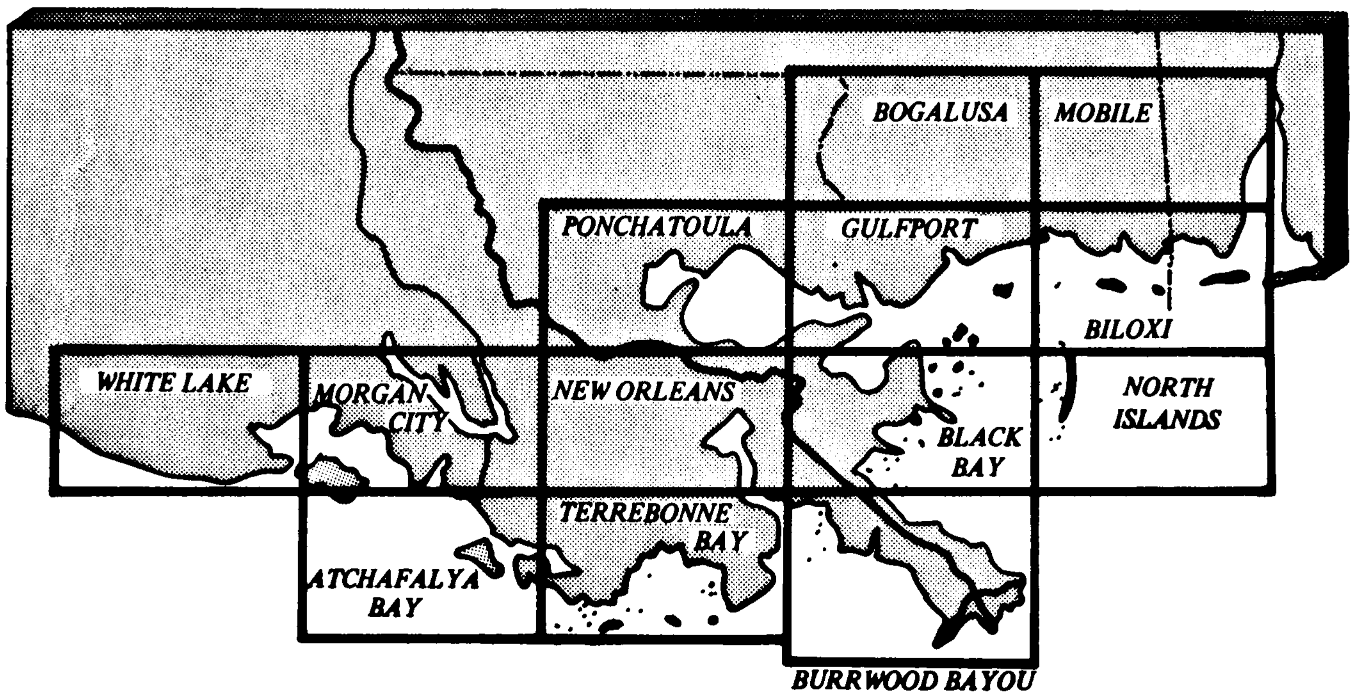
This volume of map narratives should be cited:

Garofalo, D. 1982. Mississippi Deltaic Plain Region ecological characterization: an ecological atlas. Map narratives. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/16.

The ecological atlas maps should be cited:

Garofalo, D. 1982. Mississippi Deltaic Plain Region ecological characterization: an ecological atlas. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/16. Map numbers A-1 through F-13. (No maps were printed for the White Lake quadrangle because so little land area was shown.)



MISSISSIPPI DELTAIC PLAIN REGION PROJECT AREA

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ACKNOWLEDGEMENTS

The subject matter presented in this Ecological Atlas is so varied that, in the course of both preparation and review, expertise was sought from people of many different disciplines. Members of many Federal and State agencies and of the community at large have generously contributed their time to review draft maps and narratives, frequently providing additional data during the review process. We wish to thank, in particular, the Bureau of Land Management, New Orleans OCS Office: Lawrence Handley, Villere Reggio, and Robert Rogers; U.S. Geological Survey, Water Resources Division, Baton Rouge, LA: George Cardwell, Charles Demas, Duane Everett, Max Forbes, Harold Leone, and Dale Nyman; U.S. Geological Survey, Water Resources Division, Jackson, MS: Lynette Gandl; U.S. Geological Survey, National Mapping Division, NSTL Station, MS: Frank Beatty, Pat O'Neil, and Henry Svehlak; U.S. Geological Survey Representative to National Wetlands Inventory, St. Petersburg, FL: Frederick Lavery; National Weather Service, Lower Mississippi River Forecast Center, National Oceanic and Atmospheric Administration, Slidell, LA: David Smith; National Park Service, NSTL Station, MS: Steven Shabica; U.S. Department of Agriculture, Soil Conservation Service, Alexandria, LA: Brad Spicer; U.S. Fish and Wildlife Service, Ecological Services Division: David Fruge, Tim Morton, Paul Smith and Dan Tabberer; U.S. Fish and Wildlife Service, Jackson (MS) Area Office, Endangered Species: Fred Bagley; Louisiana Department of Wildlife and Fisheries, Seafood Division, New Orleans: Charles Boudreaux, Ronald Dugas, Ralph Latapie, William Perret and Harry Schaefer; Louisiana Department of Wildlife and Fisheries, Game Division, New Orleans: Robert Beter; Mississippi Bureau of Marine Resources, Long Beach: James Franks, Dianne Hunt; Coastal Management Section of the Department of Natural Resources, Baton Rouge, LA: John Glenn and Martha Landry; Louisiana Department of Culture, Recreation and Tourism, Division of Archaeology and Historic Preservation: Philip Rivet; Mississippi Department of Archives and History: James Lauro and Sam McGayhee; Coastal Environments, Inc., Baton Rouge, LA: Karen Wicker; Louisiana State University, Center for Wetland Resources: Robert Baumann; Louisiana State University, Department of Botany: Meredith Lieux; Chevron, U.S.A., Inc., Pascagoula, MS: Charles Shaffer.

The cartographic conceptualization of the maps, i.e., the conversion of collected data, in its many varied forms, to mapped presentation was carried out by Michael Douglass, of Earth Satellite Corporation. Cartographic rendering (drafting, scribing, stick-up, and other map preparation tasks) was performed by Michael O'Brien and his assistant, Paula Miller. Appreciation is also due to Ernest Clemens and the several map narrative authors who were responsible for data collection and compilation of the draft manuscript maps. Carl Selsky and Brian Hollen, under the direction of Ronald Hodge, were responsible for all photographic map processing and final overlay production. The staff of Burk and Associates, particularly Paul Wagner, who collected data for all map topics and provided information over and above his area of contract responsibility, is gratefully acknowledged. Coeta Withgott and Annette McNeely of Earth Satellite's word processing center typed the final manuscript of the map narrative under the direction of April VonWald.

SOCIOECONOMIC FEATURES

by

Paul Waidhas
Burk and Associates, Inc.

INTRODUCTION

The socioeconomic elements mapped in this section of the atlas deal with man-made features and sites that man has designated as having special significance. In both cases the topography, resources, climatic conditions, flora, and fauna of the Mississippi Deltaic Plain Region (MDPR) are closely related to the location and extent of these socioeconomic features. Many of the items depicted on the Biological Resources, Oil and Gas Infrastructure and Mineral Resources, and other maps have influenced human habitation in the MDPR and have been altered from their natural state by human factors. Characteristics such as low elevations, vast expanses of wetlands, threat of hurricane damage, which are represented elsewhere in this atlas, have acted as constraints to man's use of the region, and in the past, have limited development. Today's level of technology has counteracted some of these limitations and, concomitantly, has led to increasingly serious impacts on the resources of the area.

HISTORIC ROLE

Archaeologists have identified ten cultural periods of Indian habitation in the MDPR. While there is evidence that the area was inhabited as early as 40,000 BC (Beavers 1977), the majority of the sites are much more recent. As this map shows, most known Indian settlements (mapped as "sensitive areas") followed a linear pattern and are located on the relatively high natural levees of streams. These cultures subsisted largely on the abundant flora and fauna found in the vicinity. The clam, *Rangia cuneata*, was one of the most widely used food sources (Sibley 1967). Shell middens consist almost entirely of these clam shells and oyster shells, which were discarded after the meat had been eaten.

Sensitive areas (outlined on the map with a solid line) contain archaeological sites whose exposed locations would make them vulnerable. For this reason, their exact locations are not given. This information is available to responsible parties, however, and may be obtained by contacting the Louisiana Department of Culture, Recreation and Tourism, Division of Archaeology and Historic Preservation, P.O. Box 44247 Capitol Station, Baton Rouge, LA 70804, telephone (504) 342-6680, or the Mississippi Department of Archives and History, Division of Historic Preservation, P.O. Box 571, Jackson, MS 39205, telephone (601) 354-7326.

During the Mississippian culture period, probably in 1542, the Indians of the MDPR first came into contact with Europeans (Sibley 1967). It was in this year that the remnants of the DeSoto expedition voyaged down the Mississippi River to the Gulf of Mexico. The French, under d'Iberville, established the first settlement in the MDPR at Biloxi in 1699. The colony of Louisiana stretched from present day Canada to the Gulf of Mexico. In order to control this vast area, the French realized that they had to establish a town near the mouth of the Mississippi River (McGinty 1951). In 1718, Bienville put fifty men to work clearing an area that became New Orleans. The original town site is the Vieux Carré or French Quarter, which is indicated as an Historic District on the map. Gradually the area became more settled as French and Spanish rule alternated in the early years of the colony. In 1764, the Acadians were forced to leave Canada and many migrated to southern Louisiana. This group, which became known as the Cajuns, has had a strong cultural impact on the area.

Like the Indians, these early settlers lived on the natural bayou and river levee ridges. These relatively high areas provided fertile soil for crops, sugar cane in particular, and gave them ready access to the surrounding region via a network of waterways. Note that most of the plantations, forts and other National Historic landmarks indicated on the map occur either on these bayou ridges or along the Mississippi Gulf Coast.

The colony of Louisiana became the Louisiana Territory after the United States purchased it in 1803 (McGinty 1951). The new owners had to defend the territory against the British in 1812, when the Battle of New Orleans was fought at Chalmette. This area figured prominently in the Civil War and some of the historic sites in Louisiana and Mississippi on the map reflect this involvement.

CURRENT SITUATION

Today, as in the past, the MDPR is the location of numerous activities that are related to area resources and locational advantages. These attributes have provided many employment opportunities that support a growing population. While the MDPR encompasses only approximately 12% of the area of Louisiana and Mississippi, it is home to over 29% of the population (U.S. Department of Commerce 1970) of these two states.* One of two Standard Metropolitan Statistical Areas (SMSA's) in Mississippi is included in the study area. In Louisiana, the New Orleans SMSA is entirely within the MDPR, while Lafayette and Baton Rouge are just beyond its borders.

*In Louisiana, the Coastal Zone and MDPR boundary follow an irregular line which does not conform to parish boundaries. Local population descriptions are not available in a format which coincides with this line and parish/county level data are used herein to describe the Louisiana and Mississippi MDPR populations.

In the 20-year period between 1950 and 1970, the population of the MDPR counties and parishes has increased by over 51%. By comparison, the remaining Mississippi counties and Louisiana parishes outside the region grew by only 11% in the same period. In Mississippi, the three coastal counties recorded an 88% increase in population (+112,579) while the remaining 79 inland counties experienced a decrease of 4% (-74,581). In Louisiana the 14 parishes that are either wholly or partially within the study area had a population increase of 47% (468,699 persons) during the 1950-1970 period. The remaining 50 parishes exhibited only a 29% increase, or an absolute increase of 489,091 persons. More information regarding population trends can be found in Table 1 and Figure 1. Migration is occurring into the MDPR from out-of-state and from inland sections of Louisiana and Mississippi. The increase in population density over the 1950-1970 period reflects these migration patterns. Between 1950 and 1970 there was a 51% increase in MDPR population density, from 104.7 to 158.5 persons per square mile. During the same period the remaining counties and parishes increased only 11%, from 45.8 to 50.8 persons per square mile. As shown in Table 2, non-coastal Mississippi counties are decreasing in density. These density comparisons reveal the marked increase in MDPR population as compared with the relatively stable population levels of the remaining areas of the two states (U.S. Department of Commerce 1970).

The abundance of employment opportunities in the MDPR region is the primary reason for this population surge. Mineral or non-renewable resources, including oil, natural gas, salt and sulfur, and their related activities provide the most resource-based jobs. Directly related activities include: geophysical exploration, extraction, transportation, refining and manufacturing. These are development or export activities that bring money in from outside of the area. There are also numerous support activities such as: ship and barge building and repair, pipeline fabrication, offshore and onshore support.

Most of the mineral-related industry of the MDPR region is located in Louisiana, which produces approximately one-third of the Nation's natural gas and one quarter of the Nation's oil (Renner 1976). The SPCC (Oil Spill Prevention, Control and Countermeasures) sites as well as industrial impoundments and landfill sites were derived from the Environmental Protection Agency's (EPA) Region IV, 1979 Louisiana Coastal Inventory. This reference did not cover the Mississippi coast.

Industrial impoundments are pits, ponds, and lagoons for the storage, treatment, and/or disposal of liquid wastes which are considered to be potential pollutants. Only sites covering 5 acres or more are shown on the map. Industrial and municipal landfills are waste dump sites 5 acres in size or larger.

The oil spill prevention and control sites (SPCC sites) on the map are those which are under the jurisdiction of the Oil Spill Prevention, Control, and Countermeasures regulations which apply to non-transportation-related facilities with oil storage capacity greater than 1,320 gallons or a single tank larger than 600 gallons. In some cases chemical facilities could not be distinguished from oil facilities on aerial photography and were mapped by EPA in the same manner although they are not covered by SPCC regulations.

Table 1. Population trends in the MDPR compared with the remainder of the two states (U.S. Department of Commerce 1970).

Parishes/counties	1950	1960	% change	1970	% change
Louisiana total	2,683,516	3,257,022	(+21.4)	3,641,306	(+11.8)
MDPR parishes	1,004,906	1,290,745	(+28.4)	1,473,605	(+14.2)
Other parishes	1,678,610	1,966,277	(+17.1)	2,167,701	(+10.2)
Mississippi total	2,178,914	2,178,141	(-0.04)	2,216,912	(+ 1.8)
MDPR counties	127,365	189,050	(+48.4)	239,944	(+26.9)
Other counties	2,051,549	1,989,091	(- 3.0)	1,976,968	(- 0.6)
Total two states	4,862,430	5,435,163	(+11.8)	5,858,218	(+ 7.8)
Total MDPR	1,132,271	1,479,795	(+30.7)	1,713,549	(+15.8)
Other parishes and counties	3,730,159	3,955,368	(+ 6.0)	4,144,669	(+ 4.8)

Table 2. Comparison of population densities per square mile in the Louisiana and Mississippi MDPR parishes/counties with the rest of the two states (U.S. Department of Commerce 1970)

Parishes/counties	Population per square mile		
	1950	1960	1970
Louisiana total	59.5	72.2	80.7
MDPR parishes	111.7	145.1	165.6
Other parishes	46.5	54.5	60.0
Mississippi total	46.1	46.1	46.9
MDPR counties	70.2	104.2	132.3
Other counties	45.2	43.8	43.5
Total two states	52.7	58.9	63.4
Total MDPR	104.7	136.9	158.5
Other parishes and counties	45.8	48.5	50.8

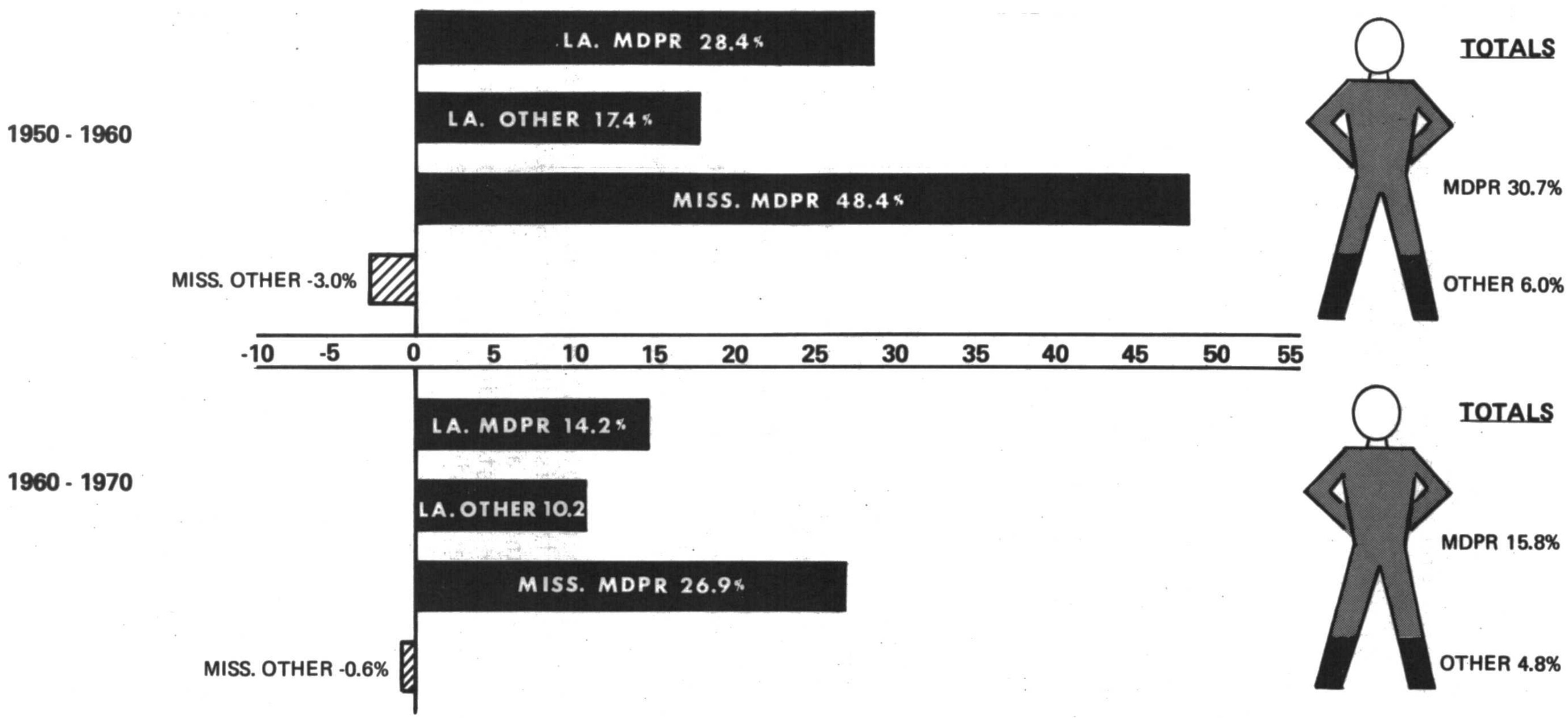

Figure 1. Percent change in MDPR populations, 1950-1960, 1960-1970 (U.S. Department of Commerce 1970)

In general, the industries and related population in the MDPR are facing limitations of a scarce resource--dry land. Finding appropriate disposal sites for municipal and industrial wastes or storage of oil and gas related products and by-products is difficult in an environment predominantly composed of coastal wetlands. The greatest concentration of dump and storage sites occurs along the Mississippi River between New Orleans and Baton Rouge. Since the EPA atlas was compiled from photointerpretation of aerial imagery, sites may exist which were not mapped.

By comparison, industrial and municipal point source discharges are located throughout the study region. Many of these point sources are part of economically beneficial industries and reflect their growth but at the same time may pose a threat to the surrounding environment.

Commercial fishing, food processing, sport fishing, charter boat use and boating are economically and culturally important MDPR activities. These activities are directly dependent on the quality of the natural environment. Coastal Louisiana and Mississippi have numerous public and private boat launches and marinas. Figures for per capita boat ownership in the two-state MDPR area are among the highest in the Nation (Table 3).

Commercial and recreational boats and ships have a vast amount of navigable water on which to operate in the MDPR. From the time of the Indians and early explorers, water routes were the primary paths of travel because of the large portion of the MDPR which was covered with natural waterways. Today, many additional miles of navigable canals, channels, and harbors have been dredged. These navigable waterways connect oil and gas fields, both on and offshore, with inland production centers. The ports of New Orleans and Gulfport are international trade centers, and New Orleans is the second largest port (in terms of tonnage) in the Nation (Renner 1976). Numerous smaller harbors along the Louisiana-Mississippi Gulf Coast also serve the fishing and oil industries.

Many of the commercially navigable waterways and harbors are improved natural streams; others, such as the Mississippi River Gulf Outlet and oil and gas field access and pipeline canals, are entirely man-made. All these channels have required dredging for construction or maintenance or both. The major dredge spoil disposal sites depicted on the maps are the larger above water and underwater spoil deposits. Lesser sites are not shown because they are too numerous.

While the MDPR is the site of much development associated with oil and gas activities, port facilities, and other features related to economic use of the land and water, the study region also has many beautiful natural, undeveloped areas. The Gulf Islands National Seashore is located between Mississippi Sound and the Gulf of Mexico. These formations are excellent examples of barrier islands with miles of undisturbed beaches. Numerous state and Federal wildlife refuges and game management areas provide birding, hunting, and fishing opportunities. State parks in the MDPR are primarily water-related, and offer boating, swimming, and fishing facilities as well as picnic areas and campgrounds. The Jean Lafitte National Historical Park is a new recreation area now in the planning and development stages. It will be a combination historical and ecological park in the freshwater wetlands of the Barataria region.

Table 3. Comparison of MDPR boat registrations with the rest of the United States (U.S. Department of Commerce 1970; Segal et al. 1976; U.S. Coast Guard 1978; Grove 1980; and Mississippi Boat and Water Safety Commission 1979).

	Estimated 1980 population	No. reg. boats	Boats/1,000 pop.
Louisiana MDPR	1,693,401	102,713	60.65
Mississippi MDPR	307,484	21,607	70.27
TOTAL MDPR	2,000,885	124,320	62.13
United States	218,059,000	8,034,905	36.85

Federal, state, and military lands shown on the map are the more important installations in the area. Federal and state office buildings, post offices, and other smaller points are not usually indicated. Many of these sites have a specific relationship to the local area. Keesler Air Force Base, for example, is not only part of the coastal defense system, but is also home base for the Weather Reconnaissance Group that observes hurricanes. The Bonnet Carre Spillway, located upriver from New Orleans, is managed by the U.S. Army Corps of Engineers. The purpose of the spillway is to protect the city of New Orleans from flooding by diverting part of the Mississippi River's flow into Lake Pontchartrain. The spillway also serves as a state wildlife management area open to public hunting and fishing.

The MDPR transportation system ties the coastal areas together and links them to inland areas and other states. The Mississippi River connects the Port of New Orleans with 22 states (Renner 1976) and virtually every foreign country. The Gulf Intracoastal Waterway provides a major regional transportation artery that connects the Mississippi ports of Pascagoula, Biloxi, Gulfport; New Orleans, Houma, Morgan City, Louisiana, and others with smaller inland waterways. These major and minor ports are served by an extensive railway system. Seventeen railroad companies operate within the area, with the larger ones, such as Illinois Central, providing connections to major market and supply centers in other parts of the country.

Interstate Highway 10, which spans the MDPR, is the primary east-west car and truck route. It connects with Interstate Highways 12, 55 and 59 which link the region with the interior parts of the country. The older U.S. highways, such as 90, 51, 49 and 61, provide the same access but with more local connections. The latter routes and numerous other Federal, state, and local highways provide additional links between the port areas, fishing communities, railroads, oil fields, and the Interstate Highway system.

While it is not feasible to discuss in detail each element of the socioeconomic features depicted on the maps, all are nonetheless important in terms of their interrelationships and the activity patterns they reveal. A broader view of human activity in the Mississippi Deltaic Plain Region can be gained by comparing these socioeconomic features with the locations of man-made and natural features shown on other maps in the atlas. Such a comparison will give the user a better understanding of the relationship between man and his environment. The MDPR contains abundant natural resources of great socioeconomic value, particularly oil, natural gas, salt, sulfur, fish, shellfish, wildlife, rich soils, and productive wetlands among others, and man depends upon the development of these resources to support the economy of the region. Oil and gas production and international shipping are closely related to other basic economic activities, such as commercial fishing. While continued development is inevitable, every effort should be made to mitigate possible adverse effects upon the environment. The impacts of development must be weighed against the consequences of destroying a natural resource base upon which other economic activities depend.

DEFINITIONS OF MAPPED TOPICS

Transportation Features:

Major Highways - Highways in the Federal Interstate System, the National System, and the state systems of Louisiana and Mississippi.

Railways - Steel wheel and steel track railroads.

Navigable Waterways - Man-made channels or those maintained by the U.S. Army Corps of Engineers and other jurisdictions, generally maintained for some sort of commercial activity and natural, navigable waterways identified on the Louisiana Department of Transportation and Development Map, updated annually.

Navigable Waterbodies - Bodies of water known to be navigable by private and commercial vessels.

Anchorages - Ocean areas utilized for commercial ship anchorage prior to acceptance at port facilities, as identified in the United States Coast Pilot 5 (U.S. Department of Commerce 1979).

Major Deep-water Port - Ports identified as "Major Deep Water" by the United States Coast Pilot 5 (U.S. Department of Commerce 1979). Deep water refers to a deep channel maintained at a depth suitable for ocean going vessels.

Major Ports - Ports identified as "Major" in the United States Coast Pilot 5 (U.S. Department of Commerce 1979).

Secondary Ports - Ports identified by various sources that do not correspond with the Coast Guard's list of deep water or major ports.

Airports Paved - Airports unpaved - Paved and unpaved designations refer to the condition of runways, identified by the Aircraft Owners and Pilots Association's Airports U.S.A. (1979), and the National Oceanic and Atmospheric Administration's aeronautical charts for Louisiana and Mississippi.

Seaplane - Seaplane bases identified as active bases in the Aircraft Owners and Pilots Association Directory.

Helicopter Heliports (including hospital heliports) - Designated as single or multiple by the Aircraft Owners and Pilots Association Directory. Multiple heliports are capable of accommodating more than one aircraft on the ground at any one time.

Conservation, Preservation and Recreation Areas:

National Seashores - Areas designated as National Seashores and administered by the National Park Service.

National Wilderness Areas - National Wilderness Areas administered by Federal land management agencies by authority of the Wilderness Act of 1964.

National Forests - Areas designated as National Forests by the U.S. Forest Service, U.S. Department of Agriculture.

State Commemorative Areas - Commemorative Areas designated by the Louisiana Department of Culture, Recreation and Tourism, Office of State Parks.

National Historic Parks - A site with historical significance, designated by a direct act of Congress, established by the Historical Sites Act of 1935, and administered by the National Park Service.

National Wildlife Refuges/State Wildlife Management Areas or Refuges - Wildlife management areas as identified by the Louisiana Wildlife and Fisheries Commission, or the Mississippi Game and Fish Commission, and the U.S. Fish and Wildlife Service.

Least Tern Areas - Areas designated in "The factors affecting the use of an artificial beach: a case study on Mississippi's gulf coast," Water Resources Institute, Mississippi State University, Appendix E, Section 1.

Sandhill Crane National Wildlife Refuge - Sandhill Crane areas identified by the Fish and Wildlife Service, U.S. Department of the Interior.

State Parks and Beach Areas - Areas designated as State Parks or Beaches under jurisdiction of the Mississippi Park Commission, or the Louisiana Department of Culture, Recreation and Tourism Office of State Parks.

Natural and Scenic Rivers (Louisiana) - Rivers identified as Natural and Scenic by the Louisiana Natural and Scenic River Systems Act.

Public Boat Launch Sites - Boat ramps provided by a public entity such as a county, parish or state, and used by the public at large.

Charter Boat Sites - Locations where boats are rented for recreational activities.

Public Marinas - Marinas provided by a public body such as a county, parish or state and used by the public at large for their recreational benefit.

Private Marinas - Marinas, such as a yacht club, available for use by members only.

Commercial Marinas - Privately owned and operated marinas, run for a profit, which may be used by the public for a fee.

Sensitive Areas (Archaeological Sites) - Archaeological sites as identified by the Louisiana Coastal Resources Atlas (Burk and Associates 1972), the Louisiana State Historic Preservation Office's Division of Archaeology and Historic Preservation, and the State of Mississippi Department of Archives and History, Archaeological Site Survey. These archaeological sites include: Indian mounds, probable (not verified); Indian mounds; shell middens, probable (not verified); shell middens; archaeological sites, and other verified archaeological sites.

National Historic Register Sites - Sites listed in the U.S. Department of the Interior's National Register of Historic Places, 1979.

Activities with Environmental Consequences:

Point Source Discharges - Industrial - where permitted industrial discharges occur. Municipal - where permitted municipal discharges occur. (In Louisiana, greater than 50,000 gallons per day.)

Major Dredge Disposal Sites - Areas of disposal of spoil from regularly maintained navigation channels.

Industrial and Municipal Landfills - Sanitary landfills and industrial waste dumps, 5 acres in size or larger.

Industrial Impoundments - Areas covering 5 acres or more, designed to store and/or dispose of liquid wastes which are potential pollutants of surface or groundwater.

Oil Spill Prevention, Control, and Countermeasures Sites (SPCC) - Non-transportation - related oil surface storage tanks with an aggregate capacity of 1,320 gallons or a single tank with capacity greater than 600 gallons. These sites include oil refineries, bulk storage sites, marine and river terminals, and oil field production, gathering and storage facilities.

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OIL AND GAS INFRASTRUCTURE AND MINERAL RESOURCES

by

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INTRODUCTION

The Mississippi Deltaic Plain Region (MDPR) contains an immense wealth of mineral resources, including petroleum, natural gas, sulfur, salt, shell, sand and gravel, and clay. In 1977, the State of Louisiana was second only to Texas in the value of mineral production with an estimated total output of 10.9 billion dollars representing 14.2 percent of the national total (U.S. Bureau of Mines in World Almanac 1980). Much of this production came from deposits that lie within or adjacent to the Mississippi Deltaic Plain Region.

OIL AND GAS

By far the most important resources of the Mississippi Deltaic Plain are the vast quantities of oil and gas that underlie much of the region. Not only are these two resources important from a regional economic standpoint, they are also important from a national perspective. In 1979, the petroleum deposits of the Mississippi Deltaic Plain Region and outer continental shelves of Mississippi and Louisiana accounted for roughly 51% of United States production and proven reserves, excluding Alaska (American Petroleum Institute 1979).

The history of oil exploration in the Mississippi Deltaic Plain Region dates back to 1901 and the discovery of the Spindletop field in nearby Texas. Drilling moved rapidly eastward into southern Louisiana and resulted in the discovery of the Jennings Field in 1902 (Owens 1975). Early drilling was concentrated around subsurface geologic structures known as salt domes. These features result from the upward movement of salt masses buried beneath thousands of feet of younger, more dense sediments. Because they are commonly topped by an impermeable caprock, these structures make excellent traps for migrating hydrocarbons.

Between 1901 and 1936, hydrocarbon exploration in Louisiana was restricted to inland areas, largely on dry land, but to a lesser extent in swamps, lakes, and coastal bays. In 1936, the State sold 121,000 acres of offshore leases and exploration rapidly moved into the open waters of the Gulf of Mexico (Owens 1975). The high productivity of offshore fields coupled with the decline in the discovery of large onshore structures has made drilling on the continental shelves especially attractive over the last 30 to 40 years.

The future of the oil and gas industry in the Mississippi Deltaic Plain Region looks especially promising for the next several decades. Enactment of Federal legislation aimed at increasing domestic production should not only spur new exploration, but should also result in the application of enhanced recovery techniques to presently known, but formerly uneconomical deposits.

The MDPR maps display elements related to oil and gas infrastructure, specifically with regard to occurrence, procurement, transportation, storage, and processing of natural gas, petroleum, and petroleum-related products. Mapped features include:

Oil and/or Gas Field - approximate size, shape, and location of past or presently producing onshore or offshore fields.

Salt Dome - approximate location of known salt domes. Often, but not always associated with occurrence of oil and gas.

Crude Oil, Natural Gas and Liquified Petroleum Pipelines - approximate location of both onshore and offshore pipelines transporting crude oil, natural gas and liquified petroleum gas, with pipeline diameters and ownerships listed where data are available. Crude oil and natural gas pipelines generally run from oil fields to storage, processing or distribution facilities. In wetland areas they are usually built atop natural or man-made levees along water corridors or lie in dredged canals. Liquified petroleum gas pipelines generally run from petroleum processing facilities to storage and processing facilities.

Meter Stations and Pumping Stations - approximate location of meter and pumping stations. A meter station records the volume of crude oil, natural gas or liquified petroleum which passes through a given pipeline. Pumping stations force the oil or gas through a pipeline between pumping stations and control the direction and rate of flow.

Platform Fabrication Site - approximate location of sites where offshore drilling platforms are constructed. Usually located near major water corridors.

Pipe Storage Facilities - approximate location of major pipeline and pipeline component storage facilities.

Service Base (Oil logistic support industry) - approximate location of firms providing procurement, maintenance, and transportation services to the oil and gas industry.

Shipyard - approximate location of shipyards related to the petroleum industry (Table 4). Many, but not all, of these yards are located on the maps.

Oil Storage Facility - approximate location of major oil storage facilities (tank farms).

Table 4. Petroleum related shipyards (Fleet Data Service 1980)

LOUISIANA	
Algiers Iron Works and Dry Dock Co., Inc.	New Orleans
Allied Shipyard, Inc.	Larose
American Gulf Shipbuilding Corp.	Larose
American Marine Corp.	New Orleans
Avondale Shipyards, Inc.	New Orleans
C.F. Bean Corp.	New Orleans
Bell-Halter, Inc.	New Orleans
Bergeron Machine Shop, Inc.	St. Bernard
Boland Marine and Manufacturing Co., Inc.	New Orleans
Bollinger Machine Shop Shipyard, Inc.	Lockport
Bourg Dry Dock and Service Co., Inc.	Bourg & Houma
Breaux's Bay Craft, Inc.	Loreauville
Calumet Shipbuilding Co., Inc.	Morgan City
Camcraft, Inc.	Crown Point
Cenac Shipyard	Houma
Conrad Industries, Inc.	Morgan City
Continental Shipbuilding, Inc.	Larose
D.W.D. Avondale Shipyards	Harahan
Delta Shipyard	Houma
Elevating Boats, Inc.	Caernarvon
Equitable Shipyards, Inc.	Madisonville
Gulf Craft, Inc.	Patterson
Halter Marine Services, Inc.	New Orleans, Chalmette Calumet, Lockport
Harvey Quick Repair Yard	Harvey
Houma Fabricators, Inc.	Houma
Houma Welders, Inc., (Marine Division)	Houma
Hunt Shipyard	Harvey
Industrial Division	Harvey
Lafco, Inc.	Lafayette
Louisiana Dock Company, Inc.	Harahan
Main Iron Works, Inc.	Houma
McDermott Shipyard	Morgan City
Modern Marine Power, Inc.	Houma
Neuville Boat Works, Inc.	New Iberia
North American Shipbuilding, Inc.	Larose
Offshore Ship Builders, Inc.	Houma
Offshore Shipyard	Venice
Albert Ortis Boat Building	Krotz Springs
Louis G. Ortis Boat Company, Inc.	Krotz Springs

LOUISIANA (continued)

Kip Plaisance Contractors, Inc.	Golden Meadow
Port Fabricators, Inc.	New Iberia
Progressive Shipbuilders and Fabricators, Inc.	Houma
Quality Shipyard (A Gulf Fleet Company)	Houma
Rayco Shipbuilders and Repairs, Inc.	Bourg
Scully Brothers Boat Builders, Inc.	Morgan City
Service Machine and Shipbuilding Corp.	Morgan City
Fred Settoon, Inc.	Morgan City
Southern Shipbuilding Corp.	Slidell
Swiftships, Inc.	Morgan City and Lafitte
R.W. Taylor Steel Complex	Slidell
Theriot-Modec, Inc.	Larose
Thrift Shipbuilding and Repair, Inc.	Sulphur and Carlyss
Todd Shipyards Corp.	New Orleans
Underwater Competition Team, Inc.	Iberia
Universal Iron Works	Houma
Zigler Shipyard, Inc.	Jennings

MISSISSIPPI

Coastal Shipbuilding, Inc.	Ocean Springs
A.W. Covacevich Shipyard	Biloxi
Halter Marine Services, Inc.	Pearlington and Moss Point
Hudson Shipbuilders, Inc.	Pascagoula
Ingall's Shipyard	Spanish Point and Greenwood Island
Marathon Shipbuilding Company	Vicksburg
Mississippi Marine Corp.	Greenville
Moss Point Marine, Inc.	Escatawpa
Quality Shipbuilders, Inc.	Moss Point
James K. Walker Marine, Inc.	Moss Point

Oil Refinery - approximate location of plants designed to refine crude oil to various other petroleum products (gasoline, kerosene, etc.).

Gas Processing Plant - approximate location of natural gas processing plants other than liquified natural gas.

Other Petroleum Products Plant (Petroleum based products other than oil and gas) - approximate location of industries using petroleum to produce other products.

NON-FUEL MINERAL RESOURCES

The Mississippi Deltaic Plain Region also contains important economic deposits of non-fuel mineral resources. These include deposits of sulfur, salt, shell, sand and gravel, and clay.

The sulfur deposits of the MDPR are found within the caprocks of several of the region's salt domes. Mining of these deposits is accomplished by means of the Frasch process, a technique developed in 1894 by Dr. Herman Frasch at Sulfur Mine, Louisiana. The Frasch process involves the use of steam which is pumped into the sulfur deposit through wells. Because of its low melting point (113.25°C), the sulfur is readily turned to liquid and the resulting slurry is pumped to the surface. In 1968, Frasch process mines along the Gulf Coast of Texas and Louisiana accounted for roughly three-fourths of U.S. production. However, unless additional reserves of this type are discovered, this output is expected to drop to 10% by the year 2000 (U.S. Department of the Interior 1970).

Besides providing the necessary geochemical and structural environments for hydrocarbon and sulfur accumulations, the salt domes of the Mississippi Deltaic Plain Region are also mined for their primary constituent - salt. Underground mines occur at two of the more famous salt domes of the MDPR, Avery Island and Weeks Island, and at a third - Cote Blanche Island, salt is removed from brine wells by means of solution mining. A brine well is formed by drilling a hole into a salt formation, introducing water and pumping the brine to the surface. In 1971, Louisiana was the Nation's leading producer of salt, contributing 13,352,000 short tons valued at $67,949,000 and representing 29.7% of domestic production (U.S. Army Engineer Topographic Laboratories 1973).

Shell is another important mineral resource of the Mississippi Deltaic Plain Region and is a consequence of the region's vast population of oysters and clams. The shells of these molluscs are used in general construction (as concrete aggregate), in road construction, in the production of cement, in the petroleum, glass, and chemical industries, and as an additive in poultry and livestock feed. The clam *Rangia cuneata* is the primary source of shell material in Lakes Pontchartrain and Maurepas, while important deposits of oyster shell occur in the more saline waters of Grand Isle Pass and just outside the project area in the Mississippi Sound. Extensive oyster shell reefs are also located in offshore areas around Marsh and Pont au Fer Islands, and in Cat Island Channel near Isle au Pitre (U.S. Army Engineer Topographic Laboratories 1975).

Sand and gravel are mined or dredged at several locations in the MDPR. Important sources of these two commodities include the Citronelle and Prairie terrace formations of Pleistocene age which occur in the northern portions of the region. These two formations have been uplifted and dissected so that their basal sand and gravel-bearing strata are locally exposed for easy access by pit mining. Other important sources of sand and gravel are the numerous point bar deposits that occur along many of the major streams and rivers north of Donaldsonville, Louisiana. These deposits can also be found along the many abandoned channels and distributaries of the ancient Mississippi River system. Finally, an almost endless supply of sand is represented by the extensive cheniers, sand ridges, and barrier islands that occur in the southern and southeastern portions of the region. One problem with these latter deposits is their frequent difficulty of access (U.S. Army Engineer Topographic Laboratories 1975).

Deposits of common clay and undifferentiated clay and shale in the Mississippi Deltaic Plain Region include several different types or uses. Actively mined deposits used in the manufacture of brick occur in Livingston and St. Tammany Parishes, in the manufacture of light aggregate in St. John the Baptist Parish, and in the manufacture of cement in Plaquemines Parish. Some clays are suitable for kiln-treatment (bloating) to an expanded product used in lightweight construction block. In addition, high potential deposits (not currently being mined) for the manufacture of brick occur in St. Mary's and St. Tammany Parishes, for the manufacture of tile and heavy products in St. Mary's and St. John the Baptist Parishes, and for the manufacture of light aggregate in Plaquemines, Orleans, St. John the Baptist, St. James, Jefferson, and Lafourche Parishes (U.S. Army Engineer Topographic Laboratories 1975).

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SOILS, GEOLOGIC/GEOMORPHIC FEATURES AND MAN-MADE LANDS

by

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GEOLOGIC/GEOMORPHIC FEATURES

Elevations in the study area covered by the Mississippi Deltaic Plain Region Ecological Atlas (from Vermilion Bay, Louisiana to the Mississippi-Alabama State line) range from sea level along the coast to more than 200 feet above sea level in the northwestern part of Harrison County, Mississippi. The lower elevations along the coast and along drainageways that dissect the uplands are subject to frequent flooding as well as deep flooding when high sea tides are created by major tropical storms in the Gulf of Mexico.

A gradual geological subsidence of land along the Louisiana coast in Recent geologic time has had a significant impact on these lands. Several broad statements concerning subsidence in this region can be made: (1) subsidence is greatest -- on the order of five or more feet per century -- in the present Mississippi River Delta; (2) subsidence on the order of one to two feet per century is a realistic figure for the present shoreline throughout the remainder of the study area; (3) subsidence decreases with distance inland and approaches zero at the surface Recent-Pleistocene contact (Louisiana Department of Transportation and Development [DOTD] 1976).

Continuous subsidence over a long period of years has modified the older deltas so that original deposits are far below sea level. Breton Sound, Chandeleur Sound, Barataria Bay, and Timbalier Bay are typical areas which were formerly marshes on the outer reaches of deltas (Chabreck 1972).

The following changes are presently taking place: (1) marsh land is changing to open water, (2) fresh marsh is changing to saline marsh, (3) swamps are changing to marsh, (4) some of the frequently flooded lands are changing to swamps, (5) lands once flood-free are now being flooded.

After the sea level reached its approximate present level, about 5,000 years ago, the Mississippi River periodically occupied new channels and deltaic systems. At least three "waves" of fine grained sediment, derived from these younger Mississippi River deltaic lobes, were swept westward and deposited along the coast. In the last few hundred years, an increasing amount of Mississippi River sediment has been carried down the present channel and delta to be "lost" off the continental slope. Hence, without these sediments to overcome subsidence, the coastal area of Louisiana is presently losing land at an estimated rate of 16.5 mi^2 per year (DOTD 1977). During the past 2,000 years, the migrating Mississippi River has created a series of subdeltas. From the oldest to youngest, the deltas are the Teche Delta, Lafourche Delta, St. Bernard Delta, and the present Birdfoot Delta. Mud lumps at the mouth of the Mississippi River are part of the current development of the Birdfoot Delta.

The origin of the salt dome islands in Iberia and St. Mary Parishes, Louisiana, is thought to be caused primarily by piercement of overlying sediment by salt forced upward by regional subsidence and differences in specific gravity between salt and surrounding sediment (Kupfer 1970).

The higher elevations of the uplands in the State of Mississippi are a combination of marine, transitional marine and fluvial sediments that were deposited during the Tertiary geologic time. Graham Ferry and Citronelle are major geologic formations in this area.

The broad flats and low ridges in the State of Mississippi, and in St. Tammany and Tangipahoa Parishes, Louisiana, were formed during the Pleistocene period; however, some of the broad flats in Mississippi were formed during the Tertiary geologic time. The floodplains that dissect the uplands in both states were formed by the reworking of local sediment in Recent geologic time.

The barrier islands of Louisiana, notably the Chandeleur Chain, Grand Terre, Grand Isle, the Timbaliers, Marsh Island, and Isle Dernieres, are relics of abandoned Mississippi River deltas. In Mississippi, however, barrier islands are primarily the result of longshore drift and deposition (Burk and Associates, Inc. 1976). Barrier islands and associated beaches are dynamic in nature and are subject to erosion and deposition from wind, offshore currents and wave action. These islands have been greatly affected by wind and water erosion and deposition in recent years. Colonized frontal sand dunes line the ocean side of the islands and are vital in maintaining the ecological stability of the shore. The main Chandeleur Island has an active dune, which varies in height from three to ten feet along its entire length. Continuous active dunes are also present from Grand Terre west to Isle Dernieres (Mendleson 1980). The back sides of the barrier islands are laced with salt marsh and a few mangrove swamps, which are utilized as feeding areas and catch basins for storm waters. Perhaps the most important function of barrier islands is the regulation of salinity and water exchange between the Gulf of Mexico and the estuaries. The bays protected by the barrier islands serve as staging areas for juvenile fish prior to their offshore migration. The barrier islands of the Mississippi and Louisiana coast have high recreation and wildlife value. Endangered species, such as the brown pelican and loggerhead turtle, as well as some hundred other species of birds, use the islands as nesting habitat (Burk and Associates, Inc. 1976).

Several factors, both natural and human-induced, threaten the integrity of the barrier islands. Jetty construction and dredging in the tidal passes and navigation channels combine with a limited sand budget resulting in either interrupting or lessening deposition via longshore transport. Canal dredging on Timbalier, East Timbalier and Grand Terre islands has rendered them vulnerable to breaching (Center for Wetland Resources, Plate 12, 1972). Vehicles crossing the dunes on the barrier islands present another management problem to be addressed, since the tire tracks destroy the vegetation subjecting the soil to wind and wave erosion.

Mud lumps are interesting geological phenomena, unique to the major tidal passes of the Mississippi Delta. The weight from overlying sediments causes subsurface, bluish-gray clays to thrust upward between the heavier sediments at the river's mouth. Mud lumps range in height from about 6 to 14 feet, and may cover an area as great as 30 acres. Their appearance and duration is erratic and variable. They may rise 20 to 33 feet in a couple of hours, or may appear at a more gradual rate. Wave action on the sides of these volcanic-like formations may result in cliff faces or terraces. Their appearance is usually accompanied by a release of marsh gas. Mud lumps may cause serious damage to oil pipelines, alter water depths and impair navigation. They represent, however, only one form of instability in the deltas, submarine slumping of bottom sediments being another (Kniffen 1976).

MAN-MADE LANDS

Man-made lands are those which have been modified or created by man's activity within the Mississippi Deltaic Plain Region (MDPR). The principal source of information on the location of these lands was interpretation of 1:24,000 scale, color infrared aerial photographs flown in October 1978 over southern Louisiana and Mississippi. Several categories of man-made or man-modified land exist in the MDPR. They are not delineated on this map. These categories include:

- Spoil islands
- Spoil deposits along waterways
- Existing and abandoned wetland reclamation areas
- Oil and mineral extraction and transportation areas.

SPOIL ISLANDS

Spoil islands are formed as the result of dredging bottom sediments in open water areas to prevent shoaling and to deepen navigation channels. These sediments are then deposited to form new dry land where water used to occur. Once land is built above the influence of tides, vegetation will take a foothold and a natural succession of vegetation species occurs. These islands, if large enough and stabilized, can be used as building sites or as active dumping sites for regular dredging operations.

SPOIL DEPOSITS ALONG WATERWAYS

Dredging and filling activities are conducted within Louisiana and Mississippi to open and maintain major canals and natural and man-made waterways for navigation. This activity deepens and frequently widens existing waterways and often builds up the natural channel levees through deposition of dredged sediments along the channel banks. Dredge and fill operations tend to lead to the creation of linear land areas adjacent to both man-made and natural waterways which sometimes extend the entire length of the waterway. Once stabilized with vegetation, man-made levees can protect adjacent areas from flooding. Along major navigation channels, dredge disposal sites are used either regularly or continuously.

EXISTING AND ABANDONED WETLAND RECLAMATION AREAS

This category includes abandoned and flooded agricultural reclamation areas (now mostly waterbodies and ponds), and leveed and drained wetlands, either developed, being developed or having the potential for urban development. The agricultural reclamation areas are former wetlands that have been leveed, pumped and drained for farming. Some are still used for farming today. Reclaimed wetlands, such as the New Orleans Lakefront Airport and Lake Vista, were filled with sediment from Lake Pontchartrain and have been developed for urban use.

OIL AND MINERAL EXTRACTION AND TRANSPORTATION AREAS

Sulfur mining is mapped on the 1:100,000 scale maps of the MDPR principally because this activity requires dredging and spoil disposal which creates impoundments and "new" land. Sulfur mining also disturbs large areas in the coastal region. Numerous oil and gas pipeline canals have not been mapped because of their small size, but dredging and filling associated with these canals represents alterations of considerable acreage within the MDPR.

It has been estimated that the total acreage of drained and filled areas in coastal Louisiana may reach or exceed 120,000 acres (Burk and Associates, Inc. 1976). Some of the potentially adverse impacts which result from such activities include: (1) loss of valuable habitat; (2) salt water intrusion through channel deepening and creation of new channels; (3) increased water turbidity through dredging operations; (4) destruction of submerged aquatic vegetation; and (5) overall alteration of the tidal flow regime and other hydrologic modifications within the coastal region.

MAJOR LAND RESOURCE AREAS

The U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS), recognizes four Major Land Resource Areas (MLRA) in this Ecological Atlas area - (1) Southern Mississippi Valley Alluvium, (2) Gulf Coast Marsh, (3) Eastern Gulf Coast Flatwoods, and (4) Southern Coastal Plain.

SOUTHERN MISSISSIPPI VALLEY ALLUVIUM MLRA

This MLRA is entirely within the State of Louisiana. These soils, which are level to nearly level, have developed from alluvial sediments deposited by the Mississippi River and its distributaries within the last 5,000 years. Elevations range from near sea level to about 20 feet at the highest elevations on the natural levees. A small acreage of older alluvium with a thin mantle of loess (Jeanerette-Patoutville Soil Association) is included in this MLRA.

This MLRA is characterized by natural levees that occupy the highest elevations and basins that occupy the lower elevations between the natural levees. The natural levees with high elevations are adjacent to Bayou Teche, Bayou Black, Bayou Lafourche, and the Mississippi River. The soils on the higher parts of the natural levees are nearly level, loamy, very fertile and classed by the SCS as prime farm land if not subject to flooding. The soils on the lower parts of the natural levees are level, clayey, very fertile and classed as prime farm land if not subject to flooding. The soils at the lowest elevations within the basins are level, clayey and subject to frequent flooding. Many of these soils are wet enough to be classed as swamp. A significant amount of the swamp land has organic material accumulated on its surface.

The soils in this MLRA which are not subject to flooding are used mainly for cropland and urban development. The frequently flooded soils are used mainly for woodland and wildlife habitat.

GULF COAST MARSH MLRA

This MLRA is along the coast of Louisiana. Elevations range from sea level to at most a few inches above sea level. Elevation may range, however, to more than 3 feet above sea level in some areas. Salt dome islands and beach ridges occurring at higher elevations than the marsh lands are included in this MLRA.

The soils of the marsh are level, have a water table at or above the soil surface most of the time, are subject to frequent flooding and support marsh vegetative types. These soils developed mostly from alluvial and marine sediments and organic accumulations.

The Gulf Coast Marsh can be divided into fresh marsh that occurs adjacent to the mainland and brackish-saline marsh that occurs adjacent to the open water of the Gulf of Mexico.

The Gulf Coast Marshes provide a productive wildlife habitat. They are a part of the estuarine complex that contributes to the support of Gulf marine life. Soils of the marsh produce excellent forage for livestock, however, only the "firm" soils will support the weight of grazing animals. The dominant use of this MLRA is for wildlife habitat.

The salt dome islands - Jefferson, Weeks and Avery - in Iberia Parish, Louisiana, range from 75 to 150 feet above the adjacent marsh. Wind blown silt (loess) mantled the salt dome islands during the Pleistocene geologic time (U.S. Department of Agriculture 1978b).

Beach ridges along the coast and on the barrier islands range in elevation from sea level to about 10 feet above sea level. The soils on these ridges developed mainly from sand and sea shells. Wind and sea wave action is gradually changing the size, shape and location of these ridges. The most active sand dunes are on the main Chandeleur Island.

EASTERN GULF COAST FLATWOODS MLRA

This MLRA includes the lands of relatively flat topography along the coast in Mississippi and Tangipahoa and St. Tammany Parishes, Louisiana. Elevations range from sea level to about 50 feet above sea level. The soils are dominantly loamy or sandy and are acid in reaction. A number of drainageways cross these uplands. The tidal marshes and coastal beaches along the coast of Mississippi are included in this MLRA. They receive salt water of varying degrees of salinity from waters of the Gulf of Mexico. Most soils in Eastern Gulf Coast Flatwoods MLRA are low in natural fertility and are used mainly for woodland, pasture and urban development.

SOUTHERN COASTAL PLAIN MLRA

This MLRA includes land with undulating topography in the northern parts of Hancock, Harrison and Jefferson Counties, Mississippi. Elevations are generally higher than 100 feet above sea level and range up to slightly higher than 200 feet above sea level in the northwestern part of Harrison County. The soils are formed from loamy sandy and clayey materials. They are of low natural fertility and are dominantly acid throughout. This MLRA is used primarily for woodland and pasture.

SOILS

Soils in the study area have been divided into four major groups and nine minor groups as follows (Table 5):

1. Soils of the Southern Mississippi Valley Alluvium MLRA.

   a. Natural levees
   b. Swamps

2. Soils of the Gulf Coast Marsh MLRA.

   a. Fresh marsh
   b. Saline marsh
   c. Salt dome islands
   d. Beach ridges

3. Soils of the Eastern Gulf Coast Flatwoods MLRA

   a. Uplands
   b. Flood Plains
   c. Marsh

4. Soils of the Southern Coastal Plain MLRA

Soil association mapping unit descriptions include the following: (1) slope, (2) internal drainage, (3) flooding hazard, (4) surface texture, (5) position on landscape, (6) special characteristics, and (7) main use.

Table 5. Selected soil use interpretations (U.S. Department of Agriculture, Soil Conservation Service).

Soil series	Sanitary facilities			Community Development			
	Septic tank absorption fields	Sewage lagoon	Sanitary landfill	Dwelling without basements	Small Commercial building	Local roads and streets	Sudsidence potential - drained
Allemands	Severe - floods, wetness	Severe - humus, seepage	Severe - humus, ponding	Severe - floods, low strength	Severe - floods, low strength	Severe - floods low strength	Medium
Atmore	Severe - wetness, percs slowly	Moderate - seepage, slope	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	None
Barbary	Severe - floods, wetness	Severe - humus, floods	Severe - floods, wetness	Severe - floods, low strength	Severe - floods, low strength	Severe - floods, low strength	Low
Baldwin	Severe - wetness, percs slowly	Severe - wetness	Severe - wetness, too clayey	Severe - wetness, shrink - swell	Severe - wetness, shrink - swell	Severe - low strength, shrink - swell	None
Buxin	Severe - wetness, floods, percs slowly	Severe - floods, wetness	Severe - floods, wetness, too clayey	Severe - floods, wetness, shrink-swell	Severe - floods, wetness, shrink-swell	Severe - floods, low strength wetness	None
Cahaba	Slight	Severe - seepage	Severe - seepage	Slight	Slight	Slight	None
Calhoun	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - low strength, wetness	None
Carlin	Severe - floods, wetness	Severe - floods, humus, wetness seepage	Severe - floods, humus, wetness, seepage	Severe - floods, humus, low strength	Severe - floods, humus, low strength	Severe - floods, humus, low strength	High

Continued

Table 5. (Continued).

Soil series	Sanitary facilities: Septic tank absorption fields	Sanitary facilities: Sewage lagoon	Sanitary facilities: Sanitary landfill	Community development: Dwelling without basements	Community development: Small commercial building	Community development: Local roads and streets	Community development: Sudsidence potential - drained
Commerce	Severe - wetness, percs slowly	Severe - wetness	Severe - wetness	Moderate - wetness	Moderate - wetness	Severe - low strength	None
Convent	Severe - wetness	Severe - wetness	Severe - wetness	Moderate - wetness	Moderate - wetness	Moderate - wetness	None
Escambia	Severe - percs slowly, wetness	0-2%:Slight 2-7%: Mod. slope 7-8%: Severe - slope	Severe - wetness	Moderate - wetness, low strength	0-4%: Mod-wetness, low strength 4-8%: Slope, wetness, low strength	Moderate - low strength, wetness	None
Eustis	0-15%: Severe - poor filter 15+%: Severe - poor filter, slope	0-7%: Severe - poor filter 7+%: Severe - poor filter, slope	0-15%: Severe - seepage 15+%: Severe - seepage, slope	0-8%: Slight 8-15%: Mod. - slope 15+%: Severe - slope	0-4%: Slight 4-8%: Mod. - slope 8+%: Severe - slope	0-8%: Slight 8-15%: Mod. - slope 15+%: Severe - slope	None
Fausse	Severe - floods, wetness	Severe - floods, wetness	Severe - floods, wetness	Severe - floods, wetness, shrink - swell	Severe - floods, wetness, shrink - swell	Severe - floods, low strength, wetness	Low
Frost	Severe - wetness, percs slowly	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness, low strength	None

Continued

Table 5. (Continued).

	Sanitary facilities			Community development			
Soil series	Septic tank absorption fields	Sewage lagoon	Sanitary landfill	Dwelling without basements	Small commercial building	Local roads and streets	Sudsidence potential - drained
Galvez	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Moderate - wetness	Moderate - wetness	Severe - low strength	None
Harleston	0-8%: Severe - wetness 8-12%: Severe - wetness, slope	0-7%: Severe - wetness 7-12%: Severe - wetness, slope	Severe - wetness	Moderate - wetness, slope	0-8%: Severe - wetness 8-12%: Severe - wetness, slope	0-8%: Slight 8-12%: Moderate - slope	None
Iberia	Severe - percs slowly, wetness	Slight	Severe - too clayey, wetness	Severe - wetness, low strength, shrink - swell	Severe - wetness, low strength, shrink - swell	Severe - wetness, low strength, shrink - swell	None
Jeanerette	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Moderate - wetness, low strength	Moderate - wetness, low strength	Severe - low strength	None
Kenner, drained	Severe - wetness	Severe - humus, wetness, seepage	Severe - wetness, seepage	Severe - humus, wetness, low strength	Severe - humus, wetness, low strength	Severe - humus, wetness, low strength	High
Lafitte	Severe - floods, wetness	Severe - humus, seepage, floods	Severe - humus, seepage, floods	Severe - floods, humus, low strength	Severe - floods, humus, low strength	Severe - floods humus, low strength	High
Lakeland	0-15%: Severe - poor filter 15+%: Severe - slope, poor filter	0-7%: Severe - seepage 7+%: Severe - slope, seepage	0-15%: Severe - seepage 15+%: Severe - slope seepage	0-8%: Slight 8-15%: Mod. - slope 15%: Severe - slope	0-4%: Slight 4-8%: Mod. - slope 8+%: Severe - slope	0-8%: Slight 8-15%: Mod. - slope 15+%: Severe - slope	None

Continued

Table 5. (Continued).

Soil series	Sanitary facilities: Septic tank absorption fields	Sanitary facilities: Sewage lagoon	Sanitary facilities: Sanitary landfill	Community development: Dwelling without basements	Community development: Small commercial building	Community development: Local roads and streets	Community development: Sudsidence potential - drained
Latonia	Slight	Severe - seepage	Severe - seepage	Slight	0-4%: Slight 4-5%: Mod. - slope	Slight	None
Leaf	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness, too clayey	Severe - wetness, shrink - swell	Severe - wetness, shrink - swell	Severe - low strength, wetness	None
Loring	0-15%: Severe - percs slowly, wetness 15+%: Severe - slope, percs slowly, wetness	0-7%: Severe - wetness 7+%: Severe - slope, wetness	0-8%: Mod. - wetness 8-15%: Mod. - slope, wetness 15+%: Severe - slope	0-8%: Mod. - wetness 8-15%: Mod. - slope, wetness 15+%: Severe - slope	0-4%: Mod. - wetness 4-8%: Mod. - slope, wetness 8+%: Severe - slope	0-15%: Severe - low strength, 15+%: Severe - slope, low strength	None
Maurepas	Severe - floods, wetness	Severe - floods, wetness, humus, seepage	Severe - floods, seepage, humus	Severe - floods, humus, low strength	Severe - floods, humus, low strength	Severe - floods, humus, low strength	High
McLaurin	Moderate - percs slowly	0-7%: Severe - seepage 7+%: Severe - slope, seepage	Slight	Slight	0-4%: Slight 4-8%: Mod. - slope	Slight	None
Memphis	0-8%: Mod. - percs slowly 8-15%: Mod. - percs slowly 15+%: Severe - slope	0-2%: Mod. - seepage 2-7%: Mod. - slope, seepage 7+%: Severe - slope	0-8%: Slight 8-15%: Mod. - slope 15+%: Severe - slope	0-8%: Slight 8-15%: Mod. - slope 15+%: Severe - slope	0-4%: Slight 4-8%: Mod. - slope 8+%: Severe - slope	0-15%: Severe - low strength 15+%: Severe - slope, low strength	None

Continued

Table 5. (Continued).

Soil series	Sanitary facilities: Septic tank absorption fields	Sanitary facilities: Sewage lagoon	Sanitary facilities: Sanitary landfill	Community development: Dwelling without basements	Community development: Small commercial building	Community development: Local roads and streets	Community development: Sudsidence potential - drained
Mhoon	Severe - wetness, percs slowly	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe- wetness, low strength	None
Myatt	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe- wetness	None
Ocilla	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Moderate - wetness	None
Ochlockonee	Severe - floods, wetness	Severe - floods, seepage, wetness	Severe - floods, seepage, wetness	Severe - floods	Severe - floods	Severe - floods	None
Patoutville	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Moderate - low strength, wetness	Moderate - low strength, wetness	Severe - low strength	None
Placedo	Severe - floods, wetness, percs slowly	Severe - floods, wetness	Severe - floods, wetness	Severe - floods, wetness, shrink - swell	Severe - floods, wetness, shrink - swell	Severe - floods, wetness, shrink - swell	None
Plummer	Severe - floods, wetness	Severe - floods, wetness	Severe - wetness	Severe - floods, wetness	Severe - floods, wetness	Severe - floods, wetness	None
Portland, flooded	Severe - floods, percs slowly, wetness	Severe - floods, wetness	Severe - floods, wetness, too clayey	Severe - floods, wetness, shrink - swell	Severe - floods, wetness, shrink - swell	Severe - floods wetness, low strength	None

Continued

Table 5. (Continued).

	Sanitary facilities			Community development			
Soil series	Septic tank absorption fields	Sewage lagoon	Sanitary landfill	Dwelling without basements	Small commercial building	Local roads and streets	Sudsidence potential - drained
Ruston	Moderate - percs slowly	0-2%: Mod. - seepage 2-7%: Mod. - slope, seepage 7+%: Severe - slope	Slight	Slight	0-4%: Slight 4+%: Mod. - slope	Moderate - low strength	None
Saucier	Severe - wetness	0-7%: Severe - wetness 7+%: Severe - slope, wetness	Moderate - wetness	0-8%: Mod. - low strength 8+%: Mod. - slope, low strength	0-4%: Mod. - low strength 4+%: Mod. - slope, low strength	0-8%: Mod. - strength 8+%: Mod. - slope, low strength	None
Savannah	Severe - wetness, percs slowly	0-7%: Severe - wetness 7+%: Severe - slope, wetness	0-8%: Mod. - wetness 8+%: Mod. - slope, wetness	0-8%: Mod. - wetness 8+%: Mod. - slope, wetness	0-4%: Mod. - wetness 4+%: Mod. - slope, wetness	0-8%: Mod. - wetness 8+%: Mod. - slope, wetness	None
Sharkey	Severe - wetness, percs slowly	Severe - wetness	Severe - too clayey, wetness	Severe - wetness shrink - swell	Severe - wetness, shrink - swell	Severe - low strength, wetness	None
Sharkey, flooded	Severe - floods, wetness, percs slowly	Severe - floods, wetness	Severe - floods, too clayey, wetness	Severe - floods, wetness, shrink - swell	Severe - floods, wetness, shrink - swell	Severe - floods, low strength, wetness	None
Smithton	Severe - percs slowly, wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	Severe - wetness	None

Continued

Table 5. (Concluded).

Soil series	Sanitary facilities: Septic tank absorption fields	Sanitary facilities: Sewage lagoon	Sanitary facilities: Sanitary landfill	Community development: Dwelling without basements	Community development: Small commercial building	Community development: Local roads and streets	Community development: Sudsidence potential - drained
Susquehanna	1-15%: Severe - percs slowly 15+%: Severe - slope percs slowly	1-2%: Slight 2-7%: Mod. - slope 7+%: Severe - slope	1-15%: Severe - too clayey 15+%: Severe - slope, too clayey	1-15%: Severe - shrink - swell 15+%: Severe - slope, shrink - swell	1-8%: Severe - shrink - swell 8+%: Severe - slope, shrink - swell	1-15%: Severe - low strength shrink - swell 15+%: Severe - slope, low strength, shrink - swell	None
Tunica	Severe - wetness, percs slowly	Severe - wetness	Severe - wetness, too clayey	Severe - shrink - swell, wetness	Severe - shrink - swell, wetness	Severe - low strength, shrink - swell	None

SOILS OF THE SOUTHERN MISSISSIPPI VALLEY ALLUVIUM MLRA

NATURAL LEVEES

AA Baldwin-Iberia-Galvez Association

Level to nearly level, poorly to somewhat poorly drained soils. The poorly drained Baldwin soils are at intermediate elevations and have clayey or loamy surface layers. The poorly drained Iberia soils are at the lower elevations, have a clayey surface layer and are dark in color. The somewhat poorly drained Galvez soils are at the highest elevations and have a loamy surface layer. This association is on the Bayou Teche natural levee. It is used mainly for cropland and urban development.

AB Commerce-Mhoon Association

Nearly level, poorly to somewhat poorly drained loamy soils. The poorly drained Mhoon soils are at the lower elevations. The somewhat poorly drained Commerce soils are at the higher elevations. This association is on the natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland and urban development.

AC Commerce-Sharkey Association

Level to nearly level, poorly to somewhat poorly drained soils. The somewhat poorly drained Commerce soils are at the higher elevations and are loamy. The poorly drained Sharkey soils are at the lower elevations and are clayey. This association is on the natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland and urban development.

AD Convent-Commerce-Sharkey-Association

Level to nearly level, poorly to somewhat poorly drained soils. The somewhat poorly drained, loamy Convent and Commerce soils are at the higher elevations. The poorly drained, clayey Sharkey soils are at the lower elevations. This association is on the natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland and urban development.

AE Jeanerette-Patoutville Association

Level to nearly level, poorly to somewhat poorly drained loamy soils. The poorly drained Jeanerette soils are at the lower elevations and are dark in color. The somewhat poorly drained Patoutville soils are at the higher elevations and are light in color. This association is on a low ridge adjacent to the Bayou Teche natural levee. It is used mainly for cropland.

AF Mhoon-Commerce Association

Nearly level, poorly to somewhat poorly drained loamy soils. The poorly drained Mhoon soils are at the lower elevations. The somewhat poorly drained

Commerce soils are at the higher elevations. This association is on the natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland.

AG Sharkey-Tunica Association

Level, poorly drained, clayey soils. The Tunica soils are at slightly higher elevations than the Sharkey soils. This association is on the natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland.

AH Sharkey-Commerce, Frequently Flooded Association

Level to nearly level, poorly to somewhat poorly drained soils that are subject to frequent flooding. The poorly drained, clayey Sharkey soils are at the lower elevations. The somewhat poorly drained, loamy Commerce soils are at the higher elevations. This association is on low natural levees of the Mississippi River Alluvial Plain. It is used mainly for woodland.

AI Sharkey-Fausse, Frequently Flooded Association

Level, poorly drained, clayey soils that are subject to frequent flooding. The Fausse soils are at the lower elevations and support a Cypress-Tupelo Gum Forest Type. Sharkey Soils are at slightly higher elevations. This association is in low basins between natural levees of the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat.

AJ Sharkey Association

Level, poorly drained clayey soils. This association is on the lower part of natural levees of the Mississippi River Alluvial Plain. It is used mainly for cropland.

SWAMPS

AL Barbary Association

Level, very poorly drained soils. They have a muck surface layer that is underlain by semi-fluid clay. These soils are rated as being "soft". This association is at very low elevations in the inter-levee depressions on the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat and supports a Cypress-Tupelo Gum Forest Type.

AM Barbary-Fausse Association

Level, very poorly drained soils. The Barbary soils have a muck surface layer that is underlain by semi-fluid clay and are rated as being "soft". The Fausse soils are clayey throughout and are rated as being "firm". This association is at very low elevations in the inter-levee depressions on the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat.

AN Barbary-Sharkey Association

Level, very poorly drained soils. The very poorly drained Barbary soils have a muck surface layer that is underlain by semi-fluid clay and are rated as being "soft". The poorly drained Sharkey soils are clayey throughout and are rated as being "firm". This association is at very low elevations on the natural levees and inter-levee depressions on the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat.

AO Maurepas Association

Level, very poorly drained organic soils. They have thick organic layers underlain by semi-fluid mineral layers. These soils are rated as being "soft". They contain numerous buried logs and stumps. This association is at a very low elevation on the Mississippi River Alluvial Plain. It is used mainly for wildlife habitat and limited woodland use. This association supports a sparse stand of cypress trees.

AP Maurepas-Hydraquents Association

Level, very poorly drained organic and mineral soils that are rated as being "soft". The Maurepas soils are organic and contain numerous buried logs and stumps. The semi-fluid Hydraquents soils are mineral. This association is at very low elevations on the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat.

AQ Hydraquents-Buxin-Portland Association

Level, very poorly drained and poorly drained soils. The very poorly drained, semi-fluid hydraquents soils are rated as being "soft". The poorly drained, clayey Buxin and Portland soils are rated as being "firm". This association is at very low elevations on the Mississippi River Alluvial Plain. It is used mainly for woodland and wildlife habitat.

AR Haplaquepts, Drained Association

Level, very poorly drained mineral soils under pump off drainage. These clayey soils in places have a thin mucky surface layer. They have "firm" surface layers after pump off drainage. This association is at a very low elevation on the Mississippi River Alluvial Plain. It is used mainly for urban development.

SOILS OF THE GULF COAST MARSH MLRA

FRESH MARSH

BA Allemands-Carlin, Fresh Association

Level, very poorly drained organic soils. The Allemands soils are underlain with semi-fluid clay at a depth of 16 to 51 inches. The Carlin soils are organic throughout and are classed as being "soft". Its organic surface layer floats and surface elevation varies with water level. This association is on the landward side of the marsh. It is used mainly for wildlife habitat.

BB Hydraquents-Medisaprists, Fresh Association

Level, very poorly drained mineral and organic soils rated as being "soft". The Hydraquents are semi-fluid mineral soils. The Medisaprists are organic soils. This association is on the landward side of the marsh. It is used mainly for wildlife habitat.

BC Medisaprists, Fresh Association

Level, very poorly drained organic soils that are rated as being "soft". This association is on the landward side of the marsh. It is used mostly for wildlife habitat.

BD Medisaprists-Hydraquents, Fresh Association

Level, very poorly drained organic and mineral soils that are rated as being "soft". The Medisaprists are organic soils. The Hydraquents are semi-fluid mineral soils. This association is on the landward side of the marsh. It is used mainly for wildlife habitat.

BE Kenner-Allemands, Drained Association

Level, very poorly drained organic soils under pump off drainage. The Kenner soils are organic throughout. The Allemands soils have an organic surface layer that is underlain by clay. These soils have "firm" surface layers under pump off drainage. This association is in the vicinity of New Orleans. It is used mainly for urban development.

BF Fluvaquents, Drained Association

Level, very poorly drained mineral soils under pump off drainage. They have a thin organic surface layer that is underlain by clay. These soils have "firm" surface layers under pump off drainage. This association is in Lafourche Parish adjacent to the natural levees of the Mississippi River Alluvial Plain. It is used mainly for pasture and cropland.

SALINE MARSH

BG Lafitte, Moderately Saline Association

Level, very poorly drained organic soils that are rated as being "soft". This association is on the seaward side of the marsh, but generally does not receive full strength Gulf of Mexico sea water. Sea water has had moderate effects on these soils. It is used mainly for wildlife habitat.

BH Medisaprists-Hydraquents, Moderately Saline Association

Level, very poorly drained mineral and organic soils that are rated as being "soft". The Medisaprists are organic soils. The Hydraquents are semi-fluid mineral soils. Sea water has had moderate effects on these soils. This association is on the seaward side of the marsh, but generally does not receive full strength Gulf of Mexico sea water. It is used mainly for wildlife habitat.

BI <u>Medisaprists-Hydraquents, Saline Association</u>

Level, very poorly drained organic and mineral soils that are rated as being "soft". The Medisaprists are organic soils. The Hydraquents are semi-fluid mineral soils. Sea water has had significant influence on these soils. This association is on the seaward side of the marsh and generally receives full strength or near full strength Gulf of Mexico sea water. It is used mainly for wildlife habitat.

BJ <u>Placedo, Saline Association</u>

Level, very poorly drained mineral soils that are rated as being "firm". This association is on the Gulf side of Marsh Island and receives full strength or near full strength Gulf of Mexico sea water. It is used mainly for wildlife habitat.

BK <u>Scatlake, Saline Association</u>

Level, very poorly drained mineral soils that are rated as being "soft". They have a mucky surface layer that is underlain by semi-fluid clay. This association is on Marsh Island and, unless controlled by artificial structures, receives full strength or near full strength Gulf of Mexico sea water. It is used mainly for wildlife habitat.

SALT DOME ISLANDS

BL <u>Memphis-Frost Association</u>

Nearly level to strongly sloping, poorly to well drained, loamy soils with high silt content. The well drained Memphis soils are on ridge tops and side slopes. The nearly level, poorly drained Frost soils are at the base of slopes. This association is on the Avery and Weeks salt dome islands in Iberia Parish, Louisiana. It is used mainly for cropland and urban development.

BM <u>Memphis-Loring Association</u>

Well drained, gently to strongly sloping, loamy soils with a high silt content. These soils are on Cote Blanche salt dome island in St. Mary Parish, Louisiana. It is used mainly for urban development.

BEACH RIDGES

BN <u>Udipsamments-Medisaprists, Saline Association</u>

Level to gently sloping, very poorly drained to excessively drained organic and mineral soils. The level to moderately sloping, excessively drained Udipsamments soils are typically sandy throughout and contain varying amounts of sea shells. They are mainly on the seaward side of the association.

The very poorly drained Medisaprists soils are organic and are mainly on the mainland side of the association. This association includes the beach ridges along the mainland coast of Louisiana and the barrier islands. It is used mainly for wildlife habitat and limited recreation and urban development.

SOILS OF THE EASTERN GULF COAST FLATWOODS MLRA

UPLANDS

CF <u>Myatt-Stough Association</u>

Level to nearly level, poorly to somewhat poorly drained soils with a loamy surface layer. The level, poorly drained Myatt soils are in broad depressed areas. The somewhat poorly drained, nearly level Stough soils are on broad low ridges. This association is used mainly for woodland.

CG <u>Calhoun-Stough Association</u>

Level to nearly level, poorly to somewhat poorly drained soils with a loamy surface layer. The level, poorly drained Calhoun soils are in broad depressed areas. The nearly level, somewhat poorly drained Stough soils are on broad low ridges. This association is used mainly for woodland.

FLOOD PLAINS

CK <u>Dystrochrepts Association</u>

Level, poorly drained loamy soils subject to frequent flooding. This association is along drainageways that dissect the uplands. It is used mainly for woodland.

CL <u>Haplaquepts-Dystrochrepts Association</u>

Level, poorly drained, loamy soils subject to frequent flooding. This association is along the Pearl River drainageway. It is used mainly for woodland.

SOILS OF MISSISSIPPI

SOILS OF THE EASTERN GULF COAST FLATWOODS MLRA

UPLANDS

CA <u>Harleston-Atmore-Escombia Association</u>

Level to gently sloping, poorly to moderately well drained soils with loamy surface layer. The moderately well drained, gently sloping Harleston soils are on ridge tops. The level, poorly drained Atmore soils are on broad flats on the drainageways. The nearly level, somewhat poorly drained Escombia soils are on low ridges. This association is used mainly for woodland.

CB Atmore-Harleston-Plummer Association

Level to gently sloping, poorly to moderately well drained soils. The level, poorly drained, loamy Atmore soils are on broad flats or in drainageways. The gently sloping, moderately well drained, loamy Harleston soils are on ridge tops. The level, poorly drained, sandy Plummer soils are in wet flats or in drainageways. This association is used mainly for woodland.

CC Hyde-Leaf-Saucier Association

Level to nearly level, poorly to moderately well drained soils with a loamy surface layer. The level, poorly drained Hyde and Leaf soils are on broad flats. The moderately well drained, very gently sloping Saucier soils are on ridge tops. This association is used mainly for woodland.

CD Benndale-Atmore-Harleston Association

Level to strongly sloping, poorly to well drained soils with a loamy surface layer. The well drained Benndale soils are on ridge tops and side slopes. The level, poorly drained Atmore soils are on low flats and in drainageways. The moderately sloping, moderately well drained Harleston soils are on ridge tops. This association is used mainly for woodland and pasture.

CE Eustis-Latonia-Lakeland Association

Gently to moderately sloping, excessively drained, sandy soils. This association is used mainly for urban development and woodland.

CH Benndale-Plummer-Ocilla Association

Level to nearly level, poorly to well drained soils. The nearly level, well drained Benndale soils have a loamy surface layer. The level, poorly drained, sandy Plummer soils are on flats and in drainageways. The level, somewhat poorly drained Ocilla soils with a sandy surface layer are on flats. This association is used mainly for urban development and woodland.

CI Smithton-Plummer-Hyde Association

Level, poorly drained soils. The Smithton and Hyde soils have a loamy surface layer. The Plummer soils have a sandy surface layer. These soils are on flats, depressions and in drainageways. This association is used mainly for woodland.

FLOOD PLAINS

CJ Ochlockonee-Harleston-Smithton Association

Level, poorly to well drained, loamy soils are on flood plains subject to frequent flooding and on broad flats. This association is used mainly for woodland.

CM Alluvial Land Association

Soils along the Pascagoula River that are varied in texture and internal drainage. They are subject to frequent flooding. This association is used mainly for woodland.

MARSH

CN Tidal Marsh Association

Soils along the coast frequently flooded by Gulf of Mexico sea water of varying salt content that supports a marsh type vegetation. Thickness of organic surface material and character of underlying mineral soil material are variable. This association is used mainly for wildlife habitat.

SOILS OF THE SOUTHERN COASTAL PLAIN MLRA

DA McLaurin-Ruston-Saucier Association

Nearly level to moderately sloping, moderately well to well drained soils with a loamy surface layer. The well drained McLaurin and Ruston soils are on the ridge tops. The moderately well drained Saucier soils are on side slopes. This association is used mainly for woodland and pasture.

DB Saucier-Benndale-Atmore Association

Level to strongly sloping, poorly to well drained soils with loamy surface layers. The moderately well and well drained Saucier and Benndale soils are on ridge tops and side slopes. The poorly drained Atmore soils are on low flats and in drainageways. This association is used mainly for woodland and pasture.

DC Cahaba-Eustis-Susquehanna Association

Gently to steeply sloping, somewhat poorly to excessively drained soils. The well drained Cahaba soils and the somewhat poorly drained Susquehanna soils have a loamy surface layer. The excessively drained Eustis soils are sandy throughout. This association is used mainly for woodland.

DD Susquehanna-Savannah-Ruston Association

Gently to steeply sloping, somewhat poorly to well drained soils with a loamy surface layer. The somewhat poorly drained Susquehanna soils are on side slopes. The somewhat poorly drained Savannah and well drained Ruston soils are on ridge tops. This association is used mainly for woodland.

GLOSSARY

Alluvium: Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Delta: Sediment build-up at the mouth of some streams in a general three sided (triangular) shape resembling and named after the fourth letter of the Greek alphabet.

Deltaic: Having to do with the formation of a delta.

Firm Marsh or Swamp: USDA, SCS term for soils that will generally support the weight of humans or livestock walking across them. Soft marsh or swamp does not have this supportability.

Frequently Flooded: USDA, SCS class for soils that are flooded more frequently than 2 years in 5.

Fresh Marsh: Salt content (NaCl) is less than 5 ppt (USDA, SCS Gulf Coast Wetland Handbook, 1978).

Loess: Fine grained material, dominantly of silt size particles, that has been deposited by wind.

Major Land Resource Area (MLRA): USDA, SCS term for large land areas with similar soils, climate, topography, and elevation (physiography), and land use.

Marsh: Periodically wet or continually flooded areas. Surface not deeply submerged. Covered dominantly with grasses, sedges, cattails, rushes, or other water-tolerant plants.

Mineral Soil: Soil with less than 30 percent organic content if mineral part is dominantly clay.

Natural Levee: A low ridge adjacent to a stream channel formed by sediment fallout from flood waters when the stream banks were overflowed.

Organic Soil: Soil with more than 30 percent organic content.

Pleistocene Geologic Time: The period of the glaciers - roughly 20,000-1,000,000 years ago.

Prime Farm Land: USDA, SCS class for land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oil seed crops. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops.

Recent Geological Time: Post-Glacier period - present to roughly 20,000 years ago.

Saline Marsh: Salt content (NaCl) exceeds 5 ppt. (USDA, SCS Gulf Coast Wetlands Handbook 1978).

Sand Dunes: Ridges composed mainly of sand and sea shells formed by wind and wave action.

Semi-fluid Mineral Soil: USDA, SCS term for unconsolidated soil material deposited in water, has greater than 100 percent water saturation, and under the squeeze test will flow between the fingers.

Soil Association: A soil mapping unit that includes in its name the dominant soil or soils on a landscape that generally occur in a repeating pattern. One to three soils may be named. These named soils and unnamed minor soils could be mapped out separately if desired on a larger scale map.

Subsidence:

(a) Geologic: Loss of surface elevation over a broad area attributed to gradual compacting of alluvial and marine sediments.

(b) Man-Influenced: Loss of surface elevation due to soil consolidation after drainage (initial subsidence) and loss of surface elevation due to decomposition of organic material after drainage and consolidation (continued subsidence).

Swamp: Soils supporting a woody vegetation with a water table at or above the soil surface most of the time and is subject to frequent flooding.

Tertiary Geologic Time: Pre-glacier period - roughly 1,000,000 to 60,000,000 years ago.

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CLIMATOLOGY AND HYDROLOGY

by

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CLIMATOLOGY

The main climatic features of the MDPR study region are its location in the subtropical humid climate and its nearness to the Gulf of Mexico. With a moisture source nearby, annual precipitation is abundant, ranging from 60 to 65 inches. Normal annual temperature is 68°F (National Weather Service 1979). A rainy season occurs from December through March. Steady rains of two to four days occur during this period. Rainfall in the summer is characterized by almost daily thunderstorms which are quite sporadic in areal coverage. Heavy rains from these thunderstorms may produce local flooding (U.S. Weather Bureau 1961). Flooding also occurs along the Mississippi River during March and April as a result of snow melt and heavy rains in its tributaries. The major damaging weather influence, however, is hurricanes. Winds over 120 miles per hour and rainfalls greater than 14 inches in a 24-hour period can be expected about once every century. Less damaging tropical storms occur, on the average, about once every 5 years. Winds to 75 miles per hour and rains of 8 to 20 inches in a 24-hour period occur with these storms. The threat of storm damage decreases inland, but hurricane force winds have been recorded over the entire study area (U.S. Weather Bureau 1955).

Tornadoes also cause severe damage in localized areas during the spring months. March is the month with the most tornadoes but April, May and February also rank high. Tornadoes also occur in the other months but damage is usually small from June through January (National Weather Service 1979).

From mid-November to mid-March, the area is subjected to cold air from the north. Although the warm water influences quickly moderate the cold air, temperatures near 0°F have been recorded. Seventy percent of the years have the lowest annual temperature above 24°F with some years staying entirely above freezing. The instability of the prevailing air mass during the summer usually does not allow afternoon temperatures to rise much above 90°F before thunderstorms occur. Maximum temperatures above 100°F are rare, occurring only about once every 20 years (National Weather Service 1979).

During the late winter and spring, the cold flow from the upstream Mississippi River enhances the formation of river fogs which may slow river traffic for many days (National Weather Service 1979).

The mean wind speed for the area is around eight miles per hour. Normal winds are slightly higher in the winter and slightly lower during the summer months. The prevailing wind direction is determined by the water/land temperature contrast. During the late fall and early winter when land temperatures are cooler than the water temperature, the prevailing wind direction has a northerly component. As the land temperature warms in the summer months, the prevailing wind direction switches to the south. Damaging winds are usually associated with tropical storm passages in the summer and fall. The threat of damaging winds is small from December through May (National Weather Service 1979).

The wind and precipitation data presented on the climatology-hydrology map were chosen for use in planning activities. The data were obtained from National Weather Service and state and local government publications. While attempting to present normal data, emphasis has been placed on extreme event analysis. Wind roses of normal monthly winds and extreme speeds and prevailing direction are presented for each area. Since the gradient is slight at this map scale, a wind rose was chosen to represent each map section.

The period of record for each station used is shown in the map collar. Varying periods of record were available among the stations and even for different parameters for the same station. Some smoothing of the maximum and minimum rainfalls was done to obtain the representative fields.

The same approach was used for rainfall estimates. One bar graph for normal monthly, minimum and maximum monthly and maximum twenty-four hour precipitation is presented for each map section. A complete extreme event analysis of rainfall return periods for durations of 0.5, 1, 2, 3, 6, 12, 24 hours and for periods of 1, 2, 5, 10, 25, 50 and 100 years is presented. Rainfall return periods are mathematical probabilities based on the period of record. The occurrence of two rainfall events exceeding 100-year return rates within a much shorter span (less than ten years) are possible and indeed, have occurred in the recent past (David Smith, National Weather Service, Slidell, La. personal communication 1980). These data were chosen because they give close approximations of rainfall rates that can be expected for each period. Other periods and durations up to twenty-four hours can be obtained by extrapolation. In summary, the climatological emphasis presented on this map was placed on extreme event analysis to provide effective planning guides. Bar graphs and wind roses were used as the form of presentation to provide clarity of information for each map section and so as not to confuse the map with more isolines. In addition, the map scale (1:100,000) precludes the use of isolines to represent rainfall since the gradient would be much too wide to include more than one line per base map area. Figure 1 shows annual precipitation normals for the entire state of Louisiana and parts of Mississippi (National Weather Service 1980).

HYDROLOGY

Hydrologic features or processes that are mapped in this atlas include coastal currents, stream and river discharge, ground water resources, and water quality for selected streams and rivers.

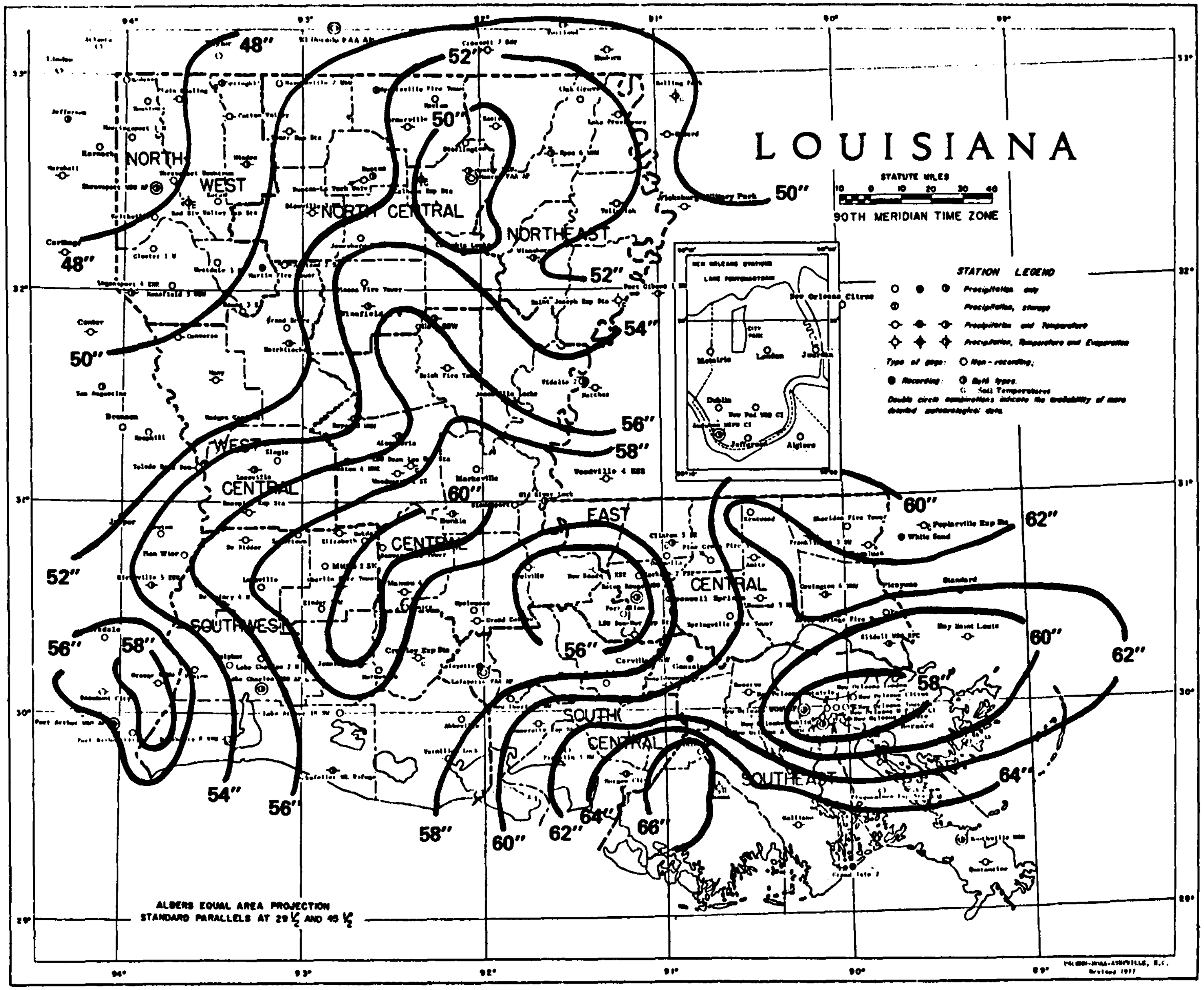

Figure 2. Annual precipitation normals for Louisiana and parts of Mississippi, 1941-1970 (National Weather Service 1980).

Currents within the MDPR are driven by (1) the movement of tides; (2) local and regional winds; and (3) the movement of regional Gulf of Mexico currents. Maximum tide range for the region is 2.5 feet (Oetking et al. 1974). The direction and magnitude of regional winds are displayed on the maps as wind roses. Regional currents enter the Gulf of Mexico from the south between the Yucatan Peninsula and Cuba (Oetking et al. 1974). One component veers sharply to the west and moves in a clockwise circulation along the Mexican and Texas coasts. Another component splits to the east and flows along the northern shore of Cuba and exits through the Florida Straits. The third dominant component of the current moves in almost a straight line from the Yucatan-Cuba entrance northerly towards the Mississippi Delta and then splits forming a counter-clockwise circulation and westerly movement of waters west of the Delta, and an easterly movement southeast of the Delta (Oetking et al. 1974).

Current roses on the maps show annual frequency of current movement in major compass directions (N, S, E, W, NE, SE, NW, SW) and an average speed for each direction (U.S. Department of the Interior n.d.). The resultant direction and speed in that direction is also shown. From the westernmost part of the project area eastward to Caillou Bay, the resultant current direction is 287.2° or west-northwest at 0.6 knot. Further east, offshore from Timbalier Bay, the resultant current direction is 306.8° with a 0.3 knot speed. Southwest of the Mississippi River Delta the resultant current direction is 325.1° with a speed of 0.2 knot, and offshore from the Chandeleur Island chain the resultant current direction is 297.8° with a speed of 0.1 knot. While currents generally flow to the west off the mouth of the Mississippi River, immediately west of the active Delta and near Barataria Bay, a clockwise circulation causes eastward flowing currents along the coast back toward the Delta (U.S. Army Corps of Engineers 1973).

Closer to shore in bays and through inlets, tides, winds, river in-flow, bathymetry and shoreline configuration play a significant role in determining current speeds and direction. In Vermilion, West Cote Blanche, East Cote Blanche, and Atchafalaya Bays, the diurnal tide is responsible for two tidal reversals. On the incoming tide, currents move westward along the coast and enter the bays through inlets. Water flow within the bays is then northward. During the out-going tide, currents move southward and exit from the bays through inlets. The current leaving Vermilion Bay through Southwest Pass causes an eastward flow of water along the coast between the pass and Shell Mound Point. East of Shell Mound Point, however, currents continue to flow westward along the coast. Tidal currents flow northward in Atchafalaya Bay during three of the four diurnal tidal periods and southward during the final ebb tide of the day (Coastal Environments 1977).

In Chandeleur-Breton Sound, two tidal systems enter the estuary, one from the north and one from the south, producing north-south flowing currents in the estuary. Current speeds are 10 to 15 centimeters per second except through narrow shallow inlets where they increase to 40 to 50 centimeters per second (Hart 1978). Within a few hours after high tide, the major flow through the sound is to the south (Hart 1978).

Stream or river discharge refers to the volume of water that passes a given point within a given period of time. In the United States, discharge is generally expressed in terms of cubic feet or cubic meters per second. Stream and river discharge data in the study area were compiled for the period of record for each station from computer-output summaries acquired from the U.S. Geological Survey, Water Resources Division in Baton Rouge, Louisiana. This information was recorded from continuous gauging stations located within or near the project area boundary. It is presented on the maps in the format of bar graphs and, whenever possible, in terms of monthly maxima, minima, and means.

Ground water resources in the study area were considered in light of both ground water availability and water quality. Ground water is represented on the maps by isolines indicating the altitude of the base of fresh ground water (Rollo 1960, 1966; Newcome 1965; Harder et al. 1967; Cardwell et al. 1967; and Baughman 1976). The water quality is represented by delineating regions of relative amounts of fresh ground water by their general characteristics. Also shown on the maps are areas where salt water occurs in sands that lie above the altitude of the base of fresh water.

The fact that ground water resources are intimately related to geologic structure and stratigraphy is well-illustrated by their effect on the altitude of the base of fresh water. In the eastern portions of Lake Pontchartrain, a major fault has resulted in abrupt change of almost 1,700 feet. Another abrupt change occurs along a zone that extends from the southern portions of Livingston Parish in Louisiana into southern Mississippi. This latter change is stratigraphic, resulting from the great thickening of Coastal Plains sediments toward the axis of the Gulf Coast geosyncline (Rollo 1960).

Water quality data were compiled from the computer summaries provided by the United States Geological Survey's Water Resources Division in Baton Rouge. This information was recorded for the period of record at water quality stations located along streams and rivers within or near the project area boundary. Water quality parameters shown on the maps include dissolved oxygen, nitrogen, and phosphorus. Selection of dissolved oxygen was based on its importance to fish, invertebrates, and bacteria. Nitrogen and phosphorus were chosen because of their importance to algae and other plants. Biochemical oxygen demand (BOD) has been shown because it is indicative of the quantities of oxygen necessary for the decomposition of organic matter by micro-organisms such as bacteria. Sediment data are presented as (1) suspended sediment in milligrams per liter; and (2) as the amount (tons) of suspended sediment discharged at a given point over a 24-hour period. Total chloride is also listed for the period of record for each station.

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ACTIVE COASTAL PROCESSES

by

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SHORELINE CHARACTERISTICS

The configuration of the Louisiana and Mississippi coasts is due largely to the deposition of vast amounts of sediment transported into the area by the Mississippi River. Over the past 5,000 to 7,000 years, this process and the wave action of gulf waters have formed a series of deltas. The Balize or modern Birdfoot Delta is the latest in the series of deltaic complexes. The Chandeleur Islands represent the former extent of the St. Bernard Delta, whereas the Timbalier and Derniere island chains together represent the former extent of the Lafourche Delta. There is evidence that the Mississippi River at one time was abandoning its Birdfoot Delta for the more favorable gradient of the Atchafalaya River, however, the establishment of the water control structure at Old River (U.S. Army Corps of Engineers 1979) halted this, and the Atchafalaya now receives more than 30% of the combined Mississippi River and Red River discharge (Roberts et al. 1980).

Apparently, the Mississippi River deltaic plain has been and still is subject to rapid as well as gradual change. Such rapid changes of the coastline are of great importance as they can affect many aspects of human life. In order to identify where above average land loss or gain is occurring, these terms must be defined. Above average erosion is defined here as being greater than or equal to the average rate of erosion per year (approx. 24 ft), and is shown on the maps as a negative value. This average rate was calculated by using the retreat rates measured at regular intervals along the Louisiana shoreline for 1954-1969, from the report entitled "Shoreline erosion in coastal Louisiana: inventory and assessment" (Adams et al. 1978). Because no specific data covering the entire study area were available on accretion rates, the same mean value was used for above average advance of coastline as that used for retreat. Above average shoreline accretion, therefore, is defined as equal to or more than 24 feet per year, and is shown on the maps as a positive value.

The Mississippi Deltaic Plain Region (MDPR) habitat maps (Wicker et al. 1980a) were used to approximate the erosion or accretion of the shoreline. Each map pair consists of two, 1:24,000 scale overlays for U.S.G.S. topographic bases, one overlay for the 1950's, one for 1978. The entire Gulf Coast shoreline of the Mississippi Deltaic Plain Region was visually divided into stable, eroding, or advancing segments by overlaying and comparing each pair of habitat maps which overlap the shoreline. Each segment was subsequently divided into smaller subsegments of roughly equal amounts of erosion or accretion along the length of the subsegment, and by direct measurement each subsegment was assigned an acreage value of retreat or advance. Using a map measuring device, the length of a shoreline subsegment was measured and the area calculated by multiplying the linear value by the amount of retreat or advance indicated by the shift of shoreline. Any subsegment found to have a measured value less than the value given in Table 6 (Appendix) for the time interval between the two maps being compared was defined as below average erosion or accretion and is shown on the map as "E" or "A".

Some islands were handled as special cases. For islands completely eroded away between the 1950's and the late 1970's, total acreage lost was measured and denoted with an asterisk. The same was done for islands which appeared in the late 1970's. Calculations of barrier island change showed that most of them eroded on their seaward sides and advanced on their protected sides, although some also eroded on their protected sides. Where a major shift of an island toward the mainland occurred, a barrier island was shown for the 1950's to have eroded away, and for the 1970's to occupy a new position closer to the mainland. This was done for data presentation, despite the fact that the island may have migrated to its new position gradually and not abruptly as portrayed.

Since the acreage of shoreline lost or gained was measured only once for a 20- to 27-year period, the data do not reflect the increasing rate of shoreline retreat that the deltaic plain is experiencing (Adams et al. 1978) or any other fluctuations of erosion or accretion or subsidence during the time period.

Subsidence is another indirect causal factor in these land changes. Subsidence is a sinking of the land in response to the compaction of sediments, depression of the crust by the great weight of the sediment load, and extraction of hydrocarbons and groundwater from within the delta. More recently, the effects of subsidence have become evident due to the channelization of the Mississippi River by levees and revetments which effectively contain its waters during floodstage, thus depriving the constantly subsiding marshland of an offsetting supply of sediment. This results in increasing the size and number of lakes with concomitant disappearance of marsh. Canalization of the region of the modern Birdfoot Delta has also reduced the effects of flooding by rapidly discharging sediment-laden flood waters and reducing overland flow to the subsiding marshes.

Severe weather, especially hurricanes, is the primary force capable of rapid erosion and redistribution of sediments. Such storms may also be an important mechanism for transporting gulf bottom sediments to the coastline. Storm surge waves caused by hurricanes are capable of eroding away entire islands and greatly altering long stretches of coastline. These storms may cause abnormally high erosion rates. The occurrence of high erosion rates in low wave energy areas suggests that the shoreline change was due to other factors. Wave energy is the capacity of a wave to do work and is theoretically proportional to the square of the wave height. This implies that the greater the wave height the greater the wave energy. Here wave energy is measured in terms of wave power, the rate at which wave energy is delivered. It is measured at the 1 foot bathymetric contour as 10^5 times percent annual offshore wave power. On the maps the numbers shown for wave energy represent the percentage of available annual offshore wave power for the area bracketed by diamonds. Annual offshore wave power for the Louisiana coast is 2808 lb/sec (Becker 1971).

Two types of structures used to influence shoreline erosion and sediment movement are seawalls and jetties. A seawall is located along the Mississippi coast from Biloxi to Bayou Caddy near Clermont Harbor, along with two short sections on the Pascagoula shorefront. The New Orleans Pontchartrain shorefront also has a seawall. Jetties extend into the Gulf from most of the major passes used by shipping. They are designed to prevent the shoaling of the passes by littoral drift (the movement of intertidal materials by the longshore current), and to induce scouring of the channel pass.

Most of the Louisiana coastline is undergoing below average erosion, i.e., less than the 24 feet per year average retreat rate calculated from the data of Adams et al. (1978). Conspicuous exceptions are the Birdfoot Delta, the barrier islands, and the stretch of coast from Caminada Pass to Belle Pass. Most of these areas have areas of relatively steep bathymetry that results in higher wave energy. Those areas suffering high erosion rates with low wave energy appear to have other factors involved (subsidence, severe weather, etc.). The most severe erosion has occurred along Scott and Dixon Bays, an area of low wave energy, where over 28,000 acres of land have been lost in the 22-year period of measurement.

The area of major land gain is in Atchafalaya Bay. Land has accreted and recently appeared near New Pass in Atchafalaya Bay forming the Wax Lake Outlet delta. The area of largest land gain, in the Lower Atchafalaya River delta, is to the east and west of the Lower Atchafalaya shipping channel. The growing Atchafalaya delta is composed of the Wax Lake Outlet delta and the lower Atchafalaya River delta. As of 1978, new land growth in this area amounts to 1,103 acres of "natural" islands and 1,800 acres of vegetated spoil (Roberts et al. 1980).

The Mississippi coast is stable from Pascagoula to Grand Island Pass, the approximate extent of the seawall. Shoreline advance occurring south and east of Pascagoula is largely the result of man's development of the coastline, as is the small spoil deposit island south of Pascagoula. Mississippi's barrier islands show maximum net rates of accretion of the western ends of Petit Bois, Horn and Ship islands and North Point of Cat Island, and maximum net erosion on the eastern ends of Petit Bois, Horn, and Ship islands, and South Spit of Cat Island (Waller and Malbrough 1976).

COASTAL MARSHES

Three basic types of coastal marshes are present in the Mississippi Deltaic Plain Region: fresh, brackish, and saline; a fourth, the intermediate marsh, is transitional between the fresh and brackish marshes. These four major types are depicted for 1949, 1968, and 1978 to show their variance with time.

The sources for these years are: (1) a map of the southern portion of Louisiana showing nine vegetation types of the Louisiana marshes (O'Neil

1949); (2) a vegetation type map of the Louisiana coastal marshes (Chabreck et al. 1968); and (3) the MDPR habitat maps (Wicker et al. 1980 after Chabreck and Linscombe 1978). Because the marsh type information on the 1950's habitat maps was too general for our purposes (i.e., the 1950's maps show fresh and non-fresh marsh categories only), O'Neil's vegetative type map was used. This map is more specific and represents a suitable base for determining, with the other maps, how all four marsh types have changed in areal extent over time. Table 7 depicts each author's mapped marsh types as they correspond to the four marsh types mapped here. Chabreck's and Wicker's marsh types correspond directly, whereas O'Neil's nine marsh types have a more complex correspondence. Wicker's (1980) correlation table for marsh types in the User's Guide to the Habitat Maps was used to correlate O'Neil's nine marsh types with the four used here, with two exceptions. For our purposes, O'Neil's floating three-cornered grass marsh is considered to be an intermediate marsh type. Its geographic position and geometry relate well to the position and geometry of the intermediate marshes of the succeeding years. This is acknowledged by Wicker (1980), although on the habitat maps this marsh type is labelled fresh rather than intermediate or non-fresh in order to correspond to the 1950's maps. Table 8 compares salinity ranges for fresh, intermediate, brackish and saline marshes provided by different authors (Wicker 1980).

Of the three map sources used, only the habitat maps delineate the coastal marshes of Mississippi. Mississippi marshes are shown to be restricted to the low lying areas immediately adjacent to Mississippi Sound, Grand Bay, Bay St. Louis and the Back Bay of Biloxi, and extend up the Pascagoula and Pearl River floodplains. These marshes are largely intermediate to saline and have undergone little change over the 22-year interval from 1956 to 1978.

The coastal marshes of Louisiana show many major changes from 1949 to 1978. North of the Atchafalaya and Cote Blanche Bays the fresh marshes have pushed to the coast, excepting three small enclaves of intermediate marsh on the coastline. In the region of Caillou Bay to Barataria Bay saline marshes have intruded further inland by as much as 10 miles. The Birdfoot Delta is also being affected by salt water encroachment. In 1949 it was almost wholly covered by fresh marshes. Now intermediate marshes have occupied the rim of the delta as far inland as 3.5 miles.

Measurement of marsh areas during this study shows that the Louisiana coastal marshes in 1978 covered about 3,000 square miles. Saline and brackish marshes each comprised a third, and of the remaining third, fresh marshes comprised two thirds and intermediate marshes covered the rest. Between 1956 and 1978 there was a reduction of almost 55% in fresh marsh acreage for the MDPR (U.S. Fish and Wildlife Service 1981).

BATHYMETRY

The bathymetry on the maps in the atlas was transferred from National Ocean Survey draft, provisional and final maps, and shows the near shore portion of the largely broad, gently sloping continental shelf with a 2-meter contour interval. Except in the active delta, the sea bottom gradually drops from 0 to 16 meters. From Southwest Pass to Pass a Loutre, there is a steep drop from approximately 4 meters at the mouths to between 40 and 60 meters in

Table 7. Four marsh categories from three sources as portrayed in the MDPR Ecological Atlas.

MDPR Ecological Atlas	O'Neil (1949)	Chabreck et al. (1968)	Wicker et al. (1980) after Chabreck and Linscombe (1978)
Fresh	1) Fresh 2) Floating fresh	Fresh	Fresh
Intermediate	1) Intermediate 2) Saw grass	Intermediate	Intermediate
Brackish	1) Brackish three-cornered grass 2) Floating three-cornered grass 3) Leafy three-cornered grass 4) Sea rim adjacent to brackish	Brackish	Brackish
Saline	1) Excessively drained salt 2) Sea rim adjacent to saline	Saline	Saline

Table 8. Comparison of salinity ranges for fresh, intermediate, brackish, and saline marshes provided by different authors (Wicker 1980).

Marsh Type	Salininity Range I[a]	Salinity Range II[b]	Salinity Range III[c]
Fresh	0 - 1 ppt	0.5 ppt	0 - 5 ppt
Intermediate	1 - 8 ppt	0.5 - 5 ppt	5 - 10 ppt
Brackish	8 - 18 ppt	5 - 18 ppt	10 - 20 ppt
Saline	18+ ppt	18 - 30 ppt	20 ppt

[a] Montz 1976
[b] Cowardin et al. 1979
[c] U.S. Army Corps of Engineers 1974

less than 2 to 4 miles offshore. This steep slope represents the advancing edge of the delta.

The various bays and sounds range in depth from 4 to 6 meters. The Breton, Chandeleur and Mississippi Sounds are dissected by numerous ship channels and their associated dredge disposal and spoil areas. The seaward edges of these sounds, and Timbalier Bay and Terrebonne Bay are bounded by barrier islands whose adjacent seaward sea floor falls at a moderate rate. Atchafalaya Bay, likewise, is cut by a shipping channel and has associated disposal and spoil areas.

HURRICANE TIDAL FLOOD SURGE

The Mississippi Deltaic Plain Region hurricane season extends from June to November and peaks in September.

Five major hurricanes: Camille, 14-22 September 1969; Carla, 4-14 September 1961; the hurricane of 25-28 June 1957; and the hurricanes of 5-24 August and 22 September-2 October 1915, were selected to show the maximum area inundated by tidal flood surges. This area of inundation along the coast is a function of both the intensity (i.e., strength) of the hurricane and where it strikes (i.e., its landfall) or nears the coast. One method of measuring hurricane intensity is with barometric pressure. The barometric pressure must be less than or equal to 29.0 inches of mercury for a storm to be classed as a hurricane. The barometric pressure measured during these five hurricanes ranged from 28.14 inches of mercury in the 5-24 August storm to 26.61 inches during Hurricane Camille, the most intense hurricane to reach the U.S. mainland. The landfalls of these hurricanes occurred over the area from near Galveston, Texas, eastward to Bay St. Louis, Mississippi. Highest flood tides ranged from 13.0 to 22.6 feet above sea level, with the highest flood surge tide recorded in Pass Christian, Mississippi during Hurricane Camille. This tidal range is sufficient to inundate much of Mississippi's narrow coastal strip and the area of the modern Birdfoot Delta excepting the highlands to the north of Lake Pontchartrain. When an entire 1:100,000 scale map was inundated by hurricane tidal flood surge a symbol is placed on the map to reflect this fact. Otherwise a boundary line is used to separate flooded from non-flooded areas.

Data on tidal inundation due to hurricanes were difficult to compare because they were recorded on different map scales. The data for Louisiana are from the U.S. Army Corps of Engineers (1972) Hurricane Study at a scale of approximately 1:2,650,000, whereas the data for Mississippi are from the U.S. Geological Survey (1969) Hydrologic Investigations Atlas at scales of 1:24,000 and 1:62,500.

TOPOGRAPHY

The Mississippi Deltaic Plain Region is a broad, flat alluvial plain of rarely more than 5 feet elevation, and is, in some places, below sea level. The two exceptions are the natural levees of the Mississippi River and smaller rivers which in places are over 20 feet in height, and the salt domes of the western part of the study area which may rise to a height of 150 feet.

The exposed Pleistocene erosional surface north of the MDPR study area and Lakes Pontchartrain and Maurepas rises from near sea level to between 30 and 50 feet at the northern boundary of the study area. This region is moderately to highly dissected by streams.

Nearly all of the study area in the State of Mississippi is higher in elevation than the narrow strip of coastal plain. The gently sloping Pascagoula floodplain extends from the coastal plain into the broad uplands to the north. The highly dissected uplands reach elevations over 200 feet in some places.

U.S. Geological Survey, Department of Commerce, and Corps of Engineers 7-1/2 and 15 minute topographic quadrangle maps were the data base for the mapped topographic information. A 5 foot contour interval is used for the study area except in roughly the northern half of the study area in the State of Mississippi where a 10-foot contour interval is used, and on the salt domes in the western part of the study area which are measured by a 25-foot contour interval. Except for the salt domes, the 20-foot contour is the highest elevation portrayed.

INLAND WATER CONTROL STRUCTURES

Inland water control structures were mapped using data from 7-1/2 and 15 minute topographic quadrangles and other collateral information. Levees, were divided into two types by the U.S. Geological Survey - primary and secondary. Most of the primary levees protect against flooding from the Mississippi River and Lake Pontchartrain. The remainder protect against flooding from the Bonnet Carre and Atchafalaya Basin Floodways and from the West Cote Blanche, East Cote Blanche, and Atchafalaya Bays. Secondary levees act as a primary defense in less flood prone areas, and as a second line of defense against backwater and storm runoff flooding of the Mississippi River communities from the swamps. Parts of the New Orleans waterfront and some smaller cities are not protected by levees but by the waterfronts themselves which are built at higher elevations than the rest of the city and, therefore, act as levees.

Revetments, an additional control against flooding, are placed along river banks to prevent erosion. In Louisiana they are found along the banks of the Mississippi River, usually along the outer bank where a river bends and erosion is most severe, and along navigation canals like the Gulf Intracoastal Waterway and the Mississippi River Gulf Outlet.

Dams and weirs are used to control the level of water. Dams are made of shells, rock, earth, etc. and are located on small bayous to impound and raise the water. Weirs, made of creosoted wood, are located just below the surface of the water. They are most frequently used to control the water level in marsh areas and their use represents an effective marsh management practice. Because of the transient nature of weirs and the ownership of some by private land holders, many were not mapped. However, those mapped represent perhaps 80% of the weirs in the study area (P. Wagner 1981; Burk and Associates, New Orleans, La; personal communication). Also, in Mississippi, because of wetland management practices which differ from those in Louisiana, weirs are not as commonly used.

Locks are used to raise and lower ships and boats from one level of water to another. Most are located along the Mississippi River between the river and the adjoining canals.

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APPENDIX
ACTIVE COASTAL PROCESSES

The retreat and advance of the Gulf Coast shoreline were calculated from measurements taken from the 1:24,000 scale habitat maps for the 1950's and 1970's (Wicker et al. 1980). The shoreline was first visually divided into stable, eroding, or advancing segments. A particular subsegment of shoreline was considered to be in one of these three categories if the shoreline shift was equal to or less than the width of the average line on a habitat map, i.e., approximately 1/50th of an inch or a 4.5-foot shift of a shoreline at real ground scale. A subsegment of eroding or advancing shoreline was defined as having roughly equal amounts of change along the length of the subsegment. Each subsegment was subsequently measured at regular intervals along its length and the mean (average) shift was calculated. This mean shift was then converted from map scale to ground scale (1 inch on the map = 2,000 feet on the ground at 1:24,000 scale) and then converted to acres (1 acre = 43,560 square feet) per nautical mile (1 nautical mile = 6,076 feet) to be consistent with the Adams et al. study (1978) (Equation 1).

Equation 1:

$$\text{(inches shoreline shift)} \times \frac{2{,}000 \text{ ft}}{1 \text{ inch}} \times \frac{6{,}076 \text{ ft}}{1 \text{ n mi}} \times \frac{1 \text{ acre}}{43{,}560 \text{ ft}^2} = \frac{\text{acre}}{\text{n mi}}$$

Each converted value for a subsegment was compared with the calculated values in Table 6 corresponding to the difference in years between the habitat maps. The calculated values were derived for all the possible time intervals between all the pairs of habitat maps by multiplying 0.012 inch/yr (the value at map scale which equals the mean retreat rate of 24 feet per year from Adams et al. 1978) by the given difference in years and using this value in Equation 1, i.e., 20 years x 0.012 inch per year = 0.24 inch of shoreline shift x 2,000 feet per inch x 6,076 feet per nautical mile x 1 acre per 43,560 square feet = 67.0 acres per nautical mile. If the measured value for a subsegment was equal to or greater than the value in the table then the shift was classified as "above average" (more than 24 feet per year) and the acreage lost or gained was indicated on the map; if the measured value was less, the shift was classified as "below average" (less than 24 feet per year) and an "A" or "E" was indicated on the map.

If a shoreline subsegment was found to show a major shoreline shift, its measured value was then multiplied by the corresponding length of shoreline in inches (at map scale), by the linear conversion factor (inch = 2,000 feet) and by the areal conversion factor (1 nautical mile = 6,076 feet) to obtain the acreage lost or gained (Equation 2).

Equation 2:

$$\text{(acres/n mi)} \times \text{(shoreline length, inches)} \times \frac{2{,}000 \text{ feet}}{1 \text{ inch}} \times \frac{1 \text{ n mi}}{6{,}076 \text{ ft}} = \text{Acres}$$

Appendix Table 6: Determination of "major" shoreline shift.

No. of years between two habitat map overlays	Calculated Value (acres/n mi)
20	67.0
22	74.0
22.5	75.5
23	77.0
23.5	78.5
24	80.0
25.5	85.5
26	87.0
27	90.0

BIOLOGICAL RESOURCES

by

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PUBLIC OYSTERING GROUNDS

The estuarine waters of the Mississippi Deltaic Plain Region (MDPR) are among the most productive natural oystering grounds in North America. In Louisiana and Mississippi, the American oyster (Crassostrea virginica) is the primary commercial species. Louisiana leads the Gulf states in production averaging in the neighborhood of 10,000,000 pounds of oyster meat annually worth $12,000,000 (U.S. Department of Commerce 1978). In Mississippi, production averages around 500,000 pounds annually.

Public oystering grounds have been set aside in both Louisiana and Mississippi waters for the harvesting of wild oysters by the states' oyster fishermen. The public grounds are state controlled areas of natural oyster production. In Louisiana, 80 to 90 percent of these natural reefs occur east of the Mississippi River in St. Bernard and Plaquemines Parishes. This is called the Red Line Area, i.e., public water bottoms from which oyster fishermen transfer seed (young) oysters to their private oyster leases. No offshore boundary is shown on the map because the Red Line Area extends out to the limit of Louisiana's jurisdiction (i.e., the 3-mile offshore boundary.) Private leases are not allowed within the Red Line Area and oyster transplanting can occur only during the open season by properly licensed vessels. On the private leases, the transplanted oysters are allowed to grow and fatten before being harvested and marketed. Oyster culture in Louisiana is essentially a farming operation in which oysters are planted, cultivated and allowed to fatten prior to marketing.

The public grounds in Louisiana encompass approximately 690,000 acres, most of which are located in the shallow estuarine waters east of the Mississippi River bordering Mississippi, Chandeleur and Breton Sounds. The most productive portions of the public grounds are the areas between Mozambique Point and California Point in Plaquemines Parish (Dugas 1977). In Mississippi, approximately 7,500 acres of waterbottoms have productive natural reefs. The largest of these is Square Handkerchief Reef, just east of the mouth of Bay St. Louis. Other small public reefs occur in Heron Bay, Biloxi Bay, Graveline Bayou, Pascagoula Bay, Point aux Chenes Bay and Middle Bay. An extensive area of dead reefs occurs between Pass Marianne and Isle au Pitre.

The natural reefs in both states have declined greatly in productivity, particularly since periodic fresh water input from the Mississippi River has been reduced by flood control levees. Navigation channels, such as the Mississippi River Gulf Outlet, have also adversely affected these natural reefs by allowing increased saltwater intrusion to occur. Approximately two-thirds of the formerly productive natural reefs are no longer productive because of these changes (Dugas 1977). The optimum salinity for maximum oyster production is in the range between 10 and 15 parts per thousand. Levees along the Mississippi River and navigation channels have caused the salinity to increase to the point where oyster diseases and predators are a serious problem, particularly when salinities exceed 15 parts per thousand.

Despite the long term trend toward increased salinities and lower production, yearly oyster production varies dramatically. Great variability exists due to the constantly changing conditions in the estuaries. Oyster production in any one year depends on prevailing salinities, amount of rainfall and river discharge, temperature, spawning success and spat fall (number of young oysters produced), predation and diseases, sedimentation, and food availability.

Oyster reefs have a number of important ecological functions. A particular community of benthic organisms is found associated with oyster reefs. This community includes sponges, bryozoans, marine worms, barnacles, crabs, mussels and snails. Sport fishes such as spotted seatrout, red drum and black drum are attracted to the reefs because of the abundance of benthic food organisms such as small blue crabs, shrimp, and molluscs. As a consequence, the reefs make excellent natural fishing areas. Oyster reefs also modify current and sedimentation patterns, help reduce salt water intrusion and wave action and serve as a hard substrate in soft bay bottoms for attachment of epifaunal species. Many shorebirds utilize oyster reefs for nesting and resting sites, particularly oystershell deposits above high tide level.

SEED OYSTER BEDS (SEED GROUND RESERVATIONS)

Seed oyster beds are areas of natural seed oyster production within the public oyster grounds where the natural production is supplemented by placement of cultch material (largely clam shell). The cultch serves as a hard substrate upon which oyster spat can set and grow to seed oysters. Oyster fishermen transplant the seed oysters to their private leases.

Seed oyster beds occur in five locations in Louisiana - Bay Boudreaux, Bay Gardene, Hackberry Bay, Caillou Lake and Bay Junop. These seed grounds encompass approximately 16,500 acres (Perret et al. 1971). Along the Mississippi Coast, cultch material is also placed on some of the public reefs to rejuvenate production.

Cultch material is normally spread from barges over a selected portion of waterbottom. Spat produced during the oyster spawning period from April through September set on the cultch material. The beds are normally harvested on alternate years and are regulated by the Louisiana Wildlife and Fisheries Commission. Commercial fishermen generally enter the seed ground from September through December to obtain seed oysters. Those fishermen who are bedding (relocating oysters) are primarily interested in the small (1-to 3-inch) seed oysters approximately a year old. These oysters remain on the private bedding grounds 3 to 5 months or longer, depending on market conditions, before harvesting.

PRIVATE OYSTER LEASES

Private oyster leases are water bottoms which oyster fishermen lease from the state. Fishermen holding the leases have sole responsibility for planting, cultivating and harvesting oysters, usually by means of an oyster lugger with a specially designed dredge. Boundaries of the leases are surveyed and delineated on maps maintained by the Oyster and Seafood Division of the Louisiana Department of Wildlife and Fisheries and the Mississippi Bureau of Marine Resources.

In Louisiana, there are currently 234,000 acres of private oyster leases (Dugas, Louisiana Department of Wildlife and Fisheries, New Orleans, personal communication, 1980). These leases are concentrated in the five primary oyster producing Parishes of Plaquemines, St. Bernard, Terrebonne, Jefferson and Lafourche. In Mississippi, leasing of private oyster grounds began in 1977. A total of 31 leases has been issued as of September 1979 encompassing 4,694 acres in Mississippi Sound (Mississippi Bureau of Marine Resources 1979). These leases occur in shallow nearshore waters of the sound near Waveland, Bay St. Louis, Biloxi and Belle Fontaine Point.

Private leases along the Louisiana coast occur inland from the public grounds. Prime areas are shallow lakes, bays and bayous with salinities averaging 10 to 15 parts per thousand. The oyster producing zones have been moving further inland over the past 40 years because of the landward shift of isohalines with resulting increase in salinities along many sections of the coast. This situation is a serious threat to the future of the oyster industry as it results in squeezing the prime oyster producing zone between increasing salinities from the south and urban pollution from the north. Thousands of acres of potentially productive oyster grounds are closed to harvesting because of high bacterial levels from domestic pollution.

Not all areas under lease in either state are producing oysters. Some areas are leased for future use and to reserve water bottoms which may become productive due to environmental changes in the future.

CLAM BEDS

The clam, <u>Rangia cuneata</u>, is widespread in the low salinity, highly organic and turbid waters of the Mississippi Deltaic Plain Region study area. Although numerous other molluscs occur in the inshore estuaries, this moderate sized clam is the most abundant mollusc in the oligohaline zone, as is the oyster in the mesohaline zone. Among ten species of molluscs known to occur in Lake Pontchartrain and Lake Maurepas, <u>Rangia</u> is the most abundant and widespread. This species occurs throughout the two lake area. It is also common in Lake Salvador, Lake Verret, Atchafalaya Bay, East and West Cote Blanche bays and Vermilion Bay. Because of its widespread occurrence and economic importance, the distribution of <u>Rangia</u> has been mapped on the Biological Resources Map.

<u>Rangia</u> is generally found in waters with average salinities less than 5 parts per thousand. It has been found in waters ranging from 0.5 to 9.0 parts per thousand (Hoese 1973).

The *Rangia* clam was long utilized by early man in South Louisiana for food, as evidenced by shell deposits in numerous Indian shell middens throughout the coastal marshes. Today, clam shell deposits in Lakes Pontchartrain and Maurepas support a large shell dredging industry. Approximately 5,000,000 cubic yards of shell are harvested annually from the two lakes (Louisiana Wildlife and Fisheries Commission 1968). This shell has a number of commercial uses including road shell, cement, fertilizer, chicken feed, lime, glass, chemicals, fill material and cultch material for oyster reefs.

Rangia has enormous ecological significance. Because of its abundance, it is a very important food source for many fishes and waterfowl, particularly lesser scaup. Other important ecological functions (Hoese 1973) are

(1) Important converter of detritus into animal matter and a reservoir for many nutrients, especially calcium carbonate.

(2) Fills an ecological niche in a habitat (oligohaline infaunal) that no other similar animal tolerates.

(3) Provides shell for storm built marsh beaches.

(4) Provides a hard substrate in bay bottoms for attachment of epifaunal species.

(5) Probably has many unknown effects on sedimentation and survival of burrowing species.

Another clam, *Mercenaria* sp., is found in saltier waters near and offshore from the barrier islands. This clam is common in Breton Sound, around the Chandeleur Islands and near the Mississippi coastal islands. This clam has good potential as the basis of a new commercial fishery.

FISH SPAWNING AND NURSERY HABITATS FOR MARINE AND ESTUARINE DEPENDENT SPECIES

The Mississippi Deltaic Plain Region wetlands are some of the richest and most productive fish spawning and nursery areas in the world. Because of the vast size of this system, Louisiana leads the Nation annually in seafood production. Approximately one-fourth of the total national fishery harvest is landed each year in Louisiana. In 1979, the volume and value of U.S. commercial fishery landings was 6.3 billion pounds, worth $2.2 billion. Louisiana led all states in volume of landings with 1.52 billion pounds, worth $198.5 million (U.S. Department of Commerce 1980). In coastal Mississippi, 383.6 million pounds of fish and shellfish were landed in 1979 worth $33.3 million.

The marshes and bays of the study area are directly connected to the nearshore waters of the Gulf of Mexico by deep tidal passes. A complex and interdependent pattern of fish spawning exists. The common sequence involves offshore spawning in the Gulf and inshore movement into the bays and marshes which are used as nursery grounds. Although there are many exceptions to the rule, the most usual life history sequence is offshore spawning in the fall and winter, followed by inshore movement into the nursery grounds in the spring. Most estuarine dependent species spend several months in the low salinity nursery grounds. The young gradually migrate into the more saline lower bays as they grow and mature. By the summer months, many species are concentrating and staging in the lower bays prior to offshore migration out of the bays into the Gulf for spawning. Staging areas are deeper more saline areas of the larger bays and lakes where fish and shellfish "stage" (group together) prior to offshore migration. Because the Gulf waters are warmer and deeper than shallow inshore waters, many species overwinter there.

Well over a hundred species of fish and shellfish utilize the waters of the study area for spawning and nursery grounds. The most abundant species of fish include Gulf menhaden, bay anchovy, Atlantic croaker, spot, sea catfish, Atlantic threadfin, striped mullet, Southern flounder, bay whiff, sand seatrout, spotted seatrout, red drum and black drum. This group of fishes includes those which are most important to the commercial and sport fishery of the Mississippi Deltaic Plain Region. All of these species are estuarine dependent, spawn in the bays or nearshore gulf waters and utilize the estuary as a nursery ground. The most abundant and commercially important shellfish are blue crab and brown shrimp and white shrimp. These species have similar life history patterns involving gulf spawning and inshore nursery ground usage during juvenile stages.

Fishes common to the Mississippi Deltaic Plain Region spawn in a variety of habitats from offshore Gulf waters inland into freshwater rivers above the boundary of tidal influence. Nine major spawning habitats have been delineated on the Biological Resources Map. From the Gulf inland, these spawning habitats include:

(1) Gulf waters (on the Continental Shelf in waters less than 200 meters deep).

(2) Marine grass beds (such as around the Chandeleur Islands and Cat, Ship, Horn and Petit Bois Islands).

(3) Tidal passes and beaches adjacent to the barrier islands.

(4) Open waters within the bays and sounds.

(5) Oyster reefs.

(6) Estuarine grass beds (such as in Lakes Pontchartrain and Salvador).

(7) Shoreline shallows along bay margins.

(8) Near river mouths.

(9) Freshwater streams above the boundary of tidal influence.

Although fall and winter spawning predominates, spawning occurs throughout the year for some species. Some fishes have prolonged spawning periods (six or more months), while others spawn over a one or two month period. A majority of the common fishes of the study area spawn in Gulf waters less than 200 meters deep. Table 9 lists the spawning habitat and spawning season of common fishes of the estuarine waters of the Mississippi Deltaic Plain Region.

Table 9. Fish spawning habitat for marine and estuarine dependent species of the Mississippi Deltaic Plain Region (after Jones et al. 1978).

1) <u>Gulf Waters (Continental Shelf waters less than 200 meters deep)</u>

Atlantic Bonito (*Sarda sarda*) spawning period unknown
Atlantic Bumper (*Chloroscombrus chrysurus*) June to August
*Atlantic Croaker (*Micropogon undulatus*) September to March
*Atlantic Cutlassfish (*Trichiurus lepturus*) June to August
Atlantic Spadefish (*Chaetodipterus faber*) March to August
Atlantic Threadfin (*Polydactylus octonemus*) December to March
Atlantic Thread Herring (*Opisthonema oglinum*) February to September
Banded Drum (*Larimus fasciatus*) May to October
Blackcheek Tonguefish (*Symphurus plagiusa*) March to September
*Bluefish (*Pomatomus saltatrix*) March to November
Butterfish (*Peprilus burti*) June to September
*Cobia (*Rachycentron canadum*) April to May
*Florida Pompano (*Trachinotus carolinus*) March to September
Gray Snapper (*Lutjanus griseus*) April to August
Greater Amberjack (*Seriola dumerili*) March to October
Gulf Kingfish (*Menticirrhus littoralis*) October to March
*Gulf Menhaden (*Brevoortia patronus*) October to March
Harvestfish (*Peprilus alepidotus*) March to August
Horse-eye Jack (*Caranx latus*) March to July
Inshore Lizardfish (*Synodus foetens*) March to April
Jack Crevalle (*Caranx hippos*) March to September
*King Mackerel (*Scomberomorus cavalla*) June to August
Ladyfish (*Elops saurus*) spawning period unknown
Leatherjacket (*Oligoplites saurus*) March to August
Lookdown (*Selene vomer*) August
Northern Kingfish (*Menticirrhus focaliger*) April to May
Permit (*Trachinotus falcatus*) April to June
Pinfish (*Lagodon rhomboides*) October to March
*Red Snapper (*Lutjanus campechanus*) June to September
Round scad (*Decapterus punctatus*) May to June
*Sheepshead (*Archosargus probatocephalus*) March to May
Shrimp Eel (*Ophichthus gomesi*) March to August
Silver Jenny (*Eucinostomus gula*) January to April
Smooth Puffer (*Lagocephalus laevigatus*) September to November
*Southern Kingfish (*Menticirrhus americanus*) October to May
*Spot (*Leiostomus xanthurus*) December to February
Spotfin Mojarra (*Eucinostomus argenteus*) May to December
Star Drum (*Stellifer lanceolatus*) April to June
Striped Anchovy (*Anchoa hepsetus*) March to July
Striped Mullet (*Mugil cephalus*) October to February
*Tarpon (*Megalops atlantica*) May to August
White Mullet (*Mugil curema*) February to May

Table 9 (concluded)

2) Marine Grass Beds (Turtle grass, shoal grass, etc.)

Halfbeak (*Hyporhamphus unifasciatus*) June to August
*Spotted Seatrout (*Cynoscion nebulosus*) (also called Speckled Trout) April to October

3) Tidal Passes and Beaches adjacent to the Barrier Islands

Longnose Killifish (*Fundulus similis*) April to September
*Red Drum (*Sciaenops ocellata*) September to November
Rough Silverside (*Membras martinica*) March to August

4) Open Waters within the Bays and Sounds

Bay Anchovy (*Anchoa mitchilli*) May to November
*Black Drum (*Pogonias cromis*) February to June
Gafftopsail catfish (*Bagre marinus*) May to August
Hogchoker (*Trinectes maculatus*) all year
Pigfish (*Orthopristis chrysoptera*) March to June
*Sea Catfish (*Arius felis*) May to August
*Silver Perch (*Bairdiella chrysura*) May to September
*Spanish Mackerel (*Scomberomorus maculatus*) July to September
*Tripletail (*Lobotes surinamensis*) June to August

5) Oyster Reefs

Naked Goby (*Gobiosoma bosci*) May to November
Oyster Toadfish (*Opsanus beta*) April to September
Skilletfish (*Gobiesox strumosus*) May to August

6) Estuarine Grass Beds (Wild celery, widgeon grass, etc.)

Rainwater Killifish (*Lucania parva*) January to July
*Spotted Seatrout (*Cynoscion nebulosus*) April to October
Tidewater Silverside (*Menidia beryllina*) March to July

7) Shoreline Shallows along Bay Margins

*Gulf Killifish (*Fundulus grandis*) April to July
March Killifish (*Fundulus confluentus*) all year
Mosquitofish (*Gambusia affinis*) March to October
Sheepshead Minnow (*Cyprinodon variegatus*) April to July

8) Near River Mouths

Atlantic Needlefish (*Strongylura marina*) February to June

9) Freshwater Streams above Boundary of Tidal Influence

*Gizzard Shad (*Dorosoma cepedianum*) March to June
*Threadfin Shad (*Dorosoma petenense*) April to July

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*Most important sport and commercial species.

After spawning, the great majority of commercial and sport fish and shellfish utilize the shallow estuarine waters of the Mississippi Deltaic Plain Region study area as a nursery ground. Nursery grounds are shallow, low salinity areas of the estuarine zone used for feeding, growth and protection by many post larval and juvenile stages of fish and shellfish. Each species has different preferences and salinity tolerances in the nursery grounds. Some species, such as Gulf menhaden, Atlantic croaker, bay anchovy, striped mullet, blue crab, and white shrimp will move into essentially fresh water for limited periods. Others, such as spotted seatrout, red drum and brown shrimp, prefer more saline portions of the lower salinity nursery grounds.

The primary nursery for most species, as delineated on the Biological Resources Map, includes the area between the 0.5 part per thousand isohaline (Chabreck 1972) (inland boundary) to the margins of the larger inland lakes and bays (seaward boundary). The larger lakes and bays serve as staging areas where fish concentrate prior to offshore movement. The estuarine zone within this area consists of shallow intermediate, brackish and saline marsh with an extensive marsh to water interface. The primary habitat utilized by most species within the nursery grounds is the marsh itself, including the marsh ponds, lagoons, tidal creeks, bayous and shallow areas immediately adjacent to the shoreline. Shallow areas of submerged vegetation are particularly attractive because of the food and protective shelter offered.

There is constant movement to and from the nursery grounds as various species migrate in and others migrate out. Seasonal variations in abundance and distribution are directly related to natural fluctuations of environmental factors. Peak populations of fishes and shellfishes occur in the spring (particularly April) with lowest populations occurring in late winter. Several distinct migrations occur throughout the year. The most dramatic is a rapid offshore migration in the fall induced by rapidly falling temperatures associated with frontal passages. Many complex and interacting factors determine abundance and species occurrence at any one time. Among the most important are temperature, salinity, food availability, water depth and predation. Temperature is particularly important and is probably the most significant factor affecting spawning, growth and migration to and from the nursery grounds. Salinity is also very important in determining the acreage of nursery grounds which provide the optimum salinity requirements for each species. For example, based on the acreage of nursery grounds with salinities higher than 10 parts per thousand, it is possible to obtain a rough idea of the size of the annual brown shrimp crop (Louisiana Department of Wildlife and Fisheries 1980).

NATURAL FISHING AREAS

The waters in and adjacent to the Mississippi Deltaic Plain Region support some of the finest sport fishing in the world. Fishermen come from all over the United States to enjoy fishing the marshes, lakes, beaches and offshore waters of Louisiana and Mississippi. Pinpointing the best fishing areas is difficult and somewhat subjective, but can be attempted based on maps and charts produced by experienced fishermen and charter boat captains. Areas shown on the Biological Resources Map and natural fishing areas are based on published or readily available fishermen's charts and guides.

In general, the best natural fishing areas include the following types of features:

- Barrier islands and beaches
- Oyster reefs and shell banks
- Submerged grass beds
- Tidal passes
- Marshy points of land
- Deep holes
- Small tidal creeks draining into larger bayous and lakes
- Areas with an accumulation of wood stumps or other bottom debris

Any type of physical structure, whether natural or man-made, will attract certain fishes because of their preference for being near an edge or a solid object. Such structures may offer food, protection from larger fishes and temporary sanctuary from tidal currents.

Many man-made structures are excellent "natural" fishing areas. Included are oil rigs and production platforms (mapped as artificial reefs), impoundments in the marsh, sunken boats, anchored barges, clam shell deposits, dead end pipeline canals, water control structures such as weirs and wood dams, bridges, piers, boat houses, docks, duck blinds, and stone jettys.

The best time to fish these areas depends largely upon the migratory habits and environmental preferences of the species sought. Most areas are best for fishing during a relatively short period of the year when environmental conditions are right for the game fish. In general, saltwater fishing is best in the marshes from April through November, and offshore fishing is best in the winter months. However, because of the movement of fishes in and out of the estuaries and along the coast, offshore fishing is good throughout the year.

ARTIFICIAL REEFS

An artificial reef is any man-made or natural structure intentionally placed in the water, which provides conditions that attract concentrations of fishes and invertebrates. Many objects in the estuarine waters of the study area, although not intentionally placed to attract fish, do function as artificial reefs. Oil and gas production platforms and drilling rigs are prime examples. The development of the petroleum industry and the construction of offshore oil platforms over the past forty years has had the indirect benefit of creating thousands of artificial reefs. A recent study indicates that these structures undergo a predictable biological succession as they age (Dugas et al. 1979). Complex biological communities develop on the steel legs of the structures in response to the availability of a solid substrate. Fish are initially concentrated around new rigs because they are solid objects offering shelter, but as time passes and biological succession occurs, a distinctive resident fish and benthic community develops to feed many fish species. As a result, the rigs are excellent areas for sport fishing for a large number of game fish.

Several studies have been done of the fish community associated with the rigs off the Louisiana coast. Sonnier et al. (1976) made underwater observations of 49 species found near offshore rigs. A creel survey was conducted by the Louisiana Wildlife and Fisheries Commission in 1978 of the charter boat sport fishery in the Grand Isle, Louisiana vicinity. This survey revealed that 32 species of fish were commonly taken around the rigs with the most common being Atlantic croaker, silver seatrout, red snapper, bluefish, king mackerel, gafftopsail catfish, and red drum.

Rigs shown on the Biological Resources Map are in oil fields within state waters inside the 3 mile state-federal demarcation line. Fish caught at these rigs are typically nearshore estuarine dependent species found in "green water" such as spotted seatrout, sand seatrout, red drum, and bluefish. Further offshore, "blue water" oceanic species (e.g., tuna, amberjack, dolphin, marlin and wahoo), are found near the rigs. Some rigs occur up to 150 miles off the Louisiana coast.

Other features mapped as artificial reefs are clam shell plants and sunken ships. Clam shell plants are deposits of *Rangia* shell and/or oyster shell intentionally placed to enhance sport fishing. Three shell plants have been placed in Louisiana waters. One is located near the shoreline just north of Cypremort Point in Vermilion Bay. The other two are in Lake Pontchartrain. One is located approximately one-half mile east of the mouth of Bayou Lacombe and the other is just east of the northern tip of the New Orleans Lakefront Airport. These areas are fairly good fishing areas, primarily in the summer and fall months. Sunken ships are excellent artificial reefs. Those mapped in Louisiana were indicated on fishing charts and maps of the delta of the Mississippi River.

Off the Mississippi coast, five artificial reefs have been created for sport fishing. Two liberty ship reefs, two rubber tire reefs and one car body reef have been placed in waters south of the Mississippi barrier islands. Although these reefs are in Federal waters beyond the boundaries of the study area, their locations are mapped. Their latitude and longitude coordinates are as follows:

	Latitude	Longitude
Liberty ship reef (2 ships)	30°9'4"N	88°44'5"W
Liberty ship reef (3 ships)	30°2'35"N	88°42'22"W
Rubber tire reef	30°4'54"N	88°36'54"W
Rubber tire reef	30°10'0"N	88°54'0"W
Car body reef	30°10'31"N	88°50'37"W

SUBMERGED VEGETATION

Submerged vegetation is an extremely important, although relatively small component of this coastal ecosystem. These submerged grasses grow in shallow, relatively clear and protected waters with predominantly sand bottoms. There are seven major areas in the Mississippi Deltaic Plain Region where the habitat conditions of substrate, water depth, water clarity and salinity are favorable for establishment of vascular grass beds. These areas occur along the shallow littoral zone of certain lake and bay shores and the shoalwater areas behind barrier islands.

The major grass beds are located (from west to east) in Bayou Sale Bay, lower Timbalier and Terrebonne bays, southern Lake Salvador (Temple Bay area), north shore of Lake Pontchartrain, Lake Catherine (Grand Coin Pocket), west side of Chandeleur Island to North Islands and along the northern shores of Ship, Horn and Petit Bois islands. These areas are indicated on the Biological Resources Map.

Two main communities of submerged vegetation occur in coastal Louisiana and Mississippi. A marine community of seagrasses occurs in saline waters near the barrier islands with turtle grass (*Thalassia testudinum*), shoalgrass (*Halodule beaudettei*), manateegrass (*Cymodocea filiformis*) and Gulf halophila (*Halophila engelmannii*) as the primary species. These grasses occur in shallow, protected waters on the northern sides of the Timbalier Islands, Chandeleur Islands in Louisiana and Ship, Horn and Petit Bois Islands in Mississippi. Further inland in brackish waters, an estuarine community of vascular grass beds occurs. The predominant species is wild celery (*Vallisneria americana*). Wild celery occurs in Lake Pontchartrain, Lake Catherine and Lake Salvador. Widgeongrass (*Ruppia maritima*) and Southern naiad (*Najas guadalupensis*) also occur in association with wild celery in those areas. These species, especially widgeongrass, occur in abundance in small brackish marsh ponds and lagoons, but no attempt was made to map this distribution. The generally turbid waters and soft mucky bottom characteristic of much of the study area are primary limiting factors to more widespread distribution of submerged grass beds. Areas directly affected by the discharge of the sediment laden Mississippi and Atchafalaya River waters are generally too turbid to allow growth of submerged grasses. *Vallisneria americana* and water star grass (*Heteranthera dubia*) are both common in the active Atchafalaya Delta, however. Also, Eurasian watermilfoil (*Myriophyllum spicatum*) is widely distributed in the ponds of the active Mississippi River Delta (D. Fruge, U.S. Fish and Wildlife Service, Lafayette, La., personal communication 1980).

Distribution within the areas of occurrence is not continuous, but characteristically in discontinuous patches with larger patches occurring offshore from the beach. Distribution and abundance also varies yearly. In years of high rainfall and river discharge, density is usually reduced, whereas in years of high average salinity, density of the beds is higher.

These grass beds have great ecological significance. Many fishes are attracted to the beds because of the abundance of invertebrate food organisms both on and in the sediments, and on the grassblades themselves. Waterfowl (especially redheads, canvasbacks and coots) feed directly on the submerged grasses. The grass beds also stabilize and bind bottom sediments, offer cover from predators, provide nursery and spawning areas, provide shelter and food for numerous organisms, supply molting habitat for blue crabs, reduce wave action, and in general provide a hospitable environment for a vast array of small marine animals.

SEA TURTLE NESTING SITES

Six species of sea turtles are known to occur in the offshore waters of the Mississippi Deltaic Plain Region. The Hawksbill, Leatherback and Kemp's Ridley are endangered species which are threatened with extinction. The Green, Olive Ridley and Loggerhead are threatened species. Only the Loggerhead has been reported to nest off the Louisiana and Mississippi coast. The range of the other sea turtles extends into the northern Gulf of Mexico, but their primary range is southern Florida, the Caribbean and Mexican Gulf waters.

The nesting habitat of the Loggerhead is on the sand beaches of the barrier islands. Nesting has been reported on the Chandeleur Islands in Louisiana and Ship, Horn and Petit Bois Islands in Mississippi. Females crawl up the beach from the Gulf, deposit their eggs in a depression, and cover them with sand. Although seldom observed, the tracks or "crawls" of these turtles are occasionally noted between the water's edge and the nesting site. The Chandeleur, Ship, Horn and Petit Bois Islands are some of the few remaining barrier islands which are sufficiently remote for these turtles to nest undisturbed.

SEA BIRD, WADING BIRD AND SHOREBIRD NESTING SITES AND CONCENTRATION AREAS

The coastal marshes, swamps, islands and beaches of the study area support large populations of sea birds, wading birds and shore birds. These birds nest in a wide range of habitats, including cypress swamps, fresh water marsh, brackish marsh, salt marsh, mangrove islands and barrier islands. Sea birds and wading birds play an important ecological role near the top of the marine and estuarine food webs and have very restrictive nesting requirements. During nesting periods, these birds are very vulnerable to disturbances which might alter their breeding behavior and success in producing young.

Surveys of nesting colonies, heronries and rookeries along the Louisiana and Mississippi coast were conducted for the U.S. Fish and Wildlife Service in 1976 and 1978. These surveys were carried out to locate nesting sites, estimate species composition and numbers and to determine chronology of breeding. Within the Mississippi Deltaic Plain Region, colonies of 26 species were found. Of a total of 134 colonies mapped in 1976, 107 were found to be in use during 1978. The most abundant species, in decreasing order, were Louisiana heron, snowy egret, cattle egret, white ibis, little blue heron, great egret, laughing gull and sandwich tern. The most widely distributed species were great egret, snowy egret, Louisiana heron, little blue heron, least tern, black skimmer, Forster's tern and black-crowned night heron. In the various habitats, the most numerous nesting birds were as follows:

cypress swamp - white ibis
freshwater marsh - snowy egret
brackish marsh - snowy and great egret
salt marsh - Louisiana heron
coastal beach - sandwich tern

Considerable variability exists from year to year in usage of nesting colonies and heronries. Man-made and natural environmental changes result in abandonment of nesting sites in some years. Permanent changes, such as beach erosion, human development and other types of natural habitat destruction result in irrevocable loss of nesting habitat.

Sea birds nest in colonies from April to August. Predominant sea bird nesters were gulls, terns and black skimmers. These birds make very high use of salt marshes and adjacent coastal beaches for nesting purposes. Four colonies of the endangered Least Tern occur on the beach along the Mississippi coast between Long Beach and Biloxi.

Wading bird nesting activity is most intense from February through July. The most common wading birds within heronries were herons, egrets, ibises and spoonbills. Habitats most often utilized were swamp and salt marsh.

Several rare birds were noted in the nesting surveys. These included American oyster catchers, sooty terns and gull-billed terns. Nesting activity of the brown pelican, a federally listed endangered species, occurs on Queen Bess Island in southern Barataria Bay, North Islands in the Chandeleur chain, and Isle au Pitre. Recently, 300 additional brown pelicans were transplanted to Isle au Pitre from Florida in an attempt to establish a nesting colony.

The Biological Resources Map shows nesting sites for individual species in some cases, and mixed colonies and rookeries where more than two species are nesting at the site. Initials provided next to the nesting sites indicate which bird species utilize that particular site.

SENSITIVE HABITAT

These areas provide habitat for vulnerable species which receive a high degree of public concern and are subject to legislative protection. These species are not named herein as this could contribute to their decline. However, the Fish and Wildlife Service will provide detailed information if contacted by industries and agencies conducting projects impacting these areas. Early coordination during the planning process with the U.S. Fish and Wildlife Service will allow most projects to go forward while providing appropriate conservation of the habitat and species of concern. Petroleum exploration and development, and other construction projects impacting areas identified as "Sensitive Habitat" should be coordinated with the U.S. Fish and Wildlife Service, Jackson Endangered Species Office, Jackson Mall, Office Suite 3185, 300 Woodrow Wilson Avenue, Jackson, Mississippi 39213, (601) 960-4900, FTS 490-4900.

WATERFOWL CONCENTRATION AREAS

The marshes, swamps, lakes and bays of the Mississippi Deltaic Plain Region constitute the largest and one of the most important waterfowl wintering areas in the United States. The study area is at the southern terminus of the Mississippi Flyway and normally provides wintering ground for between five and six million ducks and half a million geese annually. Additional millions of ducks use the Louisiana marshes for staging, resting and feeding before continuing across the Gulf of Mexico to wintering grounds in Central and South America.

Thirty species of ducks have been recorded in Louisiana and five of these nest here (U.S. Fish and Wildlife Service 1979). The mottled duck, fulvous tree duck and wood duck breed in significant numbers with the blue-winged teal and hooded merganser in lesser numbers.

Waterfowl hunting in coastal Louisiana and Mississippi is extremely popular. Louisiana has over 100,000 duck and goose hunters who hunt in the coastal wetlands (U.S. Army Corps of Engineers District, New Orleans 1974).

Waterfowl distribution is not uniform throughout the region. Definite concentration areas exist that attract high populations of wintering waterfowl every year. In general, the best waterfowl habitat is the fresh and intermediate marsh. The areas within this zone which most consistently concentrate waterfowl are shown on the Biological Resources Map. In relationship to the vast wetlands of Louisiana, the marsh areas of Mississippi are comparatively narrow, due to the relatively small drainage areas and steep slope along the coast. Most of the mainland marshes of Mississippi are dominated by Juncus roemerianus which is not a prime waterfowl food. As a consequence, the size of Mississippi's wintering waterfowl population is significantly smaller than that of Louisiana. During the ten-year period spanning 1969-1978, about 6,500 waterfowl wintered annually along the Mississippi coast (U.S. Fish and Wildlife Service 1979). The best waterfowl areas in coastal Mississippi include the Point Clear Marsh, Pascagoula Marsh and Point aux Chenes - Grand Bay Swamp.

The delineated waterfowl concentration areas provide the right combination of proper water level, preferred food and shelter which are requirements of prime waterfowl habitat. The production of desirable waterfowl foods, such as wild millet, smartweed, cyperus, three-cornered grass, wild rice, delta duck potato, bullrush, spikerush, pondweeds and wild celery is higher in fresh and intermediate marshes than elsewhere.

Ducks shift between feeding and resting areas depending on highly variable local food and water conditions. High usage is made of temporarily flooded areas when water levels are too deep for feeding in normally preferred areas. Common puddle ducks in the study area are gadwall, American widgeon, pintail, blue- and green-winged teal, mallard, Northern shoveler, and mottled duck. The most common diving ducks are lesser scaup, ringnecked ducks, redheads and canvasbacks. Divers make greatest use of the saline marsh, larger coastal lakes and bays and nearshore Gulf waters. The major species of goose which occurs in the Mississippi Deltaic Plain Region is the lesser snow goose. These geese concentrate near the mud flats around the passes at the mouth of the Mississippi River, around the coastal islands in St. Bernard Parish, near the mouth of the Pearl River and on Point au Fer and Marsh Island. Snow geese are also common in brackish marshes of Terrebonne, Iberia and St. Mary Parishes.

FURBEARER CONCENTRATION AREAS

The most abundant furbearing mannals in the Mississippi Deltaic Plain Region wetlands are muskrat and nutria. Although several other furbearers occur in significant numbers, these two species are most important economically to the fur industry and in terms of population density. Other furbearers include river otter, raccoon, opossum, mink, beaver, red fox, gray fox, and bobcat.

The muskrat and nutria have distinct habitat preferences and concentrate in particular marsh types. The muskrat shows a definite preference for brackish marshes, in which three-cornered grass, or Scirpus olneyi, occurs. The nutria is more adaptable, with a preference for cypress-tupelo gum swamp, fresh and intermediate marsh.

The nutria has been the most abundant furbearer taken by trappers in Louisiana since 1962 (R.G. Linscombe, Louisiana Department of Wildlife and Fisheries, New Iberia, La., personal communication 1980). In recent years, one to two million pelts have been taken annually, which constitute 70 to 80 percent of the furbearers trapped. This enormous harvest places Louisiana first among all states in furbearer production. Muskrat production has fallen, particularly since 1970. Reasons for this decline are not definitely known, but decrease in the quality of preferred habitat is suspected. An average of 400 to 500 thousand muskrat pelts are taken annually (Linscombe, personal communication 1980).

Population levels of these furbearers are dynamic and change from year to year depending on the prevailing condition and general "health" of the swamp and marsh. Annual fluctuations in furbearer concentrations are due partially to the following factors: amount of freshwater inflow, rainfall, severity of winter temperatures, food availability, frequency of flooding of the marsh due to tropical storms and other less known factors such as disease, parasites, and stress from interspecific competition.

DEEP TIDAL PASSES

Deep tidal passes connecting the estuaries and the Gulf of Mexico are ecologically important as migratory pathways for many estuarine dependent fish and shellfish. Post larval and adult forms of many marine and estuarine species immigrate and emigrate through these passes at certain seasons of the year. In the spring and summer, there is a large inshore migration of larval and post larval shrimp, crabs and fishes that ride tidal currents through the passes toward the upper ends of the estuarine zone. In the fall, these same species migrate back out through the passes into the Gulf for spawning and overwintering after utilizing estuarine waters as nursery grounds. Because of tidal scouring and high volumes of water movement, the passes are often 50 to 100 feet deep.

Through these deep passes, nutrients, detritus and sediments derived from the inshore bays are exported into the Gulf where they provide organic material for the marine food web. Phytoplankton, the primary producers of the marine food web, flourish on the nutrients supplied by decomposition of marsh grasses and land drainage. Many large marine fishes enter the passes and lower portions of the bays on feeding forays. The passes are therefore excellent sport fishing areas. Tidal currents, on which all life in the estuaries depends, ebb and flow through the passes. Deep tidal passes are vital to the maintenance of both inshore and nearshore fisheries productivity.

Although the study area has a highly irregular shoreline and many connections between the bays and Gulf, the deeper passes are the most important migratory pathways. Passes shown on the Biological Resources Map are the most significant in terms of fish migration and tidal movements. Most of these passes are located between the Gulf and the lower ends of the bays or large inshore lakes.

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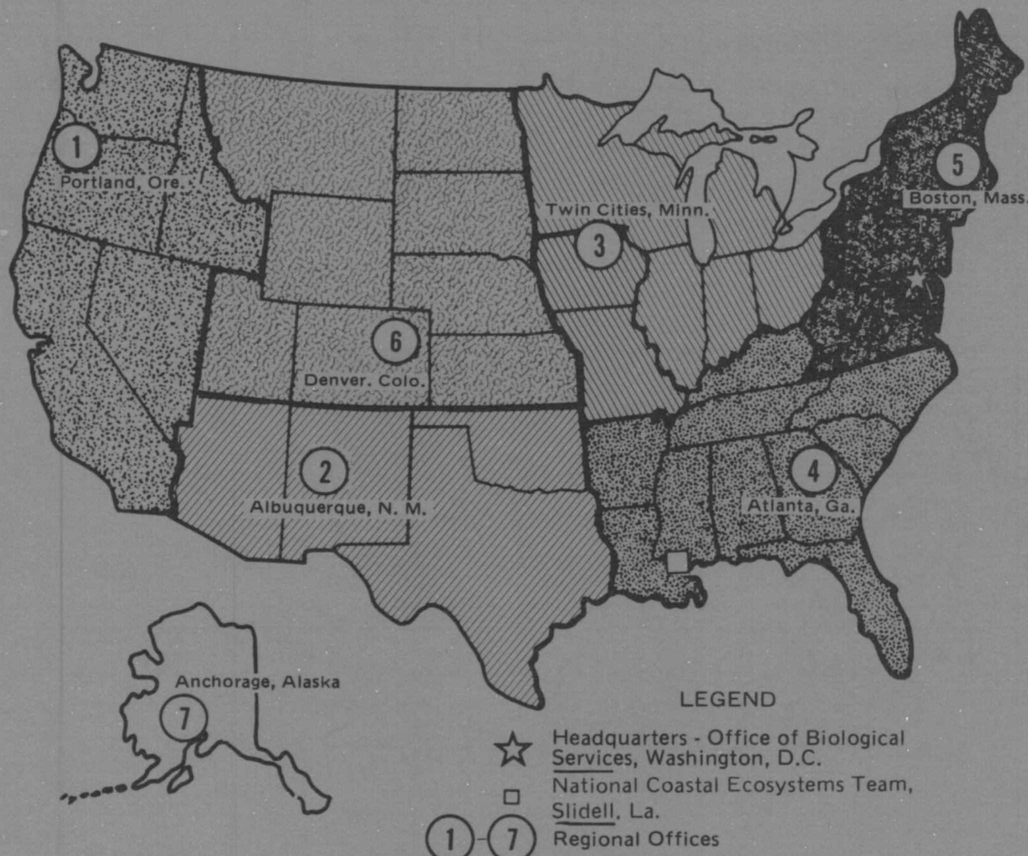

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