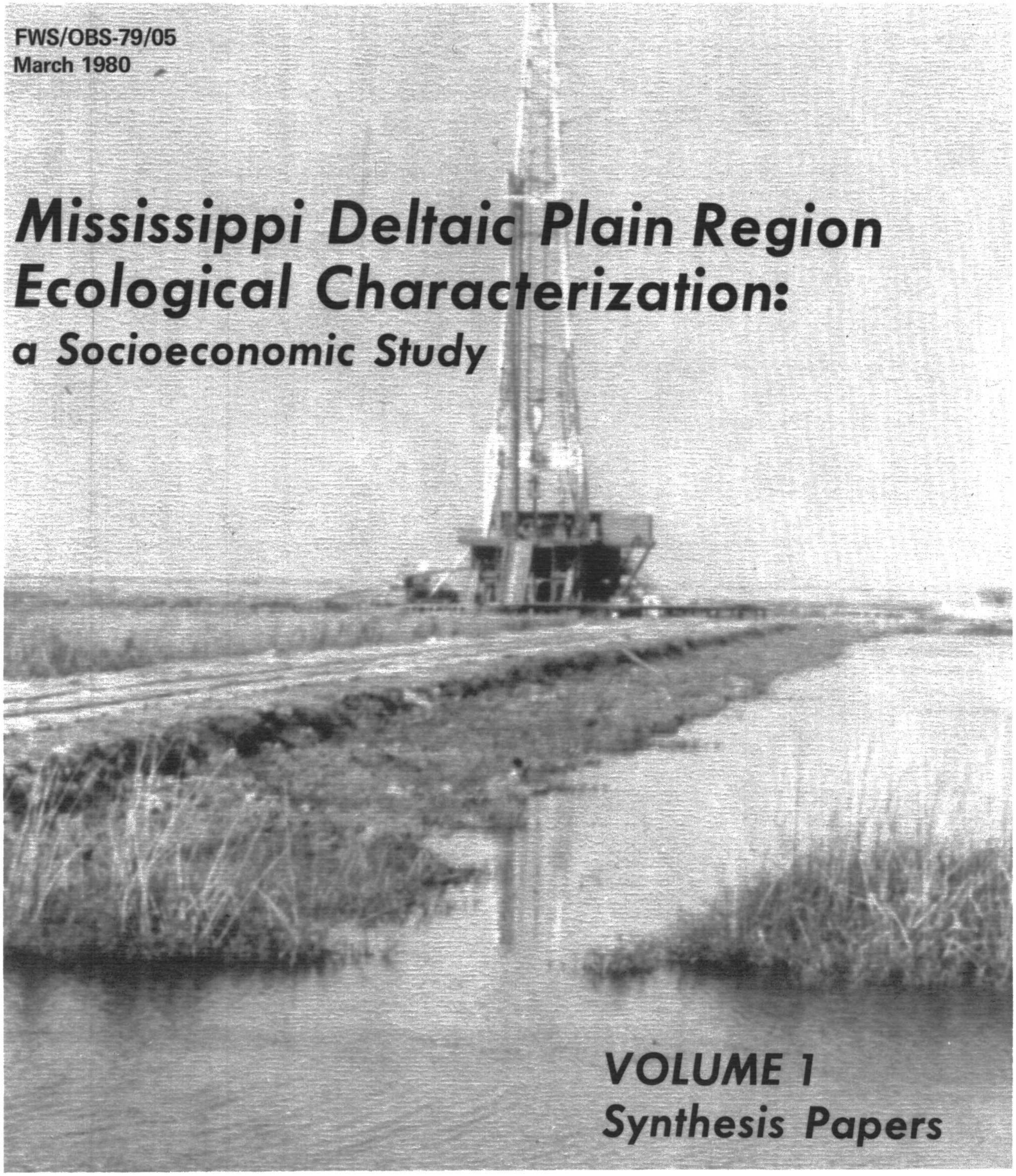
FWS/OBS-79/05
March 1980

Mississippi Deltaic Plain Region Ecological Characterization:
a Socioeconomic Study



VOLUME 1
Synthesis Papers

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.

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FWS/OBS-79/05
March 1980

MISSISSIPPI DELTAIC PLAIN REGION ECOLOGICAL CHARACTERIZATION: A SOCIOECONOMIC STUDY

VOLUME 1: SYNTHESIS PAPERS

by

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DISCLAIMER

PREFACE

The purpose of the ecological characterization was to compile existing information about the biological, physical, and social sciences for the Mississippi Deltaic Plain Region of Louisiana and Mississippi. Decisionmakers, among others, may use this report for coastal planning and management. This is one of a series of characterizations of coastal ecosystems that will be 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.

This project was conducted under Contract FWS 14-16-0009-78-095. Funding was provided by the Bureau of Land Management and the U.S. Fish and Wildlife Service. Results of this study are to be used in planning for Outer Continental Shelf oil and gas development.

Any suggestions or questions regarding this publication should be directed to:

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In any research project of this scope and interdisciplinary nature, there are a great many people who have been responsible for the final preparation of the synthesis papers, map atlases, map narratives and data appendices. First among these people are the many public and private agency representatives who cooperated with the project team and provided detailed information and thoughtful guidance in the search for unpublished data sources. The efforts of the team's research assistants were invaluable, as they fulfilled responsibilities ranging from data source reviews and content analysis to information transfer in the mapping process and the compilation of the data appendix documents and bibliographic files. Linda R. Bourgeois, Jean A. Celender, Nikylla Celine, Michael A. Colaizzi, Michael A. Fielek, Michael Hoffpauir, Henrietta W. Jeansonne, Michael A. Klein, Elizabeth Magee, Francine K. Middleton, Loretta R. Naquin, Cheryl Shields, Leslie Stafford, Edith P. Taylor and Cecilia Walker each assisted in the project.

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The Louisiana Department of Transportation and Development has cooperated with the U.S. Fish and Wildlife Service in the publication of the products of this study.

This project was conducted under Contract FWS 14-16-0009-78-095. Funding was provided by the Bureau of Land Management and U. S. Fish and Wildlife Service. Results of this study are to be used in planning for Outer Continental Shelf oil and gas development.

CONTENTS

Page

TABLES

FIGURES

ABBREVIATIONS

These abbreviations are used throughout this document and are defined here for clarity.

AAPG	American Association of Petroleum Geologists
BLM	Bureau of Land Management
FIRE	Finance, Insurance, and Real Estate
FWS	Fish and Wildlife Service
GRPC	Gulf Regional Planning Commission
ICC	Interstate Commerce Commission
LOOP	Louisiana Offshore Oil Port
MDPR	Mississippi Deltaic Plain Region
MRDC	Mississippi Research and Development Center
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
OCS	Outer Continental Shelf
SCORP	State Comprehensive Outdoor Recreation Plan
SMSA	Standard Metropolitan Statistical Area
SPR	Strategic Petroleum Reserve
TCPU	Transportation, Communication, and Public Utilities
USGS	United States Geological Survey

METRIC-TO-ENGLISH CONVERSION TABLES

Distance

1 centimeter	=	2.54 inches
1 meter	=	39.38 inches
1 kilometer	=	.62 miles

Area

1 square meter	=	1.2 square yards
1 square kilometer	=	0.4 square miles
1 hectare	=	2.5 acres

Weights

1 gram	=	0.035 ounces
1 kilograms	=	2.2 pounds
1 tonne(1000 kg)	=	1.1 short tons (2204.6 lbs)

Volume

1 millimeter	=	0.03 fluid ounces
1 liter	=	2.1 pints
1 liter	=	1.06 quarts
1 barrel	=	42 gallons
1 cubic meter	=	35 cubic feet
1 cubic meter	=	1.3 cubic yards

INTRODUCTION

Within the complex Mississippi Deltaic Plain Region (MDPR), there has been rapid economic growth and development during the past half-century. Much of this growth has been associated with hydrocarbon development both onshore and, more recently, offshore. As the MDPR has developed there has been increasing concern over the potential for serious environmental imapct. In 1953, the Outer Continental Shelf Land Acts (67 Stat. 462) was passed, establishing Federal jurisdiction over the submerged lands of the continental shelf seaward of state for administering Outer Continental Shelf (OCS) mineral exploration and development. The Secretary was empowered to formulate regulation so that the provisions of the Act might be met. In conjunction with this authority, the Department adopted three overall minerals-management goals: (1) receipt of fair market value for the minerals leased; (2) orderly development of resources; and (3) protection of the environment. Subsequent to the passage of the OCS Land Act of 1953, the Secretary of the Interior designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged Federal lands, and the United States Geological Survey for supervising production. The Bureau of Land Management was also designated by the Secretary as lead agency for environmental studies pertaining to development of OCS oil and gas resources.

The Submerged Lands Acts (67 Stat. 29) set the inner limit of authority of the Federal Government by giving coastal states jurisdiction over mineral rights in the seabed and subsoil of submerged lands adjacent to their coastline out to a distance of three nautical miles. There are two exceptions, Texas and the Gulf Coast of Florida, where jurisdiction extends to three leagues based on terms for admission to statehood.

The National Environmental Policy Act (NEPA) of 1969 requires that all Federal agencies utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences in any planning and decision-making that may have an impact on the human environment. Subsequent modifications of NEPA, which became effective July 1, 1979, call for a greater emphasis on scoping or issue identification in the environmental planning process, to avoid the excessive informational burden that had characterized previous impact assessment efforts.

The United States Fish and Wildlife Service (FWS) has developed an ecological characterization approach for describing coastal zone areas of the United States and its territories. "Characterizations provide descriptions of the socioeconomic features, biological resources, and physical processes that comprise a particular coastal ecosystem. Descriptions, where possible, are both quantitative and qualitative in nature. This information is integrated into a functional framework to provide an understanding of the interrelationships of the ecosystem" (Johnston 1978:692). In a Memorandum of Understanding (MOU), the BLM and the FWS agreed that in the course of the Ecological Characterization Study for the MDPR, socioeconomic programs should receive special attention because of extensive oil and gas activities and their impact on the area (BLM/FWS MOU 14-16-0009-78-944).

THE MISSISSIPPI DELTAIC PLAIN REGION SOCIOECONOMIC CHARACTERIZATION

For the purposes of this study the MDPR has been defined to include only fourteen of the southern Louisiana parishes and the three southernmost coastal Mississippi counties (Figure 1). Most of this study area is characterized by a mixture of land and water distinguished by the absence of notable relief and is a result of the Mississippi River deposition. For centuries, sediment-laden water has fanned out along the coast creating the deltaic environments.

East of Vermilion Bay, sediment accumulation has resulted from the sequential development of a delta system. Known as the Deltaic Plain, the area is the site of a series of seven deltaic lobes extending seaward at different times during the last 5,000 years. Except for the modern "bird-foot" delta, each lobe advanced into the shallow waters of the continental shelf and was distinguished by numerous distributaries (Kolb and Van Lopik 1958). These channels continued to bifurcate, thus aiding the distribution of the river sediments and progradation of the coast. Through time, the recurring channel changes created the intricate "horse's tail" pattern, levee fingers extending into the wetlands. Fluvial-marine materials deposited in the prodelta, interdistributary, and intradelta environments built up an estimated 75% of the Deltaic Plain (Kolb and Van Lopik 1958). Most of this land is an abandoned subdelta composed of alluvial ridges, beaches, marsh and water surfaces, where accretion has been replaced by subsidence and erosion. Natural levees formed in these areas have served since prehistoric times as favorable settlement sites. The narrowness of the strips of arable land associated with these features has contributed to the extensive acreage classified as strip and clustered settlement that has affected the socioeconomic development of the region.

The Deltaic Plain's morphology is characterized by a highly indented and irregular estuarine shoreline. These inlets serve as a nursery ground for many species of aquatic and terrestrial animals (Perret et al. 1971). Their tremendous productivity provides marsh inhabitants with a source of game and fish.

The Deltaic Plain has been the site of continuous human occupation for the last 12,000 to 14,000 years. Prehistoric inhabitants settled the dry land adjacent to many of the region's waterbodies. McIntire (1958) located and mapped over 500 of these relic encampments, distinguished by shell mounds, called middens. Materials from these former garbage dumps indicate the early use of the area's renewable resources, particularly the edible clam (Rangia cuneata). From prehistoric sites, to modern communities of French speaking "Cajuns", adjacent alluvial wetlands have supported a range of cultures and settlements. Numerous ethnic groups colonized the area, locating their homes and villages on protected and well-drained land, or in some cases, on stilts in remote bays, estuaries, or bayous.

French-Canadian farmers, trappers, and fishermen, whom the British forced from Nova Scotia in the mid-1700's, settled within the lower Mississippi's alluvial valley. They considered the semi-aqueous real estate an attractive location for their new settlements. The communities were accessible by means of winding streams called bayous (from the Choctaw bayuk or creek) and not too far from their fishing, hunting, trapping, and agricultural areas. Besides the French, a group of Yugoslavian oyster fishermen settled along the bayous, bays and lakes southeast

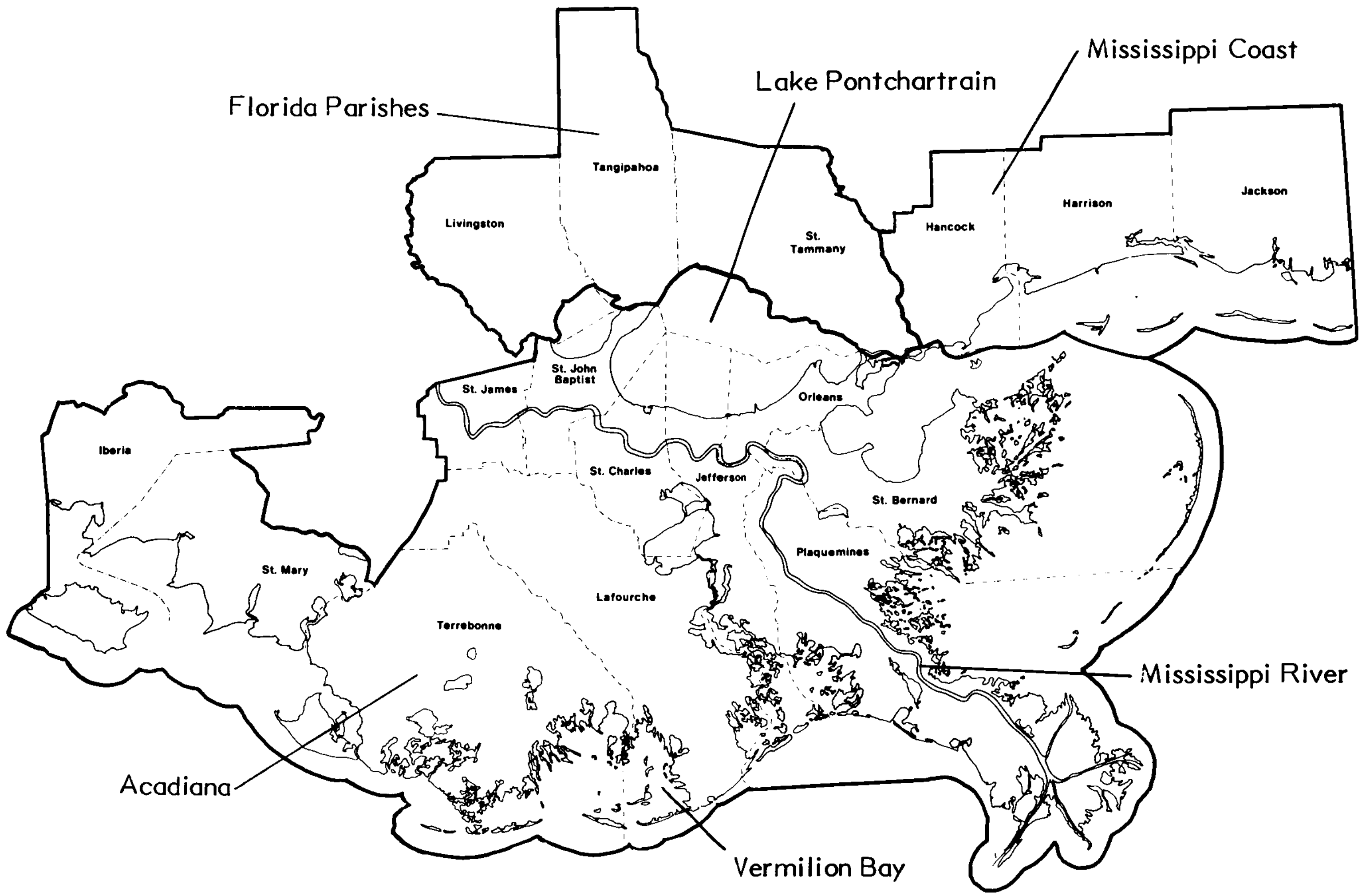


Figure 1. **Mississippi Deltaic Plain Region Socioeconomic Characterization Study Area**

of New Orleans. Adjacent to the Mississippi River, they built the villages of Olga, Empire, Ostrica, and Oysterville. In time, they were joined by other Balkan immigrants from Serbia, Montenegro, Greece, and Albania. Germans, Spanish, Irish, Italian, and Filipinos also settled within the coastal zone. They became shrimpers, laborers, oystermen, trappers and vegetable farmers.

Township survey records (plats) indicate that, by the early 1830's, settlements were established at isolated points within the marsh; those at Grand Isle, Grand Terre, Plumb Island, Bell Isle, and along lower Bayou Terrebonne are examples. Thirty years later, the region's more accessible natural levees were colonized. By 1900, communities were scattered throughout the wetlands, in an area that was approximately 95 kilometers (58.5) miles square. In each settlement, land division was assigned systematically, with every family owning property fronting on a navigable waterway, creating long, slender strips extending inland the width of the natural levees. Eventually, these land holdings coalesced into extensive strip and clustered communities that are now prominent in the maps of land use/land cover.

This dense network of ridge settlements represented a large, isolated, permanent population. Within the first three decades of the twentieth century, people began to abandon their marsh communities and seek out the amenities of larger, more service-oriented hamlets. At the same time, roads were extended seaward, but in no instance reached a site that was subsequently abandoned. Roads, following natural levees, served as nuclei for settlement.

STUDY ORGANIZATION

The Mississippi Deltaic Plain Region, extending from Vermilion Bay, Louisiana to the Mississippi-Alabama state line, is one of nine ongoing or proposed ecological characterization study areas. This study was begun in July 1978 and a full ecological characterization is scheduled for completion in 1981. The overall study purpose is to collect, organize and analyze available information from various disciplines (geology, biology, hydrology, socioeconomics, etc.) that will describe each part of the system in terms of its relation to other parts and to the Mississippi Deltaic Plain regional ecosystem as a whole.

The FWS and BLM have agreed that in the course of the Ecological Characterization Study, socioeconomic characteristics will receive special attention because of extensive oil and gas activities and their impact on the area. The MDPR socioeconomic study presented here develops and synthesizes a broad information base that represents the study area in terms of oil and gas, social-demographic, land use, transportation, commercial fishing and trapping, recreation and tourism, and agricultural production activities.

Five general tasks have been completed in conducting the MDPR socioeconomic characterization. The first step involved meeting with personnel from the Louisiana, Mississippi, and Federal agencies to identify specific needs for study focus and products. These meetings were held in New Orleans in October 1978.

The second step, data collection, continued throughout the duration of the study. A continuous process was instituted because new reports were being issued during the study time period. As the study progressed special data gaps and needs were identified, requiring additional data collection efforts. The entire program of study and technical approach were designed to deliver a series of products having maximum value in establishing resource management policy for the MDPR. Computerized bibliographic searches were conducted through local libraries and in Washington, D.C. to identify pertinent documents regarding socioeconomic variables in the MDPR. Data were gathered for a base year period in the mid-1950's and for the present or as near the present as possible. Time series data were developed when possible to establish trends that could be used in projecting future MDPR conditions.

The third step involved mapping socioeconomic variables across the entire study area. The result is a map atlas depicting the study area at a scale of 1:125,000. Thirteen separate base maps were required to cover the region. A companion volume includes narratives for the five topic overlays contained in the atlas: oil and gas, pipelines, transportation, pollution sources, and conservation/preservation/recreation.

Step four involved synthesizing the data collected into seven status papers on socioeconomic conditions of the MDPR. Papers include overviews on oil and gas activities, social demographic characteristics, land use, transportation, commercial fishing and trapping, recreation and tourism, and agricultural production. These papers were written by a team of researchers, including Dr. Donald Davis and Dr. Randall Detro of Nicholls State University in Thibodaux, Louisiana, study team members in Phoenix, Arizona, and FWS personnel.

The fifth step in the study involved producing the final products. The three products that have resulted are: seven synthesis papers (Volume 1); map narratives (Volume 2); and a detailed map atlas (Volume 3). In addition, a comprehensive data appendix and an extensive resource bibliography for the MDPR study area were developed, and are accessible through the Information Transfer Specialist, National Coastal Ecosystems Team, United States Fish and Wildlife Service, Department of the Interior, 1010 Gause Boulevard, Slidell, Louisiana 70458.

SYNTHESIS PAPERS

Synthesizing all of the socioeconomic data available for the MDPR would require years and probably not be possible due to the continuous nature of the analysis. The total bibliography constructed for this study has between 8,000 and 10,000 entries, indicating the volume of analysis that has been conducted to date. The majority of the research from which the data synthesis is derived has been done in the past twenty years since the rapid growth and development has been occurring.

The seven data synthesis papers that have been constructed provide a general socioeconomic overview of the MDPR on selected topics utilizing key references from the full bibliography. The purpose of these papers is to develop a basic understanding of the topics for the reader rather than to provide a comprehensive and highly technical treatise.

Today, oil production and proven reserves in the Mississippi Delta and Gulf shores off Louisiana and Mississippi comprise 51 percent of the Nation's total production and reserves, excluding Alaska (American Petroleum Institute 1979). Although secondary recovery and new discoveries continue to bolster onshore extraction, it is the offshore developments that have received much of the recent attention. The first synthesis paper in this volume summarizes the historical development of the oil and gas operations in the MDPR, showing the progression from onshore stable ground through more treacherous marsh and swamp environments to even more complex offshore areas. Areas of concentrated oil and gas activities are identified, documenting that the Mississippi coastal counties have relatively little hydrocarbon industry activity compared to the southern Louisiana parishes. Though southern Louisiana got a slow start, it developed rapidly into an important energy supply region. Once the petroleum resources were discovered, a chain of events occurred to guarantee that the hydrocarbons could be moved from the source areas to centers of demand. The landscape is now dominated by oil and gas fields, crossed by canals and lined with pipelines, giving the marshes a unique manmade appearance. There is no doubt at this time that the oil and gas fields within the study area are in a mature stage of production, having peaked in the early 1970's. But future declines in the total oil and gas production statistics should not be cause for severe economic reversals.

Analysis of social and demographic trends in the MDPR during the past twenty years indicates that while the development of the hydrocarbon industry has had a profound impact on the social and economic characteristics of the area, these impacts are more properly viewed as the first in a long series of growth and development episodes sustained by various forces. Because of the existing infrastructure, attractive living environment, available energy resources, accessibility to domestic and foreign markets, and regional growth patterns, the MDPR can be expected to prosper well into the future. The spectacular development of the petro-chemical strip between Baton Rouge and New Orleans, Louisiana along the Mississippi River is a classic example of recent industrial growth. Ship building and repair, grain storage, and other industries, along with oil and gas field service centers, typify the deltaic region. Many of the industrial developments are related to an inexpensive and available supply of fossil fuels, and access to deep-water shipping.

Land use patterns within the MDPR are changing as urban development spreads northward of Lake Pontchartrain. Transportation and land use in the MDPR are even more closely linked than in other parts of the country. With the possible exception of a steady supply of fossil-fuel energy, transportation may be the most important factor affecting future growth and land use decisions. Industry relies on inexpensive water transport wherever possible; thus, the Mississippi River, the ship canal (to New Orleans), the Gulf Intracoastal Waterway, and oil service canals are of critical importance. Surface land transportation is also environmentally controlled as the Deltaic Plain poses severe restrictions on railroad, expressway, and local highway construction. Rights-of-way frequently follow former Mississippi River natural levees or old shorelines. Urban, commercial, industrial, and agricultural land use have followed the transportation patterns as ingress in the wetlands was created.

Biological productivity within the study area can only be described as phenomenal. Each year fishermen catch over 45 million kilograms of estuarine-dependent fish and shellfish, primarily menhaden, oysters and shrimp (National

Oceanic and Atmospheric Administration 1975). Oysters, shrimp, and blue crab are abundant in the delta; scale fish and industrial fish, as well as muskrat and nutria constitute other significant renewable resources. Both commercial fishing and trapping are traditional activities with long, colorful histories associated with the French Cajuns and other swamp dwellers. Today, these industries continue in many areas as folk industries, but modern technology and commercial operations account for a disproportionate quantity of the catch. The fluctuating market price for fish and furs, as well as employment opportunities in the oil fields and elsewhere, render these industries most elastic.

With regard to agriculture, the MDPR can be divided into three general areas. First, parishes on the coast are characterized by large salt marsh areas where there is very little agriculture. The second tier, located just north of the coastal marshes, forms a band extending from the western end of Lake Pontchartrain to the western study area boundary. About 40 percent of this area is used for farming. The third agricultural area is located north of Lake Pontchartrain and continues eastward to the eastern study area boundary. About 50 percent of this land is used for agriculture including forest products. Agricultural activity in the coastal zone is characterized by a few major crops: sugar cane, soybeans, and rice. Increasing economic pressures are being exerted on the agricultural lands of the MDPR. Encroaching urban development and declining service and processing networks are making agriculture unprofitable in many areas.

The large variety of fresh- and salt water species make fishing the marsh's largest recreational activity. Concentrated in the MDPR, the sport is a year-round leisure-time activity that varies with the breeding cycle of the various species. Largemouth bass (*Micropterus salmoides*) and "specks" (*Cynoscion nebulosus*) are among the principal inland sport fishes, but other species are also important. The vastness and diversity of the MDPR provide both in-state and out-of-state recreationalists and tourists with a wide variety of recreational opportunities. The tourist industry in New Orleans is a mainstay of the local economy. While much of the in-state recreation is associated with fishing and hunting, out-of-state tourism focuses on viewing restored plantations, antebellum homes, bayou scenery, and New Orleans. The recreation and tourism industries will continue to be important, and possibly increasingly important, sectors of the MDPR economy.

All of these topics are discussed in more detail in the following synthesis papers. The companion map atlas and map narrative products should also be consulted for cross-referencing physical locations of MDPR socioeconomic facilities.

OIL AND GAS

Tom Seale squinted against the bright early-morning sun, inspecting the horizon for hints of land. The blue water of the Gulf of Mexico lapped lazily at the pilings below the 38-by-71 foot platform on which he was standing. It was Sunday, October 4, 1947.

The deck vibrated with the rhythmic pulsings of the big drill rig behind him, the machinery pushing a 13-inch hole ever deeper through the bottom of the sea. The platform stood in only 18 feet of water and was just 12 miles from land, but the earth's curvature made it impossible to see anything but blue water in all directions. As far as the men on Kerr-McGee Oil Industry's tiny plaform were concerned, they could have been in the middle of the Atlantic Ocean.

A beautiful day, Chief Engineer Seale recalled later. No trace of the hurricane that had lashed their precarious island with 90 mph winds and huge waves only two weeks earlier. Since September 12, they had pushed the big diamond-studded bit 1,600 feet into the earth's crust.

"Mr. Seale?" The yell of the tool pusher barely rose above the din of the machinery. "Oil's backin' up in the mud pits in the barge."

"Skim it off!"

"Skim it off hell! There's barrels of it!"

Seale excitedly ordered the crew to stop drilling and tried to raise the marine operator to call the news to his company's headquarters in Oklahoma City. "Log the hole," he was told by one of the owners.

Measurements showed the crew had hit two or three levels of oil-bearing sand starting only 1,500 feet down.

"We were all pretty excited that Sunday when the well came in," Seale recalled. "But none of us realized the historical interest it would create." (Londenburg 1972).

A few weeks later, after more drilling and installing pipe at Kerr-McGee 1, the oil community got the news.

"Kerr-McGee Oil Industries, Phillips Petroleum Co. and Stanolind Oil and Gas Co. share the honor of what will someday be marked as an event of substantial historical significance, namely, getting the first offshore oil producer in the open waters of the Gulf of Mexico," trumpeted the Oil and Gas Journal in its November 29, 1947 issue.

Their platform was not the largest over-water drilling structure ever built nor was it the first offshore well. But the rig was moveable and it proved for the first time that people could leave safety of land behind, straddle the sea on stilts, and bring oil out of the bottom of the ocean, depending on boats, barges, and Dramamine.

In a sense, that feat was the culmination of skills developed over five decades to conquer the soggy environment of the Mississippi delta, one of the richest treasure chests of gas and oil in North America. One could almost call the process leading up to Kerr-McGee I a completion of the cycle of life. Where life forms had moved from an aquatic environment and adapted to the land, man had to learn to go back to the sea in search of new sources of hydrocarbons, those gas and liquid remains of plant and animal life squeezed and fermented by heat and pressure under thick layers of rock and sediment.

There was something else of consequence that occurred in 1947. That was the last year in which the United States exported more oil than it imported (Berryhill 1974). There were strong economic and political pressures behind the need to develop offshore oil technology.

Today, oil production and proven resources in the Mississippi delta and Gulf shores off Louisiana and Mississippi comprise 51 percent of the Nation's total production and reserves, excluding Alaska (American Petroleum Institute 1979). Reserves in one field near Eugene Island, south of the delta, are estimated to be more than 300 million cubic meters (144,110 barrels)(King 1975).

Since 1947, more than 23,000 offshore wells have been drilled near the United States. More than 19,000 are in the Gulf of Mexico and nearly 90 percent of them are south of Louisiana and the Mississippi River delta (American Petroleum Institute 1979).

Louisiana produces one-third of the Nation's natural gas and one-fourth of its oil. As production has increased, so have support industries such as storage yards, pipe suppliers, and pipe lines. The needs of the oil industry have spurred growth in ship-building and all kinds of marine supply businesses that vend everything from diving equipment to fast-food shore-to-ship catering services. Behind the suppliers, exploiters, and producers of oil and gas, have come the manufacturers of petrochemicals and those who depend on the petrochemicals.

All this activity has placed a severe strain on Louisiana's scarcest natural resource -- firm, dry land with easy access to the delta's river and canal system. This report outlines the growth of the oil and gas industry, the geography and geology on which it depends, and the effects the industry has had on population distribution and land use.

Looking toward the future expansion of offshore oil and gas recovery, the discussion provides a brief inventory of land available for expanded support industries, population growth, and piggy-back petrochemical manufacturers.

GEOLOGY

Sailors exploring the coast of Louisiana and Texas in the 1600's recorded one of the earliest known oil spills but they shrugged off the importance of the syrupy black goop they saw floating on the sea (Submerged regions of...1935).

The seepage provided a tiny clue to the vast storehouse of oil and gas trapped in a geosyncline, or fold, in the earth's crust stretching along the Gulf coast from Mississippi to Texas. The oil was formed millions of years ago by the crushing and cooking action of successive layers of sedimentary deposits laid on top of organic refuse -- literally a garbage heap of plants, dinosaurs, plankton, and diatoms that either resided on land or in the sea.

The liquid and gas remnants of this organic matter -- hydrocarbons -- were trapped in sand and salt deposits laid down between 11 million and 25 million years ago during the Miocene era (Seglund 1956). Geologists have identified seven distinct layers of sedimentary deposits that have provided natural traps for pools of oil and gas. Some of the more recent layers are the result of organic decay during the Pleistocene era between 10,000 and 2 million years ago, making them quite a bit closer to the earth's surface, relatively, than the older deposits (Wilson 1965). Within these layers, geologists have located and mapped large numbers of underground salt domes. The flanks of these natural reservoirs have become a major source of oil and gas (Morrisey 1956). In addition, mining firms have found large sulfur deposits in the caprock atop salt domes buried as much as 762 meters (2,500 feet) below the sedimentary layers of sand containing oil and gas (Bartlett et al. 1952).

Wildcatters, independent oilmen who explored for oil on a speculative basis and sold the proven fields to someone else for production, made their first oil and gas discoveries on dry land in the older, deeper sand deposits. As exploration extended southward into the Mississippi delta and into the Gulf itself, drillers tapped the newer deposits laid down in the Pleistocene period (Atwater 1957).

EARLY EXPLORATION: 1901 to 1932

When one considers the difficulties of exploring for oil with heavy machinery on mucky land, or even no land at all, it is easy to understand why it took so long for oil companies to exploit southern Louisiana's oil and gas wealth. It was easier and cheaper to contend with the firm ground in Pennsylvania, Oklahoma and Texas than the humid, snake-and mosquito-infested swamps of Louisiana.

Consider, for instance, that the average elevation of the whole State is only 30 meters (100 feet) above sea level (United States Geological Survey 1977). Seven percent of the State's 12.6 million hectares area (48,500 square miles) is under water. Another 32 percent is thick, tropical forest or marshy, swampy jungle.

Normal recorded rainfall in New Orleans is 144.2 centimeters (56.8 inches) per year. Only two cities in the continental United States get more rain -- Mobile, Alabama and Key West, Florida (Bobo and Charlton 1974). Hurricanes lash the Gulf coast annually with winds sometimes raging up to 241 kph (150 mph), and torrential rain pouring millions of litres of water on the landscape. Even today, it is not unusual for a hurricane to cause more than $100 million of damage to oil rigs and facilities.

There were plenty of clues that oil and gas lay below the swamps and bayous of the Mississippi delta -- telltale oil slicks on ponds here and there or eerie bubbling and gurgling in swamps, and fetid sulphuric odors of rotten eggs. But it was not until the 1930's that oil companies felt it was worth the money and trouble to look.

Commercial oil production began in Titusville, Pennsylvania, in 1859 and wildcatters fanned out over the rest of the nation to look for other potential sources. To the west, drillers discovered oil deposits in the same underground plains that were beneath Louisiana and the Mississippi River delta.

It was not until August 1901 that a wildcatter named W. Scott Heywood drilled the first producing well in southern Louisiana (Postgate 1949). Other wildcatters followed but they quickly lost interest after struggling against the watery landscape.

In 1904, the search for oil moved to Caddo Lake in the northwest corner of the state. The lake, held to be sacred by the Caddo Indians, literally bubbled with natural gas. If the gas was set afire, it burned indefinitely. It was here that well drillers developed some of the first primitive techniques that would be needed to cope with the marine environment in the southern part of the State and, eventually, offshore (Londenburg 1972). By 1910, three sides of the lake were lined with producing wells -- but not without great cost. Crews hitting high-pressure gas pockets caused gigantic underground explosions or "blowouts" that squirted drill pipe and bits out of the earth like a farmer spitting out a toothpick. Derricks and machinery were destroyed and the resulting fires often burned for years. The glow of the flames could be seen at night 40 kilometers (25 miles) away.

With most of the lake's shorelines in production, Gulf Oil Company purchased rights in 1910 to explore 3,240 hectares (8,000 acres) of lake bottom and committed itself to drill eight wells. Moving equipment to the lake by barge along the Mississippi and Red Rivers, the company installed a platform atop cypress pilings in the water. By early May 1911, Gulf Oil Company brought in the world's first well over inland waters.

Piling-supported platform drilling soon became common from the Great Lakes to Venezuela. But oil men continued to ignore the wetlands of the Mississippi River delta. In the years between 1901 and 1923, only eight salt domes containing oil and gas were discovered (Postgate 1949). Even with the subsurface discoveries brought by the newly-developing science of geophysics, promising fields were just too much trouble to exploit.

Wetland exploration required boats and barges. Oil men needed port facilities to support their marine operations, but none existed. It was not until the 1930's that the necessary support facilities were developed sufficiently to make extensive wetland exploration practical.

Pioneers in wetland drilling experimented with many kinds of floating craft, bought or rented (Williams 1934b). To get to promising sites, they hired big suction or bucket dredges to cut channels through swamps and marshes (Williams 1944, McGhee and Hoot 1963). To build an interconnecting canal system, dredgers sometimes had to remove more than 30,000 cubic meters (approximately 1 million cubic feet) of material per mile. The waste material was piled along the sides of the canals to form high levees, or barged to drilling sites to form dikes and pads to support derricks and equipment.

In return for the canal work, operators were guaranteed lease access to drilling sites (Field operations in...1955). A major problem remained, however. No one had yet developed an efficient, economical drilling platform (Williams 1934b). Companies could move men to drilling sites by boat and even house and feed them on barges. They still needed a stable platform to hold a derrick, power supply, and drilling equipment. They also needed facilities and equipment to store the oil and gas and to get it to major supply points.

SOUTHERN DEVELOPMENT-THE EXPERIMENTAL PERIOD: 1932 to 1947

Unfortunately, no one recorded the frustration level among oil company engineers during the 1930's and 1940's but it must have been high. They tried everything that might support a load on a surface more the consistency of oatmeal than soil. Pilings sank out of sight in bottomless quagmires of quicksand. Engineers built large wooden mats but the mats often rotted, broke up, or sank.

Engineers had to rethink their understanding of load-carrying capabilities for soils whose solidity varied greatly. They were accustomed to dealing with land that could support 15,000 kilograms per square meter (3,000 pounds per square foot) The marshland they were dealing with sometimes could support only 1,200 kilograms per square meter (250 pounds per square foot) (Herbert and Anderson 1936).

Wooden mats, made up of various layers of boards laid out in crisscross patterns, did work in some shallow-water areas as a solid base for drilling activities. Pilings worked in open water. But the companies found it too expensive and time-consuming to put a drilling rig together, tear it down and move it to the next site. They needed a fast, mobile drilling system that provided the maximum drilling time and a minimum tear-down and set-up time.

The idea for a shallow water drilling platform was not new. An inventor, Thomas F. Rowland, from Greenpoint, New York, had patented a platform-and-tender drilling rig in 1936 (Londenburg 1972). Recognizing a need for a drilling platform that could operate over shallow water, he designed a platform with hydraulically activated telescoping legs. The legs were adjustable to ensure stability and could be elevated to the required working height. About the same time, a Brooklyn inventor named Samuel Lewis designed a "submarine drilling machine" that was actually "a form of jackup drillship", according to Ronald Londenburg, associate editor of Offshore Magazine.

Neither rig was built. In 1928, Louis Giliasso, a sea captain, patented a submersible drilling barge, but his idea, too, drew no interest until four years later when officials of the Texas Company were looking around for just such a platform. The company had leased large areas of southern Louisiana but wanted to avoid the expense and uncertainty of using platforms and mat structures. In 1932, G. I. McBride suggested equipping a barge with a derrick that could be floated to a drilling site and flooded so that it would rest on the bottom. Searching for patents, Texas Company officials found Giliasso's design. It was exactly what the company wanted. But nobody could find Giliasso.

His patent attorney, however, gave the company permission to build a barge from the design. In January 1933, Captain Giliasso was located in Panama, running a saloon. Within six months, he had sold the bar and returned to the United States to settle the patent legalities with the Texas Company. The company named the barge after him (Londenburg 1972).

That same year, the first attempt was made to drill a well in the Gulf of Mexico. A company, whose name is not recorded, drilled a well in 3.7 meters (12 feet) of water about 915 meters (3,000 feet) off Creole in Cameron Parish, from a platform on timber pilings. It was a dry hole, with neither gas nor oil.

The first successful well in the Gulf was drilled in October 1937 by the Pure Oil and Superior Oil companies. The site was 1,830 meters (6,000 feet) offshore from Creole in 4 meters (14 feet) of water and the companies used a 30.5 meter-by 91 meter (100-foot by 300-foot) platform on pilings (Londenburg 1972).

By 1941, 70 oil or gas fields had been developed in the southern Mississippi River delta. Most of the areas were accessible only by canal and several firms used submersible-barge rigs similar to the Giliasso. Only 10 wells had been drilled off the Louisiana coast, all in the Creole field. Only nine more were drilled through 1946, five off Louisiana and four off the Texas coast, largely because offshore crews spent as much time worrying about German submarines as drilling for oil (Londenburg 1972).

Most of the transportation systems for oil and gas were relatively primitive during the pre-war years. Pipeline systems in the delta were few. Most of the oil was barged out to the Mississippi and floated to a refinery. The pipelines that did exist ended at the river where the crude oil and gas could be put into vessels. Pipelines did not begin to take the place of bulk hauling until well after the war.

WETLAND AND OFFSHORE DEVELOPMENT AFTER WORLD WAR II

A few months after the end of World War II, Louisiana held its first offshore lease sale, auctioning off the right to drill into thousands of acres of land beneath the Gulf (Londenburg 1972).

The timing of the lease sale was not good. Congress had begun hearings on who should control offshore oil leases -- the States or the Federal government. Just 51 days after peace was declared with Japan, President Harry S. Truman issued a proclamation declaring that the United States found "reasonable and just" that nations should control mining resources along the continental shelf adjacent to their boundaries (Berryhill 1974).

The United States Supreme Court did not decide until 1954 just where the boundaries lay between State and Federal jurisidiction, but Congress had decided a year earlier that leases already issued by the States would be valid, even though they might be outside the boundaries established by the court. The legal tangle delayed major development of offshore oil and gas sources for six years. But it did not stop the first hesitant steps of the postwar pioneers who waded farther away from shore.

Mobile Oil drilled a well 8 kilometers (5 miles) offshore in 4.9 meters (16 feet) of water -- still within sight of land -- in October 1946. It was a dry hole but it was the farthest point away from land that drillers had ventured. The firm's drilling platform was supported by 52 steel pilings and 338 timbers, probably the last large assembly of wood and steel ever to be used (Londenburg 1972).

The giant step came with Kerr-McGee's successful well in October 1947. Mobile platforms had proved their worth and man had freed himself from the shoreline. Engineer Seale and another Kerr-McGee official had successfully applied a system in open water that had been used in swamps. Basically, it was a small, fixed platform for the derrick and basic machinery, and barges for other equipment, supplies and crew quarters. The company had assembled a small flotilla of war-surplus Navy landing craft, barges and air-sea rescue boats for the job. If the hole proved dry, the whole rig could be moved to another location. Support operations were headquartered 83 kilometers (52 miles) away in Berwick (Londenburg 1972).

What impressed other firms most was that the operation took little more time from rigging up to completion than onshore drilling. Despite the murky legal waters firms had to operate in, they began a serious investigation of the Gulf of Mexico's subsurface oil potential. In 1948, geophysicists found "a definite indication of the existence of upwards of 90 salt domes or other structures within the 31.4 mile zone of the Louisiana coast" (Williams 1948:154).

Within seven years, oil companies extended the offshore frontier to 80 kilometers (50 miles). By 1955, more than 40 offshore rigs were in operation with operating costs of $125 million a year. They were not without problems, however. Some rigs had trouble with unstable footing on the ocean floor. High winds, corrosion, anchor fatigue and ever-lengthening supply lines pushed up costs.

Production from offshore wells, however, increased each year. By 1973, there were 409 offshore fields, nearly double the number 10 years earlier. As the fields were developed farther from shore, engineers noticed a pattern. Areas to the southwest of Louisiana produced predominantly oil. (Wells drilled to the southeast of Louisiana had produced mostly gas.) About 14,600 wells had been drilled offshore, with the most productive wells south and west of the Mississippi delta.

In 1973, oilmen had bought rights to 1,797 tracts of Gulf bottom, with 1,333 of those off Louisiana. Although most of the leases are located in less than 183 meters (600 feet) of water, eight firms invested more than $400 million to explore 32 blocks of ocean bottom in deeper water (Offshore 1975). Some drilling has been done in water more than 305 meters (1,000 feet) deep.

One major problem offshore drillers faced was getting the oil and gas back to land. Kerr-McGee pumped the oil from its first Ship Shoal well into barges and hauled it back to the company's headquarters site on Bayou Boeuf near Morgan City, where the firm maintained a 5,700 cubic meters (93,400 cubic feet) storage facility (McCaslin 1948).

Before 1951, only one company had laid a pipeline offshore. The Marine Gathering Company had connected a 20-centimeter pipe between offshore wells in the Vermilion area and a Tennessee Gas Transmission Company line onshore. The pipeline was 14 kilometers (8.4 miles) long and, along with an independent line into Bay Marchand (McCaslin 1949), marked the beginning of offshore pipeline construction.

To replace the inefficient barge transportation system, the petroleum industry began extending the pipelines farther into the Gulf. In November 1951, a large-diameter gas line was extended into the Ship Shoal fields (A pipeline goes...1951). It was the longest pipeline of any kind offshore.

Stringing ponderous, cement-coated pipe seaward was a major challenge. Oil company engineers saw the need for a whole new industry that would require pipelaying barges, big ocean-going tugs, bigger pipe-fabrication yards and a new array of support services. Ports along the coast absorbed the growth of this new industry along with the expansion of offshore exploration.

In the early 1960's, exploration companies tapped two of the State's largest fields offshore at South Pass (Block 24) and Bay Marchand, now called South Timbalier.

Pipelines were laid more extensively as exploration crews moved farther into the Gulf. By the mid-1950's, more than 1,450 kilometers (900 miles) of pipelines had been laid. One of the largest was a 77-kilometer (48-mile) pipe, 30 centimeters (12 inches) in diameter, laid from shore to Eugene Island (Block 126) (Aldridge and Helm 1955).

Offshore pipelayers were forced to develop new methods for surveying, welding, and ditching to cope with water more than 50 meters (165 feet) deep (Bozeman 1963). The first offshore pipeline was put together almost entirely onshore, then was pulled into the water, supported every 183 meters (600 feet) by pontoons. Early pipelines put down in bays and marshes simply had been laid on the bottom. But contractors soon learned that the shallow waters of the Gulf required burying pipeline to prevent interference with boats and fishermen.

The first pipeline burying machine had been developed in 1934 for use in Galveston Bay. Shortly afterward, Frank Motley, the designer, joined Brown & Root Company and developed a system that is still used today. The system uses a forked nozzle of high-pressure water jets to cut the ocean floor from under the pipe being laid. A sled straddles the pipe and is pulled along the pipeline by a barge. As the trench is cut, the pipe sags into the trench and is buried by the tailings.

In 1952, Motley attached a ramp to a barge, allowing the pipeline to slope to the ocean floor. With the new system, a crew could lay a mile of pipe a day. At first, Motley put the pipeline together from previously prepared 37 meter (120-foot) sections, but he soon switched to an on-board assembly line, putting the pipe together a piece at a time (Londenburg 1972).

By 1973, pipelayers had laid more than 6,400 km (4,000 miles) of pipe on the bottom of the Gulf. The longest was the 460-kilometers (285-mile) "Red Snapper" that measured 76 centimeters (30 inches) in diameter. The pipe cost $127 million and connected 29 producing wells with onshore facilities (Wilson 1966). In 26 years of offshore activity prior to 1973, 14,600 wells had been dug. Thirty-seven percent of the 3,175 development wells were in the Main Pass, South Pass, and West Delta lease areas.

While the offshore drillers were moving ever deeper and farther from shore in the 1950's and 1960's, wildcatters intensified their efforts in the tidal flatlands and backwater swamps of the delta. The new activity perhaps was spurred in part by improvements in wetland technology but a more important reason was that word was getting out about the impressive results wildcatters were having in the area. Between 1952 and 1960, 32 percent of the wildcat wells had produced gas or oil. That was a 3 percent better success rate than operators in the Texas panhandle (Jarrell 1960).

In the early 1940's, many oil firms had been pessimistic about the economic importance of the Deltaic Plain (Smith 1943). Geologists were aware that oil forms pools in tops of salt domes and many believed that most of the domes in southern Louisiana had been identified and drilled. Many questioned whether further exploration was worth the cost, considering the difficulty of the terrain (Smith 1943).

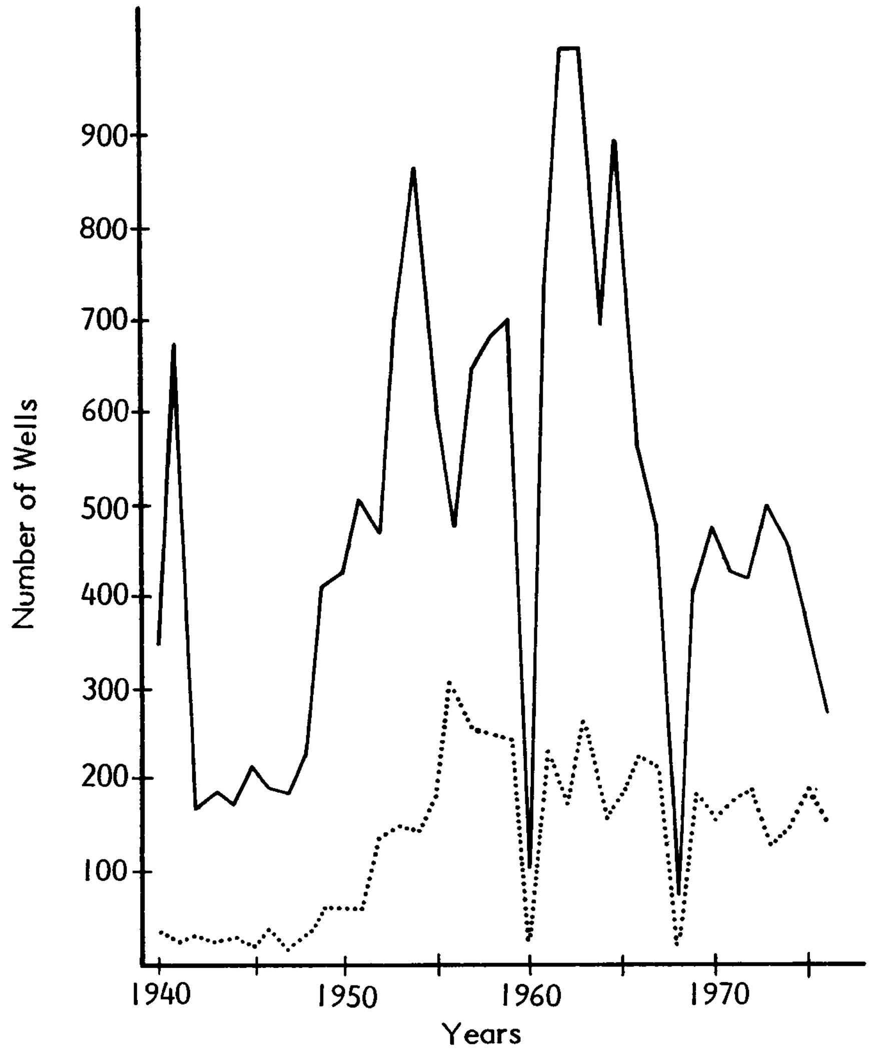
By 1950, however, oil firms had discovered six new fields, nine extensions of existing fields, and 31 new pools (Murchison and Patton 1951). Companies also enlarged the region's pipeline network. In the delta's three southwestern parishes -- St. Mary, Terrebonne and Lafourche -- the pipeline system in marshlands grew to 100 kilometers (60 miles) in length. Another 480 kilometers (500 miles) of pipeline stretched along the plain's natural levee system.

With each new extension of exploration, the pipeline system followed. Today, the Deltaic Region is a maze of overlapping and interconnecting pipelines, many of them sharing the same rights-of-way.

Between 1964 and 1973, drilling onshore began to decline from previous levels but the success rates for both exploratory and development wells remained relatively constant (Figures 2 and 3). Approximately 75 percent of the exploratory wells and about 35 percent of the development wells were dry (Edred and Johnson 1965, Hurley et al. 1973).

Oil and gas recovery in the coastal parishes reached its peak in the late 1960's (Figure 4) and offshore production peaked in 1970 (Figure 5 and 6). That year, offshore wells produced 2.4 million barrels of oil per day and onshore wells produced 129,000 barrels per day. In California and Oklahoma, oil production had peaked a year earlier. Peak production in Texas came in 1972. Oil production in all other States but Alaska had been declining for some time (American Petroleum Institute 1979).

The coastal zone now is considered in a mature stage and major new discoveries are rare. Geophysical processing activity in the MDPR peaked during the late 1940's through the late 1950's (Figure 7). In 1973, only six new fields were discovered and the only significant activity was extending existing fields. By 1974, onshore leases had declined 15 percent (Stevens and Callahan 1974).



...... Exploratory Fields: Oil, Gas & Dry within MDPR Study Area

— Proven Fields: Oil, Gas & Dry within MDPR Study Area

Figure 2. MDPR oil and gas exploration activity: exploratory and proven fields 1940 - 1976.

Sources: National Oil Scouts' & Landmen's Association Yearbook 1941, 1942, 1952, 1956.

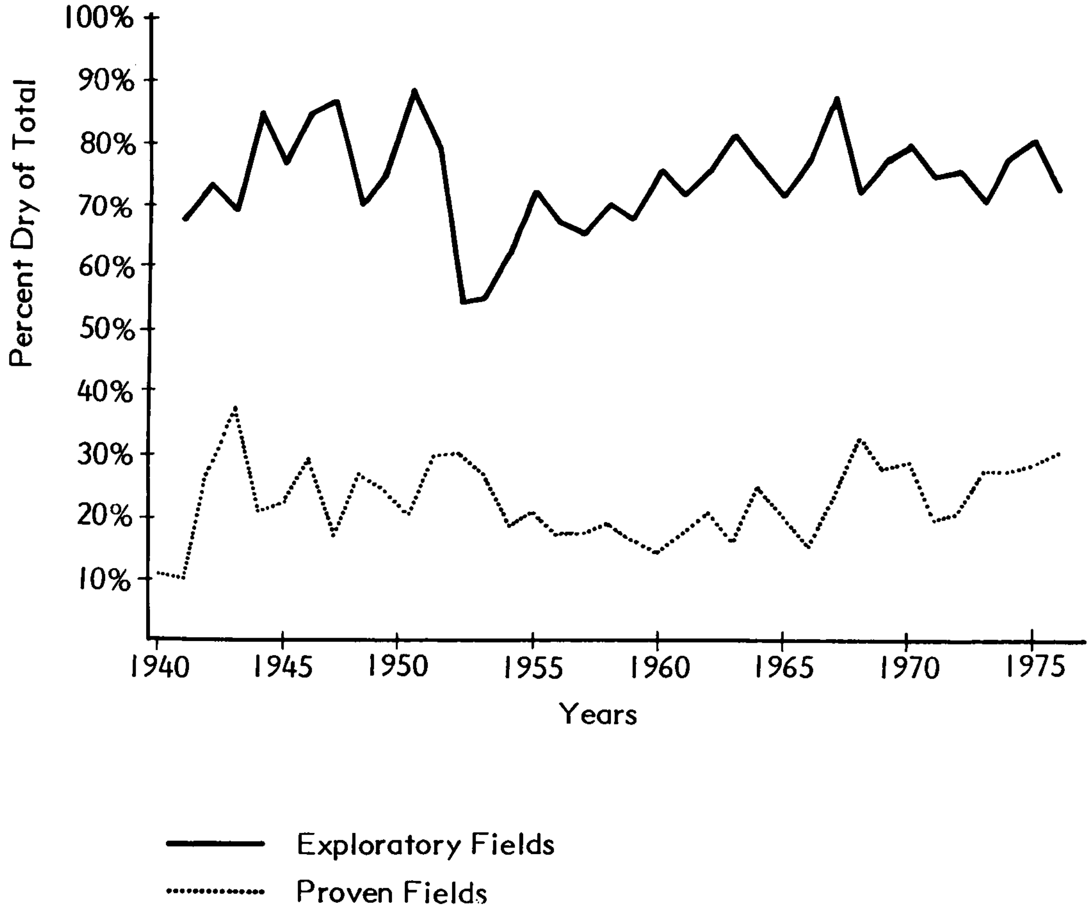


Figure 3. MDPR dry oil and gas wells as a percentage of total wells (oil, gas, and dry) 1940 - 1976.

Sources: National Oil Scouts' & Landmen's Association Yearbook 1941, 1942, 1952, 1956.

International Oil Scouts Association 1938 - 1974.

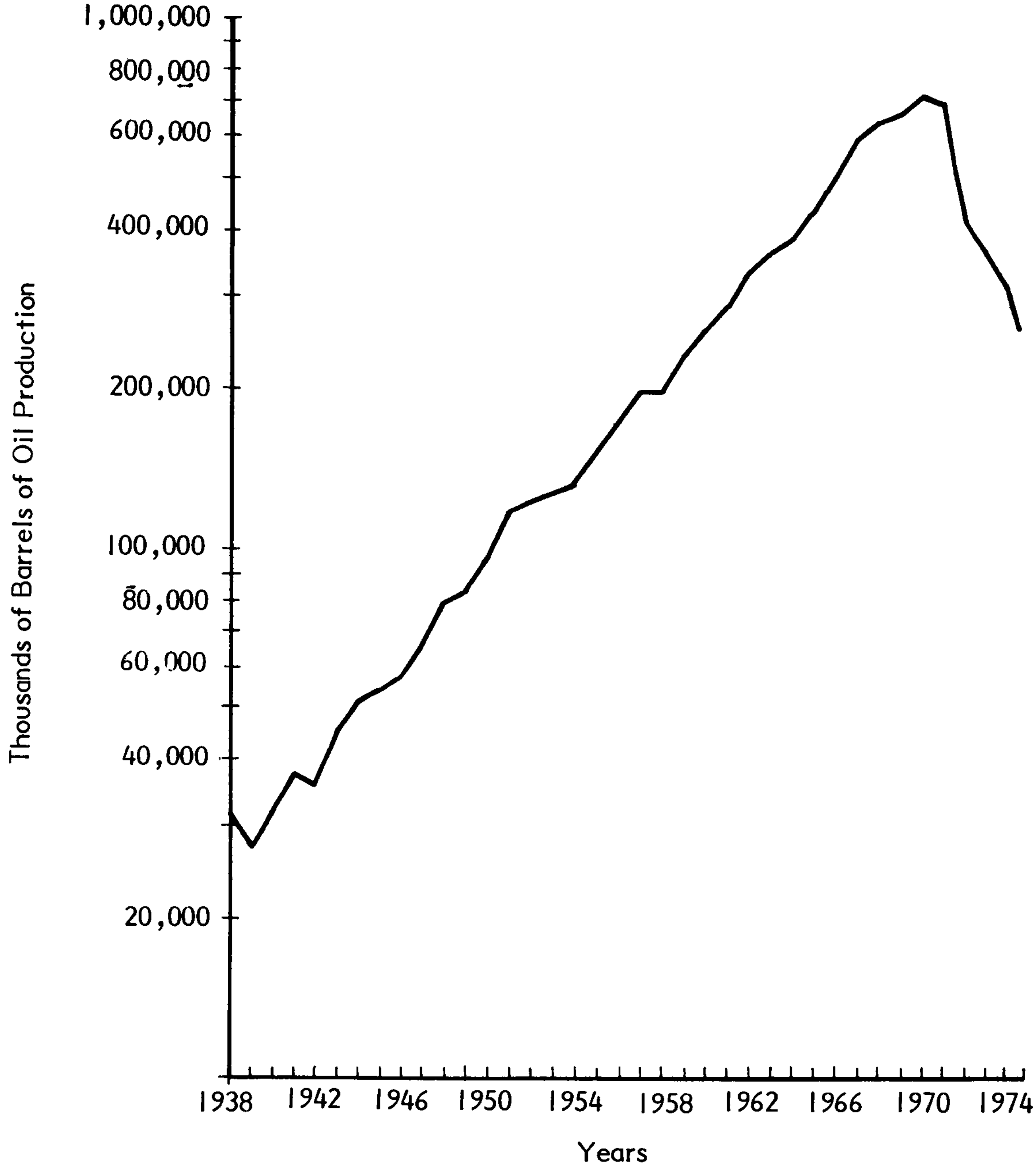


Figure 4. Louisiana oil production, 1937 - 1975.

Source: Louisiana Annual Oil/Gas Reports, 1975.

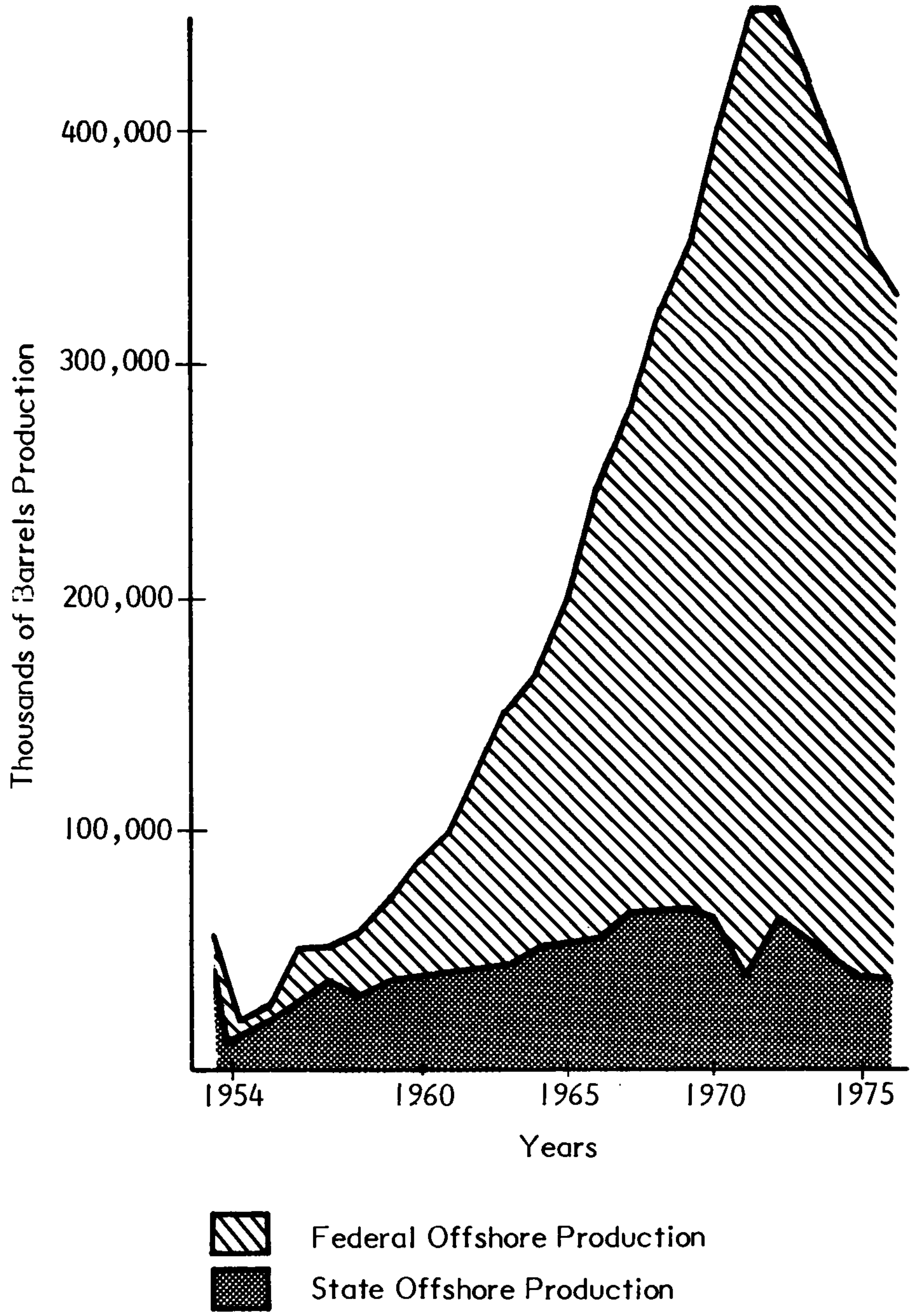


Figure 5. Louisiana offshore oil and condensate production--"State" and "Federal OCS".

Source: American Petroleum Institute, 1979, p. 13.

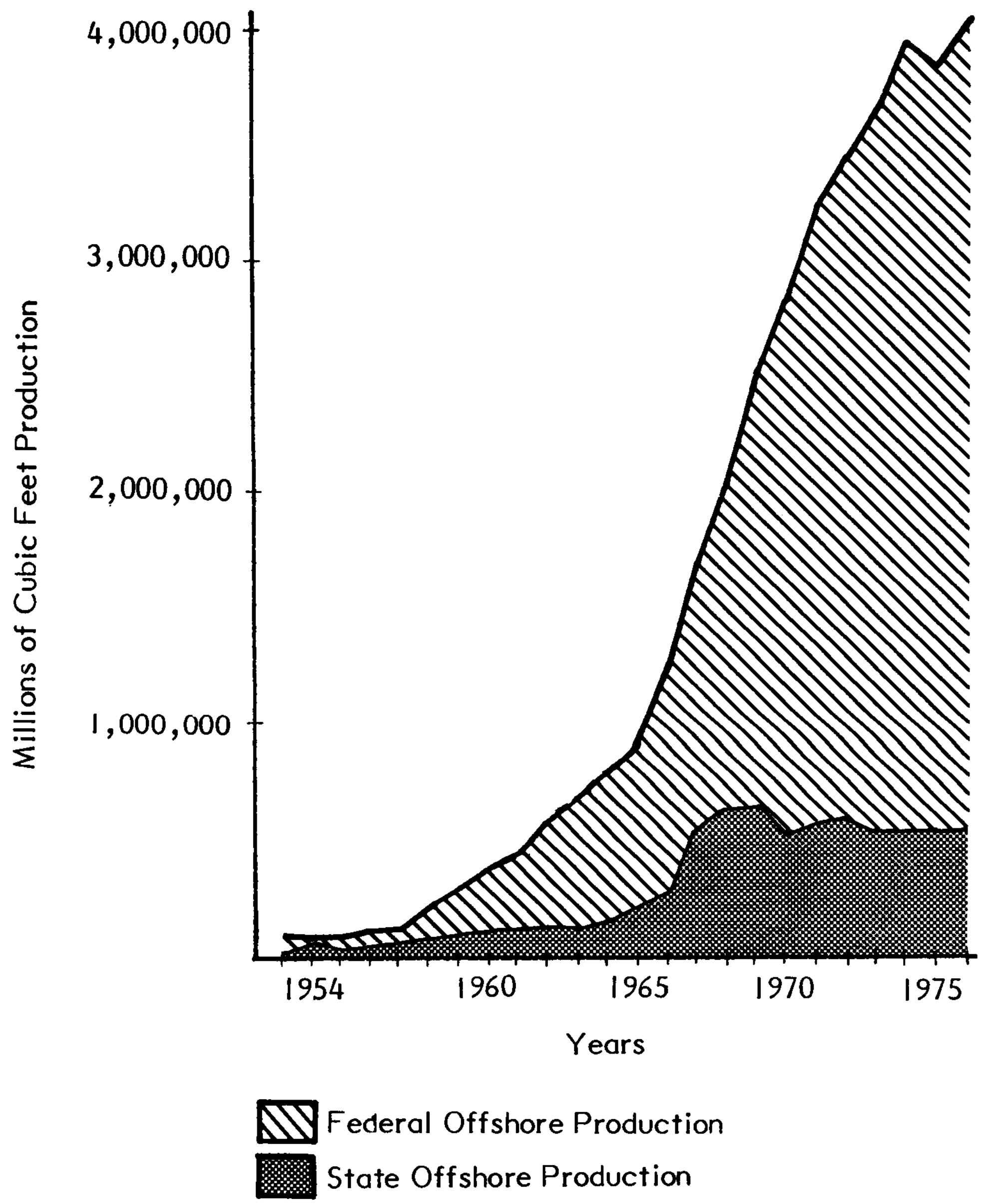


Figure 6. Louisiana offshore gas production--"State" and "Federal OCS".

Source: American Petroleum Institute, 1979, p. 13.

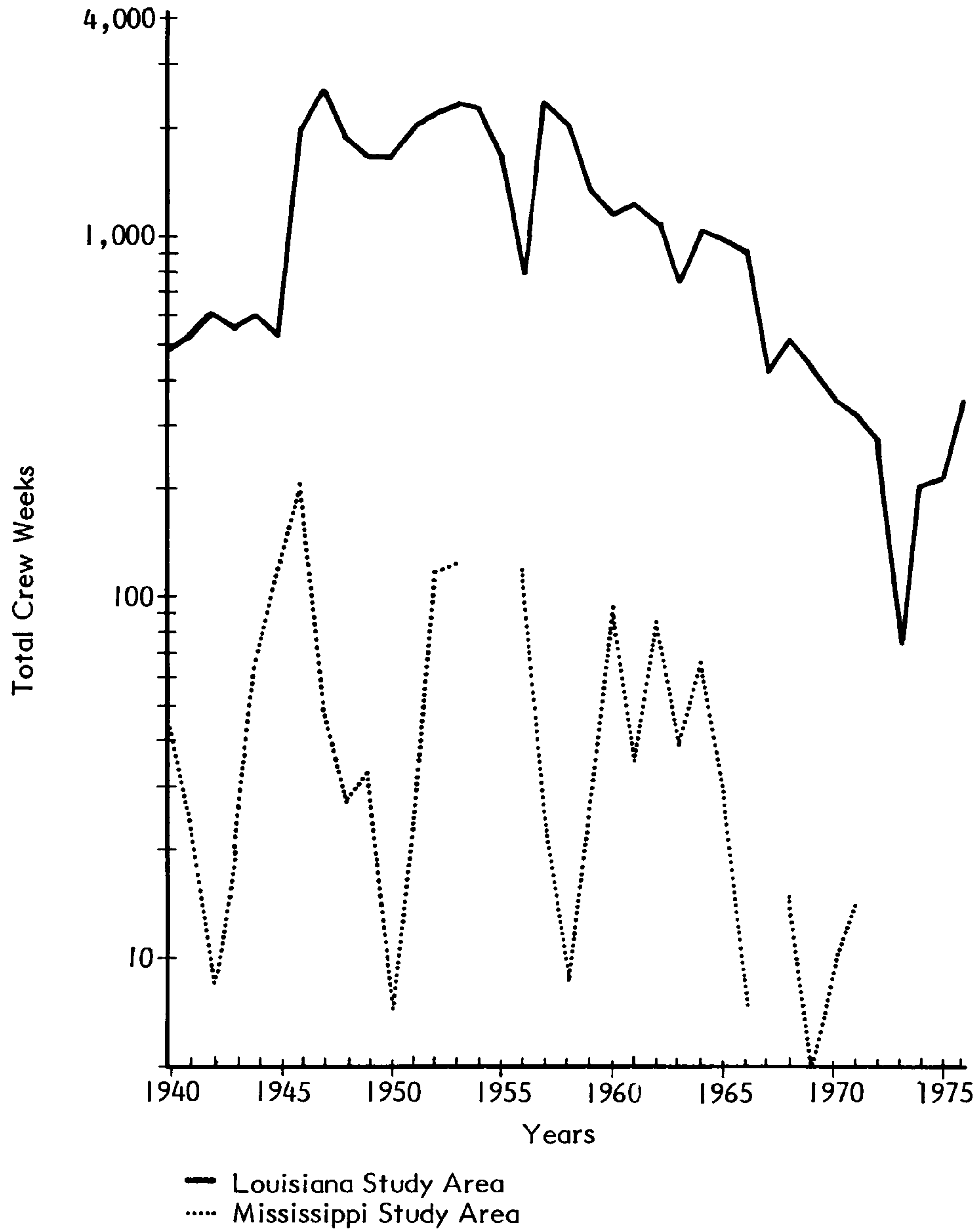


Figure 7. Geophysical exploration activities, 1940 - 1976.

Sources: National Oil Scouts' & Landmen's Association Yearbook 1941, 1942.

International Oil Scouts' Association 1938 - 1974.

In the 76-year period from W. Scott Heywood's first well in 1901, to January 1, 1978, oil crews sank 138,639 wells into Louisiana soil. Thirty-seven percent of them were dry holes. Forty-nine percent produced oil and 14 percent produced gas. More wells have been drilled in other states, and other areas have had fewer dry holes (American Petroleum Institute 1979). But because oil fields in Louisiana's wetlands and coastal area were developed later than other fields in other states, they remain one of the Nation's more important sources of hydrocarbons.

Of the Nation's 27.8 billion barrels of proven reserves as of December 31, 1978, 2.7 billion are in southern Louisiana. Only Alaska, Texas and California have greater proven reserves (American Petroleum Institute 1979).

ONSHORE LAND USE AND SUPPORT SERVICES

The dynamic growth of oil and gas exploration during the last three decades has placed an entirely different demand on the relatively few chunks of high-and-dry real estate in the Mississippi Deltaic Plain Region (MDPR); the demands for solid ground now include much more than having a firm place to anchor a drilling platform. The need for onshore support bases, platform fabrication and pipe supply yards, and ship construction and service yards have increased exponentially. Today, virtually every community that borders the bayous of the southern delta serves as headquarters for one or more support services needed by the oil and gas industry. Because firm land is at such a high premium, some firms have built extremely compact facilities to handle the large and complex operations needed to build ships, offshore platforms and other complicated pieces of machinery. Refiners and petrochemical manufacturers competed heavily for the few large plots so they could install plants as close as possible to the source of the hydrocarbons.

New jobs brought more people. Population in Louisiana's five southern parishes increased 30 percent between 1950 and 1960 (Bobo and Charlton 1974). Between 1940 and 1960, population increased 45 percent in Houma, Morgan City, New Iberia, and Thibodaux, the cities that were becoming major support centers for oil and gas development in the delta and offshore. A special census in 1975 showed that Houma's population increased 35 percent between 1960 and 1975. Morgan City's population increased 22.5 percent between 1960 and 1970, while Thibodaux's increased 12 percent (Bobo and Charlton 1974).

With population growth came a need for more government services. More than 38,000 persons in Louisiana are employed in the oil and gas industry. As a result, several cities have applied for coastal agency impact funds to offset the costs of added services that local taxpayers are unable to support.

Following is a brief summary of the impact offshore oil exploration has had on specific industries that have developed in Louisiana's lower delta.

OIL STORAGE

Because Louisiana exports 82 percent of its hydrocarbon production, the State has had little need for extensive storage facilities. Most storage sites are near refineries and petrochemical plants. New tank farms may not be needed if the industry uses underground salt domes. Four such sites already have been selected for use as part of the nation's Strategic Petroleum Reserve (SPR) program of the United States Department of Energy. The domes are in West Hackberry in

Cameron Parish, Bayou Choctaw in Iberville Parish, Weeks Island in Iberia Parish and the Sulfur Mines in Calcasieu Parish. Only Weeks Island is within the MDPR study area.

Salt domes are numerous along the Gulf coast. Because many contained oil and gas, they already are connected to, or near, the region's pipeline system. Many are within 610 meters (2,000 feet) of the earth's surface, which means that the cost of drilling and constructing caverns would be relatively low. Other salt dome storage sites are being considered near inland pipeline terminals. All of the sites except one are in the MDPR study area.

The Capline Pipeline Terminal in St. James, Louisiana, has been proposed as the distribution center for petroleum from salt domes in the Capline group. The primary site for development within the Capline group is the Napoleonville salt dome in Assumption Parish. There are four other candidates for possible development, including the Chacahoula salt dome in Lafourche Parish and the Iberia dome in Iberia Parish. Other possibilities include expansion of Bayou Choctaw in Iberville Parish or Weeks Island in Iberia Parish. One or a combination of the four possibilities could be developed as an alternative to the Napoleonville site.

The Capline project is designed to provide between 300 million to 500 million barrels storage capacity. The Capline pipelines transport oil from the St. James terminal to refineries in the upper Midwest. Plans are under way to expand the capacity of the Capline system from 900,000 barrels a day to 1.2 million barrels a day.

Storage sites for the Capline group would use both existing salt mines and new caverns in southeastern Louisiana that would be "solution-mined". Solution mining involves injecting water into the salt domes and washing away salt deposits, creating a cavern. When oil is pumped into the dome it displaces the brine. When the oil is needed, water is forced into the cavern, forcing the oil to the surface.

Plans have been made to develop 10 caverns at the Napoleonville site, converting and expanding seven existing caverns, and installing oil distribution, water supply, and brine disposal systems. When completed, the site could provide storage for 150 million barrels of oil, creating a total capacity of 333 million barrels when combined with existing storage at Weeks Island and Bayou Choctaw. The Bayou Choctaw dome is outside of the Deltaic Plain study area but is the northernmost site of the Capline group. It is 19 kilometers (12 miles) southwest of Baton Rouge and about 6.5 kilometers (4 miles) west of the Mississippi River. As many as 12 existing solution-mined caverns could be made available, providing up to 94 million barrels of oil storage.

The Weeks Island salt dome, also part of the Capline Group, is a conventional underground mine in Iberia Parish. The existing salt mine is presently operated by Morton Salt Company, using the room and pillar method of excavation. Large underground acres have been excavated and capacity is available for storage of 89 million barrels of crude oil.

The Napoleonville dome is near the northern boundary of Assumption Parish, about 48 kilometers (30 miles) south of Baton Rouge. The land area of the 610-

meter (2,000-foot) salt contour consists of about 710 hectares (1,760 acres). The total storage volume of approximately 150 million barrels will utilize seven existing solution-mined caverns while the leaching of ten new caverns would be initiated. Raw water for leaching will be obtained from Bayou Lafourche, while brine disposal will be in salt water-bearing sands at depths of 1,525 to 2,440 meters (5,000 to 8,000 feet).

The Iberia dome is located in central Iberia Parish in an agricultural area 8 kilometers (5 miles) east of New Iberia and 35 kilometers (22 miles) southeast of Lafayette, Louisiana. The dome's salt resources are presently undeveloped, and approximately 65 hectares (160 acres) of land was fenced in for the storage site. Six caverns will be leached on this site. Bayou Teche would be the source of water used first for the leaching process and later, displacement of stored oil into a pipeline.

The Chacahoula dome in Lafourche Parish is approximately 115 kilometers (72 miles) south of Baton Rouge and 105 kilometers (66 miles) west of New Orleans. There is no surface expression of the salt mass and the surrounding area is uniformly swampy. The 24 planned storage cavities, along with the associated central pumping and control facilities, would be located on a 180-hectare (450-acre) site. Bayou Lafourche is the proposed source of water for the initial leaching operations.

The Cote Blanche Salt Mine has also been proposed as a potential crude-oil storage facility suitable for the SPR Program. It is located in the coastal region of southwestern St. Mary Parish very near the earth's surface.

LOOP - LOUISIANA'S OFFSHORE OIL PORT

The Louisiana Offshore Oil Port (LOOP) is one of four deep-water facilities planned along the Gulf and West coasts to handle unloading of supertankers too large to approach shore. LOOP is the only facility under construction and is scheduled to be completed in the early 1980's at a cost of about $513 million. Other facilities are proposed off the coasts of Mississippi, Texas, and Santa Barbara, California.

LOOP is being built in about 34 meters (110 feet) of water in Grand Isle Block 59 in the Gulf. A 19-centimeter (48-inch) diameter submarine pipeline, buried 1 meter (3 feet) below the ocean floor, will connect the port with onshore facilities. A buried onshore pipeline will traverse 45 kilometers (28 miles) of marshland between the shore and the Clovelley Farm Salt Dome where crude oil will be stored. Another pipeline will connect the dome with refining facilities 85 kilometers (53 miles) away in St. James, Louisiana. Oil will be pumped out of the supertankers via floating buoys at the port, and pumps in the port's platform will boost pressure of the crude to push it to shore.

The Clovelley Farm Salt Dome will be used as a storage site for six different types of crude oil. Since the oils cannot be mixed, there is a need for numerous storage facilities. Eventually, pumping capacity in and out of the dome should reach 11,000 gallons a second, or 1.4 million barrels a day. Also included will be a 25 million barrel brine storage reservoir, facilities for fire protection, power and communications, and an operations center housing the terminal office and control equipment.

Each cavity of the dome will be of the brine-displacement type. Crude oil pumped into a cavity will displace brine into the storage reservoir located on the surface. Conversely, when brine from the reservoir is pumped into the bottom of the cavity, the crude oil will be displaced and sent through the pipeline system.

PIPE STORAGE

The Mississippi delta is covered with a labyrinth of pipelines ranging in size from 50 to 100 centimeters (2 to 40 inches) in diameter. As offshore activity has increased, so has the demand for pipe of varying dimensions. There are, however, relatively few major pipe distribution centers. Patterson Trucking maintains a 55-hectare (135-acre) yard at Morgan City where it keeps an inventory of 204,000 metric tons (185,000 tons) of pipe ranging from 5 to 25 centimeters (2 to 10 inches) in diameter. It is the largest storage facility in the MDPR, with excellent access by water, rail, and highway. Most drilling companies keep supplies of pipe at their own yards to meet short-term demands.

REFINERIES

Oil refineries along the Louisiana Gulf coast provide about 15 percent of the Nation's total refining capacity. They break down crude oil from both domestic and foreign sources, providing a complete array of fuels and petroleum byproducts.

When offshore oil production first began developing in the early 1950's, Louisiana had 16 refineries with a combined capacity of 643,000 barrels a day (Mumphrey and Carlucci 1978). Ten were located along the Baton Rouge - New Orleans corridor on the Mississippi River to take advantage of ocean tanker and barge traffic.

The State now has 23 refineries with a combined capacity of 2.1 million barrels per day. Nine are within the MDPR and have a capacity of 980,100 barrels per day, or 46 percent of the State's capacity as of January 1978 (Table 1). Since that time, another plant has been completed and three more are being planned (Table 2).

Six existing refineries plan to increase their refining capacity by a total of 232,000 barrels per day or 15 percent by 1980 (Table 3). The expansions are being made to handle the increased volume of oil expected when LOOP, the State's deep-draft, offshore oil port is completed in 1980.

In Mississippi, the largest petroleum refinery is at Pascagoula. This Chevron USA, Inc. plant can process up to 328,541 barrels per day (Cantrell 1978a).

GAS PROCESSING

About 96 percent of the natural gas withdrawn from wells in the MDPR is processed and marketed. Some is used as fuel for pumps to move gas and oil for repressuring wells and some exhanged for leases of various kinds.

Natural gas is used as fuel for refining operations, feedstock for the chemical industry, and as material for manufacturing carbon black. The greatest concentration of gas processing capacity is in St. Mary Parish where 10 units have a

Table 1. Deltaic Plain refineries in Louisiana, 1978[a].

Refinery	Location	Capacity/day[b]	Percentage
Boswell Oil Company	Mt. Airy	10,000	1.0
Good Hope	Good Hope	80,000	8.2
Gulf Oil Company	Belle Chasse	195,900	20.0
	Venice	28,700	2.9
LaJet, Inc.	St. James	N/A	--
Marathon Oil	Garyville	200,000	20.4
Murphy Oil	Meraux	95,500	9.7
Shell Oil Company	Norco	230,000	23.5
Tenneco Oil Company	Chalmette	N/A	--
Texaco, Inc.	Convent	140,000	14.3
Total		980,100	100.0

[a]Cantrell 1978a.
[b]Barrels/day

Table 2. New Louisiana refineries, 1978.

Refinery	Location	Estimated capacity/day[a]
International Processors[b] (under construction)	St. Rose	30,000
Mt. Airy Refining[c] (near completion)	Mt. Airy	12,400
Refinery Services[d] (planned)	Westwego	10,000
Tetrak Oil Inc.[d] (under construction)	Luling	30,000
	Added Capacity	84,400

[a]Barrels/day
[b]Louisiana, The State of Business 1978a
[c]Louisiana, The State of Business 1978b
[d]Cantrell 1978b

Table 3. Expansion of existing Louisiana refineries, October 1978[a].

Refinery	Location	Expanded capacity/day[b]
Gulf Oil Company	Belle Chasse	11,000
Marathon Oil Company	Garyville	102,000
Murphy Oil	Meraux	25,000
Shell Oil	Norco	28,000
Tenneco Oil Company	Chalmette	16,000
Texaco, Inc.	Convent	50,000
Total		232,000
New Refinery Capacity (from Table 2) 82,400		980,100
Existing Capacity (from Table 1)		
		1,294,500

[a]Cantrell, 1978d
[b]Barrels/day

total capacity of 4,283 million cubic feet per day (MMcf/d). These units range in size from Sun Oil's 16 MMcf/d plant at Bayou Sale to Shell's 1,200 MMcf/d plant at Calumet, which is the third largest plant in southeast Louisiana. Gas processing capacity in St. Bernard Parish is about 80 percent of that in St. Mary Parish. Three companies, Shell, Southern Natural Gas, and Union Oil, operate in two sites at Toca and Yscloskey. Shell's Yscsloskey unit is the Region's largest, with a capacity of 1,850 MMcf/d (Table 4).

Natural gas is Louisiana's most important energy source. An intricate web of pipes carries gas to the State's manufacturers and supplies 90 percent of the energy that utilities use to make electricity.

Twenty-six interstate gas pipeline companies have lines running into Louisiana to carry gas to other parts of the Nation. About three-fourths of the State's production goes out-of-state.

Mississippi has eight processing plants with a combined processing capacity of 856 MMcf/d. None is in the Deltaic Plain region.

SHIPYARDS

Prior to discovery of offshore oil and gas, the MDPR petroleum industry had little use for specially-designed marine equipment. On streams, canals, and coastal waters, the industry depended on small yacht-type crewboats, wooden shrimp trawlers, oyster luggers, menhaden boats, and converted Navy vessels. Offshore activity opened a new era in marine operations. Transportation bases and an efficient weather-forecasting service were absolutely essential for success. To service their offshore leases, drilling and production companies had to obtain a navy.

Table 4. Gas processing plants in MMcf/d by Parish, 1978.

Parish	Gas capacity	Gas production
Iberia		
Koch Oil - Bayou Postillion	25.0	12.0
Shell Oil - Weeks Island(13-14S,6&7E)	129.0	58.6
Exxon - Avery Island(53-13S,5E)	11.0	9.0
SUBTOTAL	165.0	79.6
Jefferson		
Exxon - Grand Isle(32-21S,25E)	135.0	71.0
SUBTOTAL	135.0	71.0
Lafourche		
Amoco Production - Lake Boeuf(61-15S,18E)	85.0	36.5
Exxon - Thibodaux(35&36-15S,16E)		
Liquid Products Recovery, Inc.-		
Bourg		
Napoleonville No. 1	30.0	8.0
Sun Oil - Chacahoula Central Dehydration	67.0	50.0
SUBTOTAL	257.0	107.5
Plaquemines		
Getty Oil -		
Bastian Bay(42-21S,28E)	150.0	43.0
Venice(25-21S,30E)	65.0	33.0
Gulf Oil -		
Bastian Bay(4-21S,29E)	150.0	57.0
Venice(25-21S,30E)	1,000.0	654.0
SUBTOTAL	1,365.0	778.0

(continued)

Table 4.

Parish	Gas capacity	Gas production
St. Bernard		
Shell -		
Toca(54-14S,14E)	830.0	448.3
Yscloskey(39-13S,15E)	1,850.0	1,554.3
Southern Natural Gas - Toca(56-14S,14E)	525.0	116.0
Union - Toca	190.0	119.8
SUBTOTAL	3,395.0	2,238.4
St. Charles		
Shell - Drawfish(36-13S,20E)	120.0	91.9
Norco Fractionator(6-12S,8E)	---	---
Texaco - Paradis(29-14S,20E)	800.0	NR
SUBTOTAL	920.0	91.9
St. James		
Cities Service - St. Amelia(12-12S,16E)	38.0	4.8
Liquid Products Recoverdry Inc. - Vacherie	10.0	4.0
Mid Louisiana Gas - Kenmore(44-12S,4E)	10.0	2.0
Shell - LaPlace(38-12S,15E)	12.0	9.7
SUBTOTAL	70.0	20.5
St Mary		
Atlantic Richfield - Bayou Sale(17-11S,9E)	97.0	77.0
Exxon - Garden City(45&46-15S,10E)	950.0	314.0
Placid Oil -		
Patterson #1 (48-15S,11E)	200.0	76.0
Patterson #2 (48-15S,11E)	600.0	NR
Shell - Calumet(11,12,51&52-15S,11E)	1,200.0	1,117.6
South Louisiana Plantation -		
Aymond(13-14S,9E)	45.0	34.0
Sun Gas Co.-		
Bayou Sale(14-16S,9E)	16.0	12.0
Bayou St. Vincent(16-13S,13E)	75.0	20.0
Belle Isle(5&28-17S,10E)	200.0	93.7
Texaco - Floodway(16-16S,12E)	900.0	NR
SUBTOTAL	4,283.0	1,744.4

(continued)

Table 4. (concluded)

Parish	Gas capacity	Gas production
Terrebonne		
Exxon - Lirette(23 & 32-19S,19E)		
Getty - Hollywood(101-17S,17E)	150.0	75.0
Louisiana Land and Exploration -		
Pointe au Chien(18S,20E)	125.0	109.5
Placid Oil - Lapeyrouse(71-20S,18E)	100.0	42.0
Shell -		
North Terrebonne(20,29,33-17S,15E)	1,250.0	1,106.4
Timbalier(NW¼ of 32, SW¼ of 33-19S,19E)	100.0	50.4
Superior Oil -		
Bayou Penchant(2-19S,13E)	75.0	108.0
Four Isle(24-12S,16E)	75.0	73.0
Union - Houma(26-17S,17E)	80.0	35.0
SUBTOTAL	2,330.0	1,802.3
TOTAL	12,920.0	

Source: Cantrell 1978b.

Notes: Abbreviations refer to locations within the Township and Range Survey system, as follows: (13-14S,6 & 7E) indicates that the location is within section 13, Township 14 South, Ranges 6 and 7 East of the appropriate meridian (Louisiana or St. Helena).
NW¼ of 32, SW¼ of 33-19S,19E indicates that the location is in the northwest quarter of section 32, and the southwest quarter of section 33 in Township 19 South, Range 19 East.

If the 1940's can be characterized as the beginning of the offshore era of petroleum development, then the 1950's should be considered the beginning of the marine technological revolution. In this period, boat builders installed diesel rather than gasoline engines, and designed steel rather than wooden-hulled support craft. Shipyards were fabricating vessels capable of operating in the hostile waters of the Gulf of Mexico. The boat-building trades began to grow, but the limits of well-drained land required the expanding industry to locate at scattered sites along the coast or in cities away from the high impact areas of hurricanes. In many cases, shipyards are confined to a narrow strip of land less than two acres in size.

Louisiana boat builders pioneered the industry. They constructed the first all-aluminum crewboats and installed the first gas turbines. From their designs other shipyards began to construct supply vessels (New England builds...1975). Demand has continued to expand, requiring builders worldwide to start manufacturing supply boats.

More than 100 Louisiana shipyards are working to meet the needs of the offshore operators. Most of these shipbuilders are located on the rivers and bayous of the MDPR (Table 5), and are responsible for Louisiana's position as a world leader in the construction of supply boats, towing-supply vessels, and large utility

Table 5. Shipbuilding in south Louisiana.

Cities		Shipyards
Algiers		1
Amelia		3
Baldwin		1
Bayou Vista		2
Belle Chasse		1
Berwick		1
Charenton		1
Chauvin		1
Galliano		1
Golden Meadow		3
Franklin		1
Harvey		6
Houma		7
Jeanerette		1
Lafitte		3
Larose		6
Lockport		1
Loreauville		1
Montegut		2
Morgan City		13
New Iberia		11
New Orleans		21
Patterson		2
Venice		2
Westwego		1
	SUBTOTAL	93
	OTHER	11
	TOTAL	104

Source: Authors, from a 1975 survey of Louisiana telephone directories.

craft (Table 6). Louisiana-built boats operate around the world. The shipyards contribute to the local job market, but their facilities rarely require a work area of more than 10 hectares (25 acres). Because the shipyards are not concentrated in one area, they often are not shown on land-use and land-cover maps at a scale of 1:100,000 or smaller.

Of the 122 support craft under construction in the United States, 67 percent are in Louisiana shipyards; Mississippi shipyards produce 4.1 percent. Worldwide, there are only an additional 84 vessels being built. MDPR shipyards, therefore, are involved in fabricating 42.2 percent of the world's fleet (Table 7).

Table 6. Marine service vessels under construction, January 1976.

Shipyard		Number of boats under construction
Louisiana:		
Wall Shipyard, Inc. - Harvey, Louisiana		1
Camcraft Inc. - Crown Point, Louisiana		4
American Marine - New Orleans		1
Bollinger Machine Shop and Shipyard - Lockport		2
Bourg Drydock and Service Company - Houma		1
Swiftships, Inc. - Morgan City		1
J. Ray McDermott & Company - New Orleans		15
J. Ray McDermott & Company - New Iberia		2
Service Machine & Shipbuilding - Morgan City		2
Equitable Shipyards, Inc. - Madisonville		13
Quality Equipment Company - Houma		3
Halter Marine Services, Inc. - New Orleans		22
Delmar Systems, Inc. - Larose		2
Universal Iron Works - Houma		1
American Marine Corp. - New Orleans		1
Halter Marine Services, Inc. - Lockport		10
Louisiana MDPR Construction	SUBTOTAL	81
Mississippi:		
Halter Marine Service, Inc. - Moss Point		5
	TOTAL	86

Source: Ocean industry's report...1976.

The pioneer efforts in Louisiana started the marine-service business and logistic support vessel construction industry. MDPR shipbuilders are busy, with several firms looking for land parallel to 7.6-meter (25-foot) channels to accommodate the 70-meter to 90-meter (230-foot to 295-foot) vessels of the future. A December 1974 survey reported 30 Louisiana shipyards building 1,381 support craft, including barges, tugs, supply boats, crewboats, and push boats. Admittedly incomplete and dated, the tabulation does not show the total building activity of nearly 30 percent of the State's shipyards (Construction 1974). Bayou Lafourche, Morgan City, New Iberia, and the New Orleans area are worthy of special mention. Over 60 shipyards are within these four areas. Occupying less than an acre, in some cases these fabrication facilities may have as many as three boats under construction and a two-year backlog. Louisiana's logistic support firms are having boats built to work anywhere in the world. Over 400 Louisiana-based boat rental and towing firms provide enough business to keep the shipyards working at full

Table 7. Petroleum industry boats being built in the United States, January 1976.

State	Total boats under construction	Percent United States	Percent worldwide
California	6	4.9	2.9
Florida	7	5.7	3.4
Louisiana	82	67.2	39.8
Mississippi	5	4.1	2.4
Rhode Island	1	.8	.5
Tennessee	1	.8	.5
Texas	16	13.1	7.8
Washington	4	3.3	1.9
SUBTOTAL	122		
Boats built outside of the United States	84		
Total worldwide	206		

Source: Ocean industry's report... 1976.

capacity. As the industry moves into deeper water, the 15-year to 25-year-old boats have become obsolete. New ones are required to operate in 3-meter (10-foot) swells more than 160 kilometers (100 miles) from shore. The marine service fleet is constantly being enlarged and modernized by MDPR shipyards and boat yards.

This activity, along with construction of other types of boats, keeps local newspaper classified sections filled with advertisements for structural fitters, certified welders, ship-fitters, pipe-fitters, and painters. With more than one billion pounds of seafood moving through Louisiana's ports, the demand for new, modern fishing vessels is high. Although the greatest number of boats being built are for the petroleum industry, marine fabricators also are constructing shrimp, oyster, and menhaden vessels. In addition, steel and wooden-hulled boats are constantly being built in someone's front or back yard. This cottage industry is seen on many of the bayous extending into the marsh. These "homemade" boats may be from 4.9 meters to 13.7 meters (16 feet to 45 feet) in length, for use in either the inland or offshore waters.

The economic importance of shipbuilding is particulary evident in New Orleans and Pascagoula, Mississippi. Avondale has built a major shipyard in New Orleans, and is the largest single employer in the Region. Many men travel more than 190 kilometers (120 miles) per day between the yard and their homes. They build everything from tankers to shallow-draft grain transport vessels. Currently, Avondale has a backlog of approximately 20 ship orders.

These contracts represent over $1.5 billion in investment with about 50 percent involved in expanding the country's domestic tanker and liquid natural gas carrier fleet. Litton's plant at Pascagoula is involved primarily in the construction of Navy ships. In addition to Litton's Pascagoula facility, James K. Walker Marine has a yard at Moss Point on the Pascagoula River. Several other shipbuilding and repair firms are located along the Pascagoula River. Although the company builds many types of boats, Walter Marine has recently completed a stern-rigged clammer equipped with split trawl winches for use in scalloping and bottom fishing. A December 1978 survey showed six shipyards were building 27 fishing vessels (Table 8). Coastal Engineering at Escatawpa and Gulf Fiberglass Boats at Pascagoula

Table 8. Fishing vessels under construction in Mississippi, December 1978.

Shipyards	Fishing boats under construction
Coastal Engineering Company - Escatawpa	6
Gulf Fiberglass Boats - Pascagoula	10
Halter Marine, Inc. - Moss Point	1
Quality Shipbuilders, Inc. - Moss Point	1
Joseph Adaulph Toche, Sr., Inc. - Biloxi	5
James K. Walker Marine - Pascagoula	4
Total	27

Source: United States fishing...1978.

were fabricating 16 of the boats (United states fishing...1978). Several of these firms also were engaged in construction of other vessels. Eight Louisiana shipyards were building 37 fishing boats, with Billiot Boat Works in Marrero fabricating 19 (Table 9).

PLATFORMS

In 1947 Kerr-McGee Oil Industries completed a subsea oil well in the Gulf of Mexico. The mobile platform used was a radical departure from the rigid wooden or steel piling structures that were built in-place. Two war-surplus barges and a converted Land Sea Transport (LST) were used as the drilling platform. As a result, Kerr-McGee demonstrated the feasibility of exploring for hydrocarbons in the Gulf of Mexico. The era of large-scale exploration and development offshore

Table 9. Fishing vessels under construction in Louisiana, December 1978.

Shipyard	Vessels under construction
Billiot Boat Works - Marrero	19
Blue Streak Industries - Chalmette	1
Breaux's Bay Craft, Inc. - Loreauville	6
Camcraft, Inc. - Marrero	1
Marr Enterprises - Slidell	7
Renos Boats - Akers	1
Shaner Boats, Inc. - Larose	1
Viguerie Trawlers, Inc. - Houma	1
Total	37

Source: United States fishing...1978.

was launched. By June 1948 (Williams 1948) 23 companies were either drilling, rigging up, or building platforms to explore more than 730,000 hectares (1.8 million acres) of leased ocean bottoms off the Louisiana coast. Once a lease proved productive, an oil company had to build a fixed platform to develop the site. In 31 years the industry progressed from 3.6 meters (12 feet) to an unprecedented water depth of 312 meters (1,025 feet) (Figure 8). In the interim, over 2,100 structures have been pinned to the seabed. In Louisiana's waters there are more than 1,100 major structures, each consisting of a four-piling supported platform, with two or more pieces of production equipment and/or six wells (Table 10). These "major" structures are designed for multiple completions. Shell's 46,000 ton Cognac platform will not only be the tallest offshore structure in the world, but will have a record 62 wells fanning out from its base (Metzler 1978). Along with the major platforms, there are an additional 1,100 minor pieces of equipment anchored to the sea floor.

Between 1975 and 1978 the number of structures increased dramatically. More platforms were installed in 1976 than in any other previous year, primarily as oil companies are reinvestigating tracts leased in the 1940's and 1950's. This is being done to maximize yields from marginal fields. Rising prices of both oil and natural gas have encouraged producers to reconsider their marginal fields (Gulf of Mexico...1977).

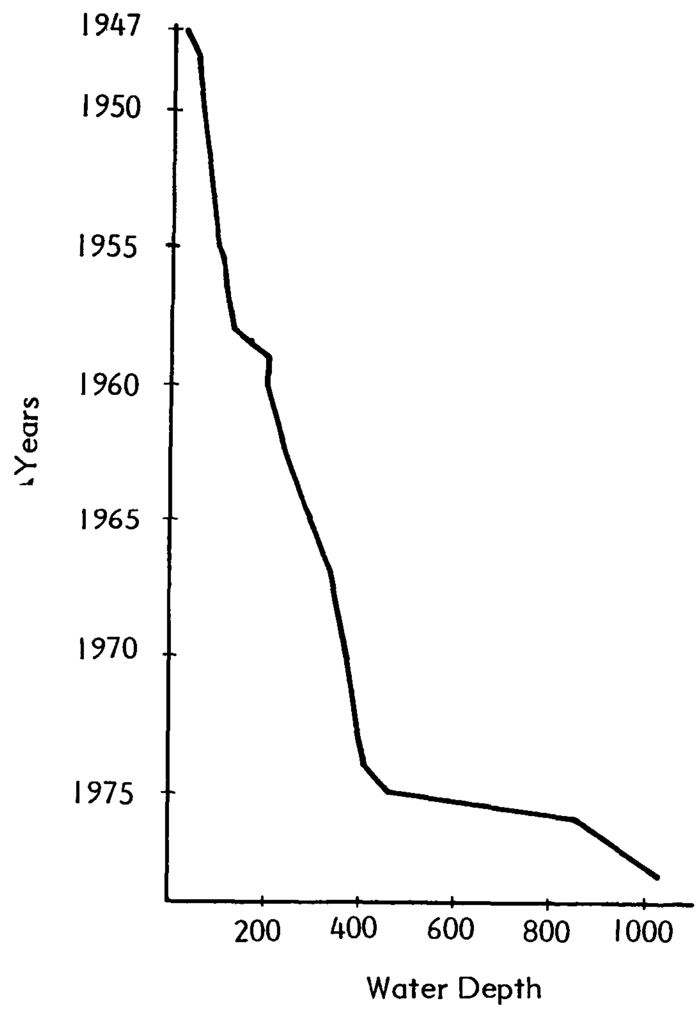


Figure 8. Water depth records for platforms, 1945 - 1978.

Source: Lee 1978.

Table 10. Major platform development in Federal waters off Louisiana through April 1978[a].

Period installed	Platforms installed
Prior to 1954	277
1954-1959	112
1960-1964	251
1965-1969	67
1970-1974	80
1975-1978	387
Total	1,174

[a]As of April 30, 1978, there were an additional 1,137 structures for a total of 2,517 offshore platforms in Federal waters off Louisiana.

Sources: Carmichael 1975.
Kent Stauffer, United States Geological Service Conservation Division (oral communication).

Platform construction generally peaks three years after a lease, yet structures can be added to the tract continuously. Several firms contract platform installation for leases over 20 years old. Most of the major structures have been erected on leases obtained from sales through 1962 (Gulf of Mexico...1977).

Off Louisiana's coast, petroleum companies, between October 1974 and December 1976, leased 1,755 tracts, involving 3.1 million hectares (7.6 million acres) at a cost of $9.8 billion (Harris et al. 1977). By 1976 there were 1,238 active leases; 749 were producing and 489 non-producing. On new leases platform installation will not be immediate, as cost of construction and the time required for completion has risen phenomenally. A creosote-piling platform used in the 1950's for shallow-waters exploration cost about $100,000. Today, deep water structures are priced in excess of $10 million, with the Cognac platform carrying a price tag of $275 million. Further, 15 years ago a platform could progress from the drawing board to delivery in 12 to 15 months. Today, a period of two to three years is the average. However, continued exploration of large numbers of undeveloped tracts and comparatively good prices for oil and gas should provide adequate incentive to produce from leases previously considered borderline economically. Further, oil companies are forming partnerships to maximize their efforts.

Oil and gas production in the Gulf of Mexico has undergone an erratic but steady growth. Even though companies are continuing to explore their offshore leases, one-third of the active leases will expire by the end of 1981. Only two-thirds of the 5.5 million hectares (13.5 million acres) being offered in 1978 can be considered new territory. As a result, older blocks, deeper wells, and deep water drilling are being considered. All three of these elements will influence the number of offshore structures constructed (LeBlanc 1978a).

A total of 196 production and well-protector structures offshore have been removed. For over 15 years steel desks and jackets have been recycled as salvage. This is a small industry, with few firms involved. It is one with a future, however. Estimates indicate that the majority of the Gulf's active leases will begin depleting reservoirs. At that time, removal will become a significant part of the offshore industry. Currently, this service costs between $100,000 and $300,000 with J. Ray McDermott's large derrick barges involved in about 50 percent of the salvage jobs (LeBlanc 1978c). As a result, near Morgan City, several salvaged platforms are in "storage" waiting to be cut up.

No Mississippi firms are directly involved in the three principal activities of platform fabrication, transport, or installation (Gladden et al. 1976).

SERVICE BASES AND REPAIR YARDS

Construction and maintenance of production platforms, and subsequent extraction and handling of subsea oil and gas, requires an extensive array of onshore facilities. Louisiana's pioneer role offshore resulted in many of the State's sites acquiring the necessary infrastructure to meet the needs of the offshore industry. Refineries, terminals, boat docks, airports, helicopter bases, repair facilities, shipyards, and pipe storage areas are essential to offshore operations.

All of these activities require space and influence local industrial land-use and land-cover patterns. Some firms are located at remote points, such as Port Pourchon or Venice, and their land area requirements reflect the significance of transportation. Transportation facilities are particularly important, as nearly 40 percent of the world's crewboats, supply vessels, and tugs are owned by Louisiana-based firms (Ocean industry's report...1976). To dock and service this marine fleet involves land along the region's limited natural levees.

In addition, cities on well-developed traffic corridors serve as nodal points, attracting all types of businesses involved in meeting the logistic needs of the offshore contractors. Expansion of these support facilities stimulates the local economy, and marked changes in urban and built-up land uses occur. Demand is high for residential, commercial industrial, and transportation services, communications and utilities, institutional, and other types of intensive land uses. In nearly all places on this coast, the natural environment limits or confines urban growth. Support industries, therefore, are agglomerated or confined within the few well-drained areas. Exploration and development on and offshore have changed the region's rural character and established the foundation for attracting primary and secondary industries to various logistic support centers.

LOGISTIC SUPPORT CENTERS

Within several MDPR communities the landscape is dotted with prefabricated metal buildings, housing companies that cater to every aspect of the offshore petroleum industry. Such companies have turned the delta settlement clusters into major logistic support centers. There are engineering firms, chemical distributors, mud companies, hardware outlets, shops specializing in marine engines, ship builders, boat repair services, towing contractors, log libraries, heliports and aircraft maintenance facilities, boat rental firms, structural fabricators, and many others. Although many sites are less than 4 hectares (10 acres) in size, all occupy space and are contributing to the MDPR's patterned landscape.

Various support craft are necessary to keep onshore and offshore operations on schedule. Mud, casing, cement, and other expendables are transported from onshore bases to the job site by a continuous ferry service. In one instance, a drilling rig working off Nicaragua was supplied from Venice, Louisiana (Ocean industry's report...1976). In linear communities flanking the Region's principal waterways, the boat industry has become an intricate part of the region's economy (Table 11).

Four settlement clusters and two cities serve as principal logistic support centers. Bayou Lafourche, Houma, Morgan City, and Plaquemines Parish are the principal strips. New Iberia and New Orleans serve as additional support centers. Eighty percent of the deltaic plain's petroleum business is located within these six areas.

Houma

There are 497 firms in Houma, an oil-field service center. In Houma and its environs, the petroleum industry has been directly or indirectly responsible for 1,340 hectares (3,312 acres) of commercial services, industrial, transportation, utilities, and commuications properties. South of the city, along the three major waterways and at the airport, there are 290 hectares (709 acres) of industrial real estate. This land is confined to eight parcels ranging from 4 hectares (10 acres) to a 54-hectare (381-acre) site adjoining the airport.

Two nearly contiguous tracts adjoining the Intracoastal Canal and Bayou Lacarpe serve as a major industrial complex. This 77.7 hectare (192 acre) area has attracted numerous petroleum-related firms. An agglomerating process has formed in this area also, with each new business attracted to the site because of market proximity and a skilled labor force. The area is a nodal point that will continue to expand. New industrial parks will join the existing land-use and land-cover patterns to enlarge the industrial base. Major dock space is confined to three sites involving 132 hectares (325 acres).

Morgan City

Morgan City's waterways attracted numerous water-oriented enterprises, making the city the fourth largest seaport in the State. Thirteen shipyards, 34 towing firms, and 49 boat charter and rental services make it one of the busiest ports for its size (Davis and Detro 1977).

Natural levees in and around Morgan City are dotted with metal buildings. These commercial businesses have moved out of the city, interrupting the continuity of the agriculture, and strip and clustered settlement patterns. Nineteen areas appear on the land-use and land-cover map involving 780 hectares (1925 acres). Several of the patterns are not related to the petroleum industry. Those that are related, however, show how the firms tend to agglomerate. Some patterns are a mixture of service-oriented retail and wholesale outlets.

Table 11. Offshore crewboats, supply vessels and tugs owned by Deltaic Plain Marine Service Company, February 1978.

Owner	Existing fleet	New vessels: Planned	New vessels: Under construction
Acadian Marine Services - New Orleans	3	4	2
Allstate Marine & Investment Services, Inc. - Houma	24	--	--
American Offshore Boat Service, Inc. - Belle Chasse	10	--	--
Luke V. Bellanger - Golden Meadow	1	1	--
Berwick Bay Oil - Morgan City	5	--	--
Bisso Marine Co. Inc. - New Orleans	3	--	1
Black Gold Marine - Harvey	14	--	7
Bollinger Offshore Boats - Lockport	12	--	--
Briley Marine Services, Inc. - Morgan City	3	--	4
Bruce Boat Rentals Inc. - Gibson	11	--	3
Otto Candies Inc. - Des Allemands	23	--	6
Candy Boats, Inc. - Morgan City	4	--	4
C-Craft Marine, Inc. - Galliano	3	--	--
Cenac Towing Co. - Houma	27	--	--
Cheramie Bros. Inc. - Golden Meadow	22	--	3
Coastal Marine Inc. - Morgan City	18	--	6
D and B Boat Rental Inc. - New Iberia	6	--	--
DAPTCO Marine - New Orleans	2	--	--
Defelice Marine Construction - Metairie	10	--	2
Domar Ocean Transportation - Morgan City	2	1	1
Euro-Pirates International - New Orleans	21	--	--
F&S Offshore Inc. - Berwick	22	--	--
Flotation Service Inc. - New Iberia	7	--	--
Galaxie Marine Service Inc. - Patterson	7	1	2
Galaxie Offshore Inc. - Belle Chasse	3	--	--
Gulf Fleet Supply Vessels, Inc. - New Orleans	75	--	11
Guzzetta Offshore Marine Service - Berwick	6	--	1
Imco Service - New Orleans	3	--	1
J-W Operating Co. - Morgan City	8	2	--
Johanna Seas, Inc. - Galliano	1	--	--
Arthur Levy Enterprises - New Orleans	5	--	3
Louisiana Mud Co. - Houma	6	--	--

(continued)

Table 11. (concluded)

Owner	Existing fleet	New vessels: Planned	New vessels: Under construction
Lytal Marine Operators - Lockport	8	2	--
Andrew Martin Sea Service - Galliano	8	--	--
Offshore Island Boats, Inc. - New Orleans	4	--	--
Offshore Service Ships Inc. - Gretna	1	--	--
Offshore Supply Ships Inc. - Gretna	1	--	--
Petro Marine - Gretna	35	--	--
Point Marine - Morgan City	2	2	2
Purlis Viator Boat Rental, Inc. New Iberia	2	--	--
Robin Boat Rental Service, Inc. - Harvey	17	--	--
Seahorse, Inc. - Morgan City	70	--	8
Seven Seas Towing Co. Inc. - Westwego	1	--	--
Sug Rossan, Inc. - Morgan City	2	--	--
Nolty J. Theriot, Inc. - New Orleans	26	--	--
Tidewater Inc. - New Orleans	296	--	11
Deltaic Plain Total	852	22	88
[a]Other Louisiana Firms	125	--	7
State Total	977	22	95
World Total	2,446	33	123
Deltaic Plain Percents	35	67	77

[a]Gulf Boat Marine Service - Cameron	14	--	3
Offshore Logistics, Inc. - Lafayette	111	--	4

Note: Many of the Offshore Logistics Boats are based in Deltaic Plain ports, but the firms have home offices in Lafayette.

Source: Marine transportation 1977.

Bayou Lafourche and Plaquemines Parish

Linear settlements along Bayou Lafourche and in Plaquemines Parish are boat and service oriented. Petroleum-related industries have located adjacent to Bayou Lafourche to meet the needs of the offshore operators. Intertwined in the elongated acreage within Plaquemines Parish are numerous industrial sites. In the southern part of this parish, industrial land-use and land-cover patterns occupy 3,639 acres. Over 50 percent of the industrial real estate is within the communities of Port Sulphur, Venice and Southwest pass with 464, 785 and 686 acres respectively. In the northern part of Plaquemines Parish, including the neighboring "New Orleans' west bank", there are 3,071 hectares (7,588 acres) of industrial property, and 902 hectares (2,230 acres) of transportation facilities.

Other Logistic Centers

New Iberia and New Orleans have 1,090 businesses related to the petroleum industry. As might be expected, these firms have played a significant role in the economic structure of the two areas.

Due to the importance of logistic support bases and ancillary services, all of the MDPR's natural levee settlements with the exception of Bayou du Large, have profited from hydrocarbon exploration and development. Dock and storage space within these areas is often confined to small sites, such as the service centers along Bayou Grand Caillou, whereas, along Petit Caillou, there are 66 hectares (162 acres) of transportation-oriented land. One site encompasses 48 hectares (118 acres) of industrial land. Sites vary from the 28-hectare (70-acre) facility at Cocodrie to numerous other facilities farther up the bayou.

Marine-related businesses have been established throughout the area. Shipbuilding and towing are particularly noteworthy. The strip and clustered settlements and the New Orleans Standard Metropolitan Statistical Area have developed into important marine-related centers.

People living in the strips of cities have been responsible for the design, construction, operation, and maintenance of drilling rigs, production platforms, crewboats, barges, piplelines, pipe-lay barges, and service vessels. They have witnessed regional transition from land-intensive to labor-intensive occupations and the associated changes in the landscape. The equipment used in working offshore had to be constructed to meet local needs. There was no precedent. Louisiana was the worldwide leader in offshore hydrocarbon exploration and had to learn from trial and error. Through the slow evolutionary process, the region has profited from the "offshore age of petroleum exploration".

PETROLEUM INDUSTRIES

The petroleum industry in the MDPR involves refining and those production processes by which refinery products are further modified to create industrial organic chemicals, the basic materials from which synthetic fibers and plastics, rubber and lubricants, and hundreds of other products are made. The growth of the Region's petrochemical industries has been intimately related to the development of mineral resources. Since 1947, when construction was completed on the first offshore oil well, the Mississippi River banks between Baton Rouge and New Orleans have been transformed into the "Petrochemical Gold Coast," also locally referred to as the "Chemical Coast".

In September 1978, the Resource and Development Department of the Illinois Central Gulf Railroad reported 45 industries located in the Louisiana parishes bordering the Mississippi River (Tables 12 and 13). Their research indicates 21 sites are available for industrial expansion, all on the river's east bank. However, a Louisiana Power and Light publication documents 88 sites available for industrial development, 52 on the river's west bank and 36 on its east bank. These potential sites vary in size from an 8-hectare (20-acre) site with 251 meters (825 feet) of river frontage to a 750-hectare (1850-acre) tract with nearly a mile of potential dock and wharf space. In addition, three industrial parks (Elmwood, Airline, and St. James) have been established to serve the needs of smaller companies.

Table 12. Petrochemical industries along the Mississippi, September 1, 1978.

1. Trans-America Match Corp.
2. International-Matex Tank Terminals, Ltd.
3. Unsamex Fertilizer
4. Chevron Oil Co.
5. General American Tank Storage & Terminal
6. Good Hope Refinery
7. Shell Oil Co.
8. Shell Chemical Co.
9. E.I. Dupunt DuNemours & Co.
10. Marathon Oil Co.
11. Nalco Chemical Co.
12. Boswell Oil Co.
13. Kaiser Aluminum & Chemical Corp.
14. Marathon Oil Co.
15. Freeport Chemical Co.
16. Joc Oil Co.
17. Skelly Oil Co.
18. Ethyl Co.
19. Texaco, Inc.
20. Swift Agricultural Chemical Co.
21. Gulf Chemical Co.
22. Shell Pipeline Co.
23. Getty Oil Co.
24. Shell Chemical Co.
25. National Phosphate Corp.
26. Hooker Chemical
27. Argus Chemical Corp.
28. Union Carbide Corp.
29. Monsanto Co.
30. American Cyanamid Co.
31. Missouri Portland Cement Co.
32. LaJet, Inc.

Source: Louisiana: Baton Rouge - New Orleans...1976.

Not all river-related industries are directly related to Louisiana's hydrocarbon resources. The industries located in the Baton Rouge to New Orleans corridor can be catalogued into five groups -- petro-chemical, grain storage and shipment, power generation, sugar processing, and steel fabrication (Table 13).

Extensive building in the 1960's, along with continued expansion and new construction, has changed the riverline landscape from rural farmland to specialized industrial uses. New industries try to take advantage of prime deep water sites on the Mississippi's cut bank, because in these locations the river constantly scours the channel. Point-bar sides of the river are areas of concentrated deposition, and industries located on these "points" require mainte-

Table 13. Other industries located along the Mississippi River, September 1, 1978.

GRAIN STORAGE AND SHIPMENT	
1.	Bunge Corp.
2.	St. Charles Grain Elevator Co.
3.	Allied Flour
4.	LaPlace Elevator Co.
5.	Cargill, Inc.
6.	Peavey's St. Elmo Elevator
7.	Farmers Export
8.	Midland Ross Co.
POWER GENERATION	
1.	Louisiana Power & Light
2.	Louisiana Power & Light
SUGAR PROCESSING	
1.	Godchaux Henderson Sugar Co.
2.	Colonial Sugars Company
STEEL FABRICATIONS	
1.	Bayou Steel

Source: Louisiana: Baton Rouge - New Orleans...1976.

nance dredging to maintain port depth. These ports, located from Baton Rouge to New Orleans, have rapidly expanded their activities, so by 1975, they were transferring over 97 million metric tons (88 million tons) of cargo.

Industrial expansion has taken place on both sides of the Mississippi, but the east bank is by far the most important. On the east bank, where there is deep water and cut bank sites, there are also the most tracts of land available for development. Also, the east bank has the ports of Destrehan, St. Rose, Gramercy, Good Hope and several others. These ports specialize in grain transfer, petroleum refining, petrochemical manufacture, and bauxite reduction.

The west bank is characterized by 16 industrial plants, with all except Farmers Export, Midland-Ross Corp., and Louisiana Power and Light considered petro-chemical industries. Two tracts on the west bank have been optioned and little or no land is available for development.

South of New Orleans, seven industrial plants have located on the east bank. They include: Amstar Corp., Kaiser Aluminum & Chemical Corp., Tenneco Oil Co., Murphy Oil Corp., AMAX Nickel Refining Co., Inc., Electro-Coal Transfer Terminal, Cal-Ky Pipeline Terminal, and Gulf Oil Corp. On the west bank, 13 tracts of riverine real estate are developed. The firms include: Louisiana Power and Light (2), FMC, Corp., Universal Mississippi River Grain Elevator Co., Koch Oil Co., Freeport Sulphur Co., Petrou Fisheries Inc., Empire Menhaden Co., and Getty Oil. Overall, industrial firms located along the river south of New Orleans are of a diverse economic mix. Of 20 firms, only eight can be classified as petroleum industries.

Development south of New Orleans is limited by the physical environment where good industrial land is confined to narrow natural levees. The flood-free land upriver from New Orleans is substantially larger and more attractive for industrial uses. In many cases, sites south of New Orleans are on land under forced drainage and often the available property is too small to accommodate the larger real estate demands of the petroleum industry. Planned new industries and expansion by existing industries along the "Chemical Coast" are indicated in Tables 14 and 15.

Table 14. New industries building along the petrochemical Gold Coast, 1977-1978.

Associated Energy Transporters - will operate a coal transfer facility at Myrtle Grove. The plant will be built in two phases, each costing $12 million.[a]
Boswell Oil Company - will build a mini-refinery at Mt. Airy at a cost of $1.8 million.[a]
Shell Chemical Company - will build a $500 million ethylene manufacturing facility at Norco.[a]
International Processors of St. Rose - plans to construct a multi-million dollar oil refinery near St. Rose. The facility is estimated to cost $7.9 million.[b]
American Cyanamid - will complete in 1978 a 240,000 mt/y ammonia plant at Avondale at an undisclosed cost.[c]

Source: [a]Development report, new plants and expansions - 1977 (partial listing). 1978a.
[b]Development report, new plants and expansions - first quarter - 1978 (partial listing). 1978b.
[c]Cantrell, 1978d.

Table 15. Plants planning expansion.

MARATHON OIL COMPANY is increasing the unleaded gasoline capacity of its Garyville refinery at an estimated cost of $160 million.[a]

TEXACO INCORPORATED will add a $100 million plus crude oil desulfurization facility to its Convent refinery.[a]

UNION CARBIDE will expand operations at its Taft facility to double its present ethyleneamines capacity at a projected cost of $52 million.[a]

CARGILL INCORPORATED will spend $1 million plus to add to its molasses facility at Reserve.[b]

CHEVRON CHEMICAL COMPANY will spend $1.4 million on expansion projects at its Belle Chasse plant.[b]

MT. AIRY REFINING COMPANY, MT. AIRY is making a $340,000 addition to its facility.[b]

TENNECO OIL COMPANY will add a pretreater and reformer to its Charmette plant at a cost of $20 million.[c]

KAISER ALUMINUM & CHEMICAL CORPORATION will spend $7.5 million to expand its Chalmette plant for the manufacture of aluminum[d]

KAISER ALUMINUM & CHEMICAL CORPORATION WILL SPEND $10.4 million to expand its Gramercy coke producing plant.[d]

KAISER ALUMINUM & CHEMICAL CORPORATION IS EXPANDING ITS Norco facility for the production of calcined petroleum coke at a cost of $250,000.[d]

LAJET, INC. will spend $1.8 million to add on to its refined petroleum products plant at St. James.[e]

Sources: [a]Development report, new plants and expansions - 1977 (partial listing). 1978a.
[b]Development report, new plants and expansions - first quarter - 1978 (partial listing). 1978b.
[c]Development report, new plants and expansions - second quarter - 1978 (partial listing). 1978c.
[d]Development report, new plants and expansions - third quarter - 1978 (partial listing). 1978d.
[e]Cantrell 1978d.

MDPR OIL AND GAS OPERATIONS: A SUMMARY

From the earliest efforts, development of Gulf coast hydrocarbon reserves has been dependent on continuous improvements in technology to overcome the environmental constraints. Beginning with wells drilled on stable inland ground, the oil and gas industry moved slowly seaward as economical and reliable methods were developed to deal with the marshes, swamps, and open Gulf waters off the Louisiana and Mississippi coasts.

One technological change whose implications will warrant future scrutiny is the implementation of directional drilling techniques. Offshore drilling activities have utilized directional drilling for several years to minimize the cost of multiple-platform fabrication while developing deep-water oil and gas fields. A single platform can be designed with drilling equipment that extends in all directions from a common center.

Onshore drilling activities, which have declined substantially in recent years, could increase in the near future, especially if market conditions make development of the Tuscaloosa Trend more financially attractive. Onshore, however, directional drilling is relatively expensive when compared with vertical drilling, because of the added distance that must be drilled to reach the same depth below ground level. Despite its greater cost, directional drilling can be less disruptive than vertical drilling activities, because hydrocarbon reserves can be extracted from beneath the surface of ecologically sensitive areas with relatively little ecological disturbance. To arrive at a set of policies that will guide hydrocarbon resource development while optimizing the use of renewable resources in the MDPR, the merits and disadvantages of directional drilling techniques should be carefully examined.

Without question, the development of the hydrocarbon industry in the MDPR has had significant socioeconomic impacts. Some of these impacts have been reviewed in this paper by presenting information on direct oil and gas related industrial developments. More important may be the secondary and tertiary impacts that have occurred and continue throughout the region. Development of transportation networks provided the sophisticated access needed for diversified urban/commercial/industrial development of an area. Increases in the incomes of residents helped to provide the stimulus for more services and goods to be produced and supplied. Immigration to the area helped to provide needed skills that have diffused throughout the MDPR into all sectors of the economy. In summation, while oil and gas development had a strong influence on the general development of the MDPR, other development stimulae have helped to continue and accelerate regional economic and population growth.

In addition to the pure historical aspects of oil and gas development in the MDPR and the descriptions of current conditions, one of the more significant findings of this analysis has been that the three Mississippi counties have had little onshore or offshore impact from hydrocarbon development when compared to the fourteen parishes in Louisiana. This is not to say that the development that has occurred in Mississippi has not been important. Rather, when looking at the MDPR as a whole, these areas (much like the Florida parishes north of Lake Pontchartrain) have had less activity and will likely continue to have less in the future (Gladden et al. 1976).

This paper has been intended to provide a general overview of oil and gas activities in the MDPR. While other topics discussed in the following synthesis papers have had some major problems with data gaps, the amount of information available on hydrocarbon activities in the MDPR is overwhelming. For this reason some sources that many readers may feel are significant have not been utilized. An effort has been made to select key references that adequately and accurately represent oil and gas activities throughout the Region.

SOCIAL & DEMOGRAPHIC CHARACTERISTICS

Like many of the nation's coastal regions, the Mississippi Deltaic Plain Region (MDPR) has become more populous, more prosperous, more urbanized, and more industrialized since World War II. While the region's growth rate has not matched the growth rates of some of the other coastal regions (most notably the north Texas Gulf Coast region and Florida's Tampa Bay region), the nature of historical economic and population growth in the MDPR has almost guaranteed that the region will continue to undergo a rapid but stable expansion trend for many years to come.

The dynamic nature of the growth trend is derived essentially from two sources: (1) long-term development of the region's vast hydrocarbon resources, accompanied by extensive service base expansion at the expense of agricultural production and commercial fishing and trapping activities; and (2) opportunities that the region presents to a growing retirement-oriented segment of the nation's population, including a relatively low average cost of living, a favorable tax structure in both Mississippi and Louisiana, an attractive climate and cultural/recreational amenities that are unique to the region.

The impact of oil and gas development on growth in the Deltaic Plain is difficult to measure accurately. The tendency is to attribute a great deal of significance to oil and gas development, if for no other reason than that the pipelines, processing plants, drilling rigs, and refineries have such high visibility. It is one thing to say that the petroleum industry has touched the lives of many Deltaic Plain residents, but it is quite another to identify the actual number of people in the region who would either not be there, or who would be doing something else, were it not for oil and gas. Extraction, transportation, and refinery activities that make up the petroleum industry itself are characterized by a sophisticated technology that requires relatively small labor inputs. The direct support provided by welders, fabricators, mud suppliers, tool and die manufacturers, and banks represents a much higher level of labor intensity. But the local record stores, supermarkets, office supply firms, architects, construction contractors and dozens of other types of business concerns are also a consequence, to some extent, of the petroleum industry.

The precise association is hazy at best between population growth and long-term development on the one hand, and the petroleum industry on the other. What we know about this association has been generally pieced together from scores of specific research efforts that were aimed at obtaining a specific association between one proposed project and its growth impacts. The cumulative impacts of a whole series of such projects is difficult to ascertain, as the sum does not necessarily equal the aggregate impact of several facilities. The presence of two new offshore lease tracts may generate "x" new jobs on shore, but there is a question that remains regarding the amount of speculative investment that surfaces in an attempt to cash in on what may or may not have been the beginning of a long-term trend. The presence of speculation and other irresistible qualities that the forces of growth have demonstrated, obscure the actual impact attributable to offshore development in this case. Unless more sophisticated growth simulation models are created to account more fully for the causal role of oil and gas development, one is left with the impression that while petroleum provided the initial impetus for growth in the Deltaic Plain Region, this growth has assumed a character of its own.

Commercial and industrial development have resulted in a substantial employment-related migrant influx. Because of the long-term period of this development and the migrant population's age and sex structure (predominantly young and at the beginning of their family-raising careers), the rate of population growth has been influenced by migrant-related natural increase (births minus deaths among new residents) as well as net in-migration. This migrant-related natural increase is not readily discernible from census records, but is a hidden source of growth with which resource planning must reckon.

As with many of the Sun Belt regions, the retirement opportunities offered in the MDPR have become an important source of non-employment-related migrant influx to the region. In addition, several outstanding colleges and universities in the greater New Orleans metropolitan area have attracted students from all over the South, if not the nation, forming an additional source of non-employment-related migrant influx. Many of these students remain in the MDPR after graduation, rearing families and contributing an additional source of population growth.

Regional population growth, then, will be seen largely as the result of intra-regional migrant shifts, for both employment and non-employment (e.g., retirement and educational) opportunities. The other source of growth, natural increase (births minus deaths) has contributed heavily to regional growth in the past. Whereas today people are generally marrying later in their lives and having fewer children, the post-war years saw an unusual rise in fertility that lasted well into the 1960's.

In light of present and projected development trends (Figure 9), the major concerns that face coastal resource management planning are threefold: (1) the effects of population growth and industrial development on land uses in the MDPR; (2) the growth-spurred demand for leisure time activities and the consequences that such a demand may have on MDPR coastal zone resources; and (3) the ability of public agencies to provide services to an expanding population.

Discussion of growth and development, their causes and consequences, will explore in greater detail the sources of population growth in the context of concerns mentioned above. Problems with data availability and consistency hamper this discussion principally where data collection has not been guided by the specific analysis required to adequately address resource management concerns. In general, we have found a basic incompatibility among state-collected data across State lines. We are also concerned that the standard Bureau of the Census racial categories do not adequately reflect the region's ethnic diversity. In addition, recent policy changes regarding energy consumption and fuel production are likely to have a profound effect on the MDPR economy. Very little research has been conducted in an effort to demonstrate (or simulate) current intersectoral relationships that obtain between petroleum production and other economic activities. Analysis of these relationships is critical to an understanding of employment-related migration, future labor force composition, and coastal zone resource utilization. The time lag between census data collection and publication creates a heavy dependence on intercensal interpolation techniques to arrive at a description of current social and demographic characteristics - a description that will not be easily updated until well into the next decade.

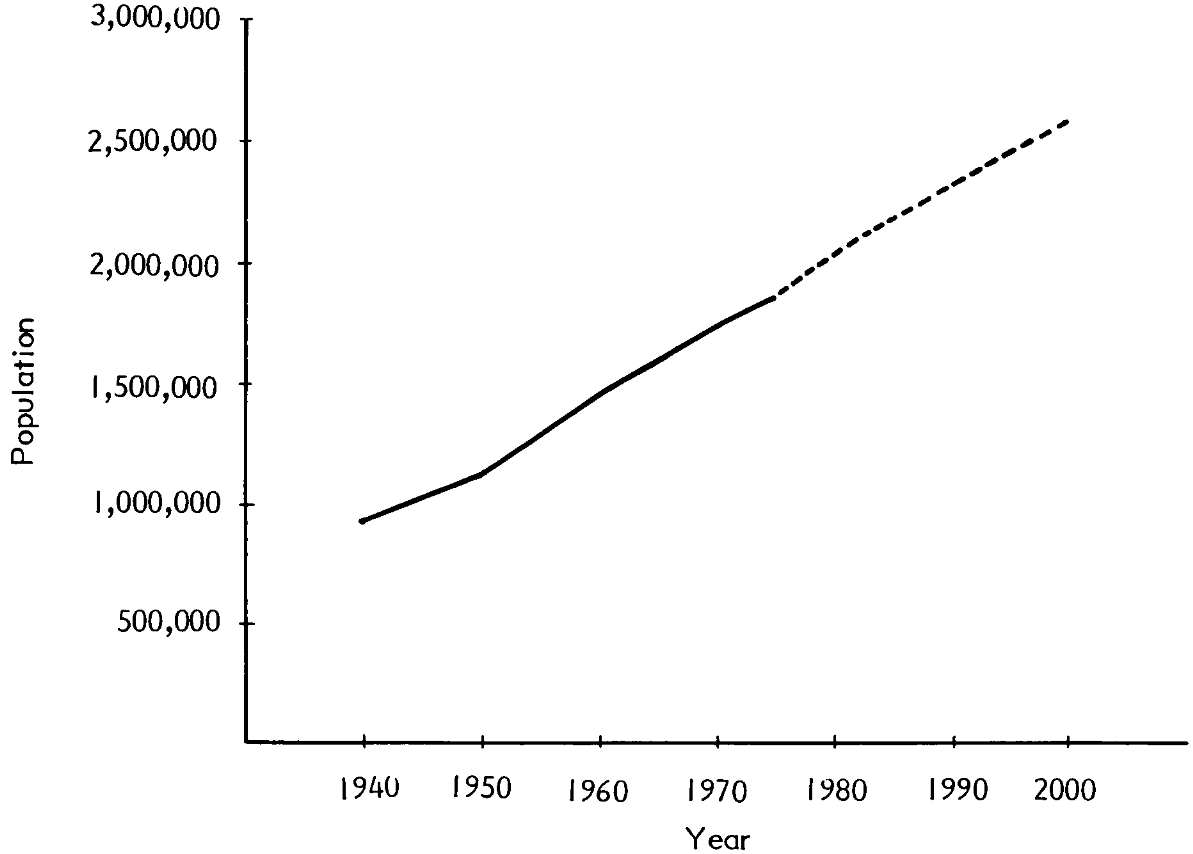


Figure 9. MDPR historical and projected population growth, 1940 - 2000

Sources: Renner, J.R. 1976.

Mississippi State University, Division of Research, College of Business and Industry, 1978.

Data gaps and inconsistencies notwithstanding, the following discussion focuses on the MDPR's human resources. The first section, "Population Growth", describes current structural characteristics of the population, development rates and regional variations, and the relative contribution made to growth by migrant influx and natural increase. The second section, "Economic Development", describes the region's labor force, current trends in commercial and industrial development, intersectoral relationships in the region's economy, and income characteristics of the region's residents. A third section, "Resource Base Pressures", identifies the consequences that projected growth and development may have on land uses and on the region's ability to meet growth-spurred demand for community services and facilities. Finally, problems with data gaps and inconsistencies are identified, along with a series of recommendations for resolving these problems.

POPULATION GROWTH: URBAN DEVELOPMENT AND SUBURBAN EXPANSION

Growth of the MDPR population accelerated after the end of World War II, reached its peak rates in the period 1950-1960, and has begun to decelerate since 1960 (Table 16). Projected growth rates indicate that this deceleration trend in population growth will continue through the beginning of the next century. Whereas during the period 1940-1950, the average annual growth rate was 2.3 percent, the average growth rate jumped to approximately 3.1 percent per year for the period 1950-1960, and then declined to approximately 1.8 percent per year for the period 1960-1970. Projected regional growth for the period 1970-1980 provides an estimated annual rate of 1.6 percent, with subsequent estimates declining to 1.5 percent from 1980-1990, and down to 1.1 percent per year for the period 1990-2000.

This growth is not evenly shared throughout the region. Orleans Parish, for example, has slowly decreased both in absolute population size and its relative share of the regional population. In 1960, Orleans Parish represented 42 percent of the region's population, but by 1975 it represented only 30 percent. By the year 2000, projections indicate that Orleans parish will account for 20 percent of the region's population (Renner 1976), which represents a startling redistribution of a once highly centralized regional population.

Jefferson, St. Bernard, and St. Tammany Parishes, on the other hand, have experienced significant population increases since the end of World War II, reflecting to a large extent the exodus that occurred from the New Orleans city center to the surrounding suburbs. Jefferson Parish population doubled between 1940 and 1950, and doubled again between 1950 and 1960. In 1960, Jefferson Parish accounted for approximately 14 percent of the MDPR population, but by 1980, it is estimated that nearly one-fourth of the entire regional population will reside in Jefferson Parish.

St. Tammany and St. Bernard Parishes are expected to receive a belated growth spurt, with St. Tammany currently experiencing the most rapid growth of any parish or county in the region. Growth is directly associated with improved transportation facilities between the New Orleans job market and lower land prices in St. Tammany Parish. Interstate 10 opened the area to suburbanization, and projections for growth rates through the next two decades indicate that the parish population will increase its present 4.3 percent of the MDPR population to almost 6 percent by the year 2000. Growth rates in St. Bernard Parish have been consistently higher than the region's growth rate as a whole. The parish population

Table 16. Parish/county and regional historical and projected population growth: MDPR 1960-2000.

Parish/county	1960	1970	1975	1980	1975-1980 % change	1980 % of total
Iberia	51,657	57,397	60,973	63,813	4.7	3.1
Jefferson	208,769	337,568	398,747	493,427	23.7	24.2
Lafourche	55,381	68,941	72,999	87,994	6.8	3.8
Livingston	26,974	36,511	42,840	47,961	11.9	2.4
Orleans	627,525	593,471	562,420	550,844	-2.1	27.0
Plaquemines	22,545	25,225	26,077	27,677	6.1	1.4
St. Bernard	32,186	51,185	58,232	71,084	22.1	3.5
St. Charles	23,219	29,550	32,162	36,729	14.2	4.8
St. James	18,369	19,733	19,599	20,198	3.1	1.0
St. John the Baptist	18,439	23,813	24,796	28,262	14.0	1.4
St. Mary	48,833	60,752	61,224	70,831	15.7	3.5
St. Tammany	38,643	63,585	81,323	86,356	6.2	4.2
Tangipahoa	59,434	65,875	71,905	72,218	.4	3.5
Terrebonne	60,771	76,049	85,069	88,032	3.5	4.3
LA MDPR Total	1,290,745	1,510,195	1,598,366	1,735,426	8.6	85.3
Hancock	14,039	17,387	18,249	19,200	5.2	.9
Harrison	119,489	134,582	143,528	165,800	15.5	8.1
Jackson	55,522	87,975	105,186	115,000	9.3	5.6
MS MDPR Total	189,059	239,944	266,963	300,000	12.4	14.8
MDPR Total	1,479,795	1,750,139	1,865,329	2,035,426	9.1	100.0

(continued)

Table 16. (concluded)

Parish/county	1990	1980-1990 % change	1990 % of total	2000	1990-2000 % change	2000 % of total
Iberia	69,115	8.3	3.0	69,738	.9	2.7
Jefferson	663,497	30.5	28.4	798,594	20.4	30.8
Lafourche	87,870	12.7	3.8	92,871	5.7	3.6
Livingston	59,788	24.7	2.6	73,375	22.7	2.8
Orleans	531,028	-3.6	22.7	517,911	-2.5	20.0
Plaquemines	32,285	16.6	1.4	32,438	.5	1.2
St. Bernard	92,045	29.5	3.9	109,412	18.9	4.2
St. Charles	45,056	22.7	1.9	54,022	19.9	2.1
St. James	21,477	6.3	.9	22,680	5.6	.9
St. John the Baptist	35,310	24.9	1.5	41,325	17.0	1.6
St. Mary	58,335	-17.6	2.5	54,779	-6.1	2.1
St. Tammany	114,653	32.7	4.9	148,676	29.7	5.7
Tangipahoa	78,722	9.0	3.4	83,876	6.5	3.2
Terrebonne	102,953	16.9	4.4	111,380	8.2	4.3
LA MDPR Total	1,992,134	14.8	85.3	2,211,077	11.0	85.2
Hancock	21,200	10.4	.9	23,400	10.4	.9
Harrison	186,800	12.7	8.0	212,200	13.6	8.2
Jackson	135,100	17.5	5.8	147,000	8.8	5.7
MS MDPR Total	343,100	14.3	14.7	382,600	11.5	14.8
MDPR Total	2,335,234	14.7	100.0	2,593,677	11.1	100.0

Sources: Renner, J. R. 1976.
Mississippi State University, Division of Research, College of Business and Industry 1978.

The parish population has always represented a relatively small proportion of the region, however, so that absolute increases in St. Bernard have not equalled the increases in some of the other parishes and counties with lower growth rates. St. Bernard Parish is expected to continue to grow at an unusually high rate, and is also expected to increase its present 3 percent share of the regional population to more than 4 percent by the year 2000.

The Mississippi coastal counties (Hancock, Harrison, and Jackson) account for a combined total of nearly 15 percent of the MDPR population. The coastal county population, centered primarily in Harrison and Jackson counties, has grown more rapidly than the MDPR has a whole. In 1940, the three counties accounted for only 9 percent of the regional population, but by 1970, they accounted for nearly 14 percent. Their present share in relation to the Louisiana parishes is expected to remain relatively constant at least through the next two decades.

It is important to note that there are several different measures with which to characterize population growth, and each one gives a slightly different image of the growth's significance. An absolute increase (or decrease) in population refers to the actual number of people who have been added to (or deleted from) a given area. This absolute measurement translates into a specific number of added sewer hookups, hospital beds, jobs, or cars on the highway. A rate of increase, expressed here in terms of percentages refers to the number of people who have been added to an area relative to the number of people who lived in that area previously. This relative measurement translates into an incremental addition of jobs, cars on the highway, and demands for services.

The distinction between absolute and relative increases is critical to an understanding of population change and its significance. In the case of St. Bernard Parish, for example, the projected addition of 12,850 persons between 1975 and 1980 is practically the same absolute change as the decrease projected for Orleans Parish (11,576 persons) in the same period. However, the relative change for St. Bernard Parish, a projected 22.1 percent increase, is more than 10 times the projected 2.1 decrease that those persons represent to Orleans Parish. On a parish by parish basis, existing facilities, developable land, and community service systems are much more likely to be capable of absorbing a two percent change than a 22 percent change in the service population, regardless of the absolute number of persons involved.

Rural to Urban Population Shift

In the last 40 years, the MDPR has been transformed from an area with only a few concentrated urban areas serving as market and distribution centers for an economy dominated by agricultural activities, to an area with a vastly expanded urban landscape accompanying diversified industrial development. Like much of the rest of the nation during this period, agricultural labor and land resource utilization in the MDPR declined as a result of technological innovations and a decrease in the real cost of capital relative to labor.

The Baton Rouge-New Orleans industrial corridor along the Mississippi River began to expand in the late 1930's and after World War II. Hydrocarbon exploration and development, both on and offshore, began in earnest during approximately the same period. A hierarchy of urban centers emerged, distinguishable on the basis of where demands originate for their locally produced goods and services. The New

Orleans Standard Metropolitan Statistical Area (SMSA) is the primary urban center in southeast Louisiana. The city has all the primary and secondary services associated with a dominant urban core, and serves an area well beyond Orleans, St. Tammany, St. Bernard, and Jefferson Parishes, which comprise the SMSA. The densely populated areas that are not properly equipped to respond to the demands of the local populations are faced with a number of municipal and regional problems. These secondary service centers are not able to adequately meet the demands of local residents. This is particularly critical in terms of transportation facilities, medical services, schools, utilities and commercial facilities. Even when the New Orleans metropolitan area is not affected by hurricanes, it is plagued by power shortages, inadequately maintained roadways and traffic congestion.

Between 1940 and 1970, the region's urban population increased substantially (Table 17). The area's rural/urban population shift within the ten-year period from 1960 to 1970 was actually a movement from the farm or fishing villages to small towns and/or from the cities to the urban fringe. In the Deltaic Plain, many small communities are located adjacent to a larger metropolitan area (e.g., Westwego in relation to New Orleans). A considerable amount of the urban growth in the past decade has been confined to these smaller places.

Part of this trend can be explained by the rural-based industrial complexes that have located in small, secondary service centers. These industries have been responsible for the out-migration from farms and swamp settlements, along with the tremendous increase in employment in non-farm rural centers. The growth of these centers has been related directly to hydrocarbon exploration and development, but these centers are not equipped with a full range of urban service capacities. Examples include New Iberia, Morgan City, Houma, many of the communities in lower Lafourche and Plaquemines Parishes, and many of the communities along the Mississippi River.

The Deltaic Plain is dotted with a number of small secondary population centers. These include communities that are linear extensions of primary urban places such as Morgan City, and communities that are adjacent to primary service centers that expanded as the core increased, as in the case of Harvey, Gretna, and Chalmette. There are also a number of secondary population centers that are relatively distant from primary service centers and serve their own market areas, as in the case of New Iberia and Thibodaux. These centers are significant because they serve as agglomeration points for public services and job opportunities; they are often removed from urban centers and serve to stabilize non-metropolitan development.

Sources of Growth: Natural Increase and Net Migration

In a recent environmental assessment of proposed Outer Continental Shelf (OCS) oil and gas leases, growth in the Gulf Coast regions is attributed to a combination of socioeconomic factors (Bureau of Land Management 1979). It is suggested that aggregate migration may be a response to cost of living differences between the Gulf Coast states and the rest of the nation. "It may be that lower price levels in the South compensate for lower per capita income levels" and represent an attractive force in regional net in-migration (Bureau of Land Management 1979). Expectations of future income are also identified as possible motivating forces in the decision to migrate toward the Gulf Coast states. The decision on the part of businesses to establish operations in the South is said to be motivated by the effect of lower prices and wages, abundant labor, and available

Table 17. Natural increase & net migration: MDPR 1970-1975.

Parish/county	1970	1975	Amount of change	Percent change	Natural increase	Net migration
Iberia	57,397	61,400	4,000	7.0	3,600	400
Jefferson	338,299	395,800	57,600	17.0	23,900	33,600
Lafourche	68,941	72,000	3,100	4.5	4,300	-1,200
Livingston	36,511	42,400	5,900	16.0	2,500	3,300
Orleans	593,471	564,300	-29,100	-4.9	19,400	-48,600
Plaquemines	25,225	25,900	700	2.8	2,000	-1,300
St. Bernard	51,185	57,800	6,700	13.0	3,100	3,600
St. Charles	29,550	32,000	2,400	8.3	1,900	500
St. James	19,733	19,600	-100	-.7	1,000	-1,200
St. John the Baptist	23,813	24,700	800	3.5	1,600	-800
St. Mary	60,752	60,600	-200	-.3	4,300	-4,500
St. Tammany	63,585	76,400	12,800	20.2	3,200	9,700
Tangipahoa	65,875	70,600	4,700	7.1	3,200	1,400
Terrebonne	76,049	83,400	7,300	9.6	6,300	1,000
LA MDPR Total	1,510,845	1,586,900	75,800	5.0	80,300	-4,100
Hancock	17,387	18,249	800	5.0	600	200
Harrison	134,582	143,528	12,300	6.6	10,400	1,800
Jackson	87,975	105,800	17,800	19.6	8,100	8,700
MS MDPR Total	239,944	267,577	30,900	12.9	19,100	11,700
MDPR Total	1,750,800	1,854,477	106,700	6.1	99,400	7,600

Sources: United States Department of Commerce, Bureau of the Census 1976.
Mississippi State University, Division of Research, College of Business and Industry 1978.

natural resources. Possible effects of the easily accessible energy sources in the southern petroleum states, and the milder climate are also cited as having an influence on the decision to relocate or establish operations in the South.

In identifying the sources of the Deltaic Plain Region's recent population growth, the relative contributions made by regional net migration and natural increase are somewhat startling. Over the period 1960 to 1970, the Louisiana Deltaic Plain parishes increased by approximately 220,000 persons, or 17 percent of their 1960 total size. Two hundred sixteen thousand new residents, 98 percent of this population growth, were the result of natural increase, whereas only 3,700 additional persons, or less than two percent of this growth resulted from net migration into the parishes (United States Department of Commerce 1971). Similarly, the Mississippi coastal counties increased by almost 51,000 between 1960 and 1970, representing a 27 percent increase over the decade. Natural increase accounted for nearly 32,000 of these new residents, or 62 percent of the decade's population growth. Net migration accounts for approximately 19,000 of this increase, or 38 percent of the growth (Mississippi State University 1978).

In the period between 1970 and 1975, natural increase in the Louisiana Deltaic Plain parishes actually made up for a net regional out-migration. While the Deltaic Plain parishes grew by almost 77,000 persons over this period, natural increase produced an estimated 80,300 new residents. More than 4,100 net migrants left the parishes. The Mississippi coastal counties grew by 13 percent between 1970 and 1975, which represented an absolute increase of 30,900 persons. Sixty-two percent of this increase, or an additional 19,100 persons, resulted from natural increase, while the 11,700 net in-migrants accounted for 38 percent of coastal county growth.

In assessing the relative significance of migrant influx, however, regarding the region as a whole is somewhat misleading. The Biloxi-Gulfport and Pascagoula-Moss Point SMSA's in Mississippi have been the areas of destination for a substantial number of regional newcomers in the past 20 years. In general, recent migration into the Deltaic Plain parishes from other origin points is relatively insignificant when compared with other Gulf Coast regions, but redistribution within the region has been extensive. St. Bernard, St. Tammany, and Jefferson Parishes have been the primary areas of relocation for Orleans Parish emigrants. In addition to Orleans Parish, other parishes that have actually had more out-migrants than in-migrants in the last 15 years are Lafourche, Plaquemines, St. John the Baptist, and St. Mary Parishes (University of New Orleans 1977). In these parishes, only a relatively high rate of natural increase has compensated for this net out-migration and contributed to overall parish population growth.

Natural increase is calculated as the number of deaths subtracted from the number of births over a given period of time. The rate of natural increase is normally calculated as the difference between the crude death rate (number of deaths per 1,000 population) and the crude birth rate (number of births per 1,000 population). Throughout the post-World War II era, both Louisiana and Mississippi had rates of natural increase that have been consistently higher than the national average (University of New Orleans 1977, Mississippi State University 1978). These higher average rates of natural increase reflect two important characteristics of the Deltaic Plain Region population: ethnic composition and age structure.

Ethnic composition as reflected in census categories distinguishes "whites" from "non-whites", and does not separately identify specific ethnic characteristics that may have an important relationship to fertility and mortality patterns (United States Department of Commerce 1971). Given this level of refinement in characterizing the Deltaic Plain Region's ethnic composition, historical trends reveal a gradual decrease in the region's percentage of minority group population relative to the entire regional population between 1950 and 1977 (Table 18). This declining percentage of minority group members indicates that growth among this sub-population has not kept pace with population increase in the region as a whole. Information is not available regarding selective migration by ethnic group status, making it impossible to identify the reasons for this slightly lower growth rate. It is known, however, that fertility rates for the region's minority group members are consistently higher than fertility rates among the majority population, and are also higher than national fertility rates for minority populations (University of New Orleans 1977, Mississippi State University 1978).

Despite the gradual decline in minority representation relative to the majority population, non-whites still represent a substantially higher proportion of the deltaic plain population than the national averages. The combination of this unusually high minority group percentage (27.6 percent for the Louisiana deltaic parishes in 1977 and an estimated 17 percent for the Mississippi coastal counties for the same year), and the typically higher fertility rates found among the region's minority group members influences to a large extent the region's relatively high rate of natural increase.

The other important influence on rates of natural increase in the Deltaic Plain Region is the population's age structure. As shown in Figure 10, the region's population was generally somewhat younger than the nation's population as a whole in 1970. The median age for Deltaic Plain residents was 24.8 years in 1970, and 28.1 years for the nation as a whole (University of New Orleans 1977). More recent age data are not available for the Deltaic Plain region, but a series of observations concerning growth dynamics and age structure leads to the conclusion that in the near-term case, natural increase will continue to contribute heavily to regional growth.

The region's relatively low rate of net in-migration over the past decade allows us to focus our attention on the deltaic plain population ages 5-14 years in 1970. Members of this age group are now entering the 15-24 years age category, and as a group, they are at the beginning of their collective family-building careers. Because this group is some 10 percent larger in relation to the Deltaic Plain Region population than its national counterpart, the total fertility output from this group can be expected to exceed national averages. In other words, it is likely that there will be relatively more active family builders who come from an area of the nation that has historically produced more births per thousand population than the nation as a whole.

On the other side of the natural increase equation, statistics show that the Deltaic Plain region has proportionately fewer elderly residents than the Nation as a whole. This relative deficit is not concentrated simply in the oldest age categories, but extends all the way through those categories of Deltaic Plain residents who were ages 35-44 years in 1970 (Figure 10). However, fewer people in the older age categories implies a continued trend of lower than average death

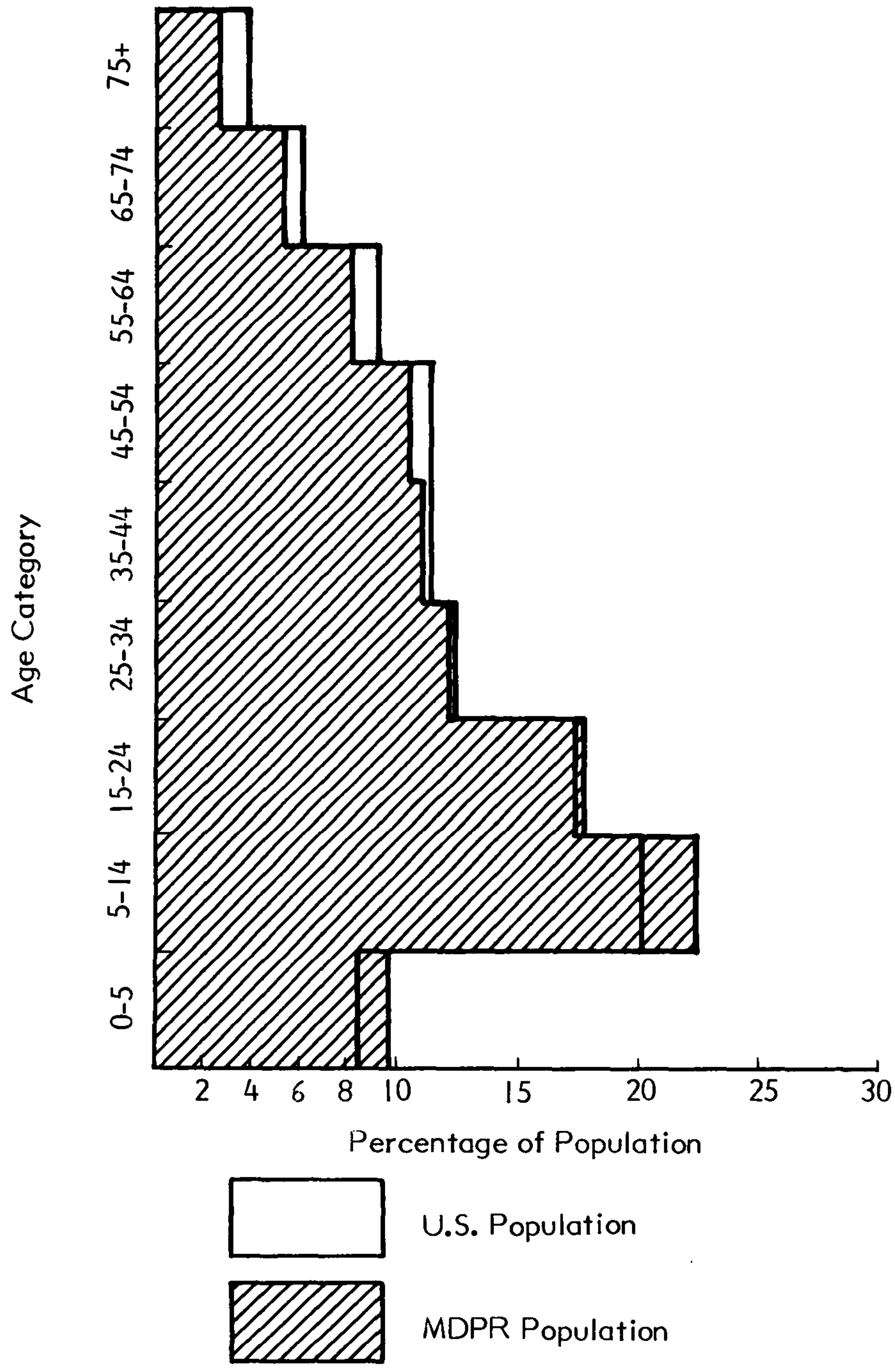


Figure 10. United States and MDPR population: age group as a percentage of total population, 1970.

Source: United States Department of Commerce, Bureau of the Census 1971.

Table 18. MDPR racial composition, 1940-1977.

Parish/county	1940 White	1940 Non-white	1940 % Non-white	1950 White	1950 Non-white	1950 % Non-white	1960 White	1960 Non-white	1960 % N whi
Iberia	23,735	13,448	36.2	27,086	12,973	32.4	36,843	14,814	28.7
Jefferson	41,834	8,593	17.0	87,604	16,269	15.7	176,845	31,924	15.3
Lafourche	32,659	5,956	15.4	36,531	5,678	13.5	48,619	6,762	12.2
Livingston	15,150	2,640	14.8	17,098	2,956	14.7	22,921	4,053	
Orleans	344,795	149,762	30.3	387,814	182,631	32.0	392,594	234,931	37.4
Plaquemines	6,864	5,454	44.3	8,731	5,508	38.7	16,041	6,504	28.8
St. Bernard	5,854	1,426	19.6	9,464	1,623	14.6	29,761	2,425	7.5
St. Charles	8,412	3,909	31.7	9,002	4,361	32.6	15,474	5,745	27.1
St. James	8,368	8,228	49.6	7,626	7,708	50.3	9,315	9,054	49.3
St. John the Baptist	7,890	6,876	46.6	7,445	7,416	49.9	8,926	9,513	51.6
St. Mary	17,152	14,306	45.52	2,102	13,746	38.3	33,755	15,078	30.9
St. Tammany	16,316	7,308	30.9	79,060	7,928	29.4	28,031	10,612	27.5
Tangipahoa	30,476	15,043	33.03	6,619	16,599	31.2	39,315	20,119	33.9
Terrebonne	25,997	9,883	27.53	2,658	10,670	24.6	48,328	12,443	20.5
LA MDPR Total	585,482	252,832	30.2	708,840	296,066	29.5	926,083	383,977	29.3
Hancock	N/A	N/A	N/A	9,852	2,039	17.1	11,784	2,550	16.1
Harrison	N/A	N/A	N/A	70,642	13,421	16.0	100,233	19,256	16.1
Jackson	N/A	N/A	N/A	24,664	6,737	21.5	44,658	10,864	19.6
MS MDPR Total	--	--	--	105,168	22,197	17.4	156,675	32,670	17.3
MDPR Total	585,482	252,832	30.2	814,008	318,263	28.1	1,082,758	416,647	27.8

(continued)

Table 18. (concluded)

Parish/county	1970 White	1970 Non-white	1970 % Non-white	1977 White	1977 Non-white	1977 % Non-white
Iberia	41,344	16,053	28.0	45,474	17,684	28.0
Jefferson	294,480	43,088	12.8	369,943	54,303	12.8
Lafourche	61,046	7,895	11.5	66,363	8,624	11.5
Livingston	32,375	4,136	11.3	40,780	5,196	11.3
Orleans	323,420	270,051	45.5	303,271	253,190	45.5
Plaquemines	18,852	6,373	25.3	19,705	6,639	23.2
St. Bernard	48,357	2,828	5.5	57,751	3,362	5.5
St. Charles	21,737	7,813	26.4	24,695	8,857	26.4
St. James	10,401	9,332	47.3	10,346	9,285	47.3
St. John the Baptist	12,738	11,075	46.5	13,748	11,950	46.5
St. Mary	43,387	17,365	28.6	43,798	17,544	28.6
St. Tammany	51,482	12,103	19.0	68,459	16,058	19.0
Tangipahoa	45,093	20,782	31.5	49,862	22,929	31.5
Terrebonne	62,251	13,798	18.1	71,169	15,666	18.1
LA MDPR Total	1,066,963	442,692	29.3	1,185,364	451,287	27.6
Hancock	14,894	2,493	14.3	N/A	N/A	N/A
Harrison	111,061	23,521	17.5	N/A	N/A	N/A
Jackson	73,547	14,428	16.4	N/A	N/A	N/A
MS MDPR Total	199,502	40,442	16.8	--	--	--
MDPR Total	1,266,465	483,134	27.6	1,185,364	451,287	27.6

Sources: United States Department of Commerce, Bureau of the Census 1940-1970.
Research and Statistics Unit, Office of Management and Finance, Louisiana Department of Labor 1978.
Mississippi State University, Division of Research, College of Business and Industry 1978.

rates per 1,000 population. Thus, natural increase (births minus deaths) is likely to continue to contribute significantly to the Deltaic Plain Region's population growth, given the preponderance of relatively young and immobile (from a regional perspective) population. A factor that could partially offset the contribution to growth made by natural increase would be an unexpected gain in retirement-oriented migrant influx to the region, which in essence would imply an influx of people with their family-building careers past, and a higher death rate.

Greater refinement in age structure data by parish/county would be extremely useful to planning agencies involved in forecasting the demand for specific medical, educational, and social services to be provided by the public sector. One of the long-term repercussions of extended life expectancies and a post-World War II fertility rate increase will likely be a steadily increasing elderly population segment. This population segment presents its own unique human resources that come from the wisdom of experience, and it also presents a collective demand for specialized geriatric services in the form of housing, medical, transportation, and leisure time facilities and services. The very young segment of the population presents similar needs for an entirely different set of services and facilities. Before decisions can be reached regarding the extent to which responsibility for providing such services is to be supported by the public sector, more detailed information is required on a refined geographic basis regarding the region's age characteristics.

Knowledge of age structure on a more refined basis can help in the evaluation of labor force availability in the face of Deltaic Plain industrial development. The relative proportion of the Deltaic Plain Region's residents that are within the active labor force age categories could be compared with the demands that industrial development place on the region's occupational skill repertoire, with comparison results revealing the extent to which there exists a labor surplus or deficit in the area. There is strong empirical evidence to suggest that migration is integrally related to the demands that industrial development places on locally available labor resources (e.g. Bureau of Land Management 1979, Chalmers and Anderson 1978). To forecast employment-related migration or the future demand for job training programs, age structural characteristics provide a sound basis for assessing the significance of underutilized human resources as well as the extent to which they are locally available.

ECONOMIC DEVELOPMENT: DIVERSITY AND PROSPERITY

While the development of hydrocarbon resources in the Deltaic Plain has been a powerful force in regional economic growth, the region's economic foundations have experienced many aftershocks in the wake of oil and gas production. Essentially, the economic growth scenario has been provided with its major impetus by the availability of natural resources in the Deltaic Plain: hydrocarbons, waterways for transportation, and a climate and water-oriented activities that have provided both commercial opportunities and, increasingly, recreational amenities. While oil and gas production represented in recent decades a primary source of attraction for industrial development, the population growth and service base expansion that initially accompanied the hydrocarbon industry's growth have become less dependent on oil and gas production as the basis for continued growth.

Agriculture has been the only economic sector to experience an actual decline in employment over the period between 1940 and 1976. Employment growth, however, has not been distributed evenly among the region's principal economic sectors, nor has every local area shared this growth to the same extent.

For the region as a whole, employment in the service and trade sectors has always been greater than for any other sectors, and employment growth in the service and trade sectors has been considerably more rapid during the period 1940-1976 than for any other sectors of the regional economy. Manufacturing employment ranked third behind service and trade sectors throughout the period 1940-1976 (Figure 11), with food products and transportation equipment (excluding motor vehicles) the outstanding product categories for manufacturing employment (Table 19). Employment in the extraction, refinement, and manufacture of petroleum-related products grew from just under 10,000 persons in 1940 to more than 40,000 persons by 1976, representing an increase of 270 percent over this period. Most of this growth was in the actual oil and gas extraction activities, rather than in related manufacturing employment. The petroleum industry has become an increasingly capital intensive operation, and it is therefore not surprising that employment growth in other sectors of the regional economy has occurred at a more rapid rate.

The regional employment impacts of hydrocarbon development on other economic sectors have been far-reaching. As previously mentioned, growth in the trade and service sectors has been higher than in any other sectors of the Deltaic Plain Region's economy. While no data are available specifically for the Mississippi Deltaic Plain Region, on a national basis it is estimated that for every 5.5 refinery jobs created, an additional 38 jobs are created in support activities, including services and wholesale/retail trade (Texas Offshore Terminal Commission 1974). Employment in the transportation, communication, and public utilities sector, along with contract construction and finance, insurance, and real estate employment have grown throughout the period 1940-1976, largely in response to growth-spurred demands for a constellation of urban and suburban facilities and services. Government and public administration employment in the region has also increased dramatically in response to urban growth, and the installation of several federal facilities (particularly in the Mississippi coastal counties) has contributed significantly to regional employment.

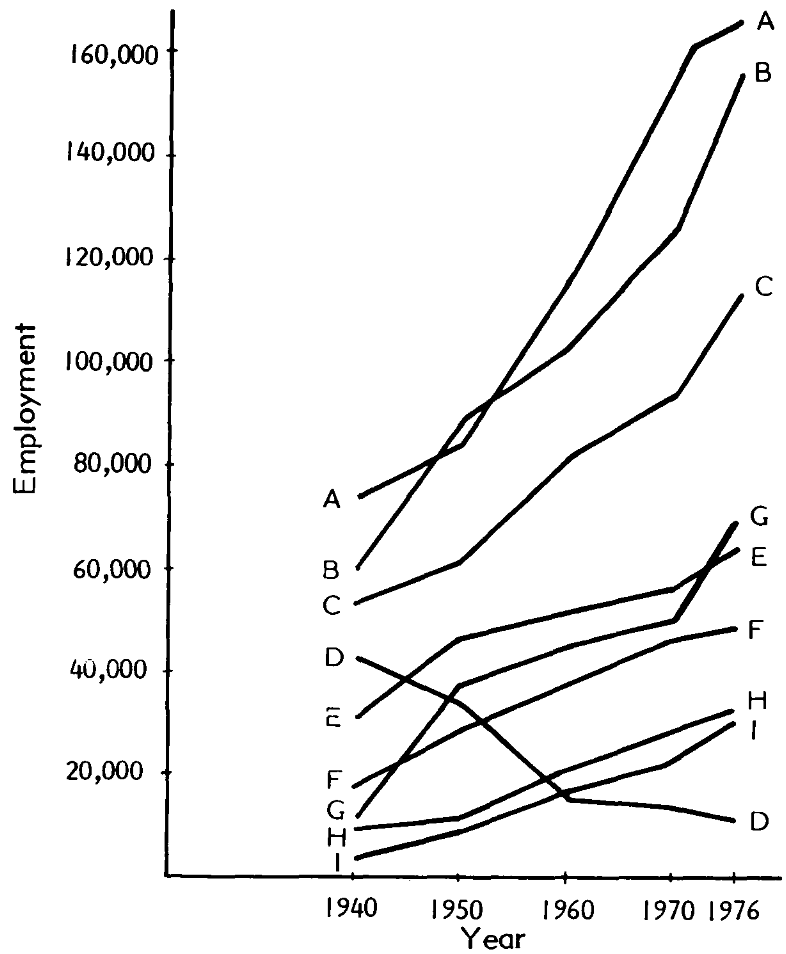
In the following sections, a more detailed characterization of changes in major employment sectors is presented.

Agriculture

On a regional basis, agricultural employment represented nearly 14 percent of the total civilian labor force in 1940, but had declined to less than two percent of the labor force by 1976 (Figure 12). Throughout this period, agricultural employment decreased by 73 percent (United States Department of Commerce 1971, University of New Orleans 1977). Livingston and Tangipahoa Parishes had the greatest amount and rate of agricultural employment decline between 1940 and 1976. Tangipahoa Parish still had the greatest concentration of agricultural employment in the region in 1976, with St. Tammany Parish ranking second (University of New Orleans 1977).

Mining

For the Deltaic Plain Region as a whole, employment in the mining sector has never exceeded five percent of the total civilian labor force (Figure 12). In 1940, mining activities (principally oil and gas extraction, with a minor amount of sulphur and gravel extraction) accounted for approximately 1.4 percent of the region's civilian labor force (United States Department of Commerce 1975). By 1976,



A. Services
B. Wholesale/Retail Trade
C. Manufacturing
D. Agriculture
E. Transportation, Communication & Public Utilities
F. Construction
G. Government
H. Finance, Insurance & Real Estate
I. Mining

Figure 11. MDPR employment by major industry group, 1940 - 1976.

Sources: U.S. Department of Commerce, Social and Economic Statistics Administration. 1975. Regional Employment by Industry, 1940-1970.

University of New Orleans, Division of Business and Economic Research. 1977. Statistical Abstract of Louisiana. 6th edition

Mississippi State University, Division of Research, College of Business and Industry. 1978. Mississippi Statistical Abstract: 1978.

Research and Statistics Unit, Louisiana Department of Employment Security. 1976. New Orleans Employment Projections Program.

Table 19. Total employment by major industry groups: MDPR 1940-1976.

Industry	Year 1940	1950	1960	1970	1976
Agriculture, agricultural services, forestry and fish	42,540	34,559	16,543	13,101	11,500
Agriculture and agricultural services	37,104	36,685	23,381	9,708	
Forestry and fisheries	5,436	7,002	4,065	3,393	
Mining	4,142	8,911	17,961	23,440	30,565
Contract construction	17,902	29,351	38,220	47,019	47,425
Manufacturing	54,761	62,048	83,174	94,376	114,345
Food and kindred products	17,307	18,494	21,487	14,527	
Textile mill products	3,252	2,372	728	678	
Apparel and other fabric textile products	4,537	4,709	5,356	5,892	
Lumber, wood products, and furniture	7,191	7,766	4,792	3,472	
Printing, publishing and allied industries	3,073	3,827	4,145	5,276	
Chemicals and allied products	2,759	8,267	6,416	8,979	
Machinery, all	1,534	2,087	3,944	4,611	
Machinery except electric	----	1,789	2,896	3,572	
Electrical machinery, equipment and supplies	----	288	1,048	1,039	
Motor vehicles and motors vehicle equipment	247	199	312	231	
Transportation equipment except motor vehicles	2,974	4,566	10,906	22,851	
Other and miscellaneous manufacturing	11,987	14,901	25,088	27,859	
Paper and allied products	----	4,529	5,033	3,446	
Petroleum refining and related industries	----	3,018	5,646	4,315	
Primary metals industries	----	675	3,542	3,591	
Fabricated and not specified metals	----	2,636	4,405	8,859	
Miscellaneous manufacturing	----	4,043	6,462	7,648	
Transportation, communication and public utilities	31,568	46,384	52,209	56,590	64,125
Railroad and railway express	6,928	8,905	6,435	4,161	
Trucking and warehousing	4,711	4,774	6,926	7,971	

(continued)

Table 19. (concluded)

Industry	Year 1940	1950	1960	1970	1976
Transportation, etc. (continued)					
Other transportation	13,598	21,508	24,651	25,820	
Communications	3,011	5,249	6,238	8,687	
Electricity, gas, water and sanitary services	3,320	5,948	7,959	9,951	
Wholesale and retail trade	60,314	88,805	103,838	126,596	158,350
Wholesale trade	11,209	19,520	21,508	31,397	
Food and dairy product stores	13,047	14,937	15,517	18,835	
Eating and drinking places	10,142	16,114	17,582	19,826	
Other retail trade	25,906	38,234	49,231	58,995	
Finance, insurance and real estate	9,802	13,238	20,969	28,276	33,735
Services	74,128	85,082	117,365	162,229	166,950
Lodging places and other personal services	14,892	15,356	18,187	21,028	
Business and repair services	5,612	9,412	12,877	19,372	
Entertainment and recreation services	3,868	5,347	4,238	5,439	
Private households	28,296	20,483	25,804	17,022	
Professional services	22,260	34,484	55,875	99,368	
Total government	11,261	37,249	45,324	50,213	69,690
Public administration	10,686	19,799	25,423	30,083	
Federal military	575	17,450	19,901	20,130	
Industry not reported (distributed)	3,622	4,704	21,187	44,423	50,210
Mississippi Deltaic Plain Region Total	306,418	405,627	496,506	604,297	632,550

Sources: United States Department of Commerce, Social and Economic Statistics Administration 1975.
University of New Orleans, Division of Business and Economic Research 1977.
Gulf Regional Planning Commission 1979a, 1979b, and 1979c.

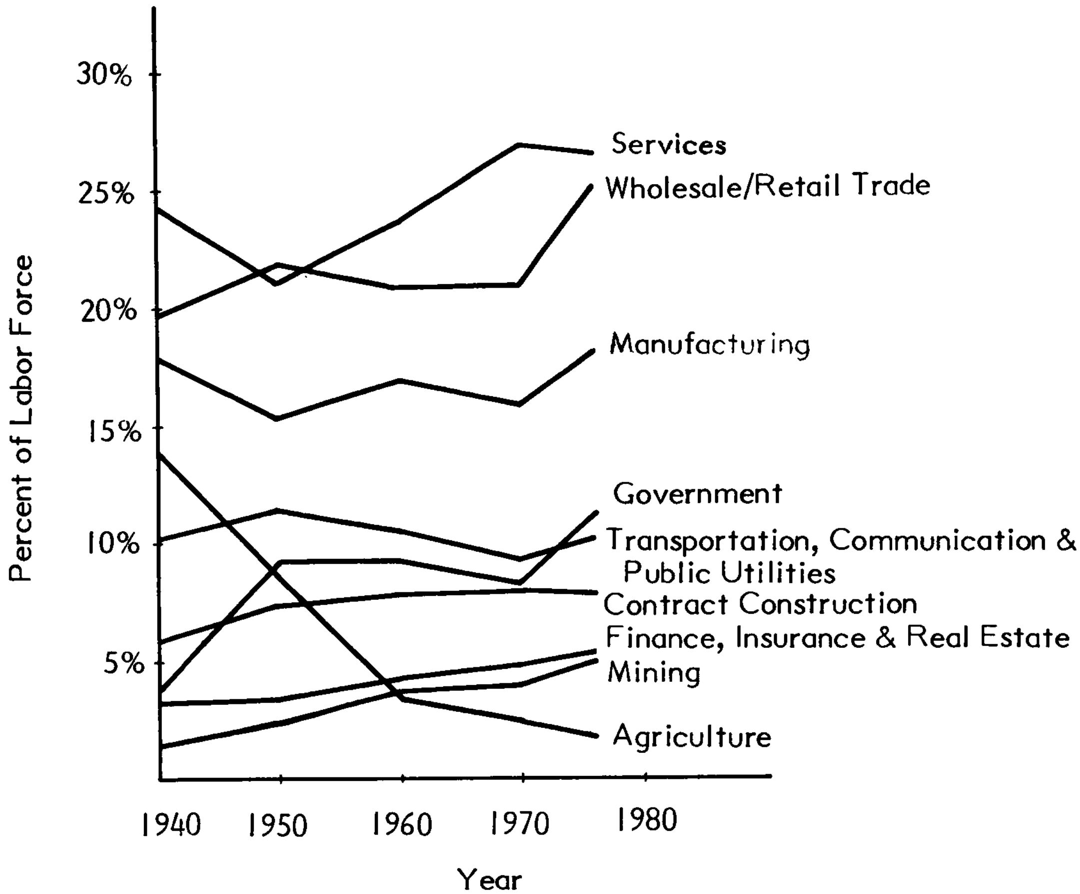


Figure 12. Employment by major industry group as a percentage of MDPR total civilian labor force, 1940 - 1976.

Sources: U.S. Department of Commerce, Social and Economic Statistics Administration 1975. Regional Employment by Industry: 1940-1970

University of New Orleans, Division of Business and Economic Research. 1977. Statistical Abstract of Louisiana. 6th edition.

Mississippi State University, Division of Research, College of Business and Industry. 1978. Mississippi Statistical Abstract: 1978.

Research and Statistics Unit, Louisiana Department of Employment Security. 1976. New Orleans Employment Projections Program.

mining employment had grown to account for approximately 4.8 percent of the region's civilian labor force (University of New Orleans 1977).

Mining activities were distributed widely across the region in the 1950's and 1960's - Terrebonne, Iberia, St. Mary, Lafourche, Plaquemines, Orleans, Jefferson, and St. Tammany Parishes each had more than 1,000 mining employees in the 1970 census (United States Department of Commerce 1975). For the period 1970-1976, the region's mining industries experienced rapid employment growth (almost five percent per year). Four areas accounted for almost all of this growth in mining employment. The New Orleans SMSA accounted for approximately 48 percent of regional mining employment; Terrebonne Parish accounted for almost 19 percent. Mining employment in Plaquemines Parish nearly tripled in six years, to the point that Plaquemines Parish had 13 percent of the region's mining employees by 1976. Extractive employment in St. Mary Parish increased by 45 percent between 1970 and 1976, so that St. Mary accounted for more than 11 percent of total regional employment in this category. Iberia experienced a 90 percent reduction in mining employment in this period. Mississippi's coastal counties accounted for only 0.5 percent of total MDPR mining employment, and the Mississippi coastal counties labor force has never been concentrated in the mining sector to the same extent as in the Louisiana Deltaic Plain parishes (United States Department of Commerce 1975, University of New Orleans 1977, Mississippi State University 1978).

Contract Construction

For the Deltaic Plain Region as a whole, contract construction employment remained relatively constant in proportion to the total civilian labor force throughout the period 1940-1976 (Figure 12). The region's contract construction employment increased by approximately 170 percent during this period, a rate of increase that is slightly higher than the rate of growth in total regional employment. Construction employment, perhaps more than employment in any other economic sector, exhibits periodic episodes of peak activity. Thus, while several of the parishes and counties within the Deltaic Plain Region have shown increased employment in the construction sector, it is difficult to predict with any certainty whether such increases are part of a region-wide, long-term trend. In 1976, more than half of the region's construction labor force was located in the New Orleans metropolitan area. It appears that construction will continue at its presently rapid rate in the area, particularly in Jefferson and St. Tammany Parishes (University of New Orleans 1977). In the Pascagoula-Moss Point metropolitan area, construction employment had increased by 33 percent between 1970 and 1976 (Gulf Regional Planning Commission 1979a, 1979b, 1979c). Due largely to the industrial development in Morgan City, St. Mary Parish experienced a 25 percent increase in construction employment over this same period (University of New Orleans 1977). The largest increases, however, have been in the hydrocarbon-rich Plaquemines Parish with its 210 percent increase between 1970 and 1976, and St. Charles Parish with a 410 percent increase in construction labor over the same period (University of New Orleans 1977). Outside of the major metropolitan areas, Plaquemines, St. Charles, and St. Mary Parishes have the region's largest construction force. Should the extraction of hydrocarbon reserves become commercially feasible along the Tuscaloosa Trend along the north shore of Lake Pontchartrain, it is likely that already rapid growth rates will become even more rapid, and this population growth is likely to be accompanied by a substantial demand for housing, roadway, and industrial facility construction.

Manufacturing

Growth in manufacturing employment in the Deltaic Plain Region was high in the late 1960's, continuing into the 1970's (Figure 12). While manufacturing employment grew by approximately 42 percent in the period between 1940 and 1970, it grew by another 21 percent between 1970 and 1976. The manufacturing sector has been the third largest source of employment throughout the period of 1940-1976 (behind services and wholesale/retail trade), and its share of the total labor force has remained relatively constant during this period. The vast majority of all manufacturing employment in the region has become increasingly concentrated in the New Orleans and Pascagoula-Moss Point SMSA's (Unversity of New Orleans 1977, Gulf Regional Planning Commission 1979c). In the New Orleans area, manufacturing actually declined in both absolute and relative amounts between 1970 and 1976. The New Orleans SMSA accounted for more than 54,000 manufacturing employees in 1970, representing almost 58 percent of the Region's total manufacturing work force in that year. By 1976, there were 2,000 fewer workers, and the very rapid growth in Jackson County, Mississippi (148 percent in six years) increased Jackson County's share of manufacturing employment to more than 25 percent of the total manufacturing work force while reducing the New Orleans SMSA share to less than 46 percent. Other areas that realized significant gains in manufacturing employment between 1970 and 1976 include: Harrison County, which represented nearly 5 percent of the manufacturing work force by 1976; Plaquemines Parish, whose manufacturing work force nearly tripled to account for 2 percent of regional manufacturing employment in 1976; St. Charles and St. Mary Parishes, which together accounted for 6.5 percent of regional manufacturing employment in 1976; and Terrebonne Parish, where manufacturing employment increased by 25 percent between 1970 and 1976, and accounted for more than 3.3 percent of total regional manufacturing employment in that year.

In terms of the distribution of manufactured goods produced in the Deltaic Plain Region, food products and transportation equipment (excluding motor vehicles) were the outstanding product categories for manufacturing employment. Employment in petroleum refinement and manufacture of petroleum related products grew from just under 3,000 persons in 1940 to more than 20,000 persons by 1976 (BLM 1979). Employment in primary metals industries and in fabricated metals grew from approximately 3,200 persons in 1950, the first year in which employment in these manufacturing sub-categories was reported, to more than 12,000 persons in 1970, the most recent year for which these sub-category data are available (United States Department of Commerce 1975).

Transportation, Communication, and Public Utilities

On a regional basis, the transportation, communication, and public utilities (TCPU) sector has remained relatively constant in its proportional share of the total Deltaic Plain Region work force in the period between 1940 and 1976 (Figure 12). This employment sector includes such activities as railroads, trucking, pipelines, shipping, public transit, communications, and electric, gas, water, and sanitary services. Throughout the period 1940-1970, employment in the TCPU sector increased approximately 79 percent, and an increase amounting to approximately 13 percent was realized between 1970 and 1976 (United States Department of Commerce 1975, University of New Orleans 1977, Mississippi State University 1978).

The New Orleans metropolitan area had the greatest concentration of employment in this sector in 1976, with almost 45,000 TCPU workers, or nearly 70 percent of the total region's workers in this sector. The New orleans SMSA had a 9 percent increase in TCPU sector employment between 1970 and 1976, but its share of the regional TCPU work force had declined slightly, from 72 percent in 1970 to approximately 70 percent of the region's employment in this sector by 1976. Between 1970 and 1976, significant increases in TCPU sector employment were realized in Harrison County, part of the Gulfport-Biloxi SMSA, which by 1976 accounted for more than five percent of the region's TCPU work force. Plaquemines Parish realized an increase of more than 100 percent in this sector between 1970 and 1976, and by 1976, the parish accounted for more than three percent of the region's TCPU work force. St. Mary and Lafourche Parishes each realized gains of approximately 40 percent in the TCPU sector employment between 1970 and 1976, and by 1976, the two parishes accounted for a combined total of more than 10 percent of the Deltaic Plain Region's TCPU work force. Minor decreases were experienced in St. James, St. John, and Tangipahoa Parishes and in Hancock or Jackson Counties between 1970 and 1976, but these areas have never accounted for a substantial portion of regional employment in the TCPU sector.

Wholesale and Retail Trade

On a regional basis, the trade sector maintained a relatively constant share of the total employment until recently. Wholesale and retail trade employment accounted for approximately 20 percent of the Deltaic Plain Region's total employment until the period between 1970 and 1976, with trade sector employment then increasing to more than 25 percent of the employed labor force (Figure 12). Only the services sector occupied a larger segment of the labor force.

During the period 1940-1970, the number of persons employed in the trade sector increased by nearly 110 percent, and between 1970 and 1976, employment in this sector grew by more than 25 percent (Figure 12)(University of New Orleans 1977, Gulf Regional Planning Commission 1979a, 1979b, 1979c). All but three of the parishes/counties that constitute the Deltaic Plain Region realized substantial increases in trade sector employment between 1970 and 1976. The three that experienced actual declines were Lafourche and St. Charles Parishes and Hancock County. The New Orleans metropolitan area, largely on the strength of an additional 40,000 trade employees in Jefferson and St. Tammany Parishes, increased its position as the primary regional trade center. Regional trade sector employment increased from 68 percent in 1970 to more than 70 percent in 1976 of the Deltaic Plain Region's total trade sector employment (University of New Orleans 1977, Mississippi State University 1978). Trade employment in Plaquemines Parish more than doubled in this six-year period, although the Plaquemines trade sector accounted for only 1.4 percent of regional trade sector employment in 1976. St. Mary, Terrebonne and Tangipahoa Parishes, and Harrison County each experienced increases in excess of 25 percent between 1970 and 1976. These four jurisdictions accounted for a combined total of approximately 17 percent of regional trade sector employment by 1976 (University of New Orleans 1977, Mississippi State University 1978).

This expansion of wholesale and retail trade centers from a relatively small number of jurisdictions to a more even regional distribution reflects a condition described earlier as a consequence of historical population shifts-- a hierarchy of urban centers emerged in the Deltaic Plain Region, distinguished on the basis of where demands originate for local trade goods. Many of the more densely populated areas in the region were not able to respond adequately to the demands of local residents, and the recent expansion of trade centers throughout the region may be regarded, in part, as a response to unmet local demands.

Finance, Insurance and Real Estate

This employment sector did not ever comprise more than five percent of the total Deltaic Plain Region employment until 1976 (Figure 12). Throughout the period 1940-1970, employment in the Finance, Insurance and Real Estate (FIRE) sector grew from less than 10,000 to more than 28,000 representing an increase of approximately 188 percent over 30 years. In the six-year period from 1970 to 1976, employment in the FIRE sector increased an additional 19.3 percent to almost 34,000 by 1976 (University of New Orleans 1977, Mississippi State University 1978).

Nearly 80 percent of the FIRE sector employees are located in the New Orleans metropolitan area, with the majority of New Orleans area employees located in Orleans and Jefferson Parishes (University of New Orleans 1977). The only other substantial concentration of FIRE employees is found in Harrison County, which accounted for approximately six percent of total regional employment in this sector in 1976. While employment continued to grow in Iberia, Lafourche, and Terrebonne Parishes and in Harrison and Jackson Counties between 1970 and 1976, these three Louisiana Deltaic Plain parishes and two Mississippi coastal counties together represented only 14 percent of the total regional FIRE sector employment in 1976. Their share of the total regional employment declined slightly from 1970, when they accounted for a combined total of 15.3 percent of the FIRE sector employment. All other counties and parishes experienced a decline both in actual amount and relative share of FIRE employment between 1970 and 1976 (University of New Orleans 1977, Mississippi State University 1978).

Services

The Deltaic Plain Region's service sector has been the leading source of employment in the region almost continuously since 1940. The 1950 census was the only reporting at which employment in the manufacturing sector surpassed service sector employment (Figure 12). Services have consistently accounted for well over 20 percent of the work force between 1940 and 1970, and between 1970 and 1976 more than 25 percent of the region's employment was accounted for by this sector.

Between 1940 and 1970, service employment grew from less than 75,000 to more than 162,000, representing an increase of almost 120 percent (Figure 11) (United States Department of Commerce 1975). Between 1970 and 1976, however, growth in service sector employment slowed considerably, with the region as a whole realizing a net increase of 2.9 percent, or only 4,700 additional service sector jobs (University of New Orleans 1977, Mississippi State University 1978). Between 1940 and 1970, the sub-category of service sector employment for which the largest increase occurred was Professional Services, which more than quadrupled to account for nearly 100,000 employees in 1970 (United States Department of Commerce 1975). Region-specific data concerning this sub-category are not available for more recent years. Entertainment, recreational, and lodging positions increased from approximately 18,000 jobs in 1940 to 26,500 in 1970 (United States Department of Commerce 1975).

It is difficult to account for the slowed growth in service sector employment between 1970 and 1976. The regional population growth rate did not decline drastically during this period, and the creation of new service sector jobs tends to be tied directly to population growth. The New Orleans metropolitan area, the Gulfport-Biloxi metropolitan area, and the Morgan City area had the greatest concentrations of service sector employees in 1976, with Jefferson, Orleans, and St. Tammany Parishes being the major service sector employment nodes in the New Orleans area (University of New Orleans 1977).

Government

For the Deltaic Plain Region as a whole, employment in the government sector grew from representing 3.6 percent of the total regional employment in 1940 to 8.3 percent in 1970 (Figure 12). This increase was the result of a 346 percent increase in government employees over the 30-year period (United States Department of Commerce 1975). Between 1970 and 1976, the government sector grew to represent 11 percent of the total regional employment force, with an increase in government employees of nearly 40 percent over the six-year period (University of New Orleans 1977, Mississippi State University 1978).

The major government employment centers are the New Orleans metropolitan area and Harrison County, Mississippi, with sizable concentrations also located in Jackson County and in Tangipahoa, Lafourche, and Plaquemines Parishes. In Harrison County, in fact, the leading employer is the government sector. Located within the county are four major federal installations: Keesler Air Force Base in Biloxi, the Naval Construction Battalion Center in Gulfport, and two Veterans Administration hospitals - one in Biloxi and one in Gulfport. As with many of the other counties and parishes, various State and local agencies are located throughout the county.

INCOME CHARACTERISTICS OF MDPR PARISHES AND COUNTIES

Between 1940 and 1970, per capita income in the Deltaic Plain increased constantly. With discovery of recoverable hydrocarbons, the period from 1960 to 1970 resulted in some noteworthy changes. For example, in those ten years, per capita income increased by more than 40 percent for every Deltaic Plain parish (Figure 13). The smallest increase was recorded in Orleans Parish with 43 percent. The largest increases occurred in Lafourche, St. James, St. John, Terrebonne, Iberia, and St. Mary Parishes; all have been affected in some way by the petroleum industry, either in the discovery, production, support, or manufacturing stages of the industry.

In 1970, one out of three households earned more than \$10,000 in the parishes of Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John, St. Mary, St. Tammany, and Terrebonne. Forty percent of the households in St. Bernard, St. Charles, and St. Tammany earned in excess of \$10,000.

Orleans, Jefferson, Plaquemines, St. Bernard, and St. Tammany

In 1970, the Parishes of Jefferson, Orleans, Plaquemines, St. Bernard, and St. Tammany enjoyed a per capita income of \$2,990, which was 10 percent above the state's average of \$2,721. Only these five river parishes had a higher per capita income than the State average.

In the decade from 1960 to 1970, however, the rates of income increases were not equal for the river parishes. Four of the five parishes recorded income

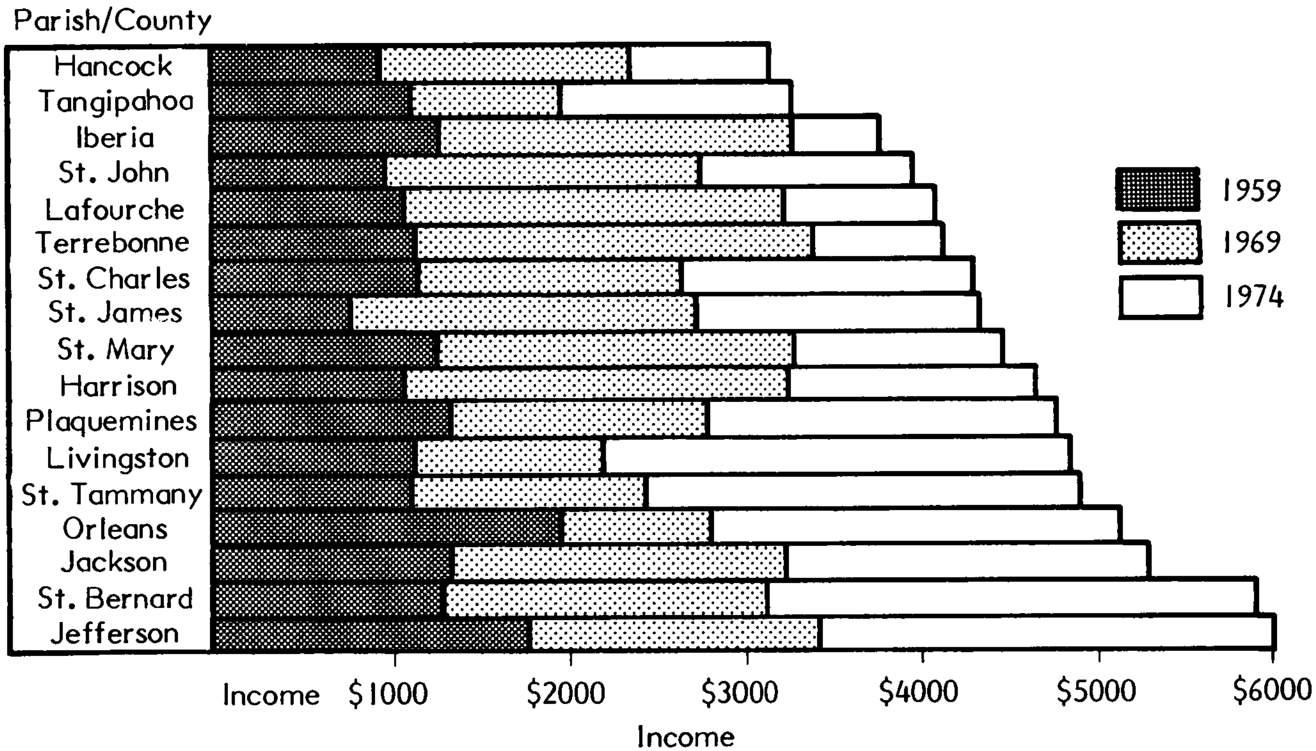


Figure 13. Per capita income[a] by MDPR parish and county for selected years.

[a]1959 data presented in 1959 dollars, 1969 data are presented in 1969 dollars, and 1974 data are presented in 1974 dollars.

Source: United States Department of Commerce 1961 - 1976.

increases greater than the State average, but Orleans did not. Orleans, which once held the position of having the highest rate of increase in per capita income in the State, had an increase of only 43 percent from 1960 to 1970, while the increase for the State as a whole was 84.5 percent.

Communities that are a part of the New Orleans metropolitan area experienced an increased median income in some cases of over 200 percent. At Buras-Triumph, Covington, Gretna, Harahan, Harvey, Jefferson Heights, Kenner, Little Farms, Marrero, Metairie, Slidell, Terry Town, and Westwego, the median income increased to more than $6,000. The largest median incomes in 1970 were at Little Farms ($11,276), Metairie ($11,448), Slidell ($10,515), and Terry Town ($11,734).

Within the Deltaic Plain, Jefferson Parish is unusual, because 51 percent of the parish's households earn more than $10,000, with only 7.7 percent earning less than $3,000 per year.

Between 1960 and 1970, the greatest per capita income increase in the New Orleans metropolitan area was recorded in St. Bernard Parish. During this period, St. Bernard's per capita income increased by 140.5 percent. St. Tammany, Plaquemines, and Jefferson nearly doubled their per capita income between 1960 and 1970.

Livingston and Tangipahoa

Livingston Parish exceeded the State average per capita income growth between 1960 and 1970, but remained below the State average in 1970. Livingston's increase during the ten-year period was 90.5 percent, from $1,150 to $2,191 per parish resident. Tangipahoa Parish increased from $1,110 to $1,946 between 1960 and 1970, representing an increase of 75.3 percent.

At Hammond and Ponchatoula, the median income level was considerably lower than the other major cities within the Deltaic Plain, reflecting, perhaps the area's rural characteristics. Without the introduction of major industry, increasing the population's annual income is difficult. As a result, Hammond's per capita income went from $2,353 in 1959 to $6,040 in 1969, while in Ponchatoula, the increase was not as great. In ten years, Ponchatoula experienced an increase in median income amounting to only $2,136, or an average $214 per year. Ponchatoula residents experienced an increase in average annual income from $3,648 in 1959 to a 1969 figure of $5,784.

Lafourche, St. Charles, St. James, St. John, and Terrebonne

The greatest percentage increase in per capita income occurred in Lafourche, St. Charles, St. James, St. John, and Terrebonne Parishes. These five Deltaic Plain parishes recorded increases of more than 150 percent in per capita income. In 1960, each parish was lower than the State average, but within ten years, each parish had at least doubled its per capita income and was higher than the State average. Income in St. James and Terrebonne Parishes more than tripled.

St. James had the greatest per capita income increase of all five parishes. In 1960, St. James residents averaged only $785 per year, but by 1970, parish residents had experienced an increase in their annual earnings of 244.7 percent, to $2,706. Terrebonne residents had a similar experience with a 204.5 percent increase, raising per capita earnings from $1,117 in 1960 to $3,402 in 1970. In 1970, Lafourche increased its per capita income to $3,224. In the same period, St. John increased from $983 to $2,746 (179.3 percent) and St. Charles increased nearly 130 percent from $1,157 to $2,659.

Cities that are a part of Lafourche, St. Charles, St. James, and Terrebonne Parishes have shown considerable income changes between 1959 and 1969. Golden Meadow increased its median household income from $4,838 to $7,351. Houma recorded an increase of from $2,712 to $8,444 or approximately $573 per year. Along the Mississippi River, the communities of LaPlace, Luling, Lutcher, and Reserve also noted significant increases in median household income. The greatest change occurred in LaPlace where the median household income went from $3,867 in 1959 to $10,062 in 1969. This represents an annual increase of nearly $720 per year. Golden Meadow, LaRose, and Thibodaux in Lafourche Parish also recorded significant median income changes. The median annual income in each community was more than $7,000 in 1970.

St. Mary and Iberia

Like the other parishes affected by the petroleum industry, St. Mary and Iberia Parishes recorded significant increases in per capita income between 1960 and 1970. In St. Mary, the residents of the parish increased their wages by nearly 160 percent, from $1,260 in 1960 to $3,268 in 1970. Close behind was Iberia with an average increase of approximately 152 percent, increasing the average income from $1,286 to $3,240 in ten years.

Between 1959 and 1969, the median household income increased considerably in St. Mary and Iberia Parishes. The communities of Berwick, Franklin, Jeanerette, Morgan City, New Iberia, and Patterson recorded substantial income increases. All but Franklin and Jeanerette more than doubled, with the largest increase occurring at New Iberia, where the average annual income of city residents increased from $2,318 in 1959 to $7,000 in 1969.

Hancock, Harrison, and Jackson Counties

Between 1960 and 1970, median household income increased considerably in the Mississippi coastal counties, although these increases do not compare favorably with increases experienced by most of the Deltaic Plain's Louisiana residents. Hancock County, which had the lowest median household income of the three coastal counties in 1960 ($3,129) increased by 107 percent by 1970 to $6,485. Harrison County had a median annual household income of $2,272, and by 1970, income had risen by 69 percent to $7,233. Jackson County had the highest median annual family income of the coastal counties in 1960, with $5,120, by 1970, income had increased by 67 percent to $8,548.

RESOURCE BASE PRESSURES AND THE FUTURE

The preceding descriptions and projections of Deltaic Plain social and demographic characteristics can be summarized briefly as follows:

1) Historically, population growth has resulted primarily from natural increase rather than net migrant influx to the region.

2) Natural increase is likely to be the major source of growth in the future, due to the regional population's age structure and ethnic composition.

3) Migration, for the most part, has taken the form of intra-regional redistribution of people from rural to urban and suburban centers. The region shares with many other Sun Belt areas the amenities that will probably attract retirement-oriented in-migrants on a growing scale.

4) Economic growth, initially stimulated by the development of hyrocarbon resources, has been characterized by increasing diversity and a broader geographic development base throughout the region.

The Deltaic Plain Region is used for a wide variety of human activities and natural processes. Many of these activities, however, do not require coastal locations. They are common, every day activities that can be undertaken anywhere and have no direct requirement for location in the Deltaic Plain. On the other hand, the region's location is absolutely necessary for many activities. Meeting those demands is therefore essential to maintaining the social and economic systems of the region.

The availability of water transportation, which often costs less than alternative modes, is an important attraction to the region. Industries that ship or receive raw materials by water often require waterfront locations on the rivers, bayous, or the coast itself.

Water is also important to many outdoor recreational opportunities: sport fishing, waterfowl hunting, boating, swimming, beach activities, and the enjoyment of unspoiled natural areas.

Agriculture makes demands on the coast for a variety of crops including rice, citrus, and grains. Rice can be grown only with the adequate amounts of water and in particular climates that are found in the region. Citrus requires warm temperatures, sunshine, and particular soils that are found only in a few areas of the country, one of which is the Deltaic Plain Region. Grain sorghum can be grown in many areas of the Nation, but the demand for this crop is sufficiently high so that the Deltaic Plain Region plays an important role in satisfying this national demand.

Facilities for electrical power, which often require thousands of acres for cooling ponds, are located in coastal areas to be near markets and to take advantage of the availability of water for cooling.

Commercial fishing for salt-water finfish or shrimp necessarily requires a location near the coast. The Gulf of Mexico produces a substantial quantity of shrimp, and the activities associated with catching and processing the shrimp are usually located near the coast. Likewise, finfish are usually processed near the locations where they are caught in the Gulf.

Petroleum production, both oil and natural gas, places demands upon the economy of the region where these natural resources are located. The hydrocarbon resource deposits in the Deltaic Plain Region yield a considerable portion of the Nation's energy supplies. Onshore and offshore production both contribute to the coastal economy and place demands on that economy for the goods and services necessary to support these activities.

In light of the demands that growth and development place on resources in the Deltaic Plain, resource management planning is faced with three key concerns: 1) the effects of population growth and industrial development patterns on land uses in the Deltaic Plain; 2) the growth-spurred demand for leisure time activities and the consequences that such a demand may have on Deltaic Plain resources; and 3) the ability of public entities to provide services to an expanding service area population.

With regard to land uses, the economic and technological developments of the past 40 years have led to a population shift from rural to urban areas. These urban areas in coastal Louisiana and Mississippi continue to experience the greatest population growth in the two States, especially in the suburban areas surrounding New Orleans, Morgan City, Gulfport, Biloxi, Moss Point, and Pascagoula. The continued industrialization of the Mississippi River, the proposed construction of a deepwater port facility, and continued offshore resource development will each contibute to these trends. Industry, commerce, housing, and agriculture compete for the space available along the natural levees. The magnitude of growth resulting from these development activities threatens the adjacent wetlands.

Independent of the magnitude of regional growth, the timing of such growth is a critical factor in determining the land uses that are likely to result. To date, the history of industrial development in the Deltaic Plain has reflected a tendency to draw on the most accessible and least expensive natural resources. Only when this portion of the resouce base nears depletion will other less accessible and more expensive portions become attractive for exploration. The sequence of industrial development, particularly in hydrocarbon resource development, is mirrored closely in the population growth and secondary development that follows. The intra-regional population shifts follow the exploration-intensive development-production-abandonment cycle that characterizes activities in the region's hydrocarbon industry.

The rapid growth of the Deltaic Plain Region's population, combined with an increase in the number of visitors from other parts of the State and Nation will create a demand for additional recreational opportunities and improved access. To accommodate this growth-spurred demand for recreational opportunities, the consequences of several decisions will have to be balanced against one another. In general, uses that the public at large may enjoy must be balanced against uses that are limited to fewer individuals. One set of factors to be weighed is the aesthetic value of areas in their natural state and the value of such areas for the protection and nurture of all types of aquatic life and wildlife. The public interest in navigation in the intracoastal waters must be balanced against access to areas preserved for their fish and wildlife protection value. In the ultimate analysis, those aspects of the Deltaic Plain environment that presently provide a source of attraction to new residents and visitors will not remain attractive without informed and far-sighted management decisions.

Perhaps the most significant source of resource base pressures is the fact that industrial development of the Deltaic Plain requires substantial public and private investment. New industry generates population growth, which increases demands for municipal services. The public investment required by a given industrial development may vary greatly depending on its location and timing. The public investment will also vary depending on the proportion of employment which goes to the indigenous work force versus that which stimulates migration into the area.

The impact of private development on demands for public investment constitutes an externality of the development and gives the public an interest in locational decisions. This interest is increased by the way in which new service demands are financed. Most municipal and educational services are financed through property taxes. This method poses several problems, particularly with regard to highly concentrated facilities, such as ports or refineries, which employ large numbers of people in construction and operational phases.

First, the industry may be located in one taxing jurisdiction while most of the residential activity takes place in another. The jurisdiction bearing the bulk of the public investment load is deprived of the growth in tax base necessary to pay the cost of new schools, parks, public safety, water treatment, and other services. This situation may lead to a decline in the quality of services, or to a high tax rate on the property of long-term residents whose incomes may not have risen as a result of the new industry.

Second, public costs are incurred before tax revenue can be collected. Refineries, power plants, and other major facilities have construction periods in excess of two years. The construction generates an influx of the specialized construction workers who build such projects. They often bring their families, and these people require the full range of municipal services. On the revenue side, however, the new development is seldom taxed in the amount of the increased public costs.

The economic multiplier accentuates the problem. The public construction required attracts more new residents who need additional services. Yet here, the construction projects may consume more tax dollars than they generate. If the problem of split taxing/spending jurisdictions is also present, the problem is compounded.

In general, people try to live relatively close to the places where they are employed. Their second choice of residential location is some sort of compromise between the availability and cost of housing, the perceived quality of life, and the relative distance to principal activity centers.

Persons building second homes for vacation and/or retirement in the Deltaic Plain usually prefer locations near the water; both of these residential tendencies point to increased development in locations near the water, which are the very areas most threatened by tropical storms and flooding. Presently, there are many areas in which the threat of hurricanes moving ashore will have a relatively high probability of striking sparsely settled developments. As development spreads throughout the region, however, the probability of a major storm striking relatively large population centers will increase. The cost of flood control and storm protection has, for the most part, been considered the burden of the public sector.

The question in general is how needed municipal services are to be provided and financed in communities that experience rapid growth due to increased industrialization. There are many partial answers available. The financing method for municipal services may be changed. Revenue sharing arrangements may be worked out between State and local authorities. Developments may be phased over longer periods. Commuter transportation may be arranged to help accommodate a higher degree of dispersion in residential settlements. Development might be restricted to areas that have already incurred the public investment costs and now have excess capacity due to the decline in the number of school age children. Industries might be required to make capital contributions to pay part of the public investment costs that their employees generate, just as land developers are now required to dedicate land for streets, parks, and schools if their developments are sufficiently large.

There are other forms of public investment that will be generated by development in the Deltaic Plain. Present development patterns being contemplated require increased port and waterway capacities. Water development projects may be warranted to replenish the ground water table and thereby reduce subsidence potential in some parts of the region. New highways and alternative transportation modes are also likely to be required. Some of these items can be financed through user fees, but others will become an additional burden on the public sector for financial support.

DATA GAPS, INCONSISTENCIES, AND RECOMMENDATIONS

The single largest problem to be resolved in synthesizing social and demographic data pertaining to the Mississippi Deltaic Plain Region is the lack of data collected specifically for the region. Data collection responsibilities are distributed throughout the Federal, State, regional planning council, parish/county, and local levels of government. Each responsible agency has its own special data needs and problem-solving interests, and the vast array of geographic specificity, relevant data categories, and forms in which data are published complicates the data synthesis effort.

If Federal census materials are to be relied upon heavily, then the parish/county becomes the common geographic unit. Data collected by the Bureau of the Census are generally comparable throughout the region, across State lines, and within a time series. Demographic information is generally available for cities and towns, and to some extent for unincorporated places. There may be a substantial time lag between data collection and publication dates, but, on the whole, a reasonable framework for characterizing salient social and demographic characteristics can be constructed.

At the State level, however, there is an apparent incompatibility between State-collected data across State lines. Mississippi does not publish county-specific employment data by industrial sector for intercensal years, but Louisiana does. Louisiana does not calculate the age and sex structure of its migrant populations on a parish-specific basis, as Mississippi does for its counties. Mississippi does not publish the same ethnic category data as Louisiana. Thus, to make generalizations about a region that encompasses portions of two states, one has to rely heavily on local reporting entities and an arduous data aggregation process.

The local agencies themselves are generally dependent to a large extent on funding from the State and Federal governments for their data collection programs. There is usually a specific information need motivated by a proposed construction project or grant application on behalf of the local agency that provides the impetus for social and demographic data collection. These data collection efforts are only undertaken on an episodic basis, and little has been done to systematize reporting of results for use in a more generalized fashion as part of a regional characterization.

At the present time, the analytical tools available for detailed characterization of the economic forces affecting the Deltaic Plain Region are somewhat limited. For example, there are no region-wide input-output models calibrated with current data to accurately reflect the flow of goods and services throughout the economy for both producing and consuming entities. It is therefore difficult to predict with any certainty the likelihood that "x" jobs created in a basic industrial sector of the regional economy will generate "y" jobs in a secondary service sector. This sort of information (and a way to generate it) is crucial to the calculation of economic costs and benefits attributable to a proposed oil and gas development or service base expansion.

Another analytical device that has not been fully developed on a regional basis is a "diversification index" for the entire region that would reveal information similar to those utilized in Mississippi's Gulf Regional Planning Commission reports (e.g., 1979a:21-23). One appropriate approach is that of the Office of Area Development, United States Department of Commerce, which developed a method of measuring industrial diversification that provides a quantitative measure or index of diversification for a specific area. The method examines the manufacturing base of an area's economy and determines the area's lack of industrial diversification in relation to the industrial diversification of the Nation as a whole. Harrison County, for example, is said to have a diversification index of 82.3 in 1976, while Jackson County's was 47.2, a low index figure that reflects the heavy concentration of shipbuilding in Jackson County. As compared to both Hancock and Jackson, Harrison County has a more diversified economic base. This greater level of diversity is one indication that the county's economy is not dependent upon any one industry for jobs. Thus, if one industry reduces its work force, the effect would not likely be overly-detrimental to the country's economy. Information of this nature would be extremely useful on a regional basis for measuring the Deltaic Plain Region's economic standing in relation to other coastal regions in the country.

The principal recommendation with regard to social and demographic data compilation is that State and regional planning agencies recognize their need for mutual assistance in formulating a comprehensive data monitoring and evaluation system to meet the multiplicity of information needs with which they are faced. The social and demographic data necessary for comprehensive coastal zone resource management planning are available. They simply need to be consolidated and monitored on a regular basis by the relevant jurisdictions. A higher level of coordination is recommended between the State and regional planning agencies to help promote a more consistent information base from which to develop policy goals and strategies.

LAND USE

INTRODUCTION

The Mississippi Deltaic Plain Region (MDPR) is a unique physiographic area of the United States. A brief discussion of some natural processes will give readers a clearer land use perspective of the MDPR. In addition, the discussion will help define terms common to this wetland habitat.

The MDPR has a humid sub-tropical climate. Regional climatic variations are broadly determined by the large land mass to the north and west and by the Gulf of Mexico to the south. These contrasting land/water surface areas produce alternate flows of cold air moving southward, and warm, moist air moving northward. Transitions between these flows frequently cause abrupt changes in weather conditions (Cross and Wales 1974).

Thunderstorms can be expected 70-80 days out of the year and are occasionally accompanied by small tornadoes, high winds, and hail. Hurricanes and tropical storms can occur from June to November. During this hurricane season, the average number of tropical storms is 0.76 per year. The overall hurricane probability for any one day is 0.56 percent in June and July; the probability increases sharply to 0.99 percent during the early part of August (United States Army Corps of Engineers 1972). Two severe hurricanes and a number of tropical storms have struck the MDPR in the past 20 years. Thunderstorms, hurricanes and tropical storms have caused serious flooding throughout the Region. This flooding occurs from excessive rainfall, storm surges or an excessive rainfall and storm surge combination (Cross and Wales 1974, United States Army Corps of Engineers 1972).

Natural resource features create microclimatic variations throughout the MDPR. These microclimatic variations are critical factors for certain land use and resource patterns. Average January temperature in the study area is 11°C to 12°C (52°F to 54°F) and the average July temperature is 27.7°C (82°F). Average annual freeze-free days range from 350 days near the mouth of the Mississippi River to 240 days in the Florida parishes (St. Tammany, Tangipahoa and Livingston). Average annual precipitation ranges from 168 centimeters (66 inches) near the Gulf Coast to 142 centimeters (56 inches) in the Florida parishes (Cross and Wales 1974, United States Army Corps of Engineers 1972).

Grazing rotation patterns and crop distribution patterns are influenced by these microclimatic variations. The natural levees provide a place for cattle to rest, leave their young, and escape mosquitoes while grazing in the coastal lowlands (Williams 1952). St. James tobacco, the "perique" variety which is grown on "points" of high ground surrounded by swamp, is not grown anywhere else in the world. Local microclimate is one important factor in the cultivation of this crop. Citrus trees, which freeze easily, are planted as near bayous as possible to take advantage of the water's microclimatic influences; orchards on bayou banks rarely freeze. Those planted on levee backslopes suffer frostbite and freeze more often than those adjacent to water surfaces.

MDPR geomorphic elements consist of recent alluvial plains, alluvial basins and Pleistocene terraces. Landform features include natural levees, point bars, cheniers/beach ridges, riverine areas, wetlands and terraces. Each landform is created by complex processes and each has specific factors that direct or constrain human use. Knowledge of landform development, a continuous natural and human-influenced process, is required to understand land use patterns and future constraints.

Natural levees are ridges of higher ground that border and confine river channels, tributary and distributary streams. Under natural conditions levees are formed by sediments deposited during overbank flow and crevassing during times of high water. Immediately adjacent to river channels, natural levees reach an approximate height of 8 meters (25 feet), and can reach a width of more than 5 kilometers (three miles) with a gently sloping grade toward adjacent flatlands and depressions (United States Army Corps of Engineers 1973). Development has traditionally occurred on the natural levee ridges where soils are relatively firm and elevations are higher than surrounding wetlands.

Point bars are a series of low ridges of granular material developed on the inside of a growing stream meander. Point bars are most common along winding stream courses of the upper delta. Ridges are highest near the stream and rise 0.6 to 4.6 meters (2 to 15 feet) above intervening swales. Swales are strips of wet, boggy ground that are usually under water during rainy periods and high water stages of the stream (United States Army Corps of Engineers 1973).

Beach ridges are sandy formations aligned along the Gulf Coast. These beach ridge forms are long, low offshore islands, land-tied islands, and low onshore ridges. Beach ridges are generally 1.9-3.1 meters (6-10 feet) above sea level and extend up to 160 kilometers (100 miles) in length. Large beach ridge islands may have continuous or interrupted lines of dunes parallel to the length of the formation. Cheniers are abandoned beach ridges that have been isolated inland during seaward migration of the coast. Beach ridges are undergoing accretion or degradation as a function of local deltaic processes. Cheniers are gradually subsiding and are being enveloped by the surrounding marshes.

Riverine areas are low, poorly drained regions of alluvial sediments in valley floodplains. Topography is generally level with elevations ranging from sea level to less than 15.4 meters (50 feet). Where riverine areas are bounded by levees (natural or human-made) the elevation can be below adjacent stream or sea levels. Riverine areas are subject to frequent and prolonged flooding (United States Army Corps of Engineers 1973).

Fresh to brackish wetlands are primarily grass and reed-covered marshes. The wetlands are drained by plant-choked, inter-levee bayous and flow into or form a chain of lakes that may be bordered by mats of floating vegetation. Marshes increase and decrease in size seasonally when flooded with overflow and rain runoff from levees. These wetlands gradually become saline nearer the Gulf. Subsidence is exceeding deposition in most of these areas and is increasing the open water surface area. Saline wetlands are commonly flooded by salt-water at high tide and during gales. These marshes extend inland from the Gulf to merge with brackish-water wetlands. Subsidence is a major factor affecting the saline wetlands because large areas are being inundated by Gulf waters as deposition fails to offset subsidence (United States Army Corps of Engineers 1973).

Prairie terraces are late Pleistocene alluvial surfaces that have been slightly uplifted and tilted seaward. These terraces border the alluvial plains and emerge from the edge of coastal marshes and swamps. Parts of the terrace surface are intricately dissected and wide areas of rough land border stream valleys. Low swamp areas also occur on the terrace surface. Elevated terraces are a succession of two or more Pleistocene alluvial surfaces, are a greater distance inland, and are higher than prairie terraces.

Four major levee systems occur in the MDPR. These levee systems are the Bayou Teche, Atchafalaya River, Bayou Lafourche, and the Mississippi River systems. Large riverine areas are located between the major levee systems north of Morgan City, Houma, and Thibodaux. Riverine areas also exist west of Lake Pontchartrain, along the Pearl River, and along the coastal river basins in Mississippi. Fresh to brackish water wetlands are located along the coast from Vermillion Bay to the Mississippi Sound. Terrebonne, Jefferson, Plaquemines and St. Bernard parishes contain large fresh to brackish water wetlands and large saline wetlands. Terrace areas are located in Iberia Parish, the Florida parishes, and the Mississippi counties. Point bar areas are limited within the study area, but some are located along Bayou Teche. The major point bar areas of the Mississippi delta are located north of the study area.

Mud lumps are a prominent geological feature of the MDPR. These small mud islands are located at the mouth of the Mississippi River passes, and range up to 3.7 meters (12 feet) in height and 49 hectares (120 acres) in area. Mud lumps are formed by the upward thrusting of fine clays between heavier, coarser, sediments being deposited on bars at the mouth of the river passes. These islands are important bird nesting areas (Louisiana State Planning Office 1977).

Salt domes, another prominent geologic feature of the MDPR, are unique from a geological, botanical, zoological, historical and archeological standpoint (Louisiana State Planning Office 1977). Oil and gas resources are trapped around salt domes.

North of Baton Rouge, the Mississippi River diverges from a single flow pattern to a distributary system. This distributary system meanders throughout the study area, creating numerous Gulf outlets. Distributary systems have, and are, creating an intricate pattern of natural levees extending seaward. Highest levee elevations and widths are found where river stage fluctuations are the greatest. In general, distributary levees attain higher elevations upstream and slope gradually seaward (Gagliano and Van Beek 1970).

Gagliano and Van Beek (1970) document in detail the geologic and geomorphic aspects of the Mississippi deltaic processes. For the past 6,000 years, the MDPR has been an area of active sediment accumulation, indicating that net progradation has occurred over a long period of time.

A delta system has inputs of discharge, sediment load, coastal erosion and subsidence. The Mississippi system carries an average sediment load of 1.1 to 1.6 million metric tons (1 to 1.5 million tons per day). This load consists of approximately 50 percent clay, 48 percent silt, and 2 percent very fine sand.

Land subsidence is a hazard along the low coastal land of the MDPR. In addition to land subsidence, the sea level is rising; this is generally attributed to the melting of glaciers and polar ice caps (Bureau of Land Management 1979). Gagliano and Van Beek (1970) estimate an average subsidence rate for coastal Louisiana to be 10.7 centimeters/century (0.35 feet/century). Land subsidence is generally attributed to extensive pumping of ground water and petroleum causing a decline in the piezometric pressure in the porous rocks allowing once-saturated beds to compress (Bureau of Land Management 1979). Subsidence may also be stimulated by overburden compaction as a result of dredging waterways. In addition, drained back-swamp peats and highly organic clays can shrink and oxidize, resulting in significant land surface subsidence (Bureau of Land Management 1979).

A deltaic system is always in a delicate balance. Simply stated, discharge patterns and sediment load create the deltaic land mass; coastal erosion and subsidence destroy the land mass. The natural interaction between these fresh water and salt-water systems creates a unique and diverse land/water habitat. In recent years, natural deltaic processes have been altered to prevent flooding and to improve navigation. As a result of such controls, virtually all overbank flooding has been prevented (Gagliano and Van Beek 1970).

In contrast to historical trends, the modern "bird-foot" delta is building outward into deep water near the edge of the continental shelf and, in most years, transported sediment is being dumped into deep water. Most of the Deltaic Plain is deteriorating because of this sediment transport pattern. During the past 30 to 40 years, land gain has been significant in only a few areas, notably in the Atchafalaya Basin. Net land loss figures are impressive for the coastal Louisiana wetlands. Land loss amounts to approximately 43 square kilometers (16.5 square miles) per year. In a 50-year period, almost 1,300 square kilometers (495 square miles) have been lost. The area lost is more than twice the size of Orleans Parish, which is approximately 540 square kilometers (210 square miles) (Gagliano and Van Beek 1970).

Land Use Classifications

Land use classifications for Mississippi and Louisiana are presented using slightly different categories. The State of Mississippi presents land use data in nine broad categories including: 1) residential; 2) commercial; 3) industrial; 4) public and semi-public; 5) rights-of-way; 6) resource production; 7) military; 8) water; and 9) unclassified. The residential contains five sub-categories: single-family, mobile home, duplex, multi-family, and mobile home park. The commercial category includes central business district activities, neighborhood to regional shopping centers, and general highway business activities. Industrial land use includes manufacturing, open storage of raw materials to finished products, salvage yards, and mine excavations. Public and semi-public lands cover all Government structures including schools, churches, hospitals, parks, public beaches, and similar uses. Rights-of-way include dedicated or reserved lands for streets, roads, highways, railroads, and utility facilities. Resource production land includes all types of farming, commercial forest, national forest, and tidal marsh. Tidal marsh is a legally protected land use for resource production. The military category includes land contracted or owned by the Mississippi Test Facility, Keesler Air Force Base, and the Naval Construction Battallion Training Center. The water category was not defined in the 1973 Regional Land Use Plan (Brooks 1973). This category was assumed to include all surface water bodies except the Mississippi Sound. The unclassified category is defined as all land uses not falling into the other classifications. No further definition was presented in the 1973 Regional Land Use Plan.

The Louisiana State Planning Office uses the same broad categories and 28 sub-categories for land use. For consistency of presentation these 28 sub-categories were combined into 10 categories similar to the Mississippi classification. Louisiana's data include a wetland category, and a bay and estuaries category, but the data do not include a NASA Military category On the following pages parish/county land use descriptions are presented by Planning Regions (Figure 14). These descriptions include population trends, current land use trends and land use projections.

LOUISIANA

A major portion of the MDPR study area is located in southeastern Louisiana, including 14 parishes. The Louisiana Office of State Planning has established planning districts in an effort to bring about consistency in all agencies involved in planning. Four planning regions (Figure 14) are located in the Louisiana study area. These regions are: 1) The Regional Planning Commission for Jefferson, Orleans, St. Bernard, St. Tammany and Plaquemines Parishes; 2) The Capital Regional Planning Commission (Livingston, Tangipahoa, and nine parishes outside the study area); 3) The South Central Planning and Development Commission (St. James, St. John the Baptist, St. Charles, Lafourche, Terrebonne and one parish outside the study area); and 4) The Acadiana Planning and Development District (Iberia, St. Mary and six parishes outside the study area).

The Regional Planning Commission for Jefferson, et al. region encompasses both highly urbanized and very remote areas. The Metropolitan New Orleans area includes Jefferson, Orleans, and St. Bernard, St. Tammany and Plaquemines Parishes. Two wilderness areas are located in Plaquemines and St. Bernard Parishes. Interstate-10 crosses the southern portion of Louisiana from Texas to Mississippi, transecting the metropolitan area of New Orleans and connecting this population center with the north shore of Lake Pontchartrain and to the State capital, Baton Rouge, located upstream on the Mississippi River and outside of the study area. The parishes of Region I are separated by, and border on, large water bodies. These water bodies include Lake Pontchartrain, Lake Borgne, Lake Salvador, the Gulf of Mexico, and the Mississippi River.

The Capital Regional Planning Commission includes 11 parishes east of the Mississippi River. The capital of Louisiana, Baton Rouge, is located in this planning district. Only two of this region's 11 parishes are within the MDPR study area: Livingston and Tangipahoa parishes. These parishes are located northwest of New Orleans and border Lake Maurepas and Lake Pontchartrain. Major cities include Denham Springs, approximately 16 kilometers (10 miles) from Baton Rouge, and Hammond which is near the intersection of Interstate Highways 12 and 55.

The South Central Planning and Development Commission consists of 6 parishes located west and south of New Orleans. Major cities in this district include Raceland, Thibodaux, and Houma. Development has ocurred along the intricate pattern of natural levees that transect this planning district from north to south and are a part of the Mississippi River distributary system. Water bodies within and bordering this planning district are numerous and include the Mississippi River, Bayou Lafourche, the lower Atchafalaya River, the Houma Navigation Canal, Lake Salvador, and numerous bays of the Gulf of Mexico.

The Acadiana Planning and Development District is located approximately 160 kilometers (100 miles) west of New Orleans. This planning district is made up of 8 parishes, but only two are included in the MDPR study area: Iberia Parish and St. Mary Parish. Iberia and St. Mary Parishes are located in the southern portion of Atchafalaya and Teche River basins. New Iberia and Morgan City are two major

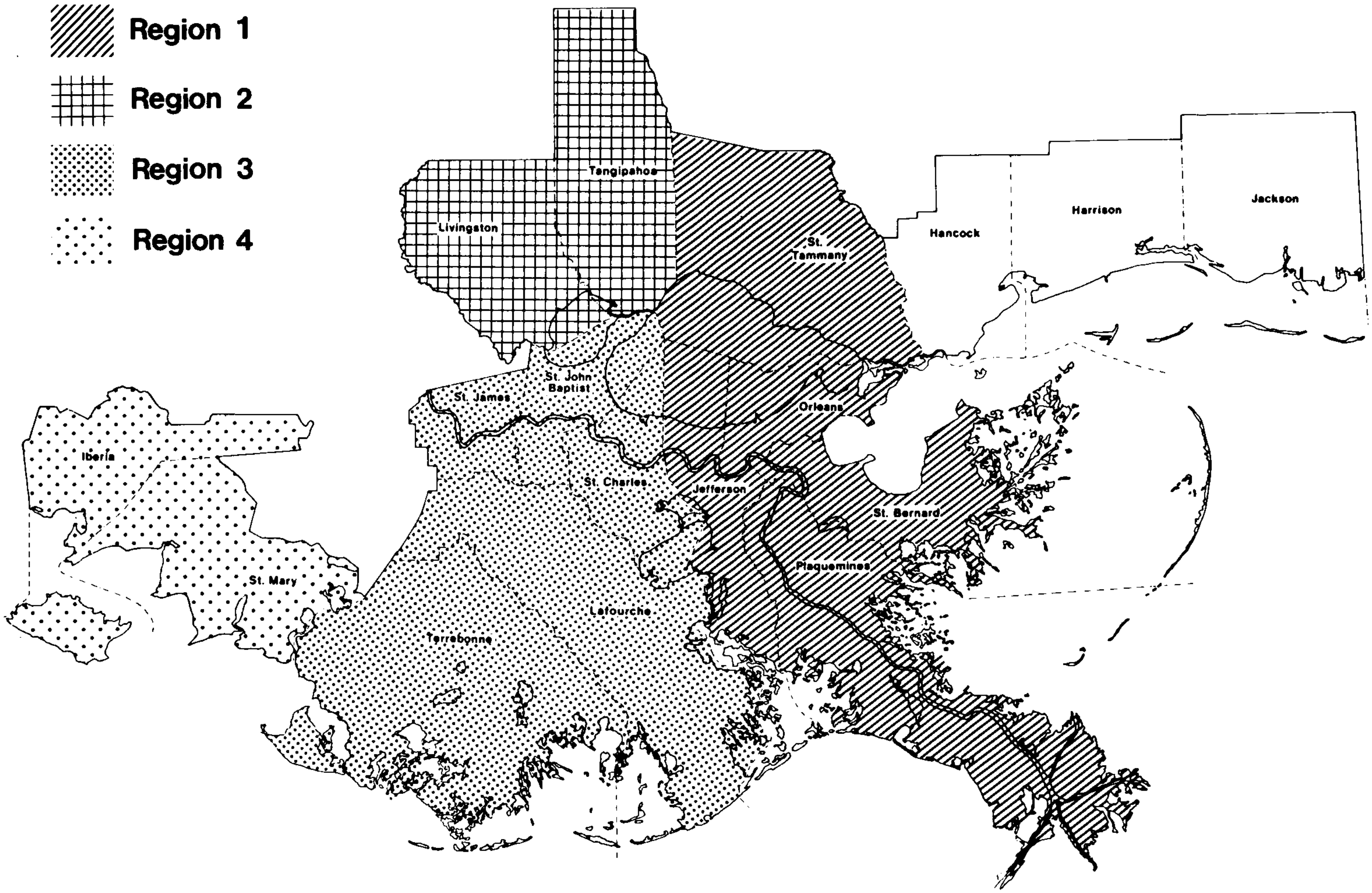


Figure 14. MDPR counties and parishes.

urban areas within this planning district. U.S. Highway 90 connects New Iberia and Morgan City with Lafayette, Houma, and New Orleans.

Regional Planning Commission for Jefferson, Orleans, St. Bernard, St. Tammany, and Plaquemines Parishes

Jefferson Parish. Jefferson Parish (Figure 15) is part of the New Orleans Standard Metropolitan Statisitical Area. Gretna, with a 1970 population of 24,870 people is the parish seat. In addition to Gretna, there are seven cities in the northern portion of Jefferson Parish with 1970 populations listed as greater than 10,000. All of these cities are suburbs of New Orleans. The southern two-thirds of Jefferson Parish does not have any cities larger than 2,500 (United States Army Corps of Engineers 1973).

Jefferson Parish's historic and projected population data are presented in Table 20 for selected years between 1960 and 2000; data are presented in three forms. These are 1) the actual, or projected population figures; 2) the percent population change; and 3) the Parish's percent of the total MDPR population. The population figures are those used by planning agencies in both states. Percent population change columns on the second page of this table indicate the rate of growth for each parish/county. Percent of the total MDPR population columns indicate parish/county growth trends with respect to the MDPR growth rate.

Jefferson Parish is projected to have the greatest percentage of the total MDPR population by 2000, and has the second highest projected percent population increase from 1980 through 2000.

Table 21 presents the 1972 Jefferson Parish land use summary. A major portion of this parish is classified as water, bays and estuaries, and wetland. Jefferson Parish has the sixth largest amount of area within the MDPR classified as water, bays and estuaries, and wetland. This parish also has the most area classified as residential and the third largest area of industrial lands. Jefferson Parish has the next to smallest amount of area classified as resource production lands.

According to Mumphrey et al. (1976), 1,806 hectares (4,597 acres) may be required by 1980, and an additional 1,276 hectares (3,153 acres) may be necessary by 1985, for residential expansion. Assuming four persons per household and the projected population change between 1980 and 1990, a density of 13.7 households per hectare (5.4 households per acre) would be required to meet these residential land use needs. According to Mumphrey et al. (1976), commercial expansion by 1985 may require 569 hectares (1,400 acres). Projected residential and commercial expansion may require a total of 3,705 hectares (9,156 acres). As indicated in Table 21, Jefferson Parish has only 2,998 hectares (7,410 acres) classified as resource production lands. If all resource production lands were converted to residential and commercial uses, 707 hectares (1,747 acres) would be required to meet projected land development needs. This may indicate a need for higher residential density or the conversion of other land use classifications to residential and commercial uses.

Orleans Parish. Orleans Parish, whose boundaries coincide with the City of New Orleans, is located between the Mississippi River and Lake Pontchartrain

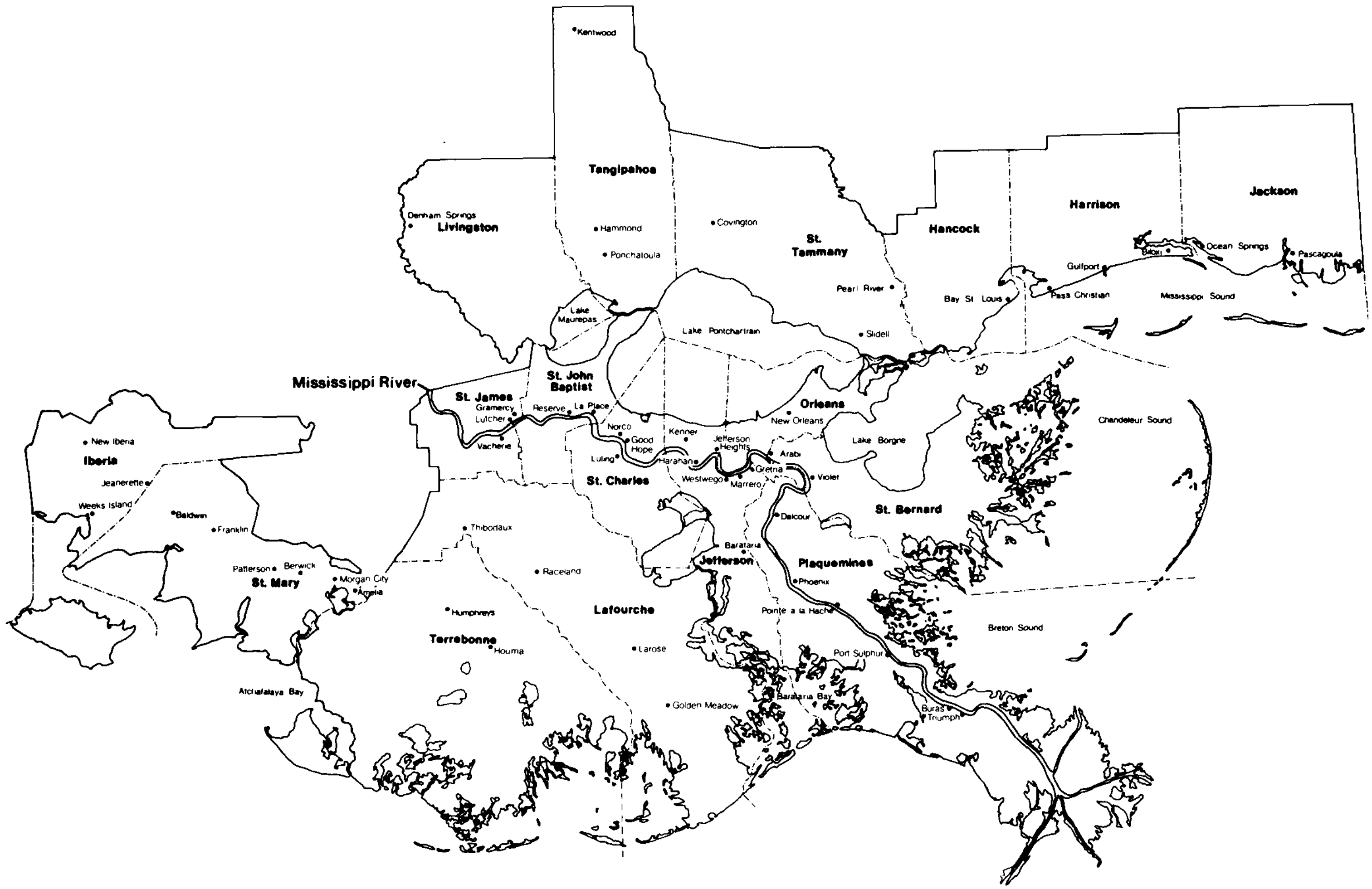


Figure 15. MDPR cities and towns.

Table 20. Historical & projected population data: MDPR, 1960-2000.

Parish/county by planning district	1960	1970	1975	1980	1975-1980 % change	1980 % of total
REGIONAL PLANNING COMMISSION FOR JEFFERSON PARISH, *et al*						
Jefferson	208,769	337,568	398,747	493,427	23.7	24.2
Orleans	627,525	593,471	562,420	550,844	-2.1	27.0
St. Bernard	32,186	51,185	58,232	71,084	22.1	3.5
St. Tammany	38,643	63,585	81,323	86,356	6.2	4.2
Plaquemines	22,545	25,225	26,077	27,677	6.1	1.4
CAPITAL REGIONAL PLANNING COMMISSION						
Livingston	26,974	36,511	42,840	47,961	11.9	2.4
Tangipahoa	59,434	65,875	71,905	72,218	.4	3.5
SOUTH CENTRAL PLANNING AND DEVELOPMENT COMMISSION						
St. James	18,369	19,733	19,599	20,198	3.1	1.0
St. John the Baptist	18,439	23,813	24,796	28,262	14.0	1.4
St. Charles	23,219	29,550	32,162	36,729	14.2	4.8
Lafourche	55,381	68,941	72,999	77,994	6.8	3.8
Terrebonne	60,771	76,049	85,069	88,032	3.5	4.3
ACADIANA PLANNING AND DEVELOPMENT DISTRICT						
Iberia	51,657	57,397	60,973	63,813	4.7	3.1
St. Mary	48,833	60,752	61,224	70,831	15.7	3.5
LA MDPR TOTAL	1,290,745	1,510,195	1,598,366	1,735,426	8.6	85.3
GULF REGIONAL PLANNING COMMISSION						
Hancock	14,039	17,387	18,249	19,200	5.2	.9
Harrison	119,489	134,582	143,528	165,800	15.5	8.1
Jackson	55,522	87,975	105,186	115,000	9.3	5.6
MS MDPR TOTAL	189,059	239,944	266,963	300,000	12.4	14.8

(continued)

Table 20. (concluded)

Parish/county by planning department	1990	1980-1990 % change	1990 % of total	2000	1990-2000 % change	2000 % of total
REGIONAL PLANNING COMMISSION FOR JEFFERSON PARISH, *et al*						
Jefferson	663,497	30.5	28.4	798,594	20.4	30.8
Orleans	531,028	-3.6	22.7	517,911	-2.5	20.0
St. Bernard	92,045	29.5	3.9	109,412	18.9	4.2
St. Tammany	114,653	32.7	4.9	148,676	29.7	5.7
Plaquemines	32,285	16.6	1.4	32,438	.5	1.2
CAPITAL REGIONAL PLANNING COMMISSION						
Livingston	59,788	24.7	2.6	73,375	22.7	2.8
Tangipahoa	78,722	9.0	3.4	83,876	6.5	3.2
SOUTH CENTRAL PLANNING AND DEVELOPMENT COMMISSION						
St. James	21,477	6.3	.9	22,680	5.6	.9
St. John the Baptist	35,310	24.9	1.5	41,325	17.0	1.6
St. Charles	45,056	22.7	1.9	54,022	19.9	2.1
Lafourche	87,870	12.7	3.8	92,871	5.7	3.6
Terrebonne	102,953	16.9	4.4	111,380	8.2	4.3
ACADIANA PLANNING AND DEVELOPMENT DISTRICT						
Iberia	69,115	8.3	3.0	69.738	.9	2.7
St. Mary	58,335	-17.6	2.5	54,779	-6.1	2.1
LA MDPR TOTAL	1,992,134	14.8	85.3	2,211,077	11.0	85.2
GULF REGIONAL PLANNING COMMISSION						
Hancock	21,200	10.4	.9	23,400	10.4	.9
Harrison	186,800	12.7	8.0	212,200	13.6	8.2
Jackson	135,100	17.5	5.8	147,000	8.8	5.7
MS MDPR TOTAL	343,100	14.3	14.7	382,600	11.5	14.8

Sources: Renner, J.R. 1976.
Mississippi State University, Division of Research, College of Business and Industry 1978.

Table 21. 1972 Land use and area for
Jefferson, Orleans, St. Bernard, St. Tammany, and Plaquemines Parishes.

Land use	Parish		
	Jefferson	Orleans	St. Bernard
Residential	12,195[a] (30,134)[b]	11,195 (27,664)	2,599 (6,422)
Commercial	1,100 (2,717)	1,299 (3,211)	100 (247)
Industrial	20,292 (50,141)	2,399 (5,928)	300 (741)
Public	300 (741)	500 (1,235)	0
Rights-of-Way	700 (1,729)	1,100 (2,717)	0
Resource Production	2,998 (7,410)	2,399 (5,928)	5,498 (13,585)
Water	128,048 (316,407)	39,184 (96,824)	352,157 (870,181)
Bays and Estuaries	18,992 (46,930)	400 (988)	138,645 (342,589)
Wetland	43,582 (107,692)	26,289 (64,961)	107,456 (265,525)
Other	16,593 (41,002)	2,299 (5,681)	11,595 (28,652)
Total	244,800 (604,903)	87,064 (215,137)	618,350 (1,527,942)

(continued)

Table 21. (concluded)

Land use	Parish: St. Tammany	Parish: Plaquemines	Total	Total percentage
Residential	10,596 (26,182)	3,099 (7,657)	39,684 (98,059)	1.6
Commercial	500 (1,235)	100 (247)	3,099 (7,657)	0.1
Industrial	1,100 (2,717)	22,491 (55,575)	46,582 (115,102)	1.9
Public	200 (494)	300 (741)	1,300 (3,211)	0.5
Rights-of-Way	300 (741)	600 (1,482)	2,700 (6,669)	.001
Resource Production	139,144 (343,824)	12,395 (30,528)	162,434 (401,375)	6.8
Water	60,476 (149,435)	817,569 (2,020,213)	1,397,434 (3,453,060)	69.0
Bays and Estuaries	0	92,063 (227,487)	250,100 (617,994)	11.0
Wetland	72,571 (179,322)	182,426 (450,775)	432,324 (1,068,275)	18.2
Other	800 (1,976)	7,197 (17,784)	38,484 (95,095)	1.6
Total	285,687 (705,926)	1,138,240 (2,812,489)	2,374,041 (5,866,497)	100.0

[a]Hectares.
[b]Acres (data were presented as acres in the primary source.)

Source: Louisiana State Planning Office 1972.

(Figure 15). Most of the population is concentrated in the western part of the parish; there has been increasing growth to the east with the development of a National Aeronautic Space Administration Facility and completion of Interstate-10 (United States Army Corps of Engineers 1973). Orleans Parish's population is projected to decrease continually through the year 2000. The decrease in population between 1970 and 2000 is expected to be 75,560, representing a projected 13 percent decrease in population (Table 20). By 1980 Orleans Parish is projected to have the greatest population in the MDPR, and by 2000 this parish is projected to have the second greatest population in the MDPR, exceeded only by Jefferson Parish.

Table 21 presents the 1972 Orleans Parish land use summary. A major portion of this parish is classified as water, bays and estuaries, and wetland. Orleans Parish is the second smallest parish/county in the MDPR, but has the second largest amount of land classified as residential. This parish has the smallest amount of land classified as resource production lands.

According to Mumphrey et al. (1976), residential expansion may occur in the eastern portion of Orleans Parish; between 1980 and 1985, 1,080 hectares (2,669 acres) may be required for residential growth. Land use projections and population data (Table 20) seem to indicate that residents of this parish are migrating to the suburbs of this parish, Jefferson, St. Bernard, and St. Tammany Parishes. According to Mumphrey et al. (1976), 731 hectares (1,807 acres) could be required for commercial uses through 1985. This projected expansion of commercial land use should make Orleans Parish the largest commercial center in the MDPR. Data seem to indicate that former residential lands may be replaced by some new commercial uses.

St. Bernard Parish. St. Bernard Parish is located southeast of Orleans Parish and is almost completely surrounded by water (Figure 15). This parish has numerous islands extending into Chandeleur and Breton Sounds. The Mississippi River Gulf Outlet runs through this parish from New Orleans southeast to the Gulf of Mexico.

Population data (Table 20) indicate that St. Bernard Parish will more than double from 1970 to 2000, but St. Bernard Parish's population is projected to represent only 4.2 percent of the MDPR in 2000. Although St. Bernard Parish's population is projected to be a small portion of the total MDPR population, growth within this parish is significant. Almost a 30 percent increase (20,961 additional people) in population is projected to occur between 1980 and 1990.

Table 21 presents the 1972 St. Bernard Parish land use summary. Over 96 percent of this parish's area is classified as water, bays and estuaries, and wetland; St. Bernard ranked second to Plaquemines Parish in this classification. Within the planning district St. Bernard has the smallest amount of area classified as residential, commercial, and industrial. Within the MDPR St. Bernard has the third smallest amount of area classified as resource production.

According to Mumphrey et al. (1976), 1,003 hectares (2,555 acres) could be required for residential development through 1985. Most of this development should occur between Arabi and Violet in the northwest portion of this parish. Based on an assumed four persons per household and the projected population change between 1980 and 1990, a density of five households per hectare (two households per acre) could be required to meet the projected residential expansion. According to Mumphrey et al. (1976), 54 hectares (134 acres) could be required for commercial expansion through 1985. A total of 1,087 hectares (2,689 acres) is projected for future growth of both residential and commercial uses. Less than one percent of the total area of St. Bernard Parish is classified as resource production. If projected urban expansion occurs and only resource production lands are converted to urban uses, 4,411 hectares (10,900 acres) of resource production land would remain in this classification.

St. Tammany Parish. St. Tammany Parish is located north of New Orleans, across from Lake Pontchartrain with the southern portion of this parish bordering on the lake (Figure 15). Direct access into New Orleans is provided by the Pontchartrain Causeway and Interstate-10. Two major urban population centers with 1970 populations greater than 5,000 are Slidell and Covington (United States Army Corps of Engineers 1973).

Population data (Table 20) indicate that St. Tammany Parish could more than double between 1970 and 2000. St. Tammany Parish is projected to have the fourth highest percentage of the total MDPR population by 2000. Data indicate that St. Tammany Parish should grow more than 32 percent by 1980 and 1990.

Table 21 presents the 1972 St. Tammany Parish land use summary. Over 40 percent of this parish is classified as resource production. St. Tammany has the second highest amount of land classified as resource production and the third highest amount of land classified as residential in the MDPR. Over 46 percent of this Parish is classified as water and wetland.

According to Mumphrey et al. (1976), 1,758 hectares (4,346 acres) may be required for residential growth through 1985. Most of this growth should occur around Slidell and Covington. Assuming four persons per household, and the projected population change between 1980 and 1990, a density of four households per hectare (1.6 households per acre) could be required to satisfy residential land use needs. According to Mumphrey et al. (1976), 379 hectares (937 acres) may be required for commercial growth through 1985. Most of this growth is predicted to occur in conjunction with the residential growth. A total of 2,137 hectares (5,283 acres) may be required for future residential and commercial growth. This potential land requirement is only 1.5 percent of the total lands in resource production. Most of the water and wetlands are located in the southern portion of this parish near potential growth areas.

Plaquemines Parish. Plaquemines Parish is located east of Jefferson Parish, west of St. Bernard Parish, and south of New Orleans (Figure 15). This Parish is divided by the lower portion of the Mississippi River. State Highways 23 and 39 parallel both sides of the Mississippi River through Plaquemines Parish. This parish could be characterized as a long peninsula extending from New Orleans through the Gulf of Mexico. According to 1970 data, two cities, Port Sulphur and Buras-Triumph, have populations greater than 3,000 (United States Army Corps of Engineers 1973).

Population data (Table 20) indicate that Plaquemines Parish is projected to increase by only 7,213 people from 1970 to 2000. The population of Plaqeumines

Parish is projected to be present 1.2 percent of the MDPR population in 2000. Plaquemines Parish is not projected to grow as fast as Jefferson, St. Bernard, or St. Tammany Parishes.

Table 21 presents the 1972 Plaquemines Parish land use summary. Plaquemines Parish has a total of 1.1 million hectares (2.8 million acres). Data show that this parish is the largest in the MDPR. In order to place this size in perspective, Plaquemines Parish is almost the size of Jefferson, Orleans, St. Bernard, and St. Tammany Parishes combined. Over 87 percent of this parish is classified as water, bays and estuaries, and wetland. This parish has the third largest area in the MDPR classified as wetland. Eight of the seventeen MDPR parishes/counties have more area classified as residential than Plaquemines Parish, but only two have more area classified as industrial.

Based on the population change between 1980 and 1990, an assumed average household size four, and an assumed density of 2.5 households per hectare (1 household per acre), 461 hectares (1,152 acres) would be required for residential expansion through 1990. If this residential development were to occur only on land classified as resource production, this development would change the resource production classification to less than 4 percent of the total parish land area.

As presented in Table 21, the industrial land use classification is seven times the residential classification. Should the industrial land use requirement expand significantly, there may not be appropriate or adequate land available without using some wetland. A 25 percent increase in industrial land requirements could consume more than 45 percent of the land classified as resource production, if only this land type was used for future industrial expansion.

Capital Regional Planning Commission

Livingston Parish. Livingston Parish (Figure 15) is located northwest of New Orleans. The southern portion of this parish borders Lake Maurepas and Ascension Parish. Interstate-12 crosses the center portion of this parish and provides access to Baton Rouge. Denham Springs is a major urban center of this parish with a 1970 population of 6,752 people (United States Army Corps of Engineers 1973).

Population data (Table 20) indicate that Livingston Parish is projected to increase by 36,864 people from 1970 to 2000. Eleven of the parishes/counties are projected to have a greater percentage of the total MDPR population than Livingston by the year 2000. Livingston Parish, however, is projected to have one of the highest growth rates as indicated by the 1980-1990 and the 1990-2000 percent change data.

Table 22 presents the 1972 Livingston Parish land use summary. Over 75 percent of this parish is classified as resource production. This resource production area is 46,300 hectares (115,400 acres) more than the total area of Orleans Parish. Twenty-two percent of this parish is classified as water, bays and estuaries and wetland. Nine of the fourteen parishes/counties have more land classified as residential and all the parishes/counties in the MDPR have more land classified as industrial except for St. John Parish.

Based on the population change between 1980 and 1990, an assumed average household size of four, and an assumed density of 2.5 household per hectares (1

Table 22. 1972 Land use and area for Capital Regional Planning Commission for Livingston and Tangipahoa Parishes.

Land use	Parish: Livingston	Parish: Tangipahoa	Total	Total percentage
Residential	2,499[a] (6,175)[b]	2,299 (5,681)	4,798 (11,856)	1.2
Commercial	100 (247)	400 (988)	500 (1,235)	0.1
Industrial	700 (1,729)	1,100 (2,717)	1,800 (4,446)	0.4
Public	0	200 (494)	200 (494)	0.5
Rights-of-Way	300 (741)	800 (1,976)	1,100 (2,717)	0.3
Resource Production	133,746 (330,486)	170,631 (421,629)	304,377 (752,115)	77.7
Water	13,195 (32,604)	10,396 (25,688)	23,591 (58,292)	6.0
Bays and Estuaries	100 (247)	0	100 (247)	0.02
Wetland	26,787 (66,196)	27,489 (67,925)	54,276 (134,121)	13.8
Other	0	800 (1,976	800 (1,976)	0.2
Total	177,427 (438,425)	214,115 (529,004)	391,542 (967,499)	100.0

[a]Hectares.
[b]Acres (data were presented as acres in the primary source).

Source: Louisiana State Planning Office 1972.

household per acre), 1,183 hectares (2,957 acres) would be necessary for residential expansion. If this residential expansion were to occur on land classified as resource production, this development would change the resource production classification by less than 1 percent.

Tangipahoa Parish. Tangipahoa Parish (Figure 15) is located north of New Orleans, the southern portion of this parish borders Lake Pontchartrain and Lake Maurepas. Major north-south and east-west access routes cross this parish. These are Interstate Highways 55 and 12 respectively.

Population data (Table 20) indicate that Tangipahoa Parish is projected to increase by 18,000 people between 1970 and 2000. Eight of the parishes/counties are projected to a have greater percentage of the total MDPR population in 2000. Eight parishes/counties are projected to have higher growth rates between 1980-1990; ten parishes/counties are projected to have a greater population growth rate between 1990-2000 than Tangipahoa Parish.

Table 22 presents the 1972 Tangipahoa Parish land use summary. Over 79 percent of this parish is classified as resource production. This resouce production area is 20,200 hectares (50,000 acres) larger than the total area of Orleans and St. James Parishes combined. Over 17 percent of Tangipahoa Parish is classified as water and wetland, and less than 2 percent of this parish is classified as residential, commercial, and industrial.

Based on the population change between 1980 and 1990 and a density of 2.5 households per hectare (1 household per acre), 650 hectares (1,626 acres) would be necessary for residential expansion. If this residential expansion was to occur only on land classified as resource production, this development would change the resource production classification by less than 1 percent. Future residential growth is expected to occur along Interstate-55 around Hammond to Kentwood (United States Army Corps of Engineers 1973). Most of Tangipahoa's water and wetlands are located near this growth area.

South Central Planning and Development Commission

St. James Parish. St. James Parish (Figure 15) is located west of New Orleans and south of Baton Rouge. Two cities, Gramercy and Lutcher had 1970 populations greater than 2,500. Convent, the parish seat, is located in the center of this parish along the Mississippi River. Major access through the parish is provided by Highways 18 and 44, which parallel the Mississippi River.

Population data (Table 20) indicate that St. James Parish is expected to increase by 2,947 people between 1970 and 2000. St. James Parish is projected to have the smallest population in the MDPR, and only three parishes/counties are projected to have lower growth rates.

Table 21 presents the 1972 St. James land use summary. St. James Parish has the smallest amount of area in the MDPR. Over 40 percent and over 50 percent of the St. James Parish is classified as resource production and wetland respectively. Only St. John Parish has less land classified as residential, commercial, and industrial.

According to Bardwell (1967), 313 hectares (774 acres) may be required for residential development through 1980. This residential development is projected to occur in the communities of Lutcher, Gramercy and Vacherie. If only land classified as resource production were used to meet this future residential expansion, less than 2 percent of the land classified as resource production would be required for residential expansion. According to Bardwell (1967), 189 hectares (468 acres) may be required for commercial and industrial expansion in 1985. A total of 502 hectares (1,242 acres) could be required for future residential, commercial, and industrial expansion. This would be 2.3 percent of the area classified as resource production.

St. John the Baptist Parish. St. John the Baptist Parish (Figure 15) is located between New Orleans and Baton Rouge. This parish is bordered on the east by Lake Pontchartrain, on the north by Lake Maurepas and on the south by Lac Des Allemands. The Mississippi River crosses through the middle of the parish. Interstate-10 crosses the northern part of the parish and Interstate-55 provides access into Tangipahoa Parish between Lake Pontchartrain and Lake Maurepas. Major urban centers are Reserve and LaPlace.

Population data (Table 20) indicate that St. John the Baptist Parish is projected to increase by 17,512 people between 1970 and 2000. St. John the Baptist Parish's population in 2000 will be 1.6 percent of the MDPR, but this parish is projected to have a population growth rate of 24.9, and 17 percent, for the years between 1980-1990 and 1990-2000 respectively.

Table 23 presents the 1972 St. John the Baptist Parish land use summary. St. John the Baptist Parish is the third smallest in the MDPR. Over 84 percent of this Parish is classified as water and wetland, and over 13 percent is classified as resource production. St. John the Baptist Parish has the smallest amount of area classified as residential, commercial, and industrial.

According to Davis (1976a), approximately 490 hectares (1,129 acres) may be required for residential expansion through 1985. Based on four persons per household and the projected population change between 1980 and 1990, a density of 3.6 households per hectare (1.5 households per acre) would be required to meet the projected residential growth. According to Davis (1976a), approximately 4,500 hectares (11,000 acres) may be required for expansion of commercial and industrial use through 1985. If future residential, commercial, and industrial development were to occur only on resource production land, 8,151 hectares (2,141 acres) would remain in the resource production classification. This would be a 37.8 percent change in the resouce production classification. Data seem to indicate a relatively large degree of commercial and industrial expansion without a corresponding rate of residential expansion.

St. Charles Parish. St. Charles Parish (Figure 15) is located west of New Orleans. This parish is bordered on the southeast by Lake Salvador and on the north by Lake Pontchartrain; the Mississippi River crosses through the parish. Western and southern boundaries are shared by St. John the Baptist and Lafourche Parishes respectively. U. S. Highway 90 crosses through St. Charles Parish and provides access to New Orleans and Houma in Lafourche Parish. According to 1970 data, two cities in St. Charles Parish had populations greater than 2,500 (United States Army Corps of Engineers 1973). These cities are Luling and Norco.

Population data (Table 20) indicate that St. Charles Parish is projected to increase by 24,472 people between 1970 and 2000. Population of St. Charles Parish is projected to represent 2.1 percent of the MDPR population in 2000. This is a projected decline with respect to the percentage of the total 1980 MDPR population.

Table 24 presents the St. Charles Parish 1972 land use summary. Over 80 percent of this parish is classified as water and wetland. Over 8 percent of this parish is classified as resource production, and over 10 percent is classified as residential, commercial, and industrial.

According to Ohmer and Ohmer (1976), 819 hectares (2,074 acres) may be required for residential expansion through 1985. Based on four persons per household and the projected population change between 1980 and 1990, a density of 2.5 households per hectare (1 household per acre) could be required to meet the projected residential growth. According to Ohmer and Ohmer (1976), 219 hectares (542 acres) may be required for commercial, industrial, and rights-of-way expansion through 1985. If future residential, commercial, industrial, and rights-of-way development were to occur only on resource production land, 8,566 hectares (21,167 acres) would remain in the resource production classification. This would be a 10.7 percent reduction in this classification.

Lafourche Parish. Lafourche Parish (Figure 15) is located southwest of New Orleans. This parish is bordered by Jefferson Parish on the east, by St. James, St. John the Baptist and St. Charles Parishes on the north, Terrebonne Parish on the west, and the Gulf of Mexico on the south. Development in Lafourche Parish occurs along the natural levees of Bayou Lafourche. Thibodaux, the parish seat, is located in the northern portion of this parish and had a 1970 population of 15,028. Two other cities in Lafourche Parish had 1970 populations that exceeded 4,000. These cities are Larose and Raceland.

Population data (Table 20) indicate that Lafourche Parish is projected to increase by 23,930 people between 1970 and 2000. Lafourche Parish is projected to have a decreasing percentage of the total MDPR population through 2000.

Table 24 presents the 1972 Lafourche Parish land use summary. Over 82 percent of this parish is classified as water, bays and estuaries, and wetland. Lafourche Parish has the third largest amount of area classified as wetland in the MDPR. Approximately 9 percent of this parish is classified as resource production, and approximately 8 percent is classified as residential, commercial, and industrial.

According to Davis (1976b), 358 hectares (886 acres) may be required for residential expansion through 1985. Based on four persons per household, and the projected population change between 1980 and 1990, a density of 6.9 households per hectare (2.8 households per acre) could be required to meet the projected residential growth. According to Davis 1976b), 3,063 hectares (7,570 acres) could be required for expansion of the commercial, industrial, and rights-of-way through 1985. If future residential, commercial, industrial, and rights-of-way were to occur only on resource production land, 4,922 hectares (123,110 acres) would remain in the resource production classification. This would represent a one percent reduction in resource production lands.

Table 23. 1972 Land use and area for
South Central Planning and Development Commission for
St. James, St. John, St. Charles, Lafourche, and Terrebone Parishes.

Land use	Parish		
	St. James	St. John	St. Charles
Residential	1,599[a] (3,952)[b]	1,100 (2,717)	1,699 (4,199)
Commercial	0	0	100 (247)
Industrial	900 (2,223)	200 (494)	10,196 (25,194)
Public	100 (247)	300 (741)	100 (247)
Rights-of-Way	0	0	0
Resource Production	25,690 (53,479)	13,095 (32,357)	9,596 (23,712)
Water	2,799 (6,916)	41,483 (102,505)	37,685 (93,119)
Bays and Estuaries	0	0	0
Wetland	32,288 (79,781)	40,084 (99,047)	51,579 (127,452)
Other	0	100 (247)	300 (741)
Total	63,376 (146,598)	96,362 (238,108)	111,255 (274,911)

(continued)

Table 23. (concluded)

Land use	Parish		Total	Total percentage
	Lafourche	Terrebonne		
Residential	4,898	5,398	14,694	
	(12,103)	(13,338)	(36,309)	1.2
Commercial	200	600	900	
	(494	(1,482)	(2,223)	0.6
Industrial	37,685	39,384	88,365	
	(93,119)	(97,318)	(218,348)	6.8
Public	200	0	700	
	(494)		(1,729)	.05
Rights-of-Way	100	300	400	
	(247)	(741)	(988)	0.3
Resource Production	50,280	30,987	129,648	
	(124,241)	(76,570)	(320,359)	9.6
Water	226,208	30,388	338,563	
	(558,961)	(75,088)	(836,589)	25.9
Bays and Estuaries	42,483	97,061	139,544	
	(104,975)	(239,837)	(344,812)	10.7
Wetland	194,021	262,894	580,866	
	(479,427)	(649,610)	(1,435,317)	44.5
Other	5,798	6,697	12,895	
	(14,326)	(16,549)	(31,863)	0.9
Total	561,873	473,709	1,306,575	
	(1,388,387)	(1,170,533)	(3,228,537)	100.0

[a]Hectares.
[b]Acres (data were presented as acres in the primary source).

Source: Louisiana State Planning Office 1972.

Table 24. 1972 Land use and area for Acadiana Planning and Development District, Iberia and St. Mary Parishes.

Land use	Parish: Iberia	Parish: St. Mary	Total	Total percentage
Residential	2,399[a] (5,928)[b]	3,499 (8,645)	5,898 (14,573)	0.7
Commercial	300 (741)	1,000 (2,470)	1,300 (3,211)	0.2
Industrial	8,097 (20,007)	22,491 (55,575)	30,588 (75,582)	3.7
Public	100 (247)	0	100 (247)	0.1
Rights-of-Way	600 (1,482)	2,199 (5,434)	2,799 (6,916)	0.3
Resource Production	(124,488)	50,380 (86,450)	34,986 (210,938)	85,366 10.4
Water	231,606 (572,299)	205,617 (508,079)	437,223 (1,080,378)	53.5
Bays and Estuaries	39,084 (96,577)	28,389 (70,148)	67,473 (166,725)	8.3
Wetland	82,161 (203,034)	95,261 (235,391)	177,422 (438,425)	21.7
Other	4,498 (11,115)	4,998 (12,350)	9,496 (23,465)	1.2
Total	419,225 (1,035,918)	398,400 (984,542)	817,665 (2,020,460)	100.0

[a]Hectares.
[b]Acres (data were presented as acres in the primary source).

Source: Louisiana State Planning Office 1972.

Terrebonne Parish. Terrebonne Parish (Figure 15) is located between Lafourche Parish on the north and east and St. Mary Parish on the west. Major water bodies within or bordering Lafourche Parish include the lower Atchafalaya River, the Houma Navigation Canal, the Intracoastal Waterway, Bayou Terrebonne, numerous lakes and the Gulf of Mexico. Houma, the Parish seat, is the major urban center in Terrebonne Parish. The 1970 population was 37,864 people. Houma is at the junction of two major navigation canals and a railroad. Access to Houma from Morgan City in St. Mary Parish and New Orleans is provided by U.S. Highway 90.

Population data (Table 20) indicate that Terrebonne Parish is to increase by 35,331 people between 1970 and 2000. This parish is projected to have the sixth largest parish/county population and accounts for 4.3 percent of the MDPR population by 2000. Terrebonne Parish is projected to have a population growth rate of 16.9 and 8.2 percent for the years between 1980-1990 and 1990-2000 respectively.

Table 23 presents the 1972 Terrebonne Parish land use summary. Terrebonne Parish has the fourth largest amount of land of any parish/county in the MDPR. More than 80 percent of this parish is classified as water, bays and estuaries, and wetland. Terrebonne Parish has the largest amount of area classified as wetland. Less than 10 percent of this parish is classified as residential, commercial, and industrial.

According to Gary (1976), 2,477 hectares (6,123 acres) could be required for residential expansion through 1985. Based on four persons per household and the projected population range between 1980 and 1990, a density of 1.5 households per hectare (0.6 households per acre) could be required to meet the projected residential growth. According to Gary (1976), 708 hectares (1,570 acres) could be required for commercial, industrial, and rights-of-way expansion through 1985. If development of future residential, commercial, industrial, and rights-of-way were to occur only on resource production land, 27,802 hectares (68,699 acres) would remain in the resource production classification. This would be a 10 percent reduction in this classification.

Acadiana Planning and Development District

Iberia Parish. Iberia Parish is located in the western portion of the MDPR (Figure 15). U.S. Highway 90 connects Iberia with Lafayette to the north and Morgan City in St. Mary's Parish to the east. The two major urban centers of Iberia Parish are New Iberia and Jeanerette. The 1970 population of New Iberia was 30,147 and the 1970 population of Jeanerette was 6,286 (United States Army Corps of Engineers 1973).

Population data (Table 20) indicate that Iberia Parish is projected to increase by 12,341 people between 1970 and 2000. This parish is projected to have the fourth smallest parish/county population, and accounts for 2.7 percent of the MDPR total population by 2000.

Table 24 presents the 1972 Iberia Parish land use summary. Iberia Parish has the fifth largest amount of area in the MDPR. Over 84 percent of this parish is classified as water, bays and estuaries, and wetland. Twelve percent of Iberia Parish is classified as resource production and less than 3 percent of this Parish is classified as residential, commercial, and industrial.

According to the Acadiana Planning and Development District (1976), 577 hectares (1,428 acres) could be required for residential expansion through 1985. Based on four persons per household and the projected population growth through 1980 and 1990, a density of 2.3 households per hectare (0.9 households per acre) would be required to meet the projected residential growth. According to the Acadiana Planning and Development District (1976), 172 hectares (427 acres) could be required for commercial, industrial, and rights-of-way through 1985. If development of residential, commercial, industrial and rights-of-way were only to occur on resource production land, 49,631 hectares (73,007 acres) would remain in the resource production classification. This would be a 1.5 percent reduction in land used for resource production.

St. Mary Parish. St. Mary Parish (Figure 15) is located between Iberia and Terrebonne Parishes. St. Mary Parish is a peninsula surrounded by the Gulf of Mexico, the lower Atchafalaya River, Grand Lake, and Lake Fausse Pointe. The major urban centers include Morgan City, Baldwin, Franklin, Berwick, and Patterson. The 1970 population of Morgan City was 16,788. Morgan City is surrounded by water and/or wetlands and is an Intracoastal Waterway Port. Baldwin has a population of 9,325 and Patterson has a population of 4,409 (United States Army Corps of Engineers 1973). These cities are located along U.S. Highway 90 that connects St. Mary Parish with Thibodaux and New Iberia.

Population data (Table 20) indicate that St. Mary Parish is projected to decrease by 5,973 people between 1970 and 2000. As indicated in Table 20, the greatest decline in population is projected to occur between 1980 and 1990.

Table 24 presents the 1972 St. Mary Parish land use summary. St. Mary Parish is the seventh largest parish in the MDPR. More than 80 percent is classified as water, bays and estuaries and wetland. Approximately 9 percent is classified as resource production and less than 7 percent is classified as residential, commercial, and industrial.

According to the Acadiana Planning and Development District (1976), 236 hectares (583 acres) could be required for residential expansion; 559 hectares (1,381 acres) could be required for commercial, industrial, and rights-of-way expansion through 1985. If development of this future residential, commercial, industrial, and rights-of-way was to occur only on resource production land 34,191 hectares (84,486 acres) would remain in the resource production classification. This would be a 2.3 percent reduction in this classification. Population data seem to indicate that future residential development may not require the projected residential land needs because St. Mary Parish's projected population begins to decline after 1980 (Table 20).

MISSISSIPPI

The eastern portion of the MDPR consists of three Mississippi coastal counties (Figure 16). These counties are Hancock, Harrison and Jackson and are part of the Gulf Regional Planning Commission. The Commission's primary purpose is to express policies designed to guide the coastal counties' development.

Hancock, Harrison and Jackson Counties comprise the entire coast of Mississippi. The distance along the Mississippi coast, between Louisiana and

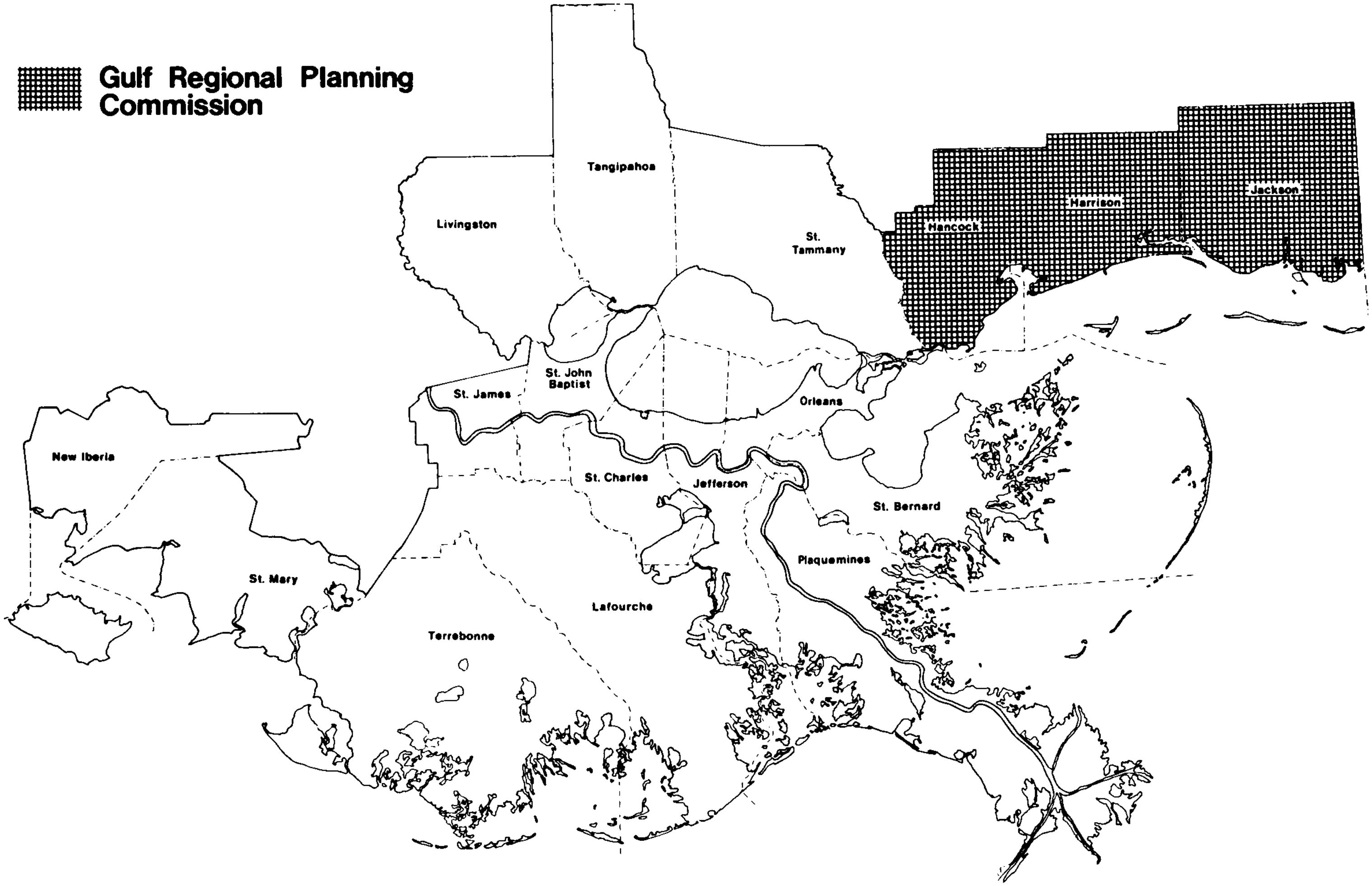


Figure 16. MDPR counties and parishes.

Alabama, is approximately 114 kilometers (70 miles). Coastal shoreline including the Barrier Islands, is approximately 600 kilometers (370 miles). The City of Gulfport, Mississippi is 122 kilometers (75 miles) east of New Orleans, Louisiana, and 122 kilometers (75 miles) west of Mobile, Alabama (Water Resource Engineers 1978).

Two distinct physiographic regions cross the Gulf counties: the coastal meadows and the coastal plains. The coastal meadows extend across the three counties along the Mississippi Sound from the shoreline to approximately 8 meters (25 feet) in elevation. This topographic region encompasses one-third of Harrison County, one-half of Hancock County, and one-half of Jackson County. The coastal plain covers the remaining portion of these counties (Gulf Regional Planning Commission 1972).

The social and demographic synthesis (see Section II) explains in detail recent growth trends for the Gulf Regional Planning Commission Counties. A brief review of recent population trends puts current land use trends in perspective. Population data for 1972 indicated that 259,990 people resided in the three county areas. Ninety-one percent of that population (236,526 people) live near the coastal section. This coastal section comprises 33.8 percent of the land, which is 1,571 square kilometers (607 square miles). The coastal section is roughly defined as 8 kilometers (5 miles) in from the coastline. Population projections for the urbanized areas (coastal section) of these counties indicated that there will be an urban population of 305,635 residents in 1984 and 416,009 in 1997, a 36 percent urban population increase is projected between 1984 and 1997 (Water Resources Engineers 1978).

Existing land use reflects historical land use, economic development, and current attitudes toward land use control. The land use and economy for most of the coast's history have involved forestry, fishing and the tourist industry. Due to the threat of hurricanes, this coastal area developed slowly through the 19th century and the early part of the 20th century. The threat of hurricane damage has continued to be a deterent to growth, although potential storm damage has lessened with the development of advance warning systems and Federal financial aids to natural disaster areas (Water Resource Engineers 1978). This Mississippi coastal region has been transformed from a rural economic base to an expanding urban economic base with diversified industrial and commercial development. Historically, land use controls were not implemented so that overutilization of natural resources occurred, such as the devastation of the virgin timber stands. In the past 40 years, sound resource management and land use control policies have been implemented. These policies include reforestation, county-wide subdivision ordinances and comprehensive land use planning. The economy of the Mississippi Gulf Coast shows a decline in agricultural, fishing and forestry employment. These uses are being replaced by manufacturing and service industries. This change in economic base is reflected in the increasing coastal urbanization, which will require continued comprehensive land use planning and land use controls (Brooks 1973).

Hancock County. Hancock County was established in 1812. Historically, this county gained recognition as an excellent resort area. Bay Saint Louis attracted large numbers of people from New Orleans. Resort, lumbering and seafood industries flourished in the early 20th Century. Uncontrolled exploitation and poor conservation practices of the lumber industry were extremely detrimental to the vast stands of virgin longleaf pine. These stands were almost totally depleted. The seafood industry also declined, and only a declining tourist industry remained to support the economy. Forest resources and the seafood industry were revitalized during and after World War II. New industry and the improving natural resources industry helped to revive Hancock County's economy (Brooks 1973). Hancock County was selected as the National Aeronautic and Space Administration site (Mississippi Test Facility) for static firing of Saturn boosters. In 1970 Hancock County suffered an economic recession from a reduction in the space program and the damage from Hurricane Camille in 1969. Currently, the economic situation has stabilized with renewed activities at the Mississippi Test Facility and the growth of the commercial and manufacturing phase (Water Resources Engineers 1978).

Hancock County has two incorporated cities, Bay Saint Louis and Waveland. The growth of these cities is directed by comprehensive community plans (Water Resources Engineers 1978). The county has a subdivision regulation that does not have provisions to deal with secondary growth problems stimulated by the rapid development of commercial and industrial land uses.

Hancock County has a total area of approximately 125,000 hectares (308,000 acres) (Table 25); from 1969 to 1972 residential land use increased by 47 percent and in 1972, 1,611 hectares (3,982 acres) were classified as residential. The regional land use plan (Brooks 1973) indicates that Hancock County has utilized only 19 percent of the total residential area that will be needed by 1990. Commercial land area showed an increase of 18 percent from 1969 to 1972; 97 hectares (239 acres) were classified as commercial in 1972. This increase was in response to residential land use growth in order to accurately provide good services. Industrial land use increased only slightly from 1969 to 1972. In 1972, 1,873 hectares (4,628 acres) were classified for industrial land use. Public and semi-public land uses, which included parks and special areas (airports), increased by 95 percent from 1969 to 1972. Six hundred seventeen hectares (1,525 acres) were classified as public and semi-public land uses in 1972. Rights-of-way increased by 4 percent during the 1969 to 1972 period. Rights-of-way in 1972 comprised 2,850 hectares (7,042 acres). During the 1969 to 1972 period resource production land use increased by 50 percent. This large increase in resource production land use was mainly due to the classification of approximately 8,043 hectares (19,875 acres) of tidal marshland as protective land use under resource production. In 1972, 24,603 hectares (60,795 acres) were classified as resource production. Within the resource production classification of agricultural and orchard, during the 1969 to 1972 period, farmland comprised 5,948 hectares (14,698 acres) and orchards comprised 1,006 hectares (2,485 acres). Within the resource production classification, commercial forests comprised 8,887 hectares (21,959 acres) in 1972; no National Forests exist in Hancock County. In 1972 federal lands including the Mississippi Test Facility and Military Installations comprised 24,603 hectares (60,795 acres). 48,748 hectares (120,445 acres) were unclassified in 1972. Within Hancock County 2,180 hectares (5,388 acres) were classified as fresh water (Brooks 1973).

Harrison County. Harrison County was established in 1841. Historically, Ship Island in the Mississippi Sound served as a supply point for the French explorers in colonial years. In the 19th Century, Ship Island served as a transfer depot for large ocean-going vessels that were restricted by their size from entering the Mississippi

Table 25. 1972 Land use and area for
Gulf Regional Planning Commission.

Land use	Parish: Hancock	Parish: Harrison	Parish: Jackson	Total	Total percentage
Residential	1,611[a] (3,982)[b]	5,762 (14,239)	4,615 (11,403)	11,988 (29,624)	2.6
Commercial	97 (239)	580 (1,434)	380 (938)	1,057 (2,611)	0.2
Industrial	1,873 4,628	967 2,389	2,097 5,182	4,937 12,199	1.1
Public	617 (1,525)	2,172 (5,367)	2,590 (6,401)	5,379 (13,293)	1.2
Rights-of-Way	2,850 (7,042)	4,125 (10,193)	4,212 (10,407)	11,187 (27,642)	2.4
Resource Production	24,603 (60,795)	75,860 (187,449)	72,128 (178,230)	172,591 (426,474)	37.0
NASA - Military	42,030 (103,856)	1,134 (2,802)	0	43,164 (106,658)	9.2
Water	2,180 (5,388)	7,397 (18,277)	5,549 (13,712)	15,126 (37,377)	3.2
Unclassified	48,748 (120,455)	55,520 (130,190)	96,970 (239,613)	201,238 (497,258)	43.1
Total	124,609 (307,910)	153,517 (379,340)	188,541 (465,886)	466,667 (1,153,136)	100.0

[a]Hectares.
[b]Acres (data were presented as acres in the primary source).

Source: Brooks, D. 1973.

Sound. As New Orleans became the major Gulf port, Ship Island diminished in importance. In 1902, a channel was dredged from Ship Island to Gulfport. This mainland seaport stimulated the fishing, seafood packing and trade industries (Brooks 1973).

Like Hancock County, resort, lumber and seafood industries flourished in Harrison County through the early 20th Century. Uncontrolled exploitation and poor conservation practices in the lumber industry were extremely destructive to the vast stands of virgin longleaf pine. This natural resource was restored through a reforestation program which helped revitalize this segment of the economy. Two military installations were established in Harrison County during World War II. These facilities were Keesler Air Force Base and the Naval Construction Battalion Center in Gulfport. Harrison County Development Commission was established in the early 1960's to encourage new and diversified industrial development. Currently, professional and related services employment is increasing in economic importance. Trade continues to be an important industry. The future growth of the seafood processing industry and chemical/metal industry should continue to expand the job market (Water Resources Engineers 1978).

Harrison County has four incorporated cities including Biloxi, Gulfport, Long Beach and Pass Christian. Each city is located along the Gulf coast and collectively they account for a major portion of the county's urban area. Unincorporated urban areas include D'Iberville, Layman, Faucier and Delisle, which are located inland along Interstate-10 and U.S. Highway 49.

Harrison County has tough subdivision regulations which are enforced by covenants between the developer and the county. The incorporated municipalities have zoning regulations that are generally well developed (Water Resources Engineers 1978). The county does not have adequate provisions to deal with secondary growth problems that may develop with the expansion of hydrocarbon and service industries.

The Mississippi Research and Development Center (MRDC) and the Gulf Regional Planning Commission (GRPC) are concerned with the growth related problems. MRDC and GRPC are working to have planning tools implemented that will guide future growth. Optimization of county resources and capabilities are a product of this planning effort. The planning entities are attempting to implement growth policies and provide planning tools so that growth stimulated by service industries will occur in an orderly and economical manner (Brooks 1973).

Harrison County has a total area of more than 150,000 hectares (380,000 acres) (Table 25). In 1972, 5,762 hectares (14,239 acres) were classified as residential. From 1969 to 1972 residential land use increased by 18 percent. Most of this growth occurred in the residential area. Rural residential areas also increased due to non-farm residents and the influx of mobile home dwellers (Brooks 1973).

Harrison County's commercial land uses increased by 18 percent from 1969 to 1972. In 1972, 5,080 hectares (1,434 acres) were classified as commercial. Commercial land uses increased at a faster rate than allowed for in the Regional Land Use Plan (Brooks 1973). Commercial land use in the unincorporated areas has expanded faster than in the incorporated areas. Unincorporated commercial land use expanded from 109 hectares (270 acres) to 141 hectares (349 acres) or by 29 percent. Incorporated commercial land use expanded by almost 9 percent from 403 hectares (997 acres) to 439 hectares (1,084 acres). This commercial land use trend could lead to an over-saturation of commercial property causing a devaluation of commercial land and incompatible land uses as residential land use expands to these areas (Brooks 1973).

Industrial land use increased by 15 percent from 1969 to 1972. In 1972, 967 hectares (2,389 acres) were classified as industrial. An objective of the Regional Land Use Plan is to make the industrial parks within the county totally productive. In 1972, 2,172 hectares (5,367 acres) were classified as public and semi-public land uses. No appreciable change in this category occurred between 1969 and 1972. Public money was utilized to improve facilities on this land rather than acquiring additional public and semi-public land (Brooks 1973).

A 3 percent increase occurred in resource production land use between 1969 and 1972. This 3 percent increase was due to the addition of 2,000 hectares (5,000 acres) of tidal marshland to the resource production classification. In 1972, 75,860 hectares (187,449 acres) were classified as resource production. Tidal lands are those lands below ordinary mean high tide and are considered resource production lands. Since 1972 a total of 2,291 hectares (5,662 acres) was classified as tidal marsh (Brooks 1973).

In 1972, over 80 percent of the resource production land was commercial and National forest. A total of 63,781 hectares (157,604 acres) was forest. Commercial forest comprised 39,829 hectares (98,395 acres) and National forests comprised 23,962 hectares (59,209 acres). Less than 13 percent of resource production land was farmland and orchards. In 1972, 7,773 hectares (19,207 acres) were farmland and 2,013 hectares (4,974 acres) were orchards. In 1972, 7,397 hectares (18,276 acres) were classified as fresh water surface areas. A total of 55,520 hectares (137,66 acres) was unclassified. Unclassified lands are scheduled to be integrated with productive land uses. By 1990, all land in the county should be in a productive status (Brooks 1973).

Jackson County

Jackson County was established in 1812. The first settlement was established by D'Iberville in 1699, and is now called Ocean Springs. Lumber, fish and naval store industries were the main source of income for the county. In the mid 1800's the resort trade expanded due to the therapeutic springs located at Ocean Springs. Like the other coastal counties, Jackson County's forests were almost depleted by the early 1900's. Reforestation programs have replenished the forest stands and regenerated the lumber industry. During this period a paper mill was established at Moss Point, which created a demand for pulp wood and diversified the forest industry. During World War II, Ingalls Ship Yard was constructed at Pascagoula. With the construction of the ship yard, Jackson County developed an industrialization program that improved park facilities and created a large industrial park on Bayou Casotte (Brooks 1973).

Jackson County has adopted countywide zoning ordinances and zoning subdivision regulations. Each of the incorporated cities, Moss Point, Ocean Springs, and Pascagoula have comprehensive plans and corresponding zoning ordinances.

Jackson County has anticipated and averted potential rapid growth problems due to the effect of land use controls. (Water Resources Engineers 1978).

Jackson County has a total of 188,541 hectares (465,886 acres). In 1972, 4,615 hectares (11,403 acres) were classified as residential. Between 1960 and 1972 residential land use increased by 44 percent. Brooks (1973) indicated that this tremendous increase in residential land use was due to a greater number of homes being built in unincorporated areas where lot sizes tend to be larger than within the cities. Brooks (1973) also indicated that the Pascagoula City Planning Commission requested a moratorium on the issuance of building permits for multi-family rental dwellings in the city. The purpose of the moratorium was to ensure that the total number of rental units does not exceed the occupancy demands.

In 1972, 380 hectares (938 acres) were classified for commercial land uses. Commercial land use increased by 13 percent from 1969 to 1972. The Regional Land Use Plan indicated that strip commercialism occurred even though comprehensive zoning existed to regulate and guide commercial expansion. This strip development occurred along U.S. Highway 90 between Ocean Springs and Pascagoula (Brooks 1973).

In 1972, 2,907 hectares (5,182 acres) were classified for industrial use (Table 25). This was an 8 percent increase from 1969 to 1972. Jackson County has one industrial park at Bayou Casotte and the Regional Plan indicated that another industrial park would be located north of Escatawpa on the Pascagoula River. The plan also indicates that the City of Ocean Springs has plans to create an industrial park that will provide job opportunities for residents of the western segment of Jackson County and that efforts are being directed to make optimum use of land already set aside for industrial purposes (Brooks 1973).

Public and semi-public land use increased by 3 percent between 1969 and 1972. In 1972, 2,590 hectares (6,401 acres) were classified as public and semi-public. The City of Ocean Springs has reconstructed Fort Maurepas to serve as a museum and historical attraction as part of the national Bicentennial. This historical site is a tremendous asset to cultural and tourist interests of the Gulf Coast Region and to the state of Mississippi. Brooks (1973) indicated that a major recreational facility was to be built on Bluff Creek, near the community of Vanleave. The regional plan for open space, recreational and environmental appearance suggested a number of recommendations to aid Jackson County in acquiring more recreational facilities (Brooks 1973).

In 1972, 72,128 hectares (178,230 acres) were classified as resource production. In 1972, 8,809 hectares (21,768 acres) were classified as farmland and 768 hectares (1,898 acres) were classified as orchard. Comparison of land use data between 1969 and 1972 indicated no change in this land use classification. Commercial forest and National forest land use did not change between 1969 and 1972. In 1972, 42,988 hectares (106,244 acres) were classified as commercial forests and 7,654 hectares (18,914 acres) were classified as National forests. An 18 percent increase in resource production land use occurred between 1969 and 1972. This increase was due to the addition of over 10,926 hectares (27,000 acres) of tidal marsh under the resource production classification. In 1972, 11,090 hectares (29,427 acres) were classified as tidal marsh (Brooks 1973).

Areas classified as fresh water did not change between 1969 and 1972. In 1972, 5,549 hectares (13,712 acres) were classified as fresh water. In 1972, 96,970 hectares (239,613 acres) were unclassified. A 9 percent decrease in unclassified land use occurred between 1969 and 1972 due to the reclassification of tidal marshland and the increase in residential land use (Brooks 1973).

DEVELOPMENT PRESSURE AND THE FUTURE

MDPR population changes and land use trends were presented for each regional planning district by parish and county. Projections for all five planning districts indicate substantial population growth and land use development.

Major residential expansion is projected to occur in the coastal section of the Mississippi counties, in St. Tammany Parish between Slidell and Covington, in the northern portions of St. Bernard and Jefferson Parishes, in Lafourche and Terrebonne Parishes between Thibodaux, Raceland and Houma, and in St. Mary and Iberia Parishes between Morgan City and New Iberia (Figure 15).

Major commercial/industrial and residential development is projected to occur in St. James, St. John the Baptist and St. James Parishes along the Mississippi River. Orleans and St. Mary Parishes were the only parishes/counties with a net decrease in projected population between 1970 and the year 2000, but land use projections for Orleans Parish indicate expansion of commercial/industrial and residential land uses. This expansion is projected to occur along Interstate-10.

The projected growth and development in the MDPR raises several primary and secondary impact questions:

1) How much wetland will be converted to urban-related uses and how will this affect wetland management?

2) How much resource production land will be converted to urban-related uses and does resource production land currently provide a buffer zone between water/wetlands and urban-related uses?

3) Will resource production land retain value (production and/or ownership pride values) or will the conversion of more wetland be required to meet urban projected expansion?

4) What type of flood control measures will be required to protect future development and how will these measures affect water/wetland management?

5) Will municipal services (wastewater and refuse treatment) meet the needs of the projected expansion and how will this affect ambient water quality values in the water/wetland areas?

6) As water/wetland recreation activities increase in response to the projected growth, how will this affect water/wetland recreation management, particularly wilderness and wildlife refuge areas?

7) As projected development occurs, how will non-point pollution sources affect ambient water quality values in the water/wetland areas?

TRANSPORTATION

INTRODUCTION

Early economic development in the United States had as a basis the development of modes and systems to transport products to marketplaces for sale or shipment. In the early 1800's, with agriculture the major focus of economic development, waterways became the prime means to move products to market, having developed for several reasons. First, most economic ventures required the availability of a transportation system with few impedances to movement. Since the current technology did not allow for adequate development of road systems, inland waterways provided that low impedance means for moving goods to markets. Second, these inland waterways provided the least costly means of transporting products, even when roadways were available. Because surface transportation rates were often 10-20 times more expensive than waterborne shipments and less than half as fast, the popularity of those modes was limited. As a result, few successful ventures, whether agricultural or industrial, occurred without direct access to waterways.

In southern Louisiana, edaphic characteristics provided less than optimum conditions for agricultural development, but climatic conditions made the area a prime location for cotton and sugar cane crops. For access and reclamation of additional land for agricultural uses, early French farmers cut drainage channels that added a supplemental element to the natural drainage pattern of the area. As agricultural pursuits expanded, these drainage canals began to serve as elements of the transportation system in moving raw cotton to gins and cane to processing plants throughout southern Louisiana.

In addition, early trappers, fishermen, and loggers developed a variety of waterways to reach prime trapping and fishing areas and cypress stands. Early inhabitants of the Louisiana wetlands built a unique canal, known as a "trainasse", to move to and from fishing and trapping locations. Traveled solely by pirogue, these 1.5-meter (5 feet) wide, 12.7-to 30.5-centimeter (6-to 12-inch) deep canals served as the major transportation element in the wetlands, later served as commercial routes in the exploitation of the muskrat and nutria resource in the early 1900's, and continue to serve local trappers and recreationalists with access to wetland resource areas.

The repeal of the Homestead Act in 1866 allowed lumber companies to purchase large tracts of the forested wetlands for utilization of cypress stands. Harvest of these stands, however, required the development of an access system and a means for removing cut logs. Like the trappers and fishermen of the marsh, lumbering operations cut canals to reach cypress stands; each canal was large enough to allow a pullboat to maneuver in dragging logs into the dredged channel. To remove logs from larger stands, the logging canal pattern included a series of intersecting channels with fan shaped waterways radiating from points along the access canals. With the depletion of the cypress resource in southern Louisiana, these distinctive radial canals now provide access to wetland areas for hunters and an accurate historical record of lumbering operations in the region.

Most early water channels in the region provided direct access to producing areas and market locations, something that roads could not provide in the marsh.

With the development of this maze of waterways in the Deltaic Plain and the development of farming operations along the Mississippi River in the central plains States, the City of New Orleans became a center for early trading in agricultural products from Louisiana, as well as serving as a crossroads for furs and grain from inland areas such as Indiana, Ohio, and Missouri. Products from northern markets were brought to New Orleans via the Mississippi River as the first leg of a longer journey to New York, Charleston, or other east coast ports, or to the international marketplaces of Liverpool or Le Havre. By the mid-1800's the Mississippi River was the major commercial waterway in the United States, and the Port of New Orleans ranked first in total commerce, slightly ahead of New York.

The development of road and rail systems in the region, like early agricultural development, was largely limited by the extent of the marsh. Few roads or railroads were constructed in the early development phases of southern Louisiana, and unlike other areas of the United States, these modes developed slowly once technological advances had overcome early problems in surfacing techniques, rail width, roadbed construction, and shipping costs. The waterway system continued to be the most utilized element of the regional transportation system due to inexpensive freight rates.

Most of the road and rail systems development occurred at New Orleans, the commercial center of the study area. Water routes allowed access to the city from Louisiana production areas, but shipment of goods and services to inland markets required the development of adequate systems to haul freight on land. Initially, railroad development provided access to markets in Mississippi and Alabama, and to major commercial centers in the central plains States. Later, road systems allowed the interconnection of smaller inland cities as a part of the overall economic development of the region.

As the scope of regional resource development began to change in the 1930's and 1940's, exploration for oil in the marsh environment spurred additional development of waterways to reach prime drilling and development areas. This waterway development was enhanced rather than hindered by the previous development of canals for movement of other goods and services, and oil exploration and shipment resulted in an expansion and improvement of early segments of the regional waterway network.

The period prior to the development of an effective wetland oil drilling technique witnessed the construction or improvement of many channels and natural waterways to provide the regional connectivity necessary to harvest and ship the various resources of the MDPR. The importance of the petroleum resources of the Gulf Coast to the growing American economy continued this system development. With the onset of World War II and the increased demand for petroleum and petroleum products, Congress appropriated the necessary funds for development of the Gulf Intracoastal Waterway (GIWW), a broad channel to serve Texas, Louisiana, and Alabama refineries with necessary crude petroleum products. During the war years the United States Army Corps of Engineers developed the GIWW to a minimum depth of 3.7 meters (12 feet) and a minimum width of 38.8 meters (125 feet). In addition, numerous tributary canals were dredged from petroleum-producing areas to the GIWW, facilitating easy movement of oil to refineries along the GIWW route. These improvements made the Intracoastal Waterway the Nation's most important inland waterway, second only to the Mississippi River in MDPR shipment tonnages.

The current transportation system of the Mississippi Deltaic Plain Region remains largely water-oriented, but the increasing sophistication of the economic structure of the region has required a corresponding rise in sophistication of transport modes and in the number of land and water transport interface points. A highly developed canal and waterway system offers readily available access to the major resource areas of the region, as well as to ports. Road and railroad systems have been expanded to serve land-based economic areas of the region and to provide support for the variety of water-based commerce attracted to and shipped from the region. The development of an additional transportation mode - the pipeline - has had an impact on the overall improvement of land and rail systems by limiting the need to serve major oil and gas producing areas of the study area by road or rail. Major road system improvements have and will continue to be made within the study area to provide access to recreational opportunities, but in general, the distribution of roadways and railroads in most areas of southern Louisiana will be limited by wetland conditions. Air travel to and from the region has increased markedly in the past two decades, although the impact of air transportation modes on the overall economic structure of the region relates more to the tourist industry than the delivery of goods and services.

The following sections of this paper identify the impact of various transport modes on the economic structure of the Deltaic Plain Region, focusing on trends in commerce and resource availability as indicators of future activity.

THE WATERBORNE COMMERCE SYSTEM: WATERWAYS AND PORTS

A flight across the marsh-swamp complex of southern Louisiana reveals the intricate web of interconnecting channels and canals. Canal construction activity in the MDPR has resulted in an area larger than Connecticut and Delaware being criss-crossed, ringed, and bisected by a massive network of human-made waterways. Until recently, new channels were added continually while old ones were rarely filled in, and the waterway complex expanded into a well-defined pattern. Through bank stabilization, channel alignment, and the maintenance of uniform channel depth, the MDPR is now served by 16 major transportation canals, rivers, or bayous as well as 12 smaller routes.

The Waterway System

The major navigable waterways of the Louisiana Deltaic Plain Region are indicated in Figure 17. The MDPR's two major traffic corridors -the Mississippi River and the Gulf Intracoastal Waterway -serve as collection routes for goods funneled through feeder waterways. These two waterways, along with numerous smaller rivers and bayous, play a significant role in commerce, particularly petroleum and farm product movements, within Louisiana. Of all commerce shipped on the Louisiana-Mississippi portion of the Gulf Intracoastal Waterway in 1976, over 20 percent (by weight) was crude petroleum.

Since 1935, the movement of petroleum and petroleum products on the Mississippi River has increased from a low of 544,000 metric tons (600,000 tons) in 1937 to a high of 133.8 million metric tons (147.5 million tons) in 1976. In fact, the Mississippi River, GIWW, and 11 major waterways all experienced substantial growth in total commodity shipments from 1955 to 1969. Trends since 1969 in petroleum shipments have been mixed: Mississippi River crude petroleum ship-

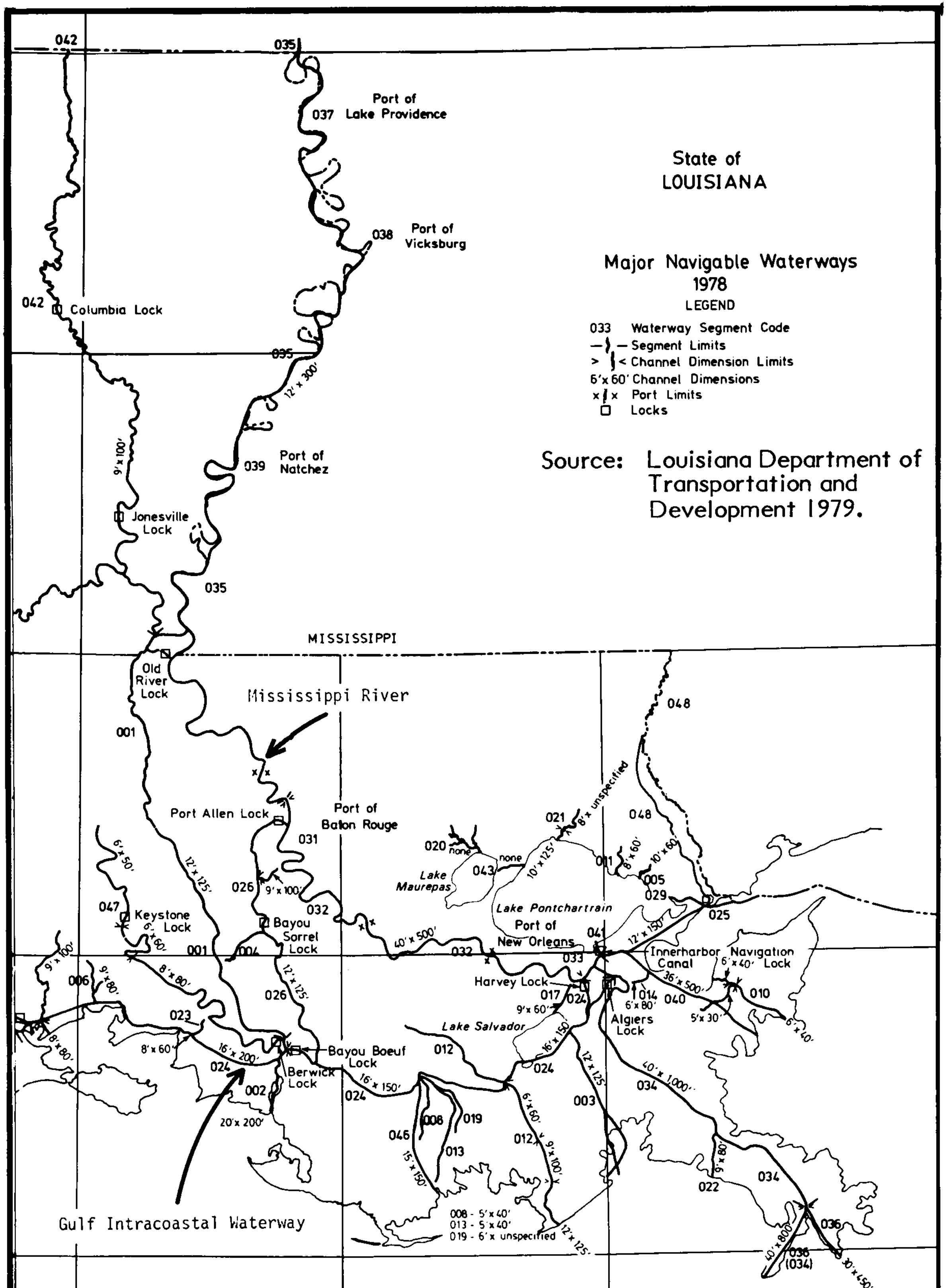


Figure 17. Major navigable waterways in Louisiana, 1978.

ments decreased in 1971 and 1973 but nearly doubled in 1976; the GIWW experienced continuous declines in crude petroleum shipments from 1969 to 1976; and along the 11 major Louisiana waterways, crude petroleum shipments declined from 1971 through 1976. Crude petroleum shipments are indicated in Table 26 for the period 1955-1976.

Increases in total waterborne commerce are a result of increased domestic and foreign market demands as well as technological advances in the shipping industry. The development of diesel powered boats with more efficient power trains (tunnel sterns and kort nozzles to focus water flow on the propeller), and the use of more effective towing practices and improved navigation aids, has allowed the delivery of 4-5 times the amount of cargo moved in the early 1900's, usually at higher speeds. The number of boats involved in river and waterway commerce has also increased dramatically, affecting the quantity of shipments throughout the region. Figure 18 indicates the number and direction of commercial vessel traffic along the major navigable waterways in 1976.

Crude petroleum shipments have constituted a fairly stable percentage of total commodities shipped in the MDPR since 1955, ranging from 17 percent to nearly 19 percent on the Mississippi River, 17.1 percent to 23.5 percent on the GIWW, and 16.9 percent to 28.6 percent on the major waterways in the MDPR (Table 26). Increases on the Mississippi River of crude petroleum shipments may be due in part to increased oil imports to the United States, while declines along the GIWW may be attributable to the increasing utilization of pipelines as a petroleum transport mode.

Analysis of origin and destination data provided by the United States Army Corps of Engineers indicates that the Mississippi River receives large quantities of crude petroleum from the Gulf of Mexico. The majority of this crude oil moves north by tanker to 10 refineries and numerous petroleum processing facilities located on the Mississippi River between New Orleans and Baton Rouge. Smaller quantities are shipped along the river beyond Baton Rouge and west into the Gulf Intracoastal Waterway, with local movements helping to meet the demands of southwest Louisiana and southeast Texas refineries.

Table 27 indicates the distribution of all shipped commodities, including crude petroleum, along the major waterways of the region. The relative contribution of farm products and other bulk cargoes is important in supporting commerce on segments of both the Mississippi and the Gulf Intracoastal Waterway. The increased profitability allowed by waterborne shipment modes is likely to increase the popularity of the water transport system for shipment of bulk cargoes.

The Port System

Port development throughout the MDPR has occurred as a result of the quantity of commerce along the major waterways of the region and the need for an interface of various land and water transport modes (Figure 19). In each case, the development of the four major ports of the MDPR - New Orleans, Pascagoula, Gulfport, and Morgan City-- occurred due to the availability of 1) water access to the port area, 2) sufficient waterborne receipts for inland or foreign markets, 3) land transportation access to the port area; and 4) sufficient land for industrial development adjacent to the port waterway.

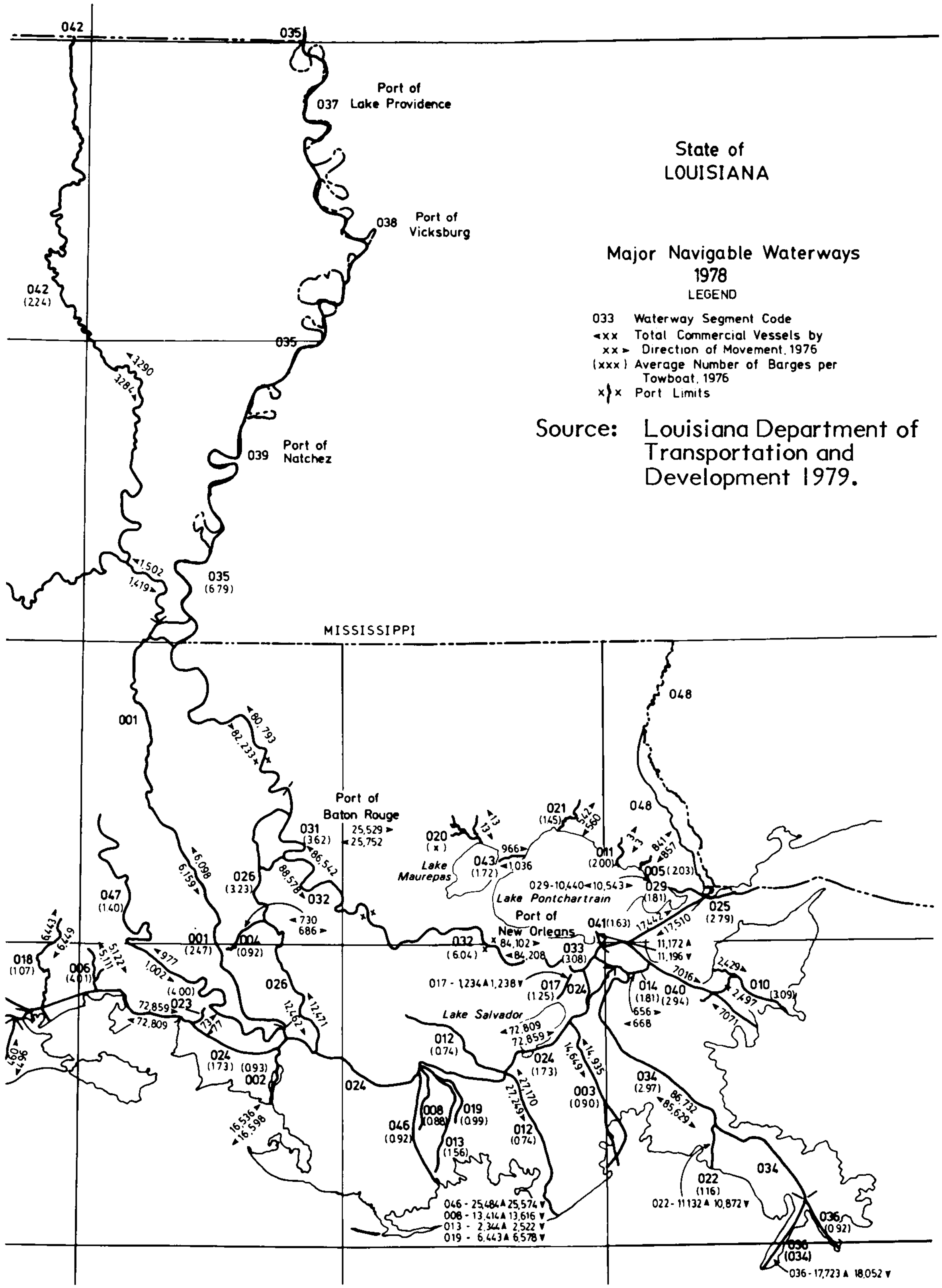


Figure 18. Commercial vessel traffic on major navigable waterways in Louisiana, 1978.

Table 26. Total crude petroleum shipments and total commodities shipped on waterways, 1955-1976 (millions of tons).

Waterway	1955	1965	1967	1969	1971	1975	1976
Mississippi River							
Crude petroleum	17.2	62.3	76.3	88.1	85.7	75.2	147.5
Total commodities	97.8	356.2	444.8	471.3	522.1	422.5	795.8
% crude petroleum	17.6%	17.5%	17.0%	18.7%	16.4%	17.8%	18.5%
Gulf Intracoastal Waterway (GIWW)							
Crude petroleum	0.6	21.6	27.6	28.4	28.2	23.9	20.2
Total commodities	53.6	96.1	117.4	131.0	141.1	124.5	118.2
% crude petroleum	1.1%	22.3%	23.5%	21.7%	20.0%	19.2%	17.1%
Major Waterways							
Crude petroleum	1.7	8.3	8.8	8.4	10.8	7.4	6.4
Total commodities	8.1	29.0	32.9	37.0	39.8	33.4	37.9
% Crude petroleum	21.0%	28.6%	26.7%	22.7%	27.1%	22.2%	16.9%

Source: United States Army Corps of Engineers 1955-1978.

Port of New Orleans. Since Spanish and French colonial days, the Port of New Orleans has served as a link between the country's interior and world markets. The port is the second largest in the United States, with only the Port of New York handling more tonnage. Total freight moved through this port rose from 42.6 million metric tons (47 million tons) in 1955 to 141.4 million metric tons (155.9 million tons) in 1976, an increase of 98.8 million metric tons (108.9 million tons). Twenty-six percent of the country's domestic dry cargo barge traffic passed through the Port of New Orleans in 1976.

In 1976, tanker traffic through the Port of New Orleans amounted to 1,091 vessels, with 145 having a draft of 12.2 meters (40 feet). In addition, there were 17,949 non-self-propelled vessels (barges) moving into the port. Dry cargo shipments involved over 45,000 vessels of self and non-self-propelled types in the port's traffic.

There are 118 barge lines operating out of New Orleans alone. Of the total waterborne commerce moving through the Port of New Orleans in an average year, barge traffic accounts for just under half the total. Of the port's total foreign commerce, it is estimated that 48 percent moves by the nearly 100,000 barges that travel in and out of the port in an average year.

Table 27. Commodities shipped on waterways, 1976 (tons).

Waterways	Farm products	Fish & other marine products	Metallic ores	Coal	Crude petroleum	Non-metallic ores, except fuels
Mississippi River						
Baton Rouge to but not including New Orleans	71,061,433	924,222	10,547,110	7,754,266	55,300,742	10,914,984
Port of New Orleans	60,682,517	1,149,386	798,230	8,438,796	24,214,127	8,362,437
Mississippi River Gulf Outlet	343,813	83,412	502,744	634,881	240,629	1,702,319
New Orleans to Mouth of Passes	47,384,876	2,800,201	27,541,449	11,647,668	67,785,624	13,442,567
Gulf Intracoastal Waterway						
Mobile to New Orleans	1,413,470	1,241,209	115,850	3,382,347	3,488,572	1,548,355
New Orleans to the Basine	599,114	4,428,696	196,650	296,105	16,705,534	5,350,909

(continued)

Table 27. (concluded)

Waterways	Farm products	Fish & other marine products	Metallic ores	Coal	Crude petroleum	Non-metallic ores, except fuels
Major Waterways						
Morgan City to Port Allen	206,810	189,291	23,694	215,043	1,560,816	3,132,011
Bayou Teche	17,487	267,788			69,474	644
Houma Navigation Canal		132,604			1,232,297	141,376
Waterway from Intra-coastal Waterway to Bayou Dulac		119,538			37,261	140,144
Bayou Terrebonne		5,305			102,690	350
Waterway from Empire to the Gulf of Mexico		133,795			720,447	2,820
Bayou Little Caillou		4,229			884,056	50

Source: United States Army Corps of Engineers 1955-1978.

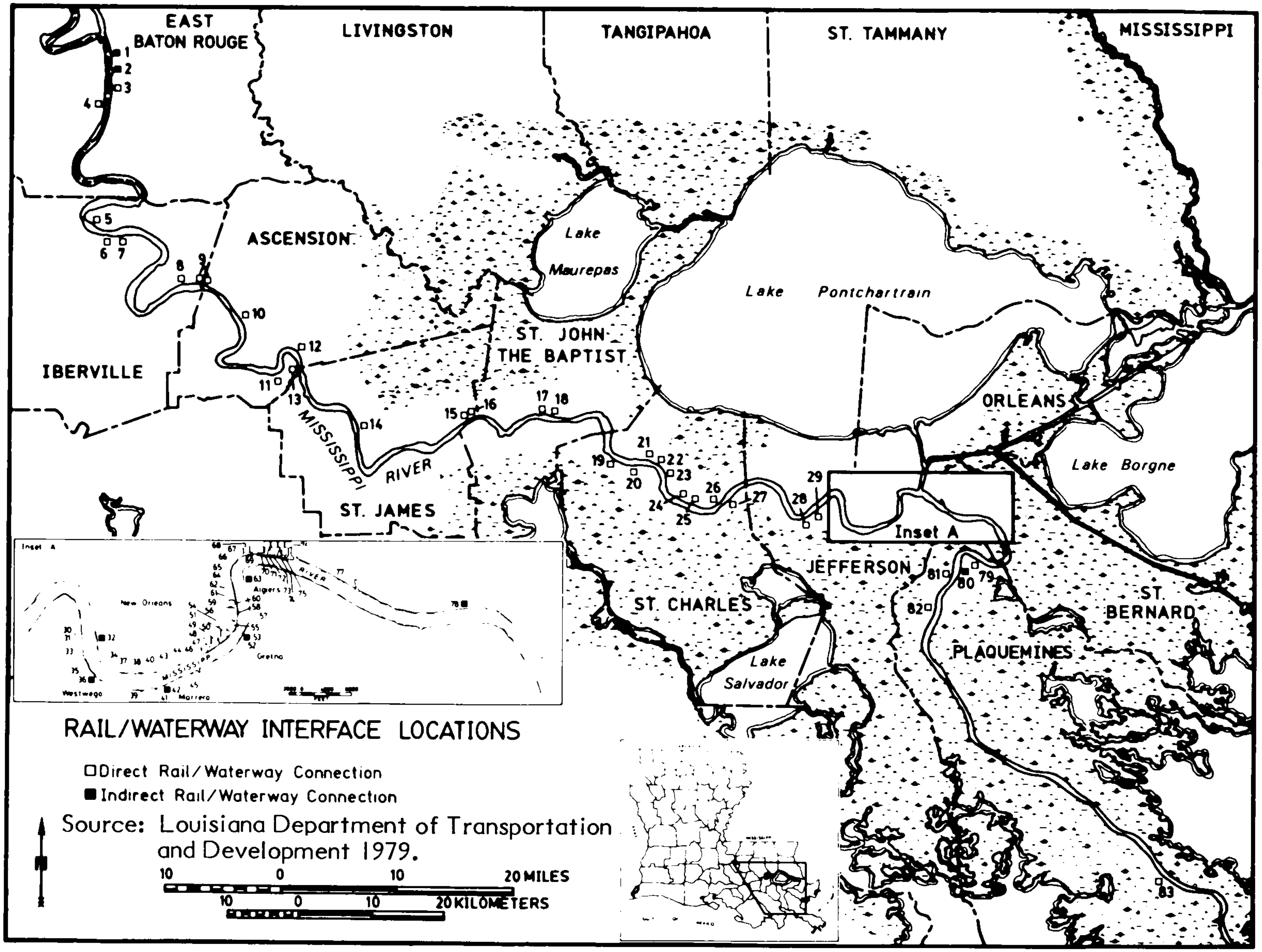


Figure 19. Rail/waterway interface locations, 1978.

Within the port of New Orleans there are nearly 18,500 meters (60,000 linear feet) of quay type wharves, representing approximately 1.4 million square meters (15 million square feet) for the handling of cargo. There are approximately 295 piers, wharves, and docks within the port with major concentrations of structures along the Mississippi (102), the Harvey Canal (63), and the Inner Harbor Navigation (or Industrial) Canal (41). Most of the remaining wharf structures can be found along Lake Borgne Canal, the Mississippi River Gulf Outlet, Michoud Canal, Bayou Sauvage, Algiers Canal, and Bayou Barataria.

Along the Mississippi River section of the port, these facilities handle a wide variety of commodities, in contrast to the Harvey Canal on which most waterborne traffic is related to the petroleum industry. Firms along this canal route generally serve an oil logistic support function, or build, repair, or maintain the extensive fleet of offshore vessels required to meet the demands of the offshore oil industry.

Freight data for 1976 waterborne commerce in the Port of New Orleans is portrayed by Standard Transportation Commodity Classification (STCC) in Table 28. Table 29 provides a guide to the STCC codes. Freight data presented in Table 28 consists of six specific movement categories. The three movement categories that relate to originating freight are: foreign exports, coastwise shipments and "internal-out". Foreign exports are those shipments originating in New Orleans that are destined for foreign countries. Coastwise shipments include all shipments originating in New Orleans with domestic (United States) destinations via carriage over the ocean or Gulf of Mexico. Internal-out shipments apply to traffic originating in New Orleans, but destined for locations along inland waterways. Terminating freight data consist of the three complementary movement categories: foreign imports, coastwise receipts, and internal-in cargo.

The Port's leading tanker cargoes were minerals, fuels, lubricants, and related products, fertilizers, vegetable oil and fats, and chemicals. Major dry cargo imports included iron and steel plates, corn, wheat, soybeans, coal, and lignite. In 1976, crude petroleum was the leading foreign import, accounting for more than 50 percent of the foreign import traffic.

In addition to the major imports, the port exported over 44.1 million metric tons (40 million tons) of commodities to foreign markets in 1976. Principal commodities shipped were corn, wheat, soybeans, coal, lignite, and grain milled products.

With improved facilities over the past 15 years, the port has undergone a dramatic change in the amount of cargo handled. In 1967, foreign and domestic shippers accounted for 10.8 million metric tons (11.9 million tons) of cargo. By 1976, 21.7 million metric tons (23.9 million tons) were shipped, with the most significant change occurring after 1974, when only 11.8 million metric tons (13 million tons) were shipped. Soybeans, crude petroleum, gasoline, distillate fuel oil, and residual fuel oil accounted for 77 percent of the port's traffic in 1976. Crude petroleum was the most important single commodity and represented 37 percent of the port's 1976 activity. Nearly 98 percent of this crude is imported to the large Chevron refinery that occupies a commanding position in the existing industrial complex.

Table 28. Waterborne commerce statistics by commodity, Port of New Orleans, 1976.

STCC[a]	Foreign		Coastwise	
	Imports	Exports	Receipts	Shipments
01	318,873	30,882,816	8,605	56,271
08	134,902	22,052	0	2,015
09	1,614	16	21	52
10	331,288	64,258	0	23,908
11	194,660	1,296,773	0	2,757,405
13	8,401,938	0	49,452	367,523
14	729,424	711,089	1,388,945	1,238,990
19	24	31	288	1
20	1,692,998	4,157,759	75,593	211,599
21	193	178	0	1
22	69,012	19,486	71	3,764
23	487	1,416	1,150	1,538
24	201,408	138,933	80	840
25	2,160	1,391	8	4,145
26	73,997	734,175	1,058	42,831
27	288	579	262	254
28	628,139	1,183,030	95,140	104,095
29	365,121	75,284	599,243	6,750,848
30	13,948	38,752	460	5,719
31	2,629	1,025	783	68
32	114,698	71,787	119	11,388
33	2,475,966	1,315,007	2,759	12,285
34	114,822	73,718	945	11,042
35	65,166	276,264	5,587	3,140
36	10,032	30,801	2,918	3,847
37	54,695	71,246	3,094	65,263
38	1,026	3,741	4,061	23
39	14,232	2,117	253	1,393
40	79,474	362,292	691	596
41	7,695	6,358	8,684	17,538
Total	16,100,909	41,542,374	2,250,270	11,698,382

(continued)

Table 28. (concluded)

Internal		Total	
In	Out	In	Out
29,629,368	108,766	29,956,846	31,047,853
0	0	134,902	24,067
1,113,657	32,445	1,115,292	32,513
122,521	256,255	453,809	344,421
4,187,370	2,588	4,382,030	4,056,766
7,164,167	6,669,368	15,615,557	7,036,891
2,011,673	2,229,110	4,130,042	4,179,189
0	0	312	32
3,313,837	634,033	5,082,428	5,003,391
0	0	193	179
578	13,040	69,661	36,290
0	0	1,637	2,954
61,232	76,749	262,720	216,522
296	3,455	2,464	8,991
440,606	13,107	515,661	790,113
0	0	550	833
1,052,343	2,334,705	1,775,622	3,621,830
7,040,113	7,408,611	8,004,477	14,234,743
855	2,018	15,263	46,489
491	0	3,903	1,093
46,474	80,814	161,291	163,989
476,501	1,694,963	2,955,226	3,022,255
17,780	54,567	133,547	139,327
16,169	64,345	86,922	343,749
5,977	8,703	18,927	43,351
14,784	12,141	72,573	148,650
0	0	5,087	3,764
24,120	8,587	38,605	12,097
208,372	89,456	288,477	452,344
855,801	125,377	902,180	149,273
57,835,085	21,923,203	76,186,264	75,163,959

[a] Standard Transport Commodity Classification.

Source: Louisiana Department of Transportation and Development 1979.

Table 29. Guide to the Standard Transportation Commodity Classification (STCC).

STCC code	Description
01	Farm products
08	Forest products
09	Fresh fish and other marine products
10	Metallic ores
11	Coal
13	Crude petroleum
14	Nonmetalic minerals except fuel
19	Ordnance and accessories
20	Food and kindred products
21	Tobacco products
22	Textile mill products
23	Apparel and other finished textile products
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Pulp, paper, and allied products
27	Printed matter
28	Chemicals and allied products
29	Petroleum and coal products
30	Rubber and miscellaneous plastic products
31	Leather and leather products
32	Stone, clay, glass and concrete products
33	Primary metal products
34	Fabricated metal products except ordnance, machinery and transportation
35	Machinery, except electrical
36	Electrical machinery, equipment, and supplies
37	Transportation equipment
38	Instruments, photographic and optical goods, watches and clocks
39	Miscellaneous products of manufacturing
40	Waste and scrap materials
41	Miscellaneous freight shipments
42	Containers, shipping, returned empty
44	Freight forwarder traffic
45	Shipper association or similar traffic
46	Miscellaneous mixed except forwarder and shipper association
47	Small packaged freight shipments

Source: Louisiana Department of Transportation and Development 1979.

The New Orleans Bulk Terminal, located on the Industrial Canal-Mississippi River Gulf Outlet, handled 2.8 million metric tons (3.1 million tons) of cargo during 1977. The terminal is a multi-purpose facility for dry bulk cargoes, providing complete storage as well as transfer service to and from vessels, barges and rail cars. The $30 million facility can handle (5.4 to 7.6 million metric tons) of bulk products a year, including heavy ores, heavy ore concentrates, alumina and grains. Coal, usually destined for final consumption in Florida power plants, soda ash, and salt are other frequently handled items; soda ash is usually destined for glass manufacturers in South America and South Africa, and salt is primarily destined for road use in Canada. Raw import sugar is a regular bulk product of the terminal, usually bound for use in one of the local refineries. Coke, either of the calcined, green or barites variety, is also handled at the Bulk Terminal prior to shipment to Africa, Canada, Europe, or Japan.

In addition to the commodity elements of transportation, the Port of New Orleans has been a pacesetter in anticipating and recognizing the Roll-on and Roll-off phenomenon (Ro/Ro). Key factors in New Orleans' pre-eminence in this area are the sufficiency of adjacent back-up acreage for marshalling huge consignments of cars, as well as favorable tariffs. Many locations within the port have the minimum 8.1 hectares (20 acres) of marshalling space required to accommodate the Ro/Ro vessel, particularly in newly developed areas. Port tariffs, too, have been modified for Ro/Ro and other carriers of project cargo to provide 30 days of free covered storage for consignments of 1.4 million kilograms (1,500 tons) or more.

New container facilities at the Port of New Orleans have been constructed at the France Road Container Terminal on the port's Inner Harbor-Navigation Canal. The initial berth, with a frontage of 253 meters (830 feet) on the canal's west bank is equipped with two container cranes and has the capacity to handle a 0.9 million metric tons (3 million tons) of containerized cargo per year. The Terminal is now fully operational. Elsewhere in the port, specifically on the Mississippi River, containers in growing numbers are being handled by almost every steamship line operating in the port. Containers are now handled at a monthly rate that produces a yearly total of some 160,000/20-foot equivalents.

Unlike other ports within the MDPR, the Port of New Orleans is designated as a Foreign Trade Zone (FTZ), the only one on the Gulf of Mexico. The Zone is a 7.5 hectare (18.6 acre) site where foreign and domestic materials are considered by the United States Custom Service to be in international commerce, allowing foreign or domestic goods to be brought into the area without formal customs inspections or the payment of duty or excise taxes.

Once in the Zone, materials may be consolidated, processed, reassembled, repackaged, co-mingled, used in manufacture, or simply stored. Materials in the FTZ may be used to manufacture products for export overseas or for domestic markets. Duty is paid on foreign materials only when transported from the FTZ to the United States, but duty is paid within the Zone on domestic merchandise that is exported to other countries.

From October, 1977 to September 1978, the FTZ's operation reflected decreases in tonnage movement and dollar value of merchandise handled. The value of merchandise moving through the Zone between October, 1977 and September, 1978 was approximately $146 million, a decrease in dollar value of $13 million. Total freight moving through the Zone was 42,600 metric tons (47,000 tons) in 1978, a decrease of 26 percent from the previous year. Duties and taxes collected also declined to 68 percent of the preceding year's total.

Port of Pascagoula. The Port of Pascagoula is comprised of two harbors: Pascagoula Harbor and Bayou Cassotte, Mississippi, which are approximately 50 kilometers (about 30 miles) west of Mobile Bay and 160 kilometers (about 100 miles) east of New Orleans. The harbor's 12.2 meter (40 foot) channel provides an access route for deep-draft vessels from the Gulf of Mexico and shallower draft vessels from the GIWW.

The Port of Pascagoula was established by the Jackson County Port Authority and is being developed from undeveloped land by private industry and local governmental agencies. Landfill on both sides of the lower reach of the Pascagoula River has provided a land resource for dock and harbor operations and port facilities to accommodate ocean shipping, barge traffic, commercial fishing vessels, and recreation craft. The harbor area includes a large storage unit for anhydrous ammonia, and over 46,500 square meters (about 500,000 square feet) of coverage storage. In addition, storage facilities are available for about 200 million liters (1,000,000 barrels) of crude oil and 2 billion liters (9,000,000 barrels) of petroleum products.

Port of Gulfport. The Port of Gulfport, though much smaller than the Pascagoula Harbor facility, is, nevertheless, important in the economic makeup of the MDPR. Although historical traffic through the port shows considerable fluctuations, the trend is toward an increase in freight tonnage handled. Approximately 50 percent of the cargo imported through the facility is bananas and plantains. The principal exports are rice, meat, paper, and paperboard products.

Port of Morgan City. In 1952, the Morgan City Harbor and Terminal District was created as a Louisiana political subdivision, and authority was given to conduct business in the best interests of those living and working in the port district. In 1962, a channel was dredged to a depth of 5.5 meters (18 feet), with a bottom width of 71.0 meters (200 feet), and a top width of 91.4 meters (300 feet).

The waterfront area of the Morgan City Harbor and Terminal District and the lower reaches of the Atchafalaya River at Patterson are headquarters for over 200 industries of which 104 have port facilities. The diversity of the industrial base of Morgan City is represented by more than two dozen categories of industrial activity classifications, and these industries occupy over 30 kilometers (20 miles) of waterfront. Traffic along the route from Morgan City to the Gulf of Mexico totaled some 4.3 million metric tons (4.7 million tons) in 1954. In 1976, reflecting the downward trend in shipping along the route, only 3.4 million metric tons of freight (3,757,227 tons) were carried. Gasoline and crude petroleum are the principal products shipped toward Texas, while crude petroleum also moves eastward from Morgan City through the Gulf Intracoastal Waterway.

RAILBORNE COMMERCE

With the general trend of increasing waterborne commerce throughout the inland waterway and port system of southern Louisiana and Mississippi, both rail and road freight modes have increased in importance to the overall economic character of the Region. The need to carry products to or from inland producing areas or markets has led to the development of rail lines serving the major MDPR ports and interconnecting with systems serving the entire United States. The increasing sophistication and diversity of the economic structure of the MDPR, as well as an increasing demand for domestic market products from the Region has made this rail development more profitable and more necessary.

Ten railroad companies currently operate approximately 1,100 kilometers (700 miles) of rail lines serving southeast Louisiana and the Mississippi coast and tying the MDPR with markets in the west, midwest, southeast, and Atlantic seaboard.

The Southern Pacific, Kansas City Southern (Louisiana and Arkansas) and Missouri Pacific (Texas and Pacific) provide direct access to western and southwestern markets. The Illinois Central Gulf Railroad and Missouri Pacific rights-of-way serve the major grain producing regions of the midwest, while the Louisville, Nashville, and Southern railroads serve commercial markets and producing areas in the south and along the Atlantic coast. The Louisiana rail distribution network is shown in Figure 19. The New Orleans and Lower Coast Railroad and the Mississippi Export line are of local importance within the region, the former serving economic ventures in Plaquemines Parish and the latter providing a direct link between port facilities in Pascagoula with Evanston, Mississippi, and a main line of the Illinois Central Gulf.

Most of the railroad activity in the region is centered near or within the Ports of New Orleans and Pascagoula where the majority of commodity exchanges for foreign or domestic commerce occur. The importance of the interface between rail and waterborne commerce is particularly evident along the Mississippi River between Baton Rouge and the Mouth of Passes, where 83 rail/waterway interface points have been identified. These interface points are of importance in providing access for grains and other farm products to foreign markets, and in allowing the shipment of chemicals and petroleum products to inland markets from port area refineries. The location of rail/water interface points and descriptions of these locations are provided in Figure 19 and Table 30.

The proliferation of these interface needs between rail and waterborne commerce led the City of New Orleans, in 1905, to create the New Orleans Public Belt Railroad (NOPB), which would operate as a switching carrier serving all railroads in the port. The NOPB exclusively serves most public wharves on the Mississippi River, the Industrial Canal, the New Orleans Bulk Terminal, and more than 160 industries. The NOPB services seven railroad companies: Illinois Central Gulf, Kansas City Southern, Louisville & Nashville, Missouri Pacific, Southern Pacific, Southern, and Texas and Pacific.

Originating and terminating rail freight tonnages for parishes adjoining the Port of New Orleans are indicated in Table 31. These data are derived directly from the 1976 Federal Railroad Administration/Interstate Commerce Commission (FRA/ICC) 1% Waybill Sample and do not represent actual tonnage. On a statewide basis, the Waybill Sample represents approximately 0.83 percent of total tonnages.

The relationship between waterborne and railroad freight activity within the Port of New Orleans is depicted in Table 32 for the top five commodities in terms

Table 30. Listing of rail/waterway interface locations exhibited on Figure 19.

Map code	Company/dock/wharf	Connecting railroad[a]
1	Consolidated Chemical Industries, Inc.	KCS, ICG
2	Allied Chemical Industries, Inc.	ICG
3	Exxon Oil and Refinery Co.	KCS, MP
4	Greater Baton Rouge Port Commission	MP, TP, KCS, L&N, ICG
5	Dow Chemical Company	TP
6	Georgia-Pacific Corporation	TP
7	Hercules, Inc.	TP
8	Cos-Mar, Inc.	ICG
9	Goliad Corporation - Division Mobil Oil Company	ICG
10	Shell Chemical Corporation	ICG
11	Triad Chemical Corporation	TP
12	Olin Corporation	ICG
13	Agrico	TP
14	Freeport Chemical Company	ICG
15	Kaiser Aluminum and Chemical Corporation	KCS, ICG
16	Kaiser Aluminum and Chemical Corporation	KCS, ICG
17	South Louisiana Port Commission	ICG
18	Godchaux Henderson Sugars, Inc.	ICG, KCS
19	Hooker Chemical Corporation	MP
20	Union Carbide Corporation	TP
21	Shell Chemical Corporation	ICG
22	Shell Oil Co., Inc.	ICG, KCS
23	General American Trans. Corporation	ICG
24	St. Charles Grain Elevator	ICG
25	Bunge Corporation	ICG
26	Cities Service Oil Co.	ICG
27	Farmers Export Co.	TP
28	American Liberty Oil Co.	TP-MP
29	Avondale Shipyards, Inc.	TP
30	Avondale Shipyards, Inc.	TP

(continued)

Table 30.

Map code	Company/dock/wharf	Connecting railroad[a]
31	Ayers Material Co., Inc.	TP
32	United States Industrial Chemicals Co.	ICG
33	Texas Pacific-Missouri Pacific Terminal	None
34	Bisso Contracting Towing & Salvage Company	NOPB
35	Gulf States Asphalt Co., Inc., of La.	TP-MP
36	United States Industrial Chemicals Co.	TP-MP
37	Nashville Avenue Wharf	NOPB
38	Public Grain Elevator	NOPB
39	Clark Oil Refining Corporation	TP-MP
40	Public Commodity Warehouse Wharf	NOPB
41	Hess Terminal Corporation	SP, TP-MP
42	Texaco, Inc.	TP-MP
43	Napoleon Avenue Wharf	NOPB
44	Stdyvesant Docks	ICG
45	Delta Commodities, Inc.	TP-MP, SP
46	Harmony Street Wharf	NOPB
47	Seventh Street Wharf	NOPB
48	Washington Avenue Wharf	NOPB
49	Third Street Wharf	NOPB
50	First Street Wharf	NOPB
51	St. Andrew Wharf	NOPB
52	Southern Pacific Lines - National Molasses Co.	SP
53	Stone Shell Oil Service	SP
54	Celeste Street Wharf	NOPB
55	Market Street Wharf	NOPB
56	Orange Street Wharf	NOPB
57	Perry Street Wharf	TP-MP
58	Robin Street Wharf	NOPB
59	Thalia Street Wharf	NOPB
60	Erato Street Wharf	ICG

(continued)

Table 30. (concluded)

Map code	Company/dock/wharf	Connecting railroad[a]
61	Julia Street Wharf	NOPB
62	Poydras Street Wharf	NOPB
63	Algiers Iron Works & Dry Docks Co., Inc.	MP
64	Bienville Street Wharf	NOPB
65	Toulouse Street Wharf	NOPB
66	Govenor Nicholls Street Wharf	NOPB
67	Esplanade Avenue Wharf	NOPB
68	Mandeville Street Wharf	NOPB
69	Press Street Wharf	NOPB
70	Louisa Street Wharf	NOPB
71	Piety Street Wharf	NOPB
72	Desire Street Wharf	NOPB
73	Congress Street Wharf	NOPB
74	Pauline Street Wharf	NOPB
75	Poland Street Wharf	NOPB
76	New Orleans Naval Support Activity (New Orleans Army Terminal)	NOPB
77	American Sugar Refining Co.	SOU
78	Murphy Oil Corporation	SOU
79	Louisiana Southern Railroad	No Terminal Co.
80	Amax Nickel Refining Co., Inc.	SOV
81	Red Star Yeast & Product Co.	NOLC
82	Chevron Chemical Co.	NOLC
83	Freeport Sulphur Co.	NOLC

[a]Connecting railroads and abbreviations:

KCS - Kansas City Southern
ICG - Illinois Central Gulf
MP - Missouri Pacific
TP - Texas and Pacific
L&N - Louisville and Nashville
SP - Southern Pacific
NOPB - New Orleans Public Belt
SOV - Southern

Source: Louisiana Department of Transportation and Development 1979.

Table 31. Originating and terminating railroad freight tonnages for parishes adjoining ports, Louisiana, 1976.

	Port of New Orleans (Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles)		
STCC[a]	ORIG	TERM	NET[b]
01	1,482	38,447	(36,995)
08	625	0	625
09	105	0	105
10	108	3,951	(3,843)
11	0	59	(59)
14	95	8,170	(8,075)
19	0	46	(46)
20	10,072	12,716	(2,644)
21	0	59	(59)
22	274	54	220
24	497	1,205	(708)
25	0	193	(193)
27	731	3,145	(2,414)
28	0	39	(39)
29	16,967	9,776	7,191
30	9,868	7,742	2,126
32	19	180	(161)
33	2,968	3,117	(149)
34	530	675	(145)
35	22	1,551	(1,529)
36	0	417	(417)
37	294	2,087	(1,793)
38	0	18	(18)
39	0	19	(19)
40	868	1,455	(587)
41	31	19	12
42	547	191	356
44	31	370	(339)
45	98	457	(359)
46	2,809	3,512	(703)
47	0	18	(18)
TOTAL	49,988	106,150	

[a]For STCC Code, refer to Table 29.

[b]NET = ORIG minus TERM; ( ) indicate negative numbers or surpluses of terminating over originating freight.

Source: Louisiana Department of Transportation and Development 1979.
Note: The 1% Waybill Sample represents approximately 0.83 percent of total tonnages.

of tonnages. Four particular commodities (01-farm products; 13-crude petoleum; 28-chemical and allied products; and 29-petroleum and coal products) reoccur in importance when analyzing import/export and internal in/out and rail freight originating/terminating relationships.

Crude petroleum (STCC 13) appears as a major item among waterborne receipts at New Orleans where it is ranked third in terms of tonnage for waterborne shipments. Crude petroleum does not appear in the 1976 1% Waybill Sample of rail freight. A review of the State summary statistics in the ICC reports indicate that a total of 4,465 tons of crude petroleum originated and 2,744 tons terminated in Louisiana during 1976. These figures are small in contrast to the millions of tons of crude petroleum imported to the State from foreign sources.

The predominance of two additional commodity groups (28-chemical and allied products and 29-petroleum and coal products) attests to the industrial orientation of New Orleans Waterborne receipts. It should also be noted, without exception, that the corresponding quantities of these products shipped from the ports exceed the quantities received from waterborne freight.

Chemicals and allied products are the predominant originating rail freight commodities at the Port of New Orleans, while petroleum and coal products are the third most important commodities in terms of rail tonnage.

At New Orleans, farm products constitute a major portion of terminating rail freight. In fact, according to data derived from the 1% Waybill Sample, farm products are the number one commodity terminating in the New Orleans area, and according to waterborne commerce statistics, they are by far the largest export commodity from the Port, ultimately destined for foreign markets. Rail freight terminations of farm products represented slightly more than 10 percent of total farm product terminations at the Port, and indicate that intermodal competition exists between rail and waterborne modes for transport of farm products from points on the interior to the Port of New Orleans. The overall trend in rail shipment of farm products is declining slightly from 1974, however.

In Mississippi, there has been a general decline in rail transport and few new facilities are planned in the future. Currently, the Louisville and Nashville Railroad operates 12 trains per day, providing freight service along the Gulf Coast between Mobile and New Orleans.

Although the Louisville and Nashville line runs through 14 States, the line operates 2,925 kilometers (1,828 miles) of track in Mississippi, the second largest commitment to service distance in any State it serves. The railroad, however, is in direct competition with a number of waterborne commerce routes as well as motor freight competition along a highway system that is responsible for nearly 28 percent of the total cost of the Interstate Highway System. Along the railroad's rights-of-way in Louisiana and Mississippi, the primary commodities handled are grain, lumber, chemicals, and petroleum-related products.

HIGHWAY MOTOR FREIGHT

The coastal lowlands during the major economic development era of the 19th Century were not served by any major highway. In fact, even by the early 1920's,

Table 32. Waterborne receipts and shipments and originating and terminating rail freight for major commodities, Port of New Orleans and adjoining parishes, 1976.

WATERBORNE RECEIPTS[a]

				Percent of Total		
Rank	STCC	Tons	Percent of total	Imports	Coastwise receipts	Internal in
1	01	29,956,846	39.32	1.06	0.03	98.91
2	13	15,615,557	20.50	53.80	0.32	45.88
3	29	8,004,447	10.51	4.56	7.49	87.95
4	20	5,082,428	6.67	33.31	1.49	65.20
5	11	4,382,030	5.75	4.44	0	95.56

WATERBORNE SHIPMENTS[a]

Rank	STCC	Tons	Percent of total	Exports	Coastwise receipts	Internal in
1	01	31,047,853	41.31	99.47	0.18	0.35
2	29	14,234,743	18.94	0.52	47.43	52.05
3	13	7,036,891	9.36	0	5.22	94.78
4	20	5,003,391	6.66	83.10	4.23	12.67
5	14	4,179,189	5.56	17.01	29.65	53.34

RAILROAD FREIGHT[b]

	ORIGINATING			TERMINATING		
Rank	STCC	Tons	Percent of total	STCC	Tons	Percent of total
1	28	16,967	33.94	01	38,477	36.25
2	20	10,072	20.15	20	12,716	11.98
3	29	9,868	19.74	28	9,776	9.21
4	33	2,968	5.94	14	8,170	7.70
5	01	1,482	2.96	29	7,742	7.29

Source: [a]United States Army Corps of Engineers 1975-1978.
[b]Louisiana Department of Transportation and Development 1979.

Note: The 1% Waybill Sample represents approximately 0.83 percent of total tonnages.

there were few paved highways and an incomplete system of gravel or shell roads serving coastal communities. This incomplete system emanated from a requirement of the original French land grants by which each landowner was required to build a levee and road across the bayou frontage of his holding. Under Spanish rule, a local official was placed in charge of road building in each district, a practice that continued after the Louisiana Purchase.

In 1813, the Louisiana legislature created police juries as parish governing bodies and gave them responsibility for road construction and maintenance, although most coastal lowlands parishes were limited in road construction efforts by wetland conditions. With the arrival of the automobile and an increasing desire for mobility, more roads were built by the State, and by the 1930's and 1940's coastal settlements were joined to the State's roadway system. Automobile registrations increased and gasoline consumption soared. Notable accomplishments during this era were the Airline Highway between Baton Rouge and New Orleans, the roadway connecting New Orleans to the Mississippi Gulf Coast, and the Huey P. Long Bridge crossing the Mississippi River at New Orleans. By the end of the 1960's, the last sizeable coastal community was added to the wetland's highway network. During the last 50 years, these routes have served as vital transportation links and settlement sites for coastal plain inhabitants.

Motor freight along these routes offered the most expansive form of commerce to all Louisiana communities although the road system was, and continues to be, outranked by waterways in total freight shipment. Road systems and access were nevertheless a large factor in the location of industries in the coastal lowlands areas.

Due to the distribution network of roadways throughout the region and the speed of highway transport, motor freight has become a more important factor in commerce in the Deltaic Plain. Several railroads, the Missouri Pacific, Texas and Pacific, and Southern Pacific operate supplemental truck routes to provide freight services to locations not served by rail. Ten rail/motor freight interface points are located within the Louisiana portion of the study area, and are served by trailer-on-flat-car ramps or containerized cargo lifts.

Information provided by the Louisiana Department of Transportation and Development loadometer studies is presented in Table 33 for motor freight carried annually during 1973, 1975, and 1977, and indicates the breakdown of freight by commodity type and rank within Louisiana. Excluding commodity groups 41-47 (these groups are not commodity specific) from consideration, six commodity groups rank in the top six in commodity shipments, although in varying order, for all three years. These groups are as follows:

01-farm products,
20-food and kindred products,
24-lumber and wood products,
28-chemicals and allied products
29-petroleum and coal products, and
33-primary metal products.

Table 33. Net calculated commodity weight (hundreds of pounds) and rank.

STCC	1973 Total[a]	1973 Percent	1973 Rank	1975 Total[a]	1975 Percent	1975 Rank	1977 Total[a]	1977 Percent	1977 Rank
01	15,684	7.32	6	10,235	8.25	6	15,253	9.74	3
09	487	0.23		1,121	0.90		0	0	
13	96	0.04		0	0		91.0	0.59	
14	11,857	5.53	8	13,214	10.65	4	8,596	5.49	8
20	26,245	12.25	3	15,359	12.37	1	24,395	15.57	1
21	10			0			93	0.06	
22	3,366	1.57		2,043	1.65		3,683	2.35	
23	231	0.11		763	0.61		747	0.48	
24	24,789	11.57	4	15,140	12.20	2	15,257	9.74	2
25	4,621	2.16		3,246	2.62		2,350	1.50	
26	5,871	2.74		4,149	3.34		7,393	4.72	9
27	21	0.01		34	0.03		40	0.03	
28	20,511	9.57	5	12,505	10.07	5	14,974	9.56	4
29	29,978	13.99	2	13,250	10.68	3	14,752	9.42	5
30	1,345	0.63		1,407	1.13		2,583	1.65	
31	337	0.16					125	0.08	
32	6,055	2.83	10	4,631	3.73	9	3,901	2.49	
33	12,668	5.91	7	6,363	5.13	7	9.251	5.90	7
34	2,482	1.16		1,643	1.32		1,441	0.92	
35	5,530	2.58		5,080	4.09	8	6,116	3.90	
36	957	0.45		1,700	1.37		2,785	1.78	
37	7,268	3.39	9	2,084	1.68		6,603	4.21	10
38	232	0.11		247	0.20		55	0.04	
39	122	0.06		12	0.01		600	0.38	
40	583	0.27		1,184	0.95		661	0.42	
41	32,157	15.01	1[b]	4,331	3.49	10	356	0.23	
47	7	0		4,261	3.43		13,745	8.77	6[b]
Total[a]	214,298	100.02		124,120	100.00		156,673	100.02	

[a]Does not include negative numbers.

[b]The dramatic change in volume from STCC 41 in 1973 to STCC 47 in 1977 is possibly an effect of data compilation and coding since they are very similar in description.

Source: Louisiana Department of Transportation and Development 1979.

These six commodity groups account for approximately sixty percent (1973 - 60.6 percent, 1975 - 58.7 percent, and 1977 - 59.9 percent) of the total net calculated commodity weight from the loadometer study data. Therefore, (although actual commodity quantities are unavailable) it appears that these are the major, recurring commodity groups carried by motor freight in Louisiana.

For comparative purposes, commodity rankings from the loadometer study data are contrasted with freight commodity statistics published by the Interstate Commerce Commission (ICC) for the southwestern region (Arkansas, Louisiana, Oklahoma, and Texas). Commodity statistics compiled from annual reports of freight commodity statistics for Class I common and contract motor carriers of property operating in intercity service are presented in the ICC report.

Total originating and terminating motor freight tonnages by commodity (STCC) are shown in Table 34. Excluding STCC 47 (small packaged freight shipments) from consideration, the top three ranked commodities (STCC 29, 28, and 20) correspond to the major commodity groups identified in the loadometer studies.

AIR TRANSPORTATION

Air transportation operations in the study area have expanded in both scope and frequency as a result of the impact of oil and gas support needs and the increasing popularity of the New Orleans area and the natural resources of the coastal wetlands for recreation activities. Four airports provide most of the scheduled air carrier operations, and are supported by 23 general aviation airports, 68 heliports, and 13 seaplane bases in serving the air transport needs of the regional economy.

New Orleans International, New Orleans Lakefront, New Iberia-Acadiana and Gulfport-Biloxi airports are centers for regional passenger operations, charter and air taxi services, and cargo services provided by 23 domestic and foreign air carriers. New Orleans International/Lakefront is currently ranked 24th in the Nation in passenger enplanements, totalling slightly more than three million passengers in 1978 and reflecting 62 percent growth over the period from 1968-1978. Total passenger enplanements by quarter are indicated in Table 35 for the period. Trends in passenger data do not seem to identify any specific quarter of the year as predominant in enplanements, indicating the year-round attractiveness of the area for tourists and businessmen, and de-emphasizing the anticipated effect of Mardi Gras and Sugar Bowl/Super Bowl activities.

In contrast to the national and international scope of New Orleans International Airport, the Gulfport-Biloxi airport provides more regionally oriented passenger services. Total passenger enplanements at this facility totalled 90,666 in 1978 and reflect a growth rate of nearly 115 percent over the 1968-1978 period, possibly attributable to the expansion of charter and air taxi services in the area.

New Iberia-Acadiana airport currently serves as a base for Petroleum Air Transport and other air taxis, but no scheduled services for commuters are currently available. Total passenger enplanements are unavailable for this facility.

Most of the commercial cargo handled by air transport services in the region is centered at New Orleans International Airport, and has fluctuated significantly

Table 34. Freight commodity statistics class I motor carriers of property ICC southwestern region (Arkansas, Louisiana, Oklahoma & Texas), 1974.

STCC	Orig. tons	Term tons
01	409,567	399,261
08	4,062	4,398
09	1,263	1,207
10	103,523	96,860
11	2,111	2,059
13	528,525	528,366
14	418,027	434,702
19	100,492	156,529
20	2,890,181	2,879,706
21	24,469	25,834
22	66,117	72,101
23	17,604	20,800
24	827,468	834,174
25	26,882	26,668
26	1,243,355	1,249,603
27	117,311	115,399
28	6,048,267	6,002,270
29	13,040,769	13,017,736
30	559,899	546,850
31	9,994	11,584
32	2,499,115	2,470,402
33	901,414	915,767
34	319,039	329,412
35	256,907	258,961
36	319,518	304,000
37	1,474,334	2,186,564
38	26,259	27,541
39	342,663	361,300
40	34,840	32,340
41	612,981	664,219
42	53,360	52,174
44	6,292	6,337
45	2,396	2,274
46	87,302	93,662
47	5,486,700	5,689,930
Total	38,863,006	39,820,980

Source: Louisiana Department of Transportation and Development 1979.

Table 35. Enplaned passengers New Orleans International and New Orleans Lakefront Airports (combined listing), 1968-1978.

	Quarter				Total
	1st	2nd	3rd	4th	year end
1968	435,067	463,564	476,233	472,234	1,852,143
1969	483,605	497,378	487,846	479,762	1,947,991
1970	481,939	456,200	468,518	462,872	1,869,529
1971	470,098	499,375	430,206	494,311	1,943,990
1972	532,049	525,770	520,505	530,320	2,109,144
1973	539,158	561,742	537,544	543,615	2,182,152
1974	563,194	587,159	459,716	508,083	2,118,152
1975	535,444	561,026	527,939	519,943	2,144,358
1976	576,483	614,552	574,985	588,714	2,354,734
1977	632,960	646,421	647,661	714,219	2,641,261
1978	723,567	762,658	763,861	748,330	3,000,416

Source: Civil Aeronautics Board 1979.

in total tonnages during the 1968-1978 period, reaching a high of nearly 18,000 metric tons (20,000 tons) in 1973 and a low of approximately 8,100 metric tons (9,000 tons) in 1968. Quarterly and yearly cargo shipments for the period are presented in Table 36, and reflect a significant decline (approximately 20 percent) in cargo operations between 1973 and 1978.

ECONOMIC DEVELOPMENT AND TRANSPORTATION SYSTEMS: A FUTURE PERSPECTIVE

The form of transportation systems in the Deltaic Plain generally evolved from major economic ventures throughout the region. Early agriculture, fishing, and trapping enterprises in the wetland areas of the region utilized waterways for personal and commercial transportation until road and railroad construction techniques had improved and those systems were extended to the marsh. Hydrocarbon exploration and development in onshore and offshore areas led to the development of pipelines as a major transport mode, and also spurred the extension of all other modes to provide support for that burgeoning industry. The expanded

Table 36. Domestic and international cargo[a] New Orleans International and New Orleans Lakefront Airports (combined listing), 1968-1978.

	Quarter				Total
	1st	2nd	3rd	4th	year end
1968	1,847	2,074	2,291	2,595	8,807
1969	2,986	2,930	2,858	2,849	11,623
1970	2,607	3,187	3,949	4,056	13,799
1971	3,670	4,295	4,162	4,393	16,520
1972	3,873	4,285	4,214	4,515	16,887
1973	4,338	4,949	4,934	4,790	19,031
1974	4,494	4,792	3,999	3,943	17,123
1975	3,724	4,299	4,205	3,918	16,146
1976	4,003	4,603	4,582	4,600	17,788
1977	3,992	4,376	4,408	4,261	17,037
1978	3,791	4,055	3,934	3,465	15,245

[a](tons).

Source: Civil Aeronautics Board 1979.

service provided by the new modes allowed a further diversification of industrial types within the region; industry was also enticed by the variety of transportation systems, favorable tax structures and tariffs, and the relative proximity of both western and eastern inland markets.

Although the waterborne mode remains predominant in commerce within the region, the diversification of industrial types has led to a specialization of transportation mode requirements: certain products are more appropriately shipped by one mode than another. This increasing specialization in commercial transportation will allow for increasing levels of efficiency in both land and water transport of goods and services throughout the region, and may provide the impetus for additional expansion of the industrial and service base of the region. Without exception, transportation modes in the region exist and flourish as a result of, and in response to, the economic activity of the area. These modes, in turn, provide the stimulus for expansion of that economic base.

Economic Growth and Transportation

The Chase Econometric Model predicts that real United States economic growth for the next ten years will occur at an annually compounded rate of 3.5 percent. It also predicts that real personal income in Louisiana will grow through 1986 at an annually compounded rate of approximately 4.0 percent. These projections generally conform to a number of national projections and also to several Louisiana forecasts. In projecting transportation activity, however, the economic projections must conform to product boundaries that make transportation forecasts meaningful. Various products use respective modes of transport in different intensities, and uneven growth among sectors of the economy will have alternative impacts on transportation needs.

In making projections for transportation analysis, comparisons are facilitated because the ultimate unit of transport is a physical quantity. That is, a ton of grain in 1978 is equivalent to a ton of grain in 1985, regardless of its changing value in the marketplace. Because economic data are typically given in monetary units, it is essential to adjust for nominal monetary changes over time. Accordingly, economic projections should be presented in constant dollars and thus can be interpreted as if growth rates are in truly physical terms.

Economic Projections

An economic model designed to project economic productivity by standard commodity groups through the year 1985 has been developed by the Louisiana Department of Transportation and Development to provide data in planning and evaluating current and future use of the State's transportation system. The model has incorporated evaluations of Louisiana's manufacturing and general economic activity, national input-output modeling, and labor force numbers and distribution into a hybrid of the Louisiana Input-Output Model for economic activity. This method allows the capability to identify interactions of industries within the State with each other, with industries outside the State, and with the consumer, emphasizing the interdependencies of the producing and consuming elements of the State's economy. Projection capability is derived from analyzing labor force trends by industry type. Since the most recent and comprehensive Census of Manufacturers prior to model development had occurred in 1972, that year was used as the base year for projections, and production change to 1985 was measured in 1972 dollars, as presented in Table 37.

The data derived from the model indicate an increased output for all commodity groups, although in varying amounts. In 1985, for example, output of basic textiles (STCC 22) is projected to increase 196.06 percent over 1972 output, whereas the production of fresh fish and other marine products (STCC 09) is projected to increase only 3.23 percent over the 1972 output.

Transportation Projections

The economic projections presented in Table 37 represent 1985 Louisiana output in 1972 dollars, which means that any observed change in output is a "real" change, reflecting increases in production rather than increases in price or value resulting from inflation. These increases in production are the key to analysis of transportation modes and systems, and specifically of future commercial activity on those systems. Trends in past commercial activity and commodity distribution on various modes will also affect future projections.

Railborne Commerce. Railborne commerce between 1969 and 1976, based on State summary statistics, indicates the predominance of five commodity groups in originating freight and seven commodity groups in terminating freight in Louisiana. In 1976 these commodities accounted for nearly 83 percent of originating freight and nearly 84 percent of terminating freight in the State. Chemicals and lumber, are the primary Louisiana commodities shipped by rail, while farm products, lumber, food products and chemicals are the major rail receipts. Significant increases in the production of those commodities (1985 vs. 1972 - Table 37) will likely increase the total quantities of those commodities shipped by rail in the future.

Several commodities: fresh fish and crude petroleum (STCC 09 and STCC 13), have shown marked decreasing trends in rail shipment over the period 1969-1976, and, due to viable alternative modes (air transport and pipelines, respectively), are likely to continue in that downward trend, increasing the specialization of the rail mode in commerce in the deltaic plain.

New Federal regulations may add another commodity to the list of major railborne products, however. Prior to the OPEC oil embargo and shortage of natural gas in 1973, industries were drawn to Louisiana by the availability of natural gas as an industrial feedstock and boiler fuel. New regulations issued by the United States Department of Energy have required utilities and industries to convert from natural gas and fuel oil to coal as a boiler fuel. This will require a substantial alteration of existing facilities while new facilities are designed or converted to burn coal. In turn, Louisiana-based industries and utilities must seek new supplies of coal to replace locally available natural gas, requiring shipments of extensive quantities of coal into Louisiana from mines located in the west and, in certain instances, from the east.

Several analyses of coal requirements for utility use suggest that more than 45 million metric tons (50 million tons) of coal per year or 145,000 metric tons (160,000 tons) would be required to supplant current use of fuel oil or natural gas as a boiler fuel. These analyses suggest that the bulk of coal transported to Louisiana would come by rail because of the limited number of coal users having river or waterway frontage; major import routes are likely to be from Shreveport to Lake Charles, Shreveport to Alexandria, or Monroe to Alexandria. The impact of this commodity on rail systems would be substantial, given the actual shipment of only 14,100 metric tons (15,618 tons) of coal in 1976.

Waterborne Commerce. Like other transportation modes in the study region, it is increasingly apparent that a specialization of commodity types transported by water will occur. The reason for this specialization will be the relative utility of this mode versus other modes (in terms of speed, cost, and required transport interfaces) to various manufacturers and shippers in the regon.

Several commodity types identified in previous sections are likely to retain their standing in waterborne commerce in the region, given production trends identified in Table 37. Farm products, petroleum products and crude oil are the

Table 37. 1985 Economic projections by STCC
State of Louisiana.

STCC code	STCC description	1972 Output (Million $) 1972 $	1985 Output (Million $) 1972 $	Value Added (Million $) 1972 $	Output: percent change
01	Farm Products	861.523	1000.138	307.440	23.05
08	Forest Products	77.598	119.120	41.692	53.51
09	Fresh fish and other marine products	73.300	75.667	26.483	3.23
13	Crude petroleum	5181.512	7164.547	2736.858	38.27
14	Non-metallic minerals, excl. fuels	230.030	276.286	143.392	20.11
20	Food and kindred products	1936.100	2564.125	646.159	32.44
22	Basic Textiles	44.900	132.930	31.903	196.06
23	Apparel and other finish textiles products	132.500	229.053	63.677	72.87
24	Lumber and wood products, excl. furnitures	474.400	790.382	303.249	66.61
25	Furnitures and fixtures	29.500	37.937	14.075	28.60
26	Pulp, paper and allied products	879.300	1135.970	429.397	29.19
27	Printing and Publishing	182.400	312.298	149.279	71.22
28	Chemicals and allied products	2604.000	5588.535	2157.175	114.61
29	Petroleum and coal products	2917.900	3935.389	578.502	34.87
30	Rubber and miscellaneous plastics	20.200	49.730	14.670	146.19
31	Leather and leather products	6.400	12.845	5.587	100.70
32	Stone, clay, glass and concrete products	267.100	360.284	156.363	34.89
33	Primary metal products	329.900	684.029	146.382	107.34
34	Fabricated metal products	415.300	735.339	307.373	77.06
35	Machinery: except electrical	201.900	373.745	155.104	85.11
36	Electric, electronic equipment	301.500	688.171	274.580	128.25
37	Transport equipment	487.200	1108.960	340.450	127.62
38	Instrument and related products	11.100	18.001	8.713	62.18
39	Miscellaneous manufact. indust.	37.600	70.522	26.728	87.56
	State Totals	17703.162	27524.008	9070.232	55.48

Source: Louisiana Department of Transportation and Development 1979.

three primary commodities of originating and terminating waterborne commerce in the study area. Given respective production increases of 23.1 percent, 34.8 percent, and 38.3 percent, it is doubtful that these commodities will be displaced by others before 1985. Several commodities, however, are likely to increase in importance in waterborne commerce as a result of increased production. The production of chemicals and allied products (STCC 28), already fourth in originating waterborne commerce, is projected to increase in 1985 by 114.6 percent over 1972 levels, and these commodities could displace crude petroleum (STCC 13) as the third most important originating waterborne commodity in the region.

Similarly, primary metal products (STCC 33), which ranked 7th in total 1976 waterborne commerce, are expected to increase in production by more than 107 percent over 1972 (Table 37) and could take the place of food products in waterborne shipments by 1985.

A key element in future development of waterborne commerce in the region is the impetus or importance placed on the amount of river or waterway frontage developed for commercial or industrial uses. Whether determinations of frontage uses are made by public agencies or corporate entities, an increase in useable frontage property will likely provide an additional increase in waterborne commerce above that generated by expected production increases.

Although the increased shipment of coal to Louisiana utility companies is expected to be largely accommodated by the rail transport mode, a percentage of that annual tonnage may be transported by barge to the study area. The differing costs of the two modes for large quantities of bulk cargo, in addition to increased bulk cargo handling facilities within the major ports of the region, may make waterborne transport of the commodity extremely competitive with rail transport. In light of the tremendous quantity of coal to be received, waterborne modes will likely move a comparable, perhaps significant, portion of the commodity throughout the region.

Motor Freight. With the increased specialization noted in both water and rail transport, it seems likely that a similar specialization will occur in motor freight commerce. Food and kindred products (STCC 20) were ranked first in both 1975 and 1977 totals of motor freight tonnages (Table 33), and are likely to continue as the major commodities carried by this mode. The increasing needs of outlying Deltaic Plain communities not served by rail is seen as the reason for this stability and probable expansion in motor freight commerce.

Motor freight offers several advantages not provided by rail or waterborne commerce. The speed of shipment is increased since commodities are likely to be delivered directly to their destinations at higher speeds without a major marshalling effort or major off-loading machinery or facilities. Perishable items such as food products are thus likely to be a major commodity of motor freight modes for the foreseeable future. Commodities such as farm products, lumber, and chemicals will probably also continue as major elements of motor freight transportation within the study area.

The planning and development of highways and highway systems has been the focus of State transportation departments in both Louisiana and Mississippi, and both States operate under Federal Highway Administration guidelines for funding and development of those systems. Like other States in which population, motor vehicle registration, and motor vehicle miles traveled are relatively low, however, both States receive small percentages of Federal funds for highway development. For this reason, most of the appropriations within each State will be focused on the operation and maintenance of existing roadways, rather than new highway construction.

Because of the importance of local interstate routes to the economies of Gulf Coast areas of Louisiana and Mississippi, it is reasonable to assume that those routes will achieve funding priority in disbursement of highway monies, and that other new highway construction will be sporadic at best. As a result, interstate motor freight shipments are likely to increase in response to greater regional productivity and product transfer requirements. Intrastate motor freight movement may stabilize on some routes as roadway design capacities are reached and exceeded by the combination of personal vehicle and commercial travel.

Air Transportation. The current growing trend in passenger enplanements at both New Orleans and Gulfport-Biloxi is expected to continue as a result of continued tourist operations within the region. The area currently supports a variety of urban tourist events that generate air travel to and from the region. These events (Mardi Gras, Super Bowl) will continue to draw growing numbers of tourists, many of whom will recreate in more rural areas of the region.

Air cargo traffic through New Orleans has experienced a 20 percent decline from 1973 after having more than doubled from 1968 figures (Table 36). While no information is available regarding commodity types that comprise the majority of cargo shipments through New Orleans, the declining cargo trend seems to indicate that the region's markets neither require (nor industries produce) high demand nor high volume products that can be carried by air. This trend contrasts with other major airports in the United States, which are currently experiencing significant increases in cargo shipments, and have designated large areas within the airport boundaries for specialized industrial activities.

As the population of the region and the variety of manufactured items increases, air cargo shipments may stabilize and perhaps begin an upswing. Few airports within the region, however, have planned industrial complexes to support manufacturing enterprises necessary to generate additional air cargo handling.

DATA GAPS AND INCONSISTENCIES

Evaluation of transportation modes and the economic activities associated with those modes within the MDPR requires a standardization of analytical techniques and of specific data for both Louisiana and Mississippi. Because of the incompatibility of the transportation planning approach between the two States, analyses of commercial traffic trends are difficult at best, and often inappropriate.

Water, rail and motor freight commerce data collected by the Louisiana Department of Transportation and Development provided exemplary data for analysis of past commercial traffic activity; the breakdown of freight data by commodity type, parish of origination and termination, and year is important in generating past traffic trends. No such data have been compiled in the Mississippi Gulf coast area, and hence the determination of historical cross-state flows of goods and services in the Deltaic Plain Region is virtually impossible.

In addition, although Louisiana transportation planners have established a model for determining future production by Standard Transportation Commodity Classification (STCC), proper utitilization of the model in projecting future traffic requires knowledge of the impact of increases in traffic on any modes in the Louisiana system. The carrying capacity of specific transportation elements must be examined against the current level of use. The Louisiana model and analysis currently assumes an unlimited capacity on all modes, which is inappropriate, given current road and rail system conditions and traffic trends. The utilization of this analytical technique could allow focusing of State improvement or development funds on transportation linkages which are reaching capacity, thus assuring the continuation of commercial and personal traffic at present rates and levels of service.

COMMERCIAL FISHING AND TRAPPING IN THE MISSISSIPPI DELTAIC PLAIN REGION

INTRODUCTION: THE BIOLOGICAL WEALTH OF THE DELTAIC PLAIN

The Deltaic Plain is a dynamic area continually altered by human developments - industrial, agricultural, and urban/residential. Marshes are drained, filled, or cut off from tidal flushing to create new land for development. The timing and volume of freshwater inflows are altered by channelization and damming for flood control, water conservation, or transporting waterborne commerce. These developments interfere with some of the periodic extremes that are beneficial to the fish and wildlife resources of the area. Extremes of variables such as salinity, tidal levels, floods and temperature, as well as nutrient and pollutant concentrations, determine species distribution and the health of the coastal ecosystem.

Biological productivity depends upon complex nutrient cycling and energy flow. Hydrological cycles and circulation patterns are important processes. Unique interactions involving tides, winds, and the inflow of nutrients and fresh water, take place in the coastal areas. Although the importance of these dynamic forces is well recognized, even specially trained ecologists cannot always predict the effects of specific interactions. Therefore, it is essential that they continue to be monitored and studied. Nowhere is the need for more information concerning these interactions greater than for the commercial fishing and trapping industries of the deltaic plain.

The biota in the Deltaic Plain are adapted to particular physical, chemical, and biological regimens. The conditions vary within defined geographical and temporal limits, but over time, the entire system achieves a balance. Some of the human activities which seem insignificant can drastically upset the balance and have far-reaching adverse long-term effects. Some of the little-noticed changes with potential for severe adverse effects include:

1. Changes in salinity due to increased or decreased circulation or to changes in the amount of freshwater inflow;

2. Reduced inflow of nutrients from marshes, swamps, and upstream watershed;

3. Reduced organic matter in wetland soils as a result of drainage and subsequent oxidation;

4. Excessive amounts of organic matter in water due to the trapping of vegetation uprooted by storm tides or floods in altered drainage and levee systems;

5. Soil deterioration resulting from monoculture, irrigation, and drainage; and

6. Increased insect disease and fire hazards resulting from monoculture.

There is no single "ideal" condition for fish and wildlife. An optimum salinity regime for even one species may be impossible to determine because of the changing interactions among the population from year to year. The least beneficial salinity condition for an estuary would be a constant level; likewise, a constant rainfall rate would be the least desirable for a diverse ecological system.

Human intrusions into the natural system - storm levees, reservoirs, highways, canals, tide barriers, bulkheads, and other structures - tend to buffer the natural environmental extremes. The result is a more constant environment that favors a few species to the detriment of all others. The select few may flourish temporarily, but soon the effects of overpopulation and overutilization of resources become evident. When the variety of organisms in an area decreases, some of the natural checks and balances resulting from different kinds of predators, diversity of food materials, and competition are removed. Consequently, the populations may have spectacular increases in numbers with subsequent catastrophic declines due to starvation and disease. Often, many years must pass before the ecosystem again becomes diverse enough to support relatively stable populations.

The biological wealth of the Deltaic Plain Region has provided a means of subsistence to its human inhabitants since prehistoric times. Hunting, trapping, and fishing in the Deltaic Plain were the principal forms of livelihood for European settlers until well into the eighteenth century. Their descendants continue to use skills that allow them to harvest the local fish and wildlife for personal and commercial use. Fishing and trapping are important parts of the region's cultural heritage and have contributed much to the lore of the countryside. Moreover, the exploitation of fish and fur resources of the Deltaic Plain have contributed to development of major ports and waterways that later were used for the region's commerce and eventually, the development of oil and gas resources (Davis 1979).

Table 38 indicates the salinity tolerance of principal shellfish, fish, and furbearers in the Deltaic Plain Region. Salinity tolerance is very important, because it determines, in part, the habitats that members of a given species will occupy. This, of course, relates to where and how a species is to be harvested. The table indicates that most shellfish are harvested in the lower portions of the region's estuaries and adjacent marine environment. On the other hand, most of the fish and furbearers are taken from fresh water areas of the upper estuary or upper portions of the river basins.

Because of the proximity of the upper estuary to agricultural lands, and to industrial and residential development on the wider and better-drained levee environments, the upper estuary is more susceptible to human impacts including pollution from land drainage and hydrological modifications. In contrast, the lower estuary, with its direct tidal exchange and proximity to the dilution effect of the Gulf of Mexico, is less vulnerable to impacts from drainage and water table changes. The lower estuary is more susceptible, however, to impacts from offshore oil spills and storm hazards.

The Deltaic Plain's commercial seafood industry developed with the exploitation of shrimp and oysters, harvested commercially since the late 1800's. These two valuable species account for nearly $50 million of income annually. As Table 39 indicates, 20 to 30 percent of the total shrimp landings in the United States occur in the ports of Louisiana and Mississippi (St. Amant et al. 1973, Barrett and Gillespie 1973, Christmas and Etzold 1977b).

A third valuable commercial marine resource is the menhaden. The first landings of menhaden were recorded in the region around 1940, although

Table 38. Environment of harvest area and salinity tolerance of principal shellfish, fish and furbearers.

Species	Salinity tolerance of adults	Principal environment of harvest areas
Shellfish		
American oyster	S[a]	Lower estuary
White shrimp	B[b],S	Middle and lower estuary
Brown shrimp	B,S	Marine area; lower estuary
Blue crab	B,S	Middle and lower estuary
Fish		
Menhaden	S	Marine areas near delta
Buffalo fish	F[c]	Upper estuary; river channel
Freshwater drum	F	Upper estuary; river channel
Channel catfish	F	Upper estuary; river channel
Blue catfish	F	Upper estuary
Hide and furbearers		
Muskrat	F,B	Fresh and brackish marsh
Nutria	F	Fresh marshes of upper estuary
Raccoon	F	Freshwater swamps
American alligator	F,B	Freshwater marshes and open swamps of upper estuary

[a]S=saline.
[b]B=brackish.
[c]F=freshwater.

Source: Jaworski 1972.

Table 39. Economic value (1976 dollars) of principal shellfish, fish and furbearer resources, 1976.

Species	Mississippi (Gulf coast counties)	Louisiana (MDPR parishes)
Oyster	$ 1,015,165[a]	$ 15,410,921[b]
Shrimp	$ 8,417,899[a]	$ 50,002,348[b]
Menhaden	$ 6,839,342[a]	$ 5,274,017[b]
Blue Crab	$ 2,67,775[a]	$ 2,952,415[b]
Muskrat pelts	----------	$ 43,367,528[c]
Muskrat meat	----------	$ 1,600[c]
Nutria pelts	----------	$ 14,781,397[c]
Nutria meat	----------	$ 158,400[c]
American alligator	----------	----------[d]

[a]United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service 1978b.

[b]United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service 1978b.

[c]Louisiana Department of Wild Life and Fisheries 1978.

[d]As of September 6, 1979, "the special rule concerning the American alligator, Alligator mississippiensis, found at S17.42(a) is amended to authorize the taking of American alligators in the State of Louisiana in those twelve parishes in which the American alligator is listed under S17.11 as threatened - similarity of appearance (Cameron, Vermilion, Calcasieu, Iberia, St. Mary, St. Charles, Terrebonne, Lafourche, St Bernard, Jefferson, St. Tammany and Plaquemines), provided that the hides of such alligators are only sold or offered for sale to persons holding a valid Federal permit to buy hides issued under the special rule and the meat or other parts, except hides, of such alligators are sold only in the State of Louisiana in accordance with the laws and regulations of that State." (Federal Register, Volume 44, Number 174, Thursday, September 6, 1979).

commercial exploitation of the species can be traced back to the early 1800's along the Atlantic Coast (Lyles 1967, Christmas and Etzold 1977a, Frye 1978). Since then, the menhaden has become the principal industrial fish taken in Louisiana and Mississippi. The reason for the apparent late development of menhaden fishing is that the oily flesh of the species is not suitable for human consumption, but when processed, it is a valuable source of oil and animal feed. Processing techniques, combined with improvements in menhaden fishing gear, have resulted in a $10 million a year industry (Perret 1968, St. Amant et al. 1973, Christmas and Etzold 1977a).

Commercial trapping activities in the Deltaic Plain rival the fishing activities, both in dollar value and volume. In the 1975-76 season, 6,404 trapping licenses were issued, with 3,524 or 55 percent in the coastal zone (telephone call 5 March 1979 from Ted O'Neil, Fur Division, Louisiana Wild Life and Fisheries Commission, Daspit 1949). Pelt sales in the winter of 1976-77 totaled more than $24 million, doubling the previous season record. The number of pelts increased by 745,000 over the previous season. Total muskrat and nutria revenue amounted to more than $19 million (Comparative takes...1978).

Trappers add to their income by selling nutria meat to mink ranchers, fertilizer processors, and to European and Japanese zoos (Waldo 1959). A large market for nutria meat was lost when the United States screwworm program was terminated in 1976. Approximately 640,000 kilograms (1.4 million pounds) of nutria meat were used annually to grow screwworm larvae in a biological control program for this cattle parasite (Davis 1978).

Trapping is a decentralized activity throughout the Deltaic Plain Region. Most of the business transactions are on a "cash and carry" basis, so statistical data regarding the value of the fur crop are probably not accurate. Indications are, however, that trapping in the Deltaic Plain is lucrative, and will continue to be, so long as the resource is available. It is possible that a continued loss of wetland habitat to development and pollution will affect the number of furbearers and therefore reduce the number available for trapping.

The following discussion focuses on historical developments, current conditions, and future prospects for commercial fishing and trapping in the deltaic Plain. The first section, "Harvest from the waters", describes the technological changes and ecological interrelationships that influence major commercial fishing activities. The next section, "Trapping in the Deltaic Plain", analyzes the relationship between variations in the trapping environment and trapping productivity. Finally, problems with data gaps and inconsistencies are identified, along with recommendations for resolving these problems.

FISHING: HARVEST FROM THE WATERS

The primary marine resources developed for commercial production include oysters, menhaden, shrimp, blue crab, and, to a lesser extent, catfish. Each of these species occupies a special ecological niche in the coastal zone, and is characterized by a specific salinity tolerance, life cycle, and susceptibility to natural predation. The history of commercial fishing in the region is marked by a succession of technological improvements that have permitted more efficient resource exploitation. This history has also been marked by changing environmental characteristics in different parts of the estuarine setting, creating changes in the level of natural predation and species availability. The following sections examine historical development and future prospects for each of the major marine resource industries, including the technological changes and ecological interrelationships that influence commercial fishing activities.

Oysters

In his Histoire de la Louisiane, (1774) Antoine Simon Le Page Du Pratz recorded "that in Lake Pontchartrain there were small oysters in great abundance that are very well tasted (II). On the other hand, when we quit the lake by another lake which communicates with one of the mouths of the river, we meet oysters four or five inches broad, and six or seven long. These large oysters eat best fried, having hardly any saltiness, but in other respects are large and delicate." Paleo-indians of the region were also aware of the value of the oyster for food. The Deltaic Plain is dotted with their middens, or refuse dumps full of oyster shells (McIntire 1958).

Since 1880, partial records of oyster landings have been kept (Moore 1899, Van Sickle et al. 1976). In Mississippi, the first record of landings noted that in 1880, 28,123 kilograms (62,000 pounds) were harvested. By contrast, in Louisiana, oyster fishermen harvested more than 500,000 kilograms (1.2 million pounds) of meat -nearly 20 times the Mississippi catch (Lyles 1967). The catch shows a progressive increase after 1800 with the first major decline in production occurring about 1910. Demand began to increase in the 1920's and stabilized in the mid-1930's. As a result, the highest annual production in Mississippi occurred in 1937, when over 5,400 metric tons (12 million pounds) were landed. This accounted for 53 percent of the Gulf total. In Louisiana, the highest production was recorded in 1939. In that year, the State's oystermen harvested more than 6 million kilograms (13,586,000 pounds)(Lyles 1967).

The industry relies almost totally on one species, which is the American oyster, *Crassostrea virginica* Gmelin. Other oyster species do not contribute significant amounts to the catch. Since the record harvests of the 1930's, the industry's catch statistics have fluctuated dramatically, with a general decline in production (Van Sickle et al. 1976, Dugas 1977). Louisiana currently leads the Gulf states in production, with an average yield of about 4.1 million kilograms (9 million pounds) of meat yearly. This figure has remained constant over the last 20 years, with only severe environmental catastrophies affecting the harvest. For example, when the Bonne Carre Spillway is opened and the sediment-laden waters of the Mississippi are directed into Lake Pontchartrain, oyster production is severely damaged for several years (Engle 1948, Dugas 1977). After the initial shock to the estuarine system, the recharged nutrient load results in excellent harvests, ultimately increasing production. Although environmental problems occasionally affect production, Louisiana generally ranks second nationally (after Maryland) in yields. Dockside value of the Louisiana oyster is between $3 and $4 million annually (Lyles 1967, United States...1968-1975).

Mississippi's oyster production has fluctuated considerably in recent years. Where Mississippi oyster meat production amounted to approximately 540,000 kilograms (1.2 million pounds) in 1972, in 1974 production had dropped to 125,000 kilograms (277,000 pounds). by 1977, production had increased to nearly 630,000 kilograms (1.4 million pounds) (National Oceanic and Atmospheric Administration

1978). Dockside value of the 1977 oyster harvest in Mississippi was approximately $1.2 million.

During the mid-1800's, oystermen discovered that oysters obtained from particular reefs had a better flavor and an added appeal to the customer. Demand for these oysters eventually overwhelmed supply. Fishermen began to move smaller oysters into the better-producing areas. In order to protect their reefs, oystermen obtained legislation that allowed Louisiana to lease them certain grounds, but placed the remaining reefs under the State's control. This would guarantee that they would always have a source of "spats" (young oysters). As a result, Dugas (1977:1) noted:

> "Louisiana's oyster grounds have, from that period to the present, been divided into two regions; state controlled (referred to as 'red-line' areas) and those set aside to be leased to private individuals. Approximately 86,400 hectares (226,364 acres) were under lease in June, 1977 and the state has under its jurisdiction approximately 279,200 hectares (690,000 acres) with 'red-line' areas. Of this 279,200 hectares, 6,658 hectares (16,453 acres) are maintained within managerial sections referred to as 'Seed Ground Reservation', and 2,726 hectares (6,737 acres) are incorporated into a 'Public Reef' located in Calcasieu Lake...."

In Mississippi, reefs are located from the Pearl River to the Mississippi-Alabama State line with some of the largest beds off the coast of Pass Christian. Studies conducted in 1966 revealed that along the Mississippi coast, there were more than 4,000 hectares (10,000 acres) of oyster reefs (Christmas 1973). In addition, there were nearly 243 hectares (600 acres) of planted beds (Christmas 1973). Although small compared to the harvested acreage in Louisiana, these beds add to the total commercial fishing industry in Mississippi.

Oysters are marketed commercially in three forms: steam-canned, raw-shop, and counter-stock (McConnell and Kavanagh 1941).

The steam-canned oysters are dredged from the natural reefs, sacked, and stacked on the lugger to be off-loaded at the cannery. They are steamed open at the cannery. The meat is removed, placed in cans, and processed. Many of the oysters used in this manner originate in beds that have been seeded by Louisiana's Department of Wild Life and Fisheries (Dugas 1975). The young oysters cement themselves to the shell used in the "seeding" process. After a spat (approximately 2.5 centimeters or 1 inch in length) has attached itself to the oyster or clam shells used in the seeding process, it remains stationary (Treadway 1971). When the oyster reaches a size of 7.6 centimeters (3 inches), they are considered marketable stock and may be legally harvested. In about two years, oysters reach the size that is preferred by the canneries. Oyster growth depends on a number of variables, such as ocean currents, salinity, and the pattern of growth of the bed (Van Sickle et al. 1976, Dugas 1977). Many of the oysters used in the steam-canning process in both Louisiana and Mississippi come from reefs in the estuarine lakes, bays, and lagoons east and west of the Mississippi River.

The oyster catch recorded in Mississippi and Louisiana includes primarily those cultured for use in the canning business. The oysters harvested for raw-shop, as well as the counter trade, are generally not reported. There is, therefore, a gap in the landing data. Raw-shop oysters are usually taken from the natural reefs, cleaned and separated, and then placed on bedding grounds leased from the State where they are allowed to mature before harvest (Van Sickle et al. 1976). The raw-shop trade involves mostly independent oystermen who bring their harvest to packing houses that remove the shells and pack the meat in containers. The containers are then shipped in refrigerated trucks to market.

The counter-stock trade utilizes oysters that are generally of uniform rounded shape and are high in salt and fat. These are considered the premium grades that are served on the half shell at the oyster bars in restaurants (McConnell and Kavanagh 1941). These oysters are cultivated on leased bedding grounds, as are the raw-shop oysters, although greater care is taken in the selection of spats and in harvesting those for the counter-stock trade.

Van Sickle et al. (1976:4) report that:

> "oysters used in steam canning and packing may vary from 2.5 to 7.6 centimeters (1 to 3 inches) in size and may not have the taste or nutritional value of oysters served in the counter trade. These oysters are usually not cultured in highly saline waters that produce the quality preferred in raw, counter-stock. Thus, fluctuations in sack or counter-grade oyster production may never be realized, as this portion of the landings is seldom reported."

As oystermen are "farmers of the sea", they must contend with a number of forces that can destroy the crop (Gunter 1955). The oyster has, in fact, a number of enemies. At the top of the "unwanted list" is the oyster drill, or boring snail (Thais haemostoma) known locally in the MDPR as a "conch" and another drill, or boring snail (Thais floridana) (McConnell and Kavanagh 1941, Waldo 1957b, Van Sickle 1976, Dugas 1977). The drill is a carnivorous gastropod that attaches itself to the oyster and bores a smooth round hole through the shell and extracts the meat (Chapman 1959, Van Sickle et al. 1976). The deadly predator occurs over a wide area in Louisiana oyster bedding waters, but it must have high salinities in order to survive (Burkenroad 1931, Galtsoff 1964). To cope with the oyster drill problem, researchers have determined that if the seed beds are placed in water bodies of low salinity, the oyster drill is not a serious predator (Galtsoff 1964).

The saltwater drum (Pogonias cromis) is another unwanted predator. These fish crush the oysters and devour the meat. The saltwater drum congregates in large schools, and the school's collective appetites can destroy a bedding ground in a single night (Van Sickle et al. 1976). A mature drum may weigh up to 110 to 132 kilograms (50 to 60 pounds). To protect the oyster crop, the fishermen surround their beds with underwater fences of galvanized wire-mesh strong enough to keep these voracious eaters out of the beds.

In the 1940's, Dermocystdium marinum became a problem (Mackin and Hopkins 1950). This water-borne parasitic oyster fungus is particularly evident in the summer and is often the cause of high summer mortalities. To counteract this pest, oyster-men now prepare their beds in September, October, and November so they can harvest the following June. Prior to the arrival of D. marinum (now classified Labyrinthomyxa marina), oysters were bedded between March and May and allowed to grow for two years. The heavy summer mortalities recorded in the 1940's permanently altered this procedure (Waldo 1957b). If the oystermen did not harvest before the hot summer months, the oyster fungus would kill from 75 to 90 percent of the crop. Research into the problem has found that if the oysters are bedded in areas with salinities less than two parts per hundred,the fungus cannot survive; it requires higher salinities (Waldo 1957b).

Although oyster culture is plagued by predators, industrial wastes, and dredging operations, the oyster fishermen continue to be the backbone of the commercial fishing industry. They have learned to live with all these problems. In 1913, there were over 1,700 persons involved in Louisiana's oyster industry (Hart 1913). Today, there are 1,371, each of whom pays a small lease fee to stake out an oyster bed. These individuals own the equipment required to profitably harvest the beds (Survey Section, Division of Oysters, Water Bottom and Seatcoods, Louisiana Department of Wild Life and Fisheries, personal communication). The industry utilizes specially designed boats and equipment that set the oystermen apart from other commercial fishermen (Van Sickle et al. 1976).

In the early years of the industry, oystering equipment was quite simple. Oystermen originally used tongs to remove the oysters from their cemented perch. These hinged, rake-like tools have a basket cradle with serrated teeth that removed the oysters from the beds and lifted them into the boat. With the tongs, the oystermen could remove oysters from deeper waters (McConnell and Kavanagh 1941, Waldo 1957b, Vujnovich 1974).

Although tongs are still used by fishermen, the development of the oyster dredge changed the industry. The first dredge appeared in 1905 (Vujnovich 1974). With very few modifications, the dredge used today resembles the first pair installed on an oyster lugger (Van Sickle et al. 1976). The dredge consists of V-shaped iron frames with ring-mesh enclosures. These are connected to the boat by a chain and dragged over the beds to scoop the oysters into the mesh sack. When full, the dredge is lifted off the bed by power-operated winches (Van Sickle et al. 1976).

Since the development of the dredge and the conversion of oyster luggers from sail to motorized power, oyster harvesting techniques have been relatively unchanged. Speed, refrigeration, and boat size are the primary improvements. Now oystermen may travel more than 320 kilometers (200 miles) to harvest oysters from prime reefs (Van Sickle et al. 1976).

In 1913, Louisiana oystermen leased almost 7,000 hectares (17,000 acres) of oysters (Hart 1913). Today, almost 81,000 hectares (200,000 acres) are involved (Dugas 1977). Not only has the amount of area increased, but so has the average lease size. This is primarily the result of the oystermen's practice of not using the entire lease area. He does this to allow the planted lease to recover naturally from oyster dredging operations. Although the reasons are not clear, fishermen have observed that using productive leases only every other year reduces the number of predators, especially the conch.

The future of the oyster industry in the Deltaic Plain will depend, in part, on the environmental changes taking place along the coast. The distribution of the oyster depends on the salinity content of the water in the estuaries and near-shore areas. Oysters are generally found in the polyhaline zone, where salinity ranges from 18 to 30 parts per thousand (ppt) (Van Sickle et al. 1976, Dugas 1977). Salinity of many of the interdistributary basins is increasing over time due to coastal deterioration brought about by land subsidence and canalization (Chapman 1968, Barrett 1970, Morgan 1972, Davis 1973). With increases in salinity, and if more firm substrata are available, oyster populations could actually increase.

Shrimp

Two species of shrimp are harvested by commercial, as well as recreational, shrimpers: white and brown (*Penaeus setiferus* and *P. aztecus*). Penaeid shrimp spawn offshore with white shrimp spawning from spring through fall, and brown from March-April and September-October. The microscopic eggs hatch within a few hours. In three to five weeks, the post-larvae move into the estuaries. Their survival depends upon a number of environmental factors, including salinity, water temperature, rainfall, and river discharge (White 1975). Once inside the estuary, a wide tolerance to salinity and temperature enables the shrimp to spread over a range of habitats (Kutkuhn 1966, Barrett and Gillespie 1975).

Perret et al. (1971) found white shrimp in fresh to saline water and in temperatures of 5° to 35°C (41° to 94.8°F). The highest catches were in the 2-24.9 ppt and over 30 ppt salinity regimes, with the optimum range between 5 and 10 ppt (Perret 1971). Barrett and Gillespie (1973) reported that brown shrimp survival may be related to water temperature, particularly after the first week in April, and salinity. A prolonged April cold spell, with water temperatures below 20°C (68°F) will seriously affect the brown shrimp's survival. Postlarval and juvenile shrimp grow rapidly in water warmer than 21°C (70°F). Below this temperature, their growth is slowed or terminated. Salinities over 10 ppt are required for the successful growth of larvae, with 19 ppt appearing to be the optimum (Barrett and Gillespie 1975).

Nursery area salinities are influenced by rainfall and river discharge. The higher salinities associated with low spring discharge and rainfall will benefit brown shrimp production, whereas white shrimp yields increase during low summer discharge and rainfall. High precipitation and river water may dilute estuarine salinities to below the tolerance limits and restrict available optimum nursery areas. Land available for this fishery in the Deltaic Plain varies from 0.8 million to 1.2 million hectares (2 million to 2.85 million acres) (Barrett and Gillespie 1975).

The equipment used for harvesting shrimp has changed for both recreational and commercial interests. For recreational outings in the past, people used cast-nets. New Orleans residents formerly spent their summer nights cast-netting shrimp along the Lake Pontchartrain seawall (Viosca 1957a). On some nights, shrimpers numbered in the hundreds and spectators in the thousands. Except for use by sport fishermen, the cast-net has been abandoned for shrimping. (Knipmeyer 1956, Padgett 1960, Captiva 1966, Love 1967).

Early commercial ventures relied almost entirely on haul seines.

> "These....usually consist of a wall of 1 1/2 inch stretched mesh ranging from 150 to 300 fathoms in length with a lead line running along the bottom and a cork line along the top. They are operated from a single boat by crews of from 8 to 20 men" (Johnson and Lindner 1934:3).

Haul seines were used mostly for white shrimp, since they tend to stay in the estuary longer than the brown shrimp (Viosca 1957a). These seines were efficient, but the otter trawl, introduced in 1915, revolutionized shrimping completely. Padgett (1960:147) comments that:

> "The haul seine could be used only in shallow waters, requiring a large crew. It could be operated for only a limited time during the summer and fall months, the otter trawl was adaptable for use over a much greater range, could be operated with fewer men, yielded a greater production per man, and was a much more efficient type of gear. With its introduction, entirely new fishing grounds were opened up and a rapid expansion of the fishery followed."

By 1920, the total shrimp catch in Louisiana was 14.5 million kilograms (32 million pounds), or nearly twice as great as the preceding year (Viosca 1920, Padgett 1960). This increase in catch is attributed generally to the acceptance and use of the otter trawl.

Along with the haul seine and otter trawl, coastal fishermen use night trawls. This rig, also called a butterfly net, or in French, a "poupier", was invented to meet the need for smaller and cheaper shrimp in the shrimp-drying industry. As the sun-drying industry declined, commercial fishermen found these nets suitable for use along with their otter trawls to maximize their harvest (Ford 1967). These nets are either mounted on boats or placed on a wharf. They are rigged on iron-pipe frames from seven to 12 feet square and equipped with small-mesh bags about 15 feet long (Johnson and Lindner 1934).

Butterfly nets are generally used at night (to catch shrimp moving with the tides) in about three feet of surface water and are mounted on 18- to 25-foot Lafitte skiffs. These shallow-draft boats, powered by automobile engines, are well suited to inland waters. Here a shallow-draft is essential for ease in moving from one bay or bayou to another (Davis and Detro 1975). In offshore water, larger vessels are used, such as the Biloxi-- and Florida-type trawlers (Love 1967).

With the advent of power boats and the development of seagoing trawlers, the shrimping grounds were greatly extended, and both drying and canning industries grew substantially. The shrimping industry was originally affected, however, by the problem of moving the perishable shrimp to market. In fact, as early as 1718, the Dutch historian Le Page Du Pratz (1774:274) stated that "there is an incredible quantity of fishes in this country...The people were not experienced enough in the art of catching them." He also observed that:

> "The Shrimps are diminutive crayfish...usually about three inches long, and of the size of the little finger...in other countries they are generally found in the sea...in Louisiana you will meet with great numbers of them more than a hundred leagues up the rivers" (Le Page Du Pratz 1774:277).

As Le Page Du Pratz (1774) noted, the shrimp are not limited to the sea--they are caught in the Deltaic Plain's shallow, tidal inland waters. As a reult, the Mississippi Sound and Barataria, Timbalier, Terrebonne, Caillou, and Atchafalaya Bays are important shrimp-producing water bodies (Barrett and Gillespie 1973). Prior to the availability of ice and modern freezing techniques, shrimp caught in these fishing grounds were taken to one of the numerous drying platforms to be dried, packaged, and sold. Although plagued by frequent hurricanes and a declining market, these water bodies, as late as 1962, supported 23 shrimp dyring platforms in Louisiana (Pillsbury 1964). Three years later, a mere 16 remained (Pillsbury 1964). The few (less than five) that now survive operate only intermittently (Davis 1976).

The shrimp-drying procedure utilized in the Deltaic Plain has its origin in the Orient, reaching Louisiana from the United States' west coast. In 1871, Chinese immigrants began harvesting San Francisco Bay shrimp (Scofield 1919; Bonnot 1932). These fishermen were quite successful and found it profitable to supply the markets with shrimp at one and one-half cents per pound. From the beginning, they dried the bulk of their catch for the Oriental export trade. By 1873, Chinese migrants from California introduced the lucrative sun-dried-shrimp process into the inland waters of Louisiana, hoping undoubtedly, to duplicate the profits generated from the San Francisco Bay enterprises (Padgett 1960).

There are conflicting reports of the original practitioner of this art in Louisiana. Although the name of the person responsible for starting this occupation is lost to history, early accounts are fairly certain that the first crude drying platform was built on the south side of the mouth of Grand Bayou in Barataria Bay at a site later to be called Cabinash (Padgett 1960).

Settlements at Basa Basa, Manila Village, (Dauenhauer 1938) Chenier Dufon, Camp Dewey, Bayou Brouilleau, like those in San Francisco Bay, were established to preserve shrimp for shipment from the production areas to the various markets (Davis and Detro 1977). Primary markets for dried shrimp were the large Oriental communities on the Pacific Coast. As production grew, distribution expanded to include most of the Far East. Today, dried shrimp from Louisiana are still sold to wholesalers in the areas settled by people from eastern Asia, particularly San Francisco's Chinatown. Recently, the market was expanded through the cellophane packaging of dried shrimp (Davis 1976). This convenience food snack is sold in taverns and grocery stores throughout the nation.

When shrimp are plentiful, several platforms continue to dry shrimp intermittently. Problems that continue to plague the industry include exorbitant operational costs, low landings, and depressed shrimp prices. As a result of increased platform operating costs, competition from fresh, frozen, and canned shrimp, and dried imports from the Ying Chong Company of San Francisco, this aspect of the shrimping industry is today in a state of decline (Davis and Detro 1975, Davis 1976).

With more sophisticated boats and equipment, the shrimp industry has grown rapidly. Numerous houses operate in the fishing communities of the Deltaic Plain (Klima and Ford 1970). The expansion of the industry has resulted in shrimp becoming the most valuable fish in Louisiana and Mississippi. The shrimp catch is second only to menhaden in quantity, but first in dollar value (Roy and Bordelon 1974). Louisiana is the leading state in volume of commercial fishery landings with from 23 to 46 million kilograms (50 to 100 million pounds) landed annually (Roy and Bordelon 1974). This represents from 20 to 25 percent of the total U.S. shrimp landings (Barrett and Gillespie 1973). In fact, since 1880, Louisiana has led the Gulf states in shrimp catch 69 percent of the time (Barrett and Gillespie 1973). Mississippi's catch, with rare exceptions, exceeds that of the menhaden in value, and the State's recorded shrimp harvest rarely exceeds the 4.5 million kilogram (10 million pounds) level (Barrett and Gillespie 1973).

In the Gulf, there are at least 90,000 commercial and recreational shrimpers (Christmas and Etzold 1977b). They utilize more than 60,000 boats that range in size from small bateaus to aluminum, steel, or fiberglass ocean-going trawlers (Christmas and Etzold 1977b). Because a large number of recreational fishermen are involved in the industry, the statistics are somewhat misleading, because the recreational catch is not reported. Although the reported catch in Louisiana and Mississippi in 1968 was 37.7 million kilograms (82.9 million pounds) and 4 million kilograms (8.9 million pounds) respectively, recreational sportsmen probably accounted for another 18 million to 23 million kilograms (40 million to 50 million pounds) (Barrett and Gillespie 1973). In 1976 Louisiana's catch was 52,162,000 pounds valued at $79 million, while Mississippi shrimpers caught 4,716,000 pounds valued at $8 million (United States. . . 1977).

In the past, shrimp was practically unknown on the tables of the average American home. It was strictly a part of the diet of the coastal fishermen and the associated regional markets. However, with the development of refrigeration and fast-food restaurants, national demand for shrimp has increased dramatically. People are willing to pay a premium price for shrimp.

Menhaden

The menhaden (*Brevoortia patronus*), or "pogies", support one of the oldest fisheries in the Gulf of Mexico. Catch statistics reveal that the first landings were in West Florida. In 1880, less than 455 kilograms (1,000 pounds) were landed. Since this small beginning, the industry has shown considerable expansion. Although considerable variability exists in the catch record, landings have steadily increased since the early 1950's (Christmas and Etzold 1977a). The production curve reached its peak in 1971 when 730 million kilograms (1.6 billion pounds) of menhaden passed through Gulf of Mexico ports (Christmas and Etzold 1977a). This amounted to nearly 75 percent of the U.S. menhaden harvest and more than 30 percent of the total U.S. commercial seafood catch. Since this record year, landings from the Gulf of Mexico have exceeded one billion pounds annually (Christmas and Etzold 1977a).

The catch statistics reveal that the menhaden fishing fleet has become increasingly efficient in harvesting this renewable resource. The fishery is highly modernized. The vessels used are from 30 to 60 meters (100 to 200 feet) in length and carry huge purse seines. These seines are required, as a school of menhaden may contain as many as 600,000 or more fish weighing a total of 276 metric tons (250 tons) (Chapoton 1970, 1972). Each vessel has large central holds below the deck where the fish are loaded, and depending on the size of the vessel, each can carry from 165 to 386 metric tons (150 to 350 tons). In some cases, when two purse boats "complete the set" around a menhaden school, the harvest can fill the hold of the boat (Lee 1953, June 1963, Perret 1968, Frye 1978).

Prior to the 1950's, menhaden schools were located by spotters in the carrier vessels' crow's nests. This was an effective technique, but since the industry began to use airplanes to spot the schools, fleet efficiency has increased. Pilots now spot fish and direct the harvesting procedure from the air.

> "The actual fishing operation is accomplished from two 11-meter (36-foot) purse seine boats, which are carried in davits aboard the carrier vessel. The purse seine is approximately 200 fathoms long and 10 fathoms deep. Half of the seine is stored aboard each boat. The top of the seine is held to the surface by floats. Metal rings run along the bottom of the net and the purse line is threaded through these rings. This acts as a draw string, and at the proper time, it is gathered together or 'pursed', thus confining the catch within the net" (Perret 1968:15).

> "To set the purse seine, the purse boats separate before reaching the school; each boat then follows a half-circle course and surrounds the school with the net. The purse line is then drawn together to confine the fish. The net is now gathered onto the purse boats by power-driven blocks, thus forcing the fish into a small section of the net. The carrier vessel then comes alongside, and the fish are pumped directly into the hold of the ship. The average set yields from 10 to 30 tons of fish" (Perret 1968:15).

Using this technique, the Deltaic Plain's 'pogie' fleet annually harvests from 330 million to 550 million metric tons (600 million to 1 billion pounds) of this industrial fish (United States...1973, Christmas and Etzold 1977a). Prior to 1963, most of the catch was made along the Atlantic coast, but now more menhaden are caught in the Gulf of Mexico (Christmas and Etzold 1977a). Most of these fish are harvested in waters that fringe the Louisiana coast; a particularly productive area is located in and around the Mississippi Delta (Dunham 1975). From these waters, menhaden fishermen harvest a catch worth, in most years, in excess of 10 million dollars (Wheeland and Thompson 1975).

Menhaden are industrial fish, i.e. they are not eaten directly, but reduced to meal, oil, and solubles. Consequently, they supply approximately 75 percent of all fish meal, 80 percent of the marine oils, and nearly 80 percent of all fish solubles produced in the United States today (Perret 1968). Through time, the by-products of the menhaden have been found to be of increasing utility and value. For example, in World War II, the meat was discovered to be high in Vitamin B-12, and was used to provide a much needed source of high-protein feed supplements (Blakeney 1970).

Menhaden oil is used in a number of products. Considerable quantities of the oil are exported to Europe for production of hydrogenated cooking oils and margarine. In the United States, the oil is used in paint, varnishes, stains, resins, putties, lubricants, and greases, as plasticizers for the rubber industry, in the manufacture of alkyd resins, and in animal feeds. Menhaden solubles are used to supplement or to replace fish meal in broiler and swine feeds. They are also used in liquid feed supplements for cattle. Menhaden fish meal is rich in high quality proteins, minerals, and other essential nutrients.

Menhaden are harvested from the third Monday in April to the second Tuesday in October (Christmas and Etzold 1977a). All of the fishing is done offshore with the exception of Breton and Chandeleur Sounds. Since most of the catch is taken inside three miles, land-based spotter planes are a logical solution to finding the schools. Once the fish are caught, they are brought to one of seven processing plants (Table 40) in the Deltaic Plain, where suction pumps unload fish

Table 40. Menhaden processing plants in the Deltaic Plain.

Plant	Location
Standard Products	Moss Point, Mississippi
Zapata Haynie	Moss Point, Mississippi
Petrou Fisheries	Empire, Louisiana
Empire Menhaden	Empire, Louisiana
Zapata Haynie	Dulac, Louisiana
Seacoast Products	Morgan City, Louisiana
Seacoast Products	Intracoastal, Louisiana

Source: Christmas and Etzold 1977a.

onto an automatic scale which determines the quantity taken (Christmas and Etzold 1977a). The unloaded fish are then placed in continuous cookers where the reduction process begins. Reduction involves cooking and pressing under high pressure to form press cakes and press liquor. Milling transforms press cakes into fish meal. Press liquor is screened and decanted to remove solids and centrifuged to remove water and impurities leaving menhaden oil. The water and dissolved solids removed by centrifugation are referred to as "sickwater" which is then concentrated to 50 percent water and 50 percent fish solids and pH adjusted to form fish solubles (Christmas and Etzold 1977a). These three products are then sold by large lot, truck lot, and car lot quantities to the various dealers or processors.

By weight, the menhaden industry is the most important fishery in Louisiana. The menhaden catch has made the ports of Empire and Dulac two of the more important fishing ports in the United States. With continued emphasis on providing protein meal to the underdeveloped countries, the future of the menhaden industry looks favorable. It is necessary to maintain the estuarine environments utilized by the juveniles (young fish) in the early stages of their development (Rientjes 1970, Dunham 1972). Since the juveniles are primarily herbivores, it is imperative that the estuary be relatively free from pollutants. If not, this critical stage of the menhaden could be seriously impacted to the point of destroying the multi-million dollar menhaden industry.

Blue Crabs

Crabbing is an activity that is not only important to commercial fishermen, but also is enjoyed by a large number of recreational sportsmen. While crabbing is a year-round activity, periods of concentrated efforts correspond to the summer and spring shrimp season. In both periods, commercial (and recreational) fishermen harvest hard- and soft-shelled blue crabs (*Callinectes sapidus*) along the roads bordering the coastal bayous and drainage canals and in estuarine open water bodies. Jaworski (1972) reports that as a commercial enterprise, "one of the earliest blue crab fisheries in the United States developed near the city of New Orleans".

An exceptional delicacy is the occasional capture of a soft-shell crab; that is, one that has shed its hard shell during the growing process. Blue crabs are found in almost all available habitats from saline to fresh water, and are worldwide in range. The sports catch exceeds the commercial catch by almost four times (Adkins 1972). In the warmer months, crabbing is an important recreational activity, providing many families with a delightful seafood at nominal expense.

The blue crab is abundant in the waters of the Deltaic Plain, occupying many different habitats. Optimal conditions include shallow water, mud and/or mud-shell bottoms, detrital matter, tidal fluctuation, warm temperatures, and mid-to-low salinities (Darnell 1959, Adkins 1972).

The green-blue crustaceans are caught in greatest numbers in periods of low salinity and temperature. In warm weather, with abundant available food, a crab can mature in about six months. In attaining adulthood, each crab sheds its shell approximately 15 times and becomes for three days on each occasion a soft-shell crab (Viosca and Gresham 1953). A *Callinectes sapidus* hatched in March will go through the various molting stages and become an adult by the end of the summer. Crabs hatched in September will not mature until the following summer. The winter cold retards their rate of growth.

When temperatures exceed 30°C (86°F), coupled with low salinities, crabs are forced to migrate to more favorable habitats or die (Viosca and Gresham 1953). If the water becomes too cold, they migrate toward the tidal channels or bury themselves in the mud or sand, or live semi-dormant on the bottom. Work by Adkins (1970) and Perret (1967) reports the highest catches occur in winter and early spring when the crabs are concentrated near the tidal channel, particularly near oyster beds. Summer months are considered the favored crabbing period, but winter and early spring yield a better commercial harvest per unit of effort.

In 1975, the crab harvest in Mississippi amounted to about 250 metric tons (1.9 million pounds), whereas in Louisiana, the catch was nearly 6,000 metric tons (11 million pounds) (United States...1978a, 1978b). This represented about 41 percent of the country's blue crab harvest. Louisiana is the leading major producer of crabmeat and, at present, the demand far exceeds the supply.

Hard-shell crabs that are about to molt are called "peelers" or "busters". Shedding crabs are obtained from trawlers and crab fishermen, and may also be taken by placing brush with branches down in the water, thus attracting crabs by offering protection and a hiding place during the molting process (Viosca and Gresham 1953, Gaidry and Dennie 1971). These crabs, both "busters" and soft-shells, are collected by placing a net under the bush while raising it from the water. Little expense, but considerable labor, is encountered in keeping the "busters" until they molt.

Gaidry and Dennie (1971:8) note that:

> "initial obstacles to overcome in setting up production of soft-shell crabs are: (1) obtaining a constant supply of "busters" or "peelers"; (2) making the holding pens for these crabs; (3) gaining experience in handling the busters in approximating an individual's time of molt by visual inspection; and (4) locating a ready market for the soft-shells. This last objective will be the easiest of all because, generally, the demand for soft-shell crabs far exceeds the supply."

In the Deltaic Plain, three methods are employed in the cultivation of soft-shell crabs. One technique involves using a floating box, large enough to hold about 150 to 250 crabs. These cages are tied to a dock along the bayous or lakes where saline water can circulate through the wooden slots that make up the sides of the float.

The second method is called the watertable, which involves a watertight trough about 1.5 meters (five feet) wide and 2.7 to 3.7 meters (nine to 12 feet) long with 15 to 20 centimeter (six to eight inch) sides. The crab fishermen may construct a series of these troughs, each stacked in a series, so they form a small pyramid. Brackish water from the nearby bayou or lake shore is pumped to the highest trough and allowed to circulate down through the other lower units (Gaidry and Dennie 1971). Because of increasing problems with oxygen-deficient or toxic water, most crabbers pump water from the bottom of the water body.

Along with the soft-shell crabs, commercial fishermen also retrieve the hard-shell crabs. Although soft-shell crabs are consumed whole, hard-shelled crabs are valuable for their crabmeat. Crabmeat production is increasing. One reason for the change in production is the abandonment of the traditional trotlines using bait and the cumbersome baited drop nets (Floyd 1968).

Following the example of Maine lobstermen, professional crabbers now use crab pots or traps to capture blue crabs. The pot is a basket-type wire-mesh enclosure that attracts the crabs inside when baited. A problem with these pots is that they are marked with buoys. Anyone can pull up the pot, remove the captured crabs, and thereby rob the crab fisherman of his harvest. Crab pots also enable the crab fishermen to harvest crabs during winter and spring seasons when the crabs lie in semi-dormant state because of relatively cold water temperatures.

Between 1953 and 1972, there were over 750 metric tons (1.7 million pounds) of blue crab landings in Mississippi (Lyles 1969). Yearly landings varied from a low of 400 metric tons (907,000 pounds) to over 1,300 metric tons (3 million pounds). Historical data show that peak production occurred in 1945 and 1948 when nearly 2,300 metric tons (5 million pounds) were processed (Perry 1975). There is no way, however, to ascertain if all of these crabs were from Mississippi waters. The landing data record the crabs that enter local processing plants. Crabs can come from any point along the Gulf coast. Recently, Mississippi crab fishermen were being paid 10 to 14 cents per live-weight pound, the price dependent upon the supply of crabs available to processing houses (Perry 1975).

In Louisiana, the crab harvest varied from a 1,950-metric ton (4.3-million pound) low in 1930 to a high of over 5,900 metric tons (13 million pounds) in both 1940 and 1950 (Lyles 1969). Since 1970, the catch varied from about 2,700 metric tons (6 million pounds) to nearly 5,000 metric tons (11 million pounds). In 1930, the total hard blue crab catch of 1,950 metric tons (4.3 million pounds) sold for $121,525 (Adkins 1972). By 1971, the State's crab fishermen were paid $1,242,521, or 10 times the 1930 value while tonnage increased by slightly more than 100 percent. This can be partially explained by the change in the dockside value of the crabs to the fishermen. Dockside prices have ranged from 1¢ to 5¢ per pound in the past to 84¢ per pound, which was the average between 1970 and 1976. The industry has, in fact, appeared to have stabilized since 1960 (Adkins 1972). Current catch statistics record an average harvest of about 4,100 metric tons (9 million pounds) valued at in excess of $6 million (United States...1968-1975). Crab pots account for the majority of the commercial catch.

Blue crabs taken commercially are marketed by a small number of commercial crab fishermen. The largest harvest corresponds inversely to shrimp seasons. When the shrimp are not plentiful, the crab harvest increases. When the shrimp season is good, however, the crab harvest declines, as greater profits can be realized by fishing for shrimp and not crabs. The data are only an estimate, at best, as commercial shrimp fishermen also eat, give away, swap for supplies, or sell many of the crabs they catch while trawling for shrimp.

Jaworski (1972) indicates that the blue crab catch is declining in the upper estuary and that catches are increasing in the lower estuary. Water quality deterioration in the upper and middle estuary may be causing this change along with improved winter harvesting (of gravid females) techniques. This has resulted in a continual decline of the soft-shell fishery while the demand for the hard-shell crab is increasing. These trends have not been well correlated to the changing human-caused environmental conditions and represent a gap in the available data.

THE TRAPPING ENVIRONMENT IN THE DELTAIC PLAIN (LOUISIANA)

For convenience, Penfound and Hathaway (1938) divided the marshes into four vegetative types: saline, brackish, intermediate, and fresh. Various maps document the zonal patterns of these vegetative assemblages (O'Neil 1949; Kolb and Van Lopic 1958; Louisiana: vegetative...1968). In general, the banks parallel the coast in an east-west direction encompassing a total of 1.6 million hectares (3.9 million acres) of land surface (Perret *et al.* 1971). The area limits are not permanent, but change with various edaphic factors, disrupting the vegetation assemblage, causing severe changes in habitat and contributing to a decline in the furbearing population.

Saline

Salt marshes conform generally to the 20 ppt salinity contour (Louisiana: vegetative...1968). The ubiquitous oystergrass (*Spartina alterniflora*) is rooted in areas influenced by regular salt-water intrusion. Floral abundance is in direct proportion to the level of the water table and salinity conditions. If these factors are changed, the paludal (marsh) surface "assumes aspects similar to a brackish and ultimately an intermediate marsh" (Wright *et al.* 1960:27). In the process of changing to brackish or intermediate type marsh, it is becoming a favorable furbearer habitat. If unchanged, these plant types will sustain about 20 percent of the coastal zone's muskrat (*Ondatra zibethicus*) houses and a limited nutria (*Myocastor coypus*) population (Palmisano 1972a). The salt marsh is a relatively poor habitat for furbearing animals, but provides valuable muskrat stock when the brackish water inhabitants are reduced during cyclic die-offs (Palmisano 1972a). The saline marshes' only other furbearing resident is the mink (*Mustela vison*) - an animal that ranges over all marsh vegetation types. From one vegetation type to another, catch statistics reveal a difference of only 2.3 mink per 405 hectares (1,000 acres) (Palmisano 1972a).

Brackish

Brackish plants tolerate salinities between 10 to 20 ppt and are categorized as either saltmeadow or brush (Wright *et al.* 1960). Wiregrass (*Spartina patens*) is the principal saltmeadow species and accounts for one-fourth of the coastal marsh's vegetation (Chabreck 1972), but the region's three-cornered grass (*Scirpus olneyi*) family provides 90 percent of the muskrat's food supply (O'Neil 1949). As a result, ten times as many muskrats may be caught in this type of marsh. Although it is "the most productive fur habitat along the northern Gulf coast" (Palmisano 1972a:172), this vegetation type has been reduced in extent by muskrat "eatouts" as well as by controlled flooding and reduced sedimentation.

Intermediate

The intermediate band is characterized by wiregrass. The fluctuating water table has created a heterogenous vegetative assemblage capable of surviving in salinities that vary from 2 to 10 ppt. The combined brackish and intermediate zone's roseau cane (Phragmites communis) and bulltongue (Sagittaria falcata) account for over 50 percent of the marshland's plants. Along with these species, the intermediate marsh in 1972 included approximately 3.2 percent three-cornered grass (Chabreck 1972). The excellent habitat accounted for the 965,889 muskrat pelts sold in 1977. The extensive three-cornered grass marshes may, by 1979, be responsible for a catch in excess of three million animals (telephone call 5 March 1979 from Ted O'Neil, Fur Division, Louisiana Wild Life and Fisheries Commission, New Orleans).

Fresh

Inland, bordering the Pleistocene uplands, freshwater salinities are measured within the 1 to 2 ppt range. Canouche (Panicum hemitomon) (also called maidencane and paille fine) is the predominant species (Chabreck 1972), although alligator grass (Alternanthera philoxeroides) is also present and is a nutria favorite (Daspit 1950). Significant nutria catches occur within this marsh; Palmisano (1972a) reports an average catch of 2.18 animals per hectare in the early 1970's. In addition, this type of marsh until recently accounted for the largest raccoon (Procyon lotor) harvest, primarily because of the high price paid for the animal's pelt. Otter (Lutra canadensis) are also trapped with an average of 1 per 810 hectares (1 per 2000 acres) of fresh and intermediate marsh (Palmisano 1972a). Muskrat tend to avoid these environments, since they prefer brackish marshes.

In canouche regions, a type of "trembling marsh" may develop. This condition, locally called "flotant" (Russell 1942) results when the matted, cane-like maidencane roots intermingle, creating a mat from 38 to 45 centimeters (15 to 18 inches) thick (O'Neil 1949). The upper vegetative layer may float on a six-meter (20-foot) column of subaqueous organic ooze (Russell 1942).

Marsh Improvement

To improve the commercial animal harvest, marsh dwellers burn the marsh. By igniting the paludal surface, trappers remove the less desirable vegetation. This practice was a rarity before 1910. By the 1920's, burning was a well-established practice and is now a common activity (Hoffpauer 1967) considered by some to be an annual necessity (Wilson 1967). The conscious burning of marsh has enhanced the muskrat population by "eliminating many of the predators and by causing a great increase in the amount of three-cornered grass in the area" (O'Neil 1949). Marsh fires were originally set to aid alligator hunters, but effectively increased the muskrat population, thus adding a valuable furbearing animal to the trapper's harvest.

THE TRAPPING INDUSTRY

For many people, trapping is a profession thought to be confined primarily to the region of Alaska and Canada. Few people recognize that North America's most productive fur-producing region is Louisiana's alluvial wetlands. According to severance tax records, this extensive near-sea-level habitat is responsible for 40 percent of the nation's yearly fur harvest, with some seasons recording as much as 65 percent (Davis 1978).

The Deltaic Plain fur industry dates back to the 1700's, when Louisiana was not a fur producer, but an important link in the export trade (O'Neil and Linscombe 1975). Flatboats traveling along the Mississippi's numerous tributaries collected the northern trappers' winter harvests and transported the pelts to St. Louis which was regarded for over 100 years as the Fur Capital of North America. (O'Neil and Linscombe 1975). From St. Louis, the unprocessed skins were sent to New Orleans for shipment to the major world markets. The industry was concentrated in the temperate and polar latitudes. The subtropical marshes were ignored, until the 1800's when the alligator, mink, otter, and raccoon were recognized as valuable hide- and furbearing-animals (Davis 1978). Louisiana's wetlands were then considered an important furbearing habitat--one that could be exploited easily. Within 150 years, the marshes became the country's primary fur producing region, with an annual harvest greater than Alaska and Canada combined (O'Neil 1969, Davis 1978). The original species did not account for this spectacular growth since the alligator, mink, otter, and raccoon were replaced by muskrat and nutria as the principal furbearers.

Prior to 1900, the muskrat was an under-exploited resource in the wetlands. Until the 1914-1922 increase in fur prices from 8 cents a pelt to 50 cents, hunting was more profitable than trapping, with a brace of ducks (ususally 2 or 3 ducks) selling for 25 cents (Chatterton 1944, Davis 1978). Before the sale of game was prohibited, market hunters would kill 200 mallards (Anas platyrhynchos) a day, packing their kill in refrigerated boxes (McPherson 1951, St. Amant 1959). The contents were then loaded on sleds and dragged by oxen or wagon teams to high land for shipment to New Orleans and other places. Using this method, market hunters came into the Chenier Plain in large numbers every winter and shipped out thousands of waterfowl. With the 500 percent increase in fur prices, local people changed their winter subsistence activity from hunting to trapping (Chatterson 1944). As a result, the trapper spent the weeks before the season preparing for the winter catch. Camps were renovated; traps were repaired; trapping rights obtained; and in some instances, entire families were moved into trapping areas where they would stay for two months or more.

The first trapping camps were one-room, palmetto-thatched huts. There was no need for a larger structure, because a trapping family spent most of its time out-of-doors. Through time, the camps evolved into more permanent structures, with wood-burning or butane stoves supplying heat, with white-gas or kerosene lanterns furnishing light and a cistern supplying water. They were rough-hewn buildings, but were actively used only three months of the year in December, January and February, which are the primary trapping months for furbearers. Everything required at the camp had to be hauled in by boat or pirogue (Waldo 1965). Large boats provided camp access, but motorized pirogues (canoes) and mudboats have allowed the average trapper to increase his trapline from 150 to 400 traps (O'Neil and Linscombe 1975).

The modern trapper uses his home as a base camp. Here pelts are fleshed, washed, stretched, and dried. They are then sold to a local buyer who sells to one of the State's fur dealers. In only a few isolated portions of Lafourche, Plaquemines, and Terrebonne Parishes can one still find the traditional trapping family working out of its marsh cabin.

People who have trapped all of their lives go into the marsh because they enjoy the out-of-doors. In recent years, the "sport" of the job became quite profitable. In 1977, the trappers on the Chenier Plain received $9.00 or better for nutria pelts-- a considerable increase over the 50 cents paid in the 1943-1944 season (Comparative takes...1978).

The earliest muskrat pelts were offered to the northern market in 1870, but were considered useless (O'Neil 1949, 1968, O'Neil and Linscombe 1975, Davis 1978). Prior to the second half of the 19th century, the animal ranged as far south as southeastern Arkansas and by 1900, had become a permanent resident of Louisiana's marshes (O'Neil 1949). Apparently, they were not newcomers; analysis of a Cameron Parish Indian midden revealed muskrat bones approximately 700 years old (Harvest Time...1956). Although the small mammal inhabited the wetlands, Arthur (1931) and O'Neil (1949) did not uncover any evidence that the animal was included in the French fur trade. Fur buyers were interested in buffalo (Bison bison) and the American beaver (Castor canadensis). They considered the muskrat worthless, but by 1914, the animal was on the fur market (Chatterton 1944) and destined to become the number one furbearer-- a market position it would eventually lose to the nutria.

Unlike the indigenous muskrat, the nutria, or South American coypu, is an alien animal. The Argentinean rodent was introduced into the wetlands in 1938 and is now well established throughout the State (O'Neil 1949, O'Neil and Linscombe 1975). In less than 30 years, it has supplanted the muskrat to become the principal animal trapped. December, January and February are the legislated trapping months for muskrat and nutria.

Muskrat

The muskrat's habitat area is recognized, in part, by the animal's houses, built of vegetation and mud, from which the animals forage into the surrounding terrain (O'Neil and Linscombe 1975). Despite a high reproductive rate, this small rodent is subject to cyclic fluctuations (Ashbrook 1953, O'Neil 1965).

If an area is not trapped for a number of years, the muskrat and nutria will exceed the land's carrying capacity. If the overcrowding is not checked naturally, the vegetation cannot support the foraging population. Under these conditions, the land is over-utilized and an "eat out" can occur. The problem is so severe that in less than two years, "some of the State's finest muskrat-producing marshes have been eaten out" (O'Neil 1969). Before muskrat became a fashionable fur, "eat outs" destroyed valuable Chenier Plain cattle range. The rodent was hunted with pitchforks and dogs (O'Neil and Linscombe 1975), and ranchers in some areas gave a five cent per tail bounty (O'Neil 1949).

As early as 1845, land survey crews described a Deltaic Plain "eat out", (Managing the...1956). In 1923, much of the Chenier Plain's marsh had been eaten out; nearly all of the muskrat had been killed off by a 1915 hurricane, but in eight years they had overrun the marsh (O'Neil 1949). It was suggested that mudboats be used to cut 76 to 51 cm (16 feet by 10 feet) ditches to remove water from the "eat out", thus permitting the dormant seeds to lie in the mud to germinate and speed up the revegetation process (Washburn 1951).

Many times, denuded ("eaten out") areas never completely recover from such over-population pressure; it often takes years to establish even small muskrat populations (O'Neil and Linscombe 1975). One tract in St. Bernard Parish is known as the "richest fur pocket in the world," yet "eat outs" have been so severe that at times the land is not even trapped (Managing the...1956:11). Trappers remove some of these animals with the result that this furbearing animal's habitat is protected and the survival of this renewable resource is assured. One natural check on the muskrat population is hurricanes. In 1956, Hurricane Flossy nearly destroyed the muskrat crop in the southeastern marshes (Webert 1956). Later hurricanes were equally severe in their impact on furbearer populations, but such checks on population increase are vital to the ecosystem.

Nutria

Unlike the muskrat, which are trapped only in marshes, nutria can be trapped in an extensive area that covers approximately 8 million hectares (5,000 square miles), nearly six times the marsh's land surface (O'Neil 1963). Nutria are vegetarians, feeding on water bulbs, plants, and roots (Daspit 1949). As the population spreads, muskrat nests are often taken over by the nutria (O'Neil 1968). Hurricane Audry (1957) forced the foraging nutria into the sugar cane and rice belts, where they attacked agricultural crops. Farmers were outraged and lobbied for a 25 cent bounty, but no money was appropriated. Some relief came from Hurricane Carla (1961) which destroyed nearly all of southwestern Louisiana's marsh furbearers. Destruction was so complete that, as O'Neil notes (1968:12) "there has probably never been a period that any of our marshes were so sterile of mammals".

For the same time and effort, a trapper can handle five times as many muskrat as nutria, getting up to 49 muskrats per hectare (20 per acre) (Wilson 1967), whereas, with the nutria, he will trap one animal on every 1.2 or 1.6 hectares (3 or 4 acres). The nutria was originally considered a nuisance; it was heavy to carry out of the marsh, difficult to skin (Dozier and Ashbrook 1950), and was confined to freshwater wetlands. Local attitudes have changed, however. The nutria harvest annually yields over $7 million and represents more than half of the State's fur income-- all derived from a dozen South American coypu that escaped from captivity and diffused throughout the State (Daspit 1950).

Two distinct nutria populations exist in Louisiana: the western (in the Chenier Plain) and eastern (in the Deltaic Plain). Chenier Plain nutria have an undercoat whose color, density, and quality are preferred by furriers. These characteristics are missing in the eastern variety, because the Deltaic Plain's floating peat marshes are low in nutritional value and the region's woody stubble rubs off the underfur reducing its market value (O'Neil 1968). Of the eastern catch, only St. Bernard Parish's yields can compare with southwestern Louisiana's wetlands. It was not until the early 1960's that New York furriers developed a processing technique for the thin-pelted eastern nutria (O'Neil 1968). Both animals can now be used. By the 1962-1963 season, nutria pelts accounted for 53 percent of the State's fur harvest. In 30 years, the alien rodent replaced the muskrat and ever since, the harvest has numbered at least one million pelts per year (O'Neil and Linscombe 1975). In 1970, European fur buyers recognized the fur's value and increased the demand further. Now the trapper has a market for all of the animals he can capture (Davis 1973). Without processing and manufacturing facilities, however, Louisiana receives only 20 percent of the value of the industry with 80 percent leaving the State (Morgan and O'Neil 1976).

Other Furbearers

Raccoon, mink, and otter are also important fur-producing animals. From 1928 to 1931, the raccoon coat was a fashionable garment, with Louisiana pelts selling for over \$7.00 each. After the Depression, raccoon skins sold for only 27 cents (O'Neil and Lincombe 1975). By the early 1970's, however, the animal was again popular and a pelt sold for over \$6.00. This "masked bandit" is difficult to catch and is considered an "avaricious" muskrat predator. By eating the trapped animals, the unwelcomed poacher reduces the trapper's income (Harvest Time...1948).

In the past, wild mink was also a valuable fur, but with the advent of domesticated varieties wild animal pelts have lost much of their value. The catch declined from over 184,000 in the 1950-1951 season to an all-time low of 18,805 in the winter of 1973-1974 (telephone call 5 March 1979, from Ted O'Neil, Fur Division, Louisiana Wild Life and Fisheries Commission, New Orleans). In recent years, the average price per pelt has been over \$5.00 with an annual yield of approximately \$30,000.

River otter is the highest priced fur harvest, for the Deltaic Plain. Their pelts average \$17.62 each, and in the 1976-1977 season, sold for \$45.00 each. The State produces over 4,000 each year, with approximately 80 percent of the catch originating in the coastal parishes (telephone call 5 March 1979, from Ted O'Neil, Fur Division, Louisiana Wild Life and Fisheries Commission, New Orleans).

American Alligator

Although present throughout the State, the greatest concentration of alligator is within the coastal marshes (Chabreck 1965). There are more than 500,000 "gators" living in the coastal zone's fresh to slightly brackish habitats (Ted O'Neil, personal communication, Fur Division, Louisiana Wildlife and Fisheries Commission, New Orleans). Muskrat, nutria, rabbits (*Sylvilagus aquaticus*), rails (*Rallus longirostris saturatus*), and waterfowl feed in these marsh zones and provide food for this omnivorous predator.

First described in 1718, the alligator has survived two centuries of hunting (Wilkinson 1892). Even after they were extensively harvested to meet the Civil War demand for shoe leather (Johnson 1969), the marshes supported a tremendous population. In fact, "as late as 1890, some 280,000 alligator skins were being processed annually in the United States" (Waldo 1957:12).

The alligator has been harvested commercially since the mid-1800's (Waldo 1957a). Between 1880 and 1904, hide hunters reduced the species an estimated 80 percent. During the next 60 years, hunters were encouraged by escalating prices. In 1916, a 1.5-meter (5-foot) skin was sold for only 40 cents; by 1928, a skin was worth \$1.25. By 1963, the price has soared to \$20.00 (Palmisano 1972b). Thus, a trapper received a sizable income supplement (Yancey 1959). The "gator" population reached its lowest level in the late 1950's.

Despite a continuous decline in numbers, no protective measures for the alligator population were initiated until 1960, when a 1.5-meter (5-foot) size limit and 60-day season were established. In 1966, the alligator was placed on the

Federal list of rare and endangered species. In 1970, laws were enacted to prohibit the interstate shipment of illegally-taken alligators. Throughout the southeast, protective legislation, along with habitat preservation, have allowed the reptile to make a dramatic recovery (Chabreck 1965, Chabreck 1967, Nichols et al. 1976). Louisiana considers the animal a renewable resource, and since 1972, hunting has been sanctioned in Calcasieu, Cameron, and Vermilion Parishes and, in 1978, in the Parishes of Iberia, St. Mary, Terrebonne, Lafourche, St. Charles, Jefferson, Plaquemines, St. Bernard and St. Tammany (Joanen et al. 1972, Joanen et al. 1973, Dennie 1973). In 1976, 198 trappers harvested 4,389 Chenier Plain alligators whose hides sold for $52.49 per meter ($16 per foot) and were valued at $501,977 total (Louisiana Fish...1977; Alligator: It's...1977; Louisiana State Planning Office 1977).

In response to a population increase, the United States Department of the Interior reclassified the Louisiana reptile in January, 1977, from an endangered to a threatened species. The alligator population has grown so large, that alligators are killing off the furbearing animals (Dennie 1973), threatening the trappers' livelihood. The threatened species status still restricts hunters' killing of alligators to several closely regulated hunts.

Recent changes in law have allowed Louisiana's Wild Life and Fisheries Commission to establish an alligator season in 12 parishes in the coastal zone. The season will extend from 7 September to 7 October 1979. Hunting will be permitted in Iberia, St. Mary, Terrebonne, Lafourche, St. Charles, Jefferson, Plaquemines, St. Bernard, and St. Tammany Parishes within the Deltaic Plain. The alligator season in these parishes is a result of the recent reclassification of the alligator by the United States Department of the Interior. Under guidelines adopted by Louisiana, a quota by area, a minimum size, and hunting hours has been established. Trappers and landowners will be issued special tags for the exact number of alligators that can be harvested for their lease or land. No alligators under four feet in length may be legally harvested. Hunting will be permitted only between one-half hour before sunrise and one-half hour after sunset (Hunting dates set...1979).

COMMERCIAL LEASES

To maximize land use, trapping leases were established when land owners initiated trapping agreements after the "trappers' war" of the late 1920's (Davis 1975). By assigning property to licensed trappers, freelance trappers and boot-leggers were unable to work the land. Competition and poaching on choice trapping grounds by "outlaws" and "outsiders" was terminated. By 1940, nearly all of the marsh area in Louisiana was managed for trapping purposes (Washburn 1951). There was probably more land area covered with three-cornered grass than in any previous period. As a result, over 4 million muskrat pelts were harvested. By the 1947-1948 season, trappers were removing nearly 4 million pelts per year from their leases (Comparative takes...1978, Daspit 1948, 1949).

The average trapper's lease involves from 41 to 121 hectares (100 to 300 acres) and has made trapping a fully commercial operation (Davis 1978). A trapper's fees for his lease are based on the land's carrying capacity, on a percentage of the catch, or on a cash per hectare basis. In some cases, leases may be based on the land company's estimate of what a trapper is capable of harvesting.

Trapping is partially a function of natural fur prices. When the price of fur increases, so does trapping activity. In recent years, fur prices have soared and with the rising cost of petroleum-based synthetic furs, natural furs may become even more attractive economically. Trapping in the Deltaic Plain is also tied to the abundance of furbearers. Although it is not possible to show that coastal deterioration, flood control, and the stabilization of river diversions has changed the proportion of fresh, intermediate, brackish, and saline marsh. By monitoring the changing marsh situation, it may be possible to forecast changes in future fur harvest.

DATA GAPS AND RECOMMENDATIONS

It is evident that the population of commercially harvestable species is fluctuating. The soft-shell blue crab fishery continues to decline, for example, while alligator populations seem to be increasing. Most of the population data available about these species have been developed from reported "catch" statistics and are most likely incomplete. Even if these data are complete, they may not fairly represent the actual fish and wildlife populations of the Deltaic Plain, since fishing and trapping on a commercial scale are a function of the prices available to the trappers and fishermen.

It is obvious that there are environmental changes occurring within the Deltaic Plain. Large scale agricultural and industrial development of the land adjacent to the marshes and coastal areas is causing increased sedimentation, chemical pollution, and changing the salinity regime of the waters. Without accurate population data, it is impossible to establish causal relationships between these environmental changes and increase or decline of the commercial (and non-commercial) species.

If there is a desire to maintain or increase the commercial species, some mechanism must be established to monitor numbers without exclusive reliance on uncertain "catch" statistics.

RECREATION AND TOURISM

INTRODUCTION

The water bodies and biologic resources of the Mississippi Deltaic Plain Region (MDPR) attract both resident recreationalists and out-of-state tourists in rapidly increasing numbers. The income generated by the recreation/tourist trade plays an important role in the region's economic structure. Further, most of the participant demand of these users is associated with the renewable resources of the Deltaic Plain, and approximately 90 percent (of both total pounds landed and total dollar value) of the commercial fish catch of the Gulf Coast was of species that are dependent on estuaries, where the impacts of recreation and tourism are likely to be great.

Of the 184.3 million people over 9 years of age in the United States in 1975, 96 million citizens spent 4.2 billion user days engaged in hunting, fishing, and wildlife-associated recreation (Table 41)(United States Department of Interior 1977). Based on user day values, an angler day is valued at $11.50/day, whereas a hunting day is valued at $12.20/day. Big game hunting activities located in less accessible and more saline waters of the Deltaic Plain tend to generate higher participant day values. Although some activities, such as crabbing, may generate relatively low user day values, nonconsumptive activities such as wildlife photography and nature study may generate over $20/recreation day of value in the Deltaic Plain (Jaworski and Raphael 1978). In the Great Lakes, Raphael and Jaworski (1979) calculated that fish, wildlife, and nonconsumptive recreation generated an average economic value of $490/wetland acre/year.

Table 41. Economic value of participant day and annual expenditures of participants engaged in fishing and hunting activities, 1975.

Recreational activity	Value of participant day	Average annual participant expenditures
Fresh Fishing	$ 8.99	$187.94
Salt-water Fishing	16.65	210.36
Big Game Hunting	20.30	196.92
Migratory Bird Hunting	10.82	110.35
Small Game Hunting	6.29	103.68

Source: United States Department of Interior 1977.

RECREATION IN THE MISSISSIPPI DELTAIC PLAIN REGION

One of every two Americans is involved in outdoor recreation. With water serving as the largest single attraction, the coastal zone is a focal point for such outdoor activities (David 1969). Of the many outdoor recreational environments, the shoreline has an unusually strong appeal for most users, providing a variety of water-oriented recreational activities including fishing, hunting, boating, and swimming. Millions of recreationalists and tourists are seeking the multiple use opportunities that are provided by the coastal zone resource.

Recreational Environments in the Deltaic Plain

The recreational environments of the Deltaic Plain consist primarily of beaches, piney woods, freshwater lakes, and estuarine bays and marshlands. Where public access is available and public facilities have been developed, the beach attracts the largest number of users. The State of Mississippi's beaches can accommodate more than 100,000 users at one time. Since the late 1800's, Mississippi's coastal beaches have attracted New Orleans' investors who have purchased and maintained summer homes. Many "cottages" remain in the same families for generations and improved interstate highway travel has intensified their use.

Woodlands and high terrain provide a scenic view and appeal to those potential users who desire some respite from urban life. Although the Deltaic Plain does not have bluff or high terrain environments, the three "Florida" or "Piney Woods" parishes of Louisiana contain wooded Pleistocene terrace landscapes, freshwater rivers, and lakes. A number of parks, complete with swimming and picnicking facilities, are located in the piney woods region.

The marsh-estuary complex of the Deltaic Plain grades from the freshwater tupelo gum - cypress swamps, across marshland environments, into saline near-shore and shelf environments. The various environments are connected by north-south flowing bayous and tidal estuarine systems and by a maze of artificial canals and waterways that have been constructed by trappers and oil-gas interests. Except where parks or other public facilities have been developed, use of the freshwater swamps is generally restricted to crawfishing, deer hunting, waterfowl hunting, small game hunting, sport fishing, and recreational boating. Waterfowl hunting during the fall season is extremely popular in the lakes and bayous of fresh and brackish water environments. In contrast, where the waters of the Deltaic Plain become more saline in nature, the more popular recreational activities are crabbing, shrimping, and salt-water fishing (Ford 1955).

RECREATION IN LOUISIANA'S DELTAIC PLAIN

Unlike California and Texas, Louisiana's coastline is not rimmed by attractive beaches or bluffs. This wetland area, comprised of 3.2 million hectares (8.1 million acres) of marsh and associated estuarine waters, makes up more than 25 percent of the Nation's total wetlands. The wetland coast may, in fact, be the most ignored but most promising shoreline type for future recreational use (Outdoor Recreation Resources Review Commission 1963).

> "Each of the five indicators employed to measure increases in demand for outdoor recreational opportunities -- population trends, changes in amounts of disposable income, growth in amount and nature of leisure time, increased mobility of the population, and increases in the sale of licenses -- showed that the next fifteen to twenty years in Louisiana

should witness a rapidly growing demand for improvement of existing outdoor recreational resources and for the provision of additional opportunities, especially in or near metropolitan areas in the coastal region of the state" (Grimes and Pinhey 1976:7).

In places, the wetlands extend inland as far as 129 kilometers (80 miles) and serve as a major recreational focus of boating, fishing, hunting, and trapping.

As Grimes and Pinhey (1976) note, by the year 2000, Louisiana's wetlands must meet the recreational demand of the State's expanding population (Table 42). With two-thirds of Louisiana's inhabitants located within two hours driving time of the marshlands and 41 percent of the State's population living within the Deltaic Plain (Templet 1976), the coastal wetlands and associated offshore waters are already available to a large population for day or overnight use. The canals and offshore rigs that are part of Deltaic Plain hydrocarbon industry provide the user with access routes and artificial reefs for recreational activity.

Martin (1972) indicated that in 1970 Louisiana's deltaic wetlands supported an estimated 10 million man-days of recreational activity annually. If this figure

Table 42. Projected populaton for the Deltaic Plain.

Parish	1970 population	1985 population
Iberia	57,397	58,520
Jefferson	337,568	526,291
Lafourche	68,941	79,175
Livingston	36,511	53,353
Orleans	593,471	587,649
Plaquemines	25,225	28,424
St. Bernard	51,185	101,947
St. Charles	29,550	43,907
St. James	19,733	19,262
St. John the Baptist	23,813	32,985
St. Mary	60,752	75,184
St. Tammany	63,585	140,812
Tangipahoa	65,875	69,608
Terrebonne	76,049	91,361
Deltaic Plain Total	1,509,655	1,908,478
State Total	3,641,666	4,146,327
Percent in Deltaic Plain	41.5	46.0

Source: Paterson et al. 1974.

increases to 20 million user days by 1980, as expected, Louisiana's 3.3 million hectares (8.1 million acres) of deltaic wetlands will be worth $37/wetland acre/year or $94/wetland hectare/year (assuming a user day value of $15/day). The onshore and offshore wetland areas of Louisiana are utilized at a relatively intense rate because of their accessibility and because they are free of high user fees and other use-inhibiting factors.

Two coastal areas are currently receiving intense in-state recreation and tourist use pressure. New Orleans residents built recreational dwellings as early as the 1800's at the small village of Milneburg, on the shores of Lake Pontchartrain. Contemporary examples of recreational centers now include Chef Menteur, Little Woods, North Shore, and Spanish Fort. With improvements in surface transportation, the summer cottages of the past now serve the metropolitan New Orleans region as year-round recreational housing. In many localities, the problem is how to use a finite amount of available shoreline property to meet increased demands.

Grand Isle in Jefferson Parish provides beaches, boat launches, surf fishing, historic sites, and scenic areas. This 11.3-kilometer (7-mile) long barrier island meets many of the requirements for day and overnight use. Grand Isle is located within 250 kilometers (150 miles) of major urban centers, has primary highway access, and provides the only available beach along the southeastern Louisiana coast.

Population projections for the Louisiana Deltaic Plain indicate that by 1985 the 14 Deltaic Plain parishes will have 1.9 million residents. The coastal parishes, already far ahead of the non-coastal parishes in user days of recreation, are also experiencing a faster rate of increase of population and income growth (Paterson et al. 1974). With this growth, the demand for recreational real estate will increase. Presently there are only 16.6 hectares (36 acres) of beach property in the coastal parishes. In response to the limited lake front and beach properties, camps are often constructed in the marsh environment.

Louisiana Camps

In Louisiana's marshlands, there are 10,220 seasonally-occupied recreational dwellings or camps. Of this total, 3,644 are categorized as isolated camps because they are accessible only by water. The camps provide sportsmen with a summer site for fishing and boating and a winter base for waterfowl hunting and trapping. In order to construct a camp in the marsh, one must obtain a lease and adhere to guidelines established for property owners and governmental permitting authorities in the coastal zone.

Four parishes in Louisiana contain most of the camps: Terrebonne (2,074), Jefferson (1,724), Plaquemines (1,090), and Orleans (1,051). These 5,939 units account for 58 percent of the total camp structures and reflect the significance of camp-based recreation there. Jefferson Parish has the largest number (1,410) of camps with highway access (Gary and Davis 1979).

Isolated camps are found almost exclusively in the southwestern portion of the Deltaic Plain. Of this area's 8,516 camps, over 40 percent (3,438) are accessible only by water. The largest number of camps without highway access are in Terrebonne Parish, where 1,189 isolated camp sites occur. Seasonally inhabited structures must be self-sufficient; freshwater may be obtained from cisterns and electricity is often produced by gasoline-powered engines (Gary and Davis 1979).

In the past, some of these camps functioned as marsh and swamp settlements. Township survey records indicate that as early as 1830 there were homes in the marsh and on natural levees adjacent to bayous. By 1873, Chinese and Filipino immigrants had established a lucrative shrimp-drying industry and had built piling-supported villages at Basa Basa, Bayou Broulleau, Cabinas, and Manila Village. These structures were copied by Yugoslav oystermen and Cajun trappers who also built settlements in the marsh, and by 1900 these communities were scattered throughout the Deltaic Plain. At such isolated settlements as Bayou Gauche, Camardelle, China, Faleau, Filipino, Isle Jean Charles, and Marvais Bois, gardens were planted in wooden boxes or tubs, and a subsistence living was derived from trapping, hunting, and fishing (Detro and Davis 1975).

These original marsh and swamp communities no longer serve as permanent settlements. Today, former swamp dwellers and/or their descendants spend their leisure time in the old homes that now serve as recreation centers and trapping bases. Along with the former swamp dwellers, the marsh also appeals to many newcomers who often use oil company canal levees to base their camps. These two groups built 8,516 recreational dwellings with more than 40 percent accessible only by boat or seaplane. At present, the largest number of camps are located at Grand Isle (1,353), Chef Menteur (883), Cocodrie (597), North Shore (405) and Lake Decade (88). Louisiana's coastal people exhibit a long cultural tradition of utilizing the marshlands for subsistence and recreation.

PRINCIPAL RECREATIONAL ACTIVITIES

Louisiana's coastal marshes provide outdoor enthusiasts with year-round recreational opportunities. In fall and winter, hunters, trappers, and fishermen harvest ducks, muskrat, nutria, alligator, and numerous fresh- and salt-water fish. In contrast, spring is the season to shrimp, crab, crawfish, and fish for spotted seatrout (*Cynoscion nebulosus*), largemouth bass (*Micropterus salmoides*), and red snapper (*Lutjanus campechanus*). From the beginning of spring until the first cold front moves through the area, fishing and boating are the principal elements in the use-cycle. By late September, the gallinule (*Gallinula chloropus*) season is open, followed by quail, dove, rail, snipe, duck, and geese (Chabreck and Joanen 1966).

Waterfowl Hunting

Louisiana is a wintering area for between 6 to 8 million waterfowl per year; approximately 75 to 80 percent concentrate in the coastal marsh (Burts and Carpenter 1975). The 36 waterfowl species that winter in Louisiana make hunting an extremely important and popular recreational activity (St. Amant 1959).

The coastal wetlands are a valuable habitat, since they serve as a winter feeding ground for many species of waterfowl as well as for marsh and shore birds. Sportsmen take advantage of the birds migratory cycle and have utilized the Chenier and Deltaic Plains as a major waterfowl hunting locale, bagging 2.8 million waterfowl in the 1977-1978 season (Table 43).

In the 1977-1978 season, 52.5 percent of Louisiana's waterfowlers hunted in the coastal zone, but only 17.0 percent in the Deltaic Plain *per se* (Table 43). The East-Coastal zone area corresponds roughly to the Louisiana Deltaic Plain region. Deltaic Plain sportsmen hunted a total of almost 180,000 days or 12.4 percent of the total days hunted in the State. For their efforts, they harvested 21 percent of the waterfowl killed in Louisiana during the 1977-78 season.

Table 43. Waterfowl hunting data in Louisiana, by zone, 1977-1978 season.

All waterfowl	Number of hunters[a] 1977	percent	Days hunted[a] 1977	percent	Birds bagged[a] 1977	percent
West-Coastal	59,622	35.6	472,488	36.4	1,204,409	42.5
Inland	25,060	19.9	250,765	19.3	405,618	14.3
East-Coastal[b]	28,466	17.0	160,167	12.4	591,321	20.9
Inland	54,538	32.5	413,695	31.9	630,601	22.3
State Total	167,686	100.0	1,297,115	100.0	2,831,949	100.0

[a]Figures are averaged and represent best estimates.
[b]The East-Coastal zone corresponds to the Louisiana Deltaic Plain Region.

Source: Gauthier 1978b.

In that same season, Louisiana's waterfowl hunters in the coastal zone contributed 63 percent of the total State waterfowl harvest (Table 43). The East-Coastal zone, has approximately one-half of the hunters and harvests 50 percent less waterfowl than the West-Coastal zone.

When the coot, duck, and goose harvests are analyzed individually, some geographical differences are readily apparent (Table 44). Although the Deltaic Plain or East-Coastal zone had 53, 15 and 7.4 percent of the State's coot, duck, and goose hunters, respectively, during the 1977-1978 season the region harvested 70 percent of all coots, 15 percent of all ducks, and 4 percent of the State's total goose harvest. Because of the attraction of the western rice fields and perhaps the Rockefeller Refuge as well, the West-Coastal marshlands harvest three times as many ducks and 19 times more geese than the East-Coastal zone.

To avoid heavy "shooting pressure," 16 State and Federal wildlife refuges (Table 45), and management areas (Table 46) were established throughout the coastal zone. The first marsh area was purchased for $51.89 per hectare ($21.00 per acre) in 1968. The Salvador and Pointe-au-Chien Wildlife Management Areas marked the beginning of land acquisitions for this purpose within the Deltaic Plain. Since 1968,a number of tracts have been acquired. Often, funds to buy land came from oil royalties from other Wild Life and Fisheries Commission properties. Reduced hydrocarbon production in recent years has slowed the land acquisition program (Ensminger 1969, Wills 1974).

The first wildlife management area was established in 1911 and since then other properties have been purchased by the public as resting areas for migratory waterfowl (Chabreck 1967). The 33,184.9 hectare (82,000 acre) Marsh Island refuge is described as "one of the most important wildlife areas on the North American Continent, particularly from the standpoint of migratory waterfowl and fur bearing animals" (Yancey 1962:14). Currently, the Louisiana Department of Wild Life and Fisheries operates and manages 35 wildlife areas encompassing a total of 401,996.35 hectares (993,333 acres) (Brunett and Wills 1978). Of this total,

Table 44. Survey Louisiana coot, duck and goose harvest by zone, 1977 - 1978 season.

Selected waterfowl harvested	No. of hunters[a]	%	Hunter days[a]	%	Birds bagged[a]	%	Birds/ hunter	Birds/ day	Days/ hunter
Coot									
West-Coastal	1,939	15.17	8,110	9.41	18,816	5.50	9.7	2.3	4.2
Inland	549	4.30	20,394	23.67	32,002	9.35	58.3	1.6	37.1
East-Coastal	6,754	52.84	37,338	43.34	240,847	70.34	35.7	6.5	5.5
Inland	3,539	27.69	20,306	23.58	50,731	14.81	14.2	2.5	5.7
Total[b]	12,781	100.00	86,148	100.00	342,396	100.00	26.8[c]	3.2[c]	52.5[c]
Ducks									
West-Coastal[d]	45,930	33.88	381,057	35.33	1,078,078	46.05	23.5	2.8	12.7
Inland[d]	20,999	15.49	199,170	18.47	343,671	14.68	16.4	1.7	14.1
East-Coastal[d]	20,278	14.96	116,556	10.81	344,907	14.73	17.0	2.9	8.6
Inland[d]	48,360	35.67	381,662	35.39	574,376	24.54	11.9	1.5	10.1
Total[b]	135,567	100.00	1,078,445	100.00	2,341,032	100.00	17.3[c]	2.5[c]	11.4[c]
Goose									
West-Coastal	11,753	60.78	83,321	62.87	107,515	72.39	9.1	1.3	7.1
Inland	3,512	18.16	31,201	23.55	29,945	20.16	8.5	1.0	8.9
East-Coastal	1,434	7.42	6,273	4.73	5,567	3.75	3.9	0.9	4.4
Inland	2,639	13.64	11,727	8.85	5,494	3.70	2.1	0.5	4.4
Total[b]	19,338	100.00	132,522	100.00	148,521	100.00	7.7[c]	0.9[c]	6.2[c]
Coastal Total	88,088		632,655		1,795,730		20.4[c]	2.8[c]	7.2[c]
Inland Total	79,598		664,460		1,036,219		13.0[c]	1.6[c]	8.3[c]
State Total	167,686		1,297,115		2,831,949		16.9[c]	2.2[c]	7.7[c]

[a] All numbers are estimates.
[b] Total includes "areas unknown".
[c] All numbers are averaged.
[d] Includes segments 1(November 5 - December 4) and 2(December 17 - January 5).

Note: The material presented represents only estimates. Louisiana's Department of Wild Life and Fisheries notes that "only those estimates with a variation of plus or minus 20% or less at the 80% confidence level are considered useful for administrative purposes".

Source: Gauthier 1978b.

Table 45. State and Federal wildlife refuges.

Refuge	Location
Marsh Island State Wildlife Refuge	Iberia Parish
Shell Key Federal Wildlife Refuge	Iberia Parish
East Timbalier Island Reservation[a]	Lafourche Parish
Delta National Migratory Waterfowl Refuge	Plaquemines Parish
Breton Islands National Wildlife Refuge	St. Bernard Parish
St. Tammany Wildlife Refuge	St. Tammany Parish

[a]Formerly a National Wildlife Refuge.

Source: Burk and Associates, Incorporated 1978.

164,261.4 hectares (405,890 acres) are within the Deltaic Plain. With 40 percent of the State's wildlife areas, the Deltaic Plain can serve a large recreational population. Available land, however, will meet only 18 percent of the 1985 demand (Grimes and Pinhey 1976). Therefore, any environmental impact to these areas, including the location of pipelines, canals, and other manmade features will directly and indirectly affect the area's recreational potential.

On many managed tracts, earthen plugs and weirs are built to control water levels and salinities and improve the vegetation cover preferred by the winter wildlife population. On private land, petroleum canal levees create impoundments that improve the duck habitat. As an added advantage, fish and blue crab congregate in the water flowing over impoundment weirs. At such sites, sports fishermen can catch several ice chests full of fish in a day.

The Deltaic Region is divided into two hunting zones. The zones represent duck migration and wintering areas within Louisiana that are closely associated with the Central Flyway (West Zone) and the Mississippi Flyway (East Zone) (Bateman 1975). In general, waterfowl harvest of the Mississippi Flyway is twice that of the Central Flyway (Sorenson et al. 1977). Moreover, a point system is used to control the harvest of selected species. The daily bag limit is 100 points (Table 47).

In the spatial analysis of the waterfowl harvest, the Deltaic Plain's waterfowlers are likely to "limit out" with American and red-breasted merganser, blue-winged teal, bufflehead, common goldeneye, great scaup, hooded merganser, lesser scaup, mottled duck, shoveler, and wigeon (Table 48). Coots, mergansers, and diving ducks characterize the harvest from the Deltaic Plain marshes. In contrast, statewide bag estimates in the 1977-1978 season showed that the typical waterfowl hunter harvested the following species in descending order of importance: mallard, green-winged teal, blue-winged/cinnamon teal, gadwall, wood duck, and lesser scaup (Sorenson et al. 1977). During the season, 2.3 million ducks were harvested; 14.7 percent came from the eastern coastal marshes or the Deltaic Plain Region (Table 48).

Table 46. Land owned or leased by Louisiana Department of Wild Life and Fisheries for public use - wildlife management areas.

Name of area	Acreage (hectares)	Location	Recreational activities available	
Atchafalaya Delta	125,000 (50,587)	St. Mary Parish-Atchafalaya Bay 18 miles (29 kilometers) SW of Morgan City	Hunting:	Waterfowl Snipe
			Fishing:	Bass Bream Crappie Catfish
Attakapas	25,500 (10,320)	St. Mary, St. Martin and Iberia Parishes, 20 miles (32 kilometers (NW of Morgan City	Hunting:	Deer Squirrel Rabbit Waterfowl
			Fishing:	Bream Crappie Catfish Buffalo
Biloxi	39,728 (16,078)	St. Bernard Parish, Hopedale, 9 miles (14.5 kilometers) south; Shell Beach 6 miles (9.7 kilometers SW Hwy. 46	Hunting:	Deer Squirrel Rabbit Waterfowl Doves Snipe
			Fishing:	Bream Salt Water Species
Bohemia	33,000 (13,355)	Plaquemines Parish, 4 miles, (6.4 kilometers) south of E. Pointe-a-la Hache	Hunting:	Deer Squirrel Rabbit Waterfowl Doves Snipe
			Fishing:	Bass Bream Crappie

(continued)

Table 46.

Name of area	Acreage (hectares)	Location	Recreational activities available
Manchac	8,325 (3,369)	St. John the Baptist Parish, 17 miles (27.3 kilometers)NE of LaPlace, and East of U.S. Hwy. 51	Hunting: Deer Rabbit Waterfowl Snipe Fishing: Bass Bream Crappie Buffalo
Pass-A-Loutre	66,000 (26,710)	Plaquemines Parish 10 miles (16.1 kilometers) S. of Venice, access boat on the Mississippi River	Hunting: Waterfowl
Pearl River	26,716 (10,812)	St. Tammany Parish 6 miles (9.6 kilometers) E. of Slidell	Hunting: Deer Squirrel Rabbit Turkey Waterfowl Woodcock Fishing: Bass Bream Crappie Catfish
Pointe-Au-Chien	29,000 (11,736)	Terrebonne and Parishes	Hunting: Deer Squirrel Waterfowl Fishing:Salt Water Species
Salvador	31,000 (12,545)	St. Charles Parish 10 miles (16.1 kilometers) SW of New Orleans	Hunting: Deer Squirrel Rabbit Waterfowl Snipe Fishing:Bass Bream Crappie Catfish

(continued)

Table 46. (concluded)

Name of area	Acreage (hectares)	Location	Recreational activities available	
Wisner	21,621 (8,750)	Lafourche Parish 8 miles (12.9 kilometers) S. of Leesville and 5 miles (8 kilometers) E. of Grand Isle, Hwy. 1	Hunting:	Rabbit Waterfowl
			Fishing:	Salt Water Species

Source: Brunett et al. 1978.

In the 1977-1978 season, the State issued 349,043 "basic hunting" licenses; 91,254 or 26 percent were for the 14-parish marsh environments (Louisiana Wild Life and Fisheries Commission 1979). Compared to the 1950-1951 season, this represents an increase of 52,359 licenses or a 45.58 percent change (Table 49). The State issued also 10,885 "non-resident trip" and "season" hunting licenses; 985 or 9 percent were in the Deltaic Plain (Table 50). These licensed hunters can be divided into two categories - those who hunt waterfowl, and those who hunt quadrupeds, principally white-tailed deer (Odocoileus virginianus) and swamp rabbit (Sylvilagus acquaticus). Since the Deltaic Plain Region has 41 percent of the State's population, it is under-represented in the purchase of basic licenses and in the issuance of non-resident and season licenses. It is important to remember that where a person buys a license is not indicative of where (s)he hunts.

Unlike the Chenier Plain or West-Coast marshes where hunting as a club member prevails, the eastern marsh (deltaic plain) is hunted on an individual basis. Leases are required, and can be quite expensive, but local people have not organized into structured clubs. They prefer to obtain a hunting lease for their family. The area then becomes available for all members of the extended family. When the marsh was settled, individual hunting areas were claimed, and shooting times were established by the community. Each individual hunting territory was respected and this tradition continues. If a person trespasses, it is usually an outsider or individual who feels he has an historical claim to the property.

Due to the demand for hunting space, expenditures related to this sport are greater than with fishing. A 1975 study reports the estimated monetary value of hunting at $82.8 million (Table 51), while fishermen's expenditures totaled $40.1 million (Table 68). In order to successfully hunt the marsh, a person has to trespass, obtain a lease, join a hunting club, or pay a high daily use fee (Yancey 1953). For those recreationalists who cannot afford to join a club or pay the daily fees, the wildlife management areas, refuges and preserves that allow hunting provide an alternative. In fact, purchases of the Pointe Au Chien and Salvador tracts were considered by sportsmen as some of Louisiana's finer land acquisitions.

Table 47. 1978-1979 daily bag limit, totaling 100 points, based on the migratory waterfowls' point value[a].

Points[b]	Migratory Waterfowl[c]
100	Canvasback (Aythya valisineria)
70	Mallard Hen (Anas platyrhynchos)
	Wood Duck (Aix sponsa)
	Black Duck (Anas rubripes)
	Hooded Merganser (Lophodytes cucullatus)
	Redhead (Aythya americana)
35	Mallard Drake (Anas platyrhynchos)
	Mottled Duck (Anas fulvigula)
	Ring-necked Duck (Aythya collaris)
	All Ducks Not Listed[d]
10	Pintail (Anas acuta)
	Gadwall (Anas strepera)
	Northern Shoveler (Anas clypeata)
	American Wigeon (Anas americana and A. penelope)
	Scaup (Aythya affinis and A. marila)
	Blue-winged Teal (Anas discors)
	Green-winged Teal (Anas carolinensis)
	Cinnamon Teal (Anas cyanoptera)
	Red-breast Merganser (Mergus serrator)
	American Merganser (Mergus merganser)

[a]Point categories subject to change each year.

[b]Point totals from: Louisiana Department of Wild Life and Fisheries 1978a.

[c]Scientific names from: St. Amant 1959.

[d]This list includes: American Goldeneye (Bucephala clangula); Bufflehead (Bucephala albeola); Common Scoter (Oidemia nigra); Fulvous Whistling Duck (Dendrocygna bicolor); Harlequin Duck (Histrionicus histrionicus); Masked Duck (Oxyura dominica); Old Squaw (Clangula hyemalis); Ruddy Duck (Oxyura jamaicensis); Surf Scoter (Melanitta perspicillata); White-winged Scoter (Melanitta deglandi).

These areas provide waterfowlers an opportunity to hunt without the added expense of a lease or club membership and dues (Ensminger 1969).

Waterfowl Species Hunted

Waterfowl hunting is a traditional winter sports activity. As a renewable resource, the migratory populations are maintained by properly managing the wetlands environment. This is accomplished by closely regulating hunting activity

Table 48. Species composition and area of harvest of ducks in Louisiana, 1977 - 1978 season.

Species	Statewide bag estimates		Area distribution by percent			
	Total[a] (1,000)	%	West inland	West coastal	East inland	East coastal
American and Red-Breasted Merganser	8	.3	7.7	7.7	15.4	69.2
Black Duck	2	.1	--	50.0	25.0	25.0
Blue-winged Teal	234	10.0	4.6	44.8	10.3	40.2
Bufflehead	3	.1	--	--	40.0	60.0
Canvasback	8	.4	25.0	25.0	25.0	25.0
Common Goldeneye	5	.2	12.5	12.5	--	75.0
Gadwall	245	10.5	6.6	55.5	17.6	27.6
Great Scaup	3	.1	20.0	20.0	--	60.0
Green-winged Teal	417	17.8	19.7	42.5	12.5	25.3
Hooded Merganser	20	.87	20.6	23.5	17.6	38.2
Lesser Scaup	260	11.1	9.9	29.7	13.4	47.0
Mallard	410	17.5	23.0	26.9	36.8	13.3
Mottled Duck	56	2.4	6.4	58.5	4.3	30.9
Pintail	172	7.4	15.2	55.7	10.4	18.7
Redhead	5	.2	42.9	14.3	42.9	--
Ringnecked Duck	64	2.7	26.2	15.9	36.4	21.5
Ruddy Duck	10	.4	81.3	12.5	--	6.3
Shoveler	100	4.3	10.8	48.5	7.2	33.5
Surf Scoter	1	.03	100.0	--	--	--
Wigeon	137	5.8	4.4	36.4	13.2	46.1
Wood Duck	178	7.6	41.8	6.2	46.6	5.5
Total Bag	2,338[a]	341.0[a]	1,078[a]	576.0[a]	343.0[a]	
Percent		100.0	14.6	46.1	24.6	14.7

[a]Species composition and area distribution percentages shown in this table were taken from a 1977-78 regular duck season wing collection survey conducted by the United States Fish and Wildlife Service. Their survey includes 3,910 wings collected from ducks harvested within 51 of the 64 parishes with results tabulated on a west and east, inland and coastal basis.

Estimated total bag for each species was determined by applying the percentage figures from the Federal wing collection survey to the duck bag as estimated by the State survey. These estimates were rounded to the nearest thousand for each species.

Source: Gauthier 1978b.

Table 49. A comparison of hunting licenses issued by Parish for "basic resident" hunting.

Parish	1950 1951	1960 1961	1970 1971	1974 1975[a]	1977 1978	Net change 1950-1978
Iberia	3,869	4,449	5,015	4,820	5,031	+1,162
Jefferson	5,558	9,340	15,198	16,131	18,813	+13,255
Lafourche	4,265	5,162	8,182	7,034	8,720	+4,455
Livingston	2,973	3,845	5,745	5,123	5,455	+2,482
Orleans	0	12,704	17,084	12,459	10,422	+10,422
Plaquemines	1,271	1,580	2,175	2,122	2,331	+1,060
St. Bernard	1,000	1,328	3,102	3,930	4,281	+3,281
St. Charles	1,514	2,097	2,945	3,226	3,049	+1,535
St. James	1,369	1,532	1,448	1,641	1,553	+184
St. John	889	988	1,680	1,574	2,107	+1,218
St. Mary	2,848	4,409	6,158	5,540	5,961	+3,113
St. Tammany	3,287	4,564	6,318	6,990	7,588	+4,301
Tangipahoa	5,499	5,958	7,257	7,462	7,311	+1,812
Terrebonne	4,553	5,109	7,956	7,644	8,632	+4,079
Total	38,895	63,065	90,263	85,696	91,254	+52,359
State Total	234,195	257,438	338,953	328,009	349,043	+114,848
Percent	16.60	24.49	26.62	26.12	26.14	+45.58

[a]Includes $2.00 and $5.00 resident licenses.

Source: Louisiana Wild Life and Fisheries Commission 1952, 1962, 1972a, 1979.

within breeding, migration, and wintering areas (Herring 1974, Duffy and Hoffpaeur 1966). Habitat preservation is the key to maintenance of the waterfowl resource, and in south Louisiana's marshes, private, State, and Federal landowners are managing their property for waterfowl production (Managing...1956, Thomas 1959, Baldwin 1967, Yancey 1968).

Dabbling Ducks

Of the two principal ducks in the wetlands, the dabbling or surface feeders are the most numerous and recreationally significant (Burts and Carpenter 1975). These birds include the North American wigeon, black duck, gadwall, mallard, pintail, shoveler, blue-winged teal, green-winged teal, and wood duck. The transients move southward from August 15 to November 15 and return in the spring (Yancey 1968). During their winter stay, mallards and pintails prefer feeding on cultivated grains. Lynch (1967) reports that marshes and other natural aquatic habitants are less popular feeding grounds than coastal rice fields. Gadwall, shoveler, and teal, while not regular visitors, will on occasion feed in cut-over or fallow rice fields. Like black ducks, they seem to prefer the marshes and shallow waters of coastal lagoons that are rich in submerged aquatic plants and invertebrate fauna. Wigeon feed mainly on green vegetation and are considered a "pond duck"; whereas wood ducks winter in timbered wetlands, but do congregate in the open marshes (Lynch 1967).

Table 50. Hunting licenses issued by Parish for "non-resident trip" and "season" hunting, 1950-51 to 1977-78.

Parish	1950 1951	1960 1961	1970 1971[a]	1977 1978	Net change between 1950 & 1978
Iberia	39	27	51	46	+7
Jefferson	-	2	72	78	+78
Lafourche	-	1	-	22	+22
Livingston	1	1	10	6	+5
Orleans	-	105	324	212	+212
Plaquemines	-	60	-	17	+17
St. Bernard	-	-	1	4	+4
St. Charles	-	-	31	21	+21
St. James	-	-	-	-	-
St. John	-	-	7	4	+4
St. Mary	21	16	72	51	+30
St. Tammany	8	36	190	303	+295
Tangipahoa	-	6	75	68	+68
Terrebonne	1	5	27	153	+152
Total	70	259	860	985	+915
State Total	1,277	3,187	9,773	10,885	+9,608
Percent	5.48	8.12	8.79	9.04	+9.52

[a]Includes reciprocal licenses.

Source: Louisiana Wild Life and Fisheries Commission, 1952, 1956, 1962, 1966, 1972a, 1976, 1979.

Diving Ducks

Many divers are at home in fresh or salt-water. They may dive to depths of 6.1 meters (20 feet) to feed on aquatic vegetation and animals (Burts and Carpenter 1975). These winter residents include the canvasback, hooded merganser, redhead, ringneck, ruddy, lesser scaup, and greater scaup.

Ringneck and ruddy ducks are freshwater divers and prefer lakes and ponds. Canvasback and redhead can tolerate more brackish conditions. They often concentrate in salt-water areas or on very large freshwater bodies. The most abundant and versatile diver is the lesser scaup (*Aythya affinis*). Locally known as a "dos gris" (literally "gray back"), scaup winter within fresh to salt-water habitats; they have no "preferred" environment. The hooded mergansers are "bay or sea ducks", that feed on crustaceans, mollusks and fish (Lynch 1967).

Table 51. Estimated monetary value of hunting in Louisiana,[a] 1975.

Species	Estimated[b] No. hunters	Man days of hunting	Value of trip	Total value
Deer	167,332	1,904,221[c]	$17.47	$33,266,000
Squirrel	214,812	1,919,802[c]	7.62	14,628,000
Rabbits	130,090	1,135,663[c]	7.62	8,653,000
Quail	36,116	235,289[c]	7.62	1,792,000
Doves	81,610	466,451[c]	7.62	3,554,000
Waterfowl (ducks, geese & coots)	79,563	1,073,513[c]	9.73	10,445,000
Turkey	9,000	50,000[c]	17.47	873,000
Gallinule	4,209	20,000	7.62	152,000
Rail	7,306	35,000	7.62	266,000
Snipe	21,711	200,000	7.62	1,524,000
Woodcock	30,519	60,000	7.62	457,000
Raccoon	40,875	800,000	7.62	6,096,000
Opossum	17,881	[d]	7.62	[d]
Fox	10,237	100,000[d]	7.62	762,000
Bobcat	5,142	50,000[d]	7.62	381,000
TOTAL VALUE				$82,849,000

[a]Louisiana Department of Wild Life and Fisheries 1978b.
[b]Hunters' mail surveys (Department of Wild Life and Fisheries 1978b).
[c]Figures from Hunters' mail surveys (Department of Wild Life and Fisheries).
[d]Included with raccoon.

Geese

The Louisiana goose harvest consists primarily of the blue goose along with some white-fronted goose and even smaller numbers of the snow goose (Table 52). Although the season is closed to the Canada Goose, these birds generally winter north of Louisiana anyway. Very small numbers of geese (i.e., only 4.7 percent of the State's total) are harvested from the East-Coast or Deltaic Plain Region. In contrast, the waste grains in the ricefields of the West-Coast region attract large flocks of blue and white-fronted geese.

Big Game Hunting

The white-tailed deer is Louisiana's principal "big game" animal, and is found throughout the State. There are more white-tailed deer in Louisiana today than at any time in its history. This is the result of restocking efforts conducted in the 1950's. The legal harvest of deer increased and so has the number of hunters. During the 1960-1961 season, there were 56,462 "big game" licenses issued in Louisiana; 6,623 licenses or 12 percent were in the Deltaic Plain. In the 1977-1978 season, license sales increased to 163,476; 26,520 or 16 percent were in the Deltaic Plain (Table 43). It should be noted, of course, that license issue locations and hunting locations are not necessarily the same. License issue is really the indication of the residence of the hunter.

In Louisiana, in 1973, the individuals involved in this sport spent 1.6 million man-days hunting deer (Moore 1977). They hunted the pine-hardwood hill land, upper Mississippi-Red River bottomland, Mississippi-Atchafalaya deltas, the coastal marshes, and the southwest prairies. In the marshes, deer prefer wooded

Table 52. Geese wintering in Louisiana[a].

Blue Goose (*Chen caerulescens*)
Canada Goose (*Branta canadensis*)
Hutchins Goose (*Branta canadensis minima*)
Ross Goose (*Chen rossii*)
Snow Goose (*Chen hyperborea*)
White-fronted Goose (*Anser albifrons*)

[a]In the 1978-1979 season, the daily bag and possession limits was five, which could include blue, snow, and white-fronted geese. No more than two could be white-fronted with the season closed for Canada Geese.

Source: St. Amant 1959.

ridges, natural levees, or petroleum canal levees, cheniers, and *coteaus*. These elevated sites provide cover and food, and as "high ground", they allow the hunter to walk the marshes.

Louisiana's deer hunters harvested 9,669 animals in the 1975-1976 season (Louisiana Department of Wild Life and Fisheries 1978b). Iberia, Plaquemines, St. Tammany, and Terrebonne were the most important wetland parishes. Since 1966, the wetlands harvests have shown considerable improvement, with the percentage of animals taken nearly doubling. Days hunted have increased by more than 300 percent since 1966. As indicated in Table 51, deer hunting in 1975 generated a total value of $33.3 million and a user day value of $17.47/day.

Fishing

The species diversity of fresh and salt-water fish and shellfish in the Deltaic Plain results in fishing generating the highest participation rates of all the recreational activities. Fishing is a year-round leisure-time activity that varies with the breeding cycle of the various fish species, water levels, fishing pressure, and habitat productivity (Lambou 1963). Over 11,265 kilometers (7,000 miles) of wetland shoreline provide the fisherman with extensive recreational opportunities. However, there will be need for more fishing areas, since only about 10 percent of the 1985 participant demand can be accommodated with current areas (Grimes and Pinhey 1976).

Table 53. Big game hunting licenses in Louisiana by Parish, 1960-61 to 1977-78[a].

Parish	1960 1961	1964 1965	1970 1971	1974 1975[b]	1977 1978[c]	Net change between 1960 & 1978
Iberia	305	312	667	1,051	1,074	+769
Jefferson	663	765	1,868	2,028	4,854	+4,191
Lafourche	318	363	805	1,02	1,353	+1,035
Livingston	1,036	1,340	2,764	2,508	2,512	+1,476
Orleans	1,607	1,193	2,229	3,115	3,031	+1,424
Plaquemines	128	176	211	401	519	+391
St. Bernard	143	182	371	784	984	+841
St. Charles	345	309	566	764	922	+577
St. James	262	234	301	414	485	+223
St. John	121	142	342	444	694	+573
St. Mary	488	596	1,048	1,787	1,837	+1,349
St. Tammany	411	782	2,001	2,790	3,364	+2,953
Tangipahoa	541	958	1,793	2,565	2,998	+2,457
Terrebonne	255	287	696	1,444	1,893	+1,638
Total	6,623	7,639	15,662	21,118	26,520	+19,897
State Total	56,462	84,749	127,997	149,852	163,467	+107,005
Percent	11.73	9.01	12.23	14.09	16.22	+18.59

[a]Big game licenses not issued in 1950-1951 or 1954-1955.
[b]Includes "Big Game" reciprocal licenses.
[c]Includes "Non-Resident Big Game" licenses.

Source: Louisiana Wild Life and Fisheries Commission 1962, 1966, 1972a, 1976, 1979.

During the 1977-1978 season, Louisiana issued 394,043 resident fishing licenses; 123,705 licenses or 31.4 percent were in the Deltaic Plain (Table 54). Since the 1950-1951 season, the number of resident licenses increased in the coastal parishes by 118,706. Sport fishing continues to grow in popularity. During the same period, non-resident trip and season license sales increased by 26,767 with the percent of total sales attributed to the region increasing to a 1977-1978 level of 24.2 percent (Table 55). Because it is legal to fish without a license, provided the pole does not have a reel, these numbers may under-represent the true figures (Table 56).

Intense activity periods are equated with the summer months. There are times when so many people seek marsh access that 100 or more automobiles with boat trailers are counted at public coastal launching sites (Gary and Davis 1979). Camps are in constant use and, to the uninitiated, the isolated and uninhabitated marshland appears heavily trafficked. In many places, it is difficult to find a "pond" or "location canal" that is not being utilized.

Table 54. Fishing licenses issued in Louisiana's Deltaic Plain for resident fishing, 1950-51 to 1977-78.

Parish	1950 1951	1960 1961	1970 1971[a]	1977 1978	Net change between 1950 & 1978
Iberia	538	2,458	5,985	6,759	+6,221
Jefferson	764	7,238	17,502	28,026	+27,262
Lafourche	490	1,753	3,995	10,548	+10,058
Livingston	381	1,385	3,058	4,105	+3,724
Orleans	[b]	15,685	29,813	22,970	+22,970[b]
Plaquemines	61	811	2,307	3,464	+3,403
St. Bernard	175	1,331	5,475	7,039	+6,864
St. Charles	255	1,724	2,511	4,401	+4,146
St. James	85	467	594	1,298	+1,213
St. John	32	342	1,245	2,562	+2,530
St. Mary	286	1,659	3,870	5,343	+5,057
St. Tammany	431	1,816	8,492	9,448	+9,017
Tangipahoa	762	1,548	4,799	5,946	+5,184
Terrebonne	739	3,714	6,128	11,796	+11,057
Total	4,999	41,931	95,774	123,705	+118,706[b]
State Total	72,044	127,198	326,723	394,043	+321,999[b]
Percent	6.93	32.96	29.31	31.39	

[a]Includes $1.00 and $2.00 licenses.
[b]No information available for 1950 in Orleans Parish.

Source: Louisiana Wild Life and Fisheries Commission 1952, 1962, 1972a, 1979.

Along Louisiana's coast there are 60 species of fish that are associated with the estuarine or marine environment (McIntire et al. 1975). Freshwater fishermen seek a diversity of fish species, especially largemouth bass, catfish, "sac-a-lait" or crappie, and bluegill or bream. The black bass (largemouth bass) is considered the State's most sought after game fish. Lake Des Allemands serves as the principal habitat for blue or channel catfish (*Ictalurus punctatus*) as well as for Opelousas catfish (*Pylodictis olivaris*). A number of other important fresh- and brackish-water fish are described in Table 57.

Salt-water fishermen primarily catch spotted seatrout; Atlantic croaker (*Micropogon undulatus*), one of the most abundant commercial fish along the Gulf coast (Rogillio 1975); redfish (*Sciaenops ocellata*), sometimes referred to as "bull" or "rat" reds; and black drum (*Pogonias cromis*) (Table 58). The spotted seatrout is the main species caught in Louisiana and Mississippi, representing 40 percent of the daily salt-water fish catch of the Louisiana Deltaic Plain (Louisiana Wild Life and Fisheries Commission 1970a). The Atlantic croaker, which is also an industrial fish, appears to be underutilized by the recreation sector.

Table 55. A selective list of the Deltaic Plain's most productive coastal lakes.

Lake	Description
Lake Cataouatche	Located in the southeast coastal section of Louisiana, this waterbody contains good populations of most species of freshwater fish. Limited access through Bayou Segnette from Westwego, or through Seller Canal to Bayou Verret.
Grand Lake	Popular fishing spot in the Atchafalaya Basin; located in upper portion of St. Mary Parish. Good fishing for largemouth bass, spotted bass, crappie, bream, and catfish.
Lac Des Allemands	A productive island lake that borders on the boundary of St. John the Baptist and Lafourche Parish. Contains selective freshwater fishing for bass, bream, and catfish. Access and facilities are limited.
Lake Penchant	A popular lake located in the center of Terrebonne Parish. Contains fair populations of largemouth bass, bream, crappie, and catfish.
Lake Salvador	A very large freshwater lake located on the St. Charles, Lafourche, and Jefferson Parish. Rich in bass, bream, and crappie. Access, however, is limited.

Source: Davis, F. 1979.

Along the Gulf coast, the gigging of the southern flounder (Paralichthys lethostigma) at night in shallow waters along the beach is very popular. This activity is a favorite sport for those recreationalists who have camps at Grand Isle as well as for those who visit the Mississippi beaches. A successful outing is attained when 10 or more flounder are gigged, but some people are happy to get one!

Often organized into clubs, the fresh- and salt-water anglers have added new meaning to the word "rodeo". In south Louisiana, it means a fishing contest (Lantz and Carver 1975, Duffy 1975a). Davis (1979) reported 19 rodeos along the Louisiana-Mississippi coasts in 1978.

Table 56. Fishing licenses issued in Louisiana's Deltaic Plain non-resident trip and season licenses, by parish, 1950-51 to 1977-78.

Parish	1950 1951	1960 1961	1970 1971[a]	1977 1978	Net change between 1950 & 1978
Iberia	3	27	129	132	+129
Jefferson	1	10	121	590	+589
Lafourche	-	3	12	374	+374
Livingston	55	67	42	39	-16
Orleans	-	305	380	5,783	+5,783
Plaqemines	-	3	2	19	+19
St. Bernard	-	2	19	86	+86
St. Charles	-	-	58	124	+124
St. James	-	-	1	9	+9
St. John	-	3	19	85	+85
St. Mary	-	41	111	230	+230
St. Tammany	78	294	1,517	1,573	+1,495
Tangipahoa	215	77	231	340	+125
Terrebonne	14	17	42	227	+213
Total	366	849	2,684	9,611	+9,245
State Total	11,024	12,701	23,331	39,791	+28,767
Percent	3.32	6.68	11.50	24.15	+32.13

[a]Includes all license categories ($2.00,$3.00,$5.00 and $6.00)

Source: Louisiana Wild Life and Fisheries Commission 1952, 1962, 1972a, 1979.

In Louisiana's offshore waters there are more than 2,000 oil platforms. Each structure serves as an artificial reef for fish communities. The fishing activity near the "rigs" is often excellent. To take advantage of the clustering of fish around the platforms, 45-50 charter boats ferry salt-water anglers to these sites (Table 59). These charter boat facilities are located at Empire, Buras, Venice, Grand Isle, Cocodrie, Intracoastal City, Cameron, Reggio, Houma, and Delcambre. The captains of these 8 to 15 meter (28- to 50-foot) boats know the "rigs" that yield the highest catches.

Spotted Seatrout

Whether called spotted weakfish, spotted seatrout, or speckled seatrout; "specks" are the Deltaic Plain's most sought after salt-water species (Davis 1972). Found in shallow, coastal waters, specks average from .45 - 1.36 kilograms (1 to 3 pounds). As the temperature falls they tend to seek deeper water (Gresham 1962).

Table 57. Fishing - general provisions for fresh water game fish in Louisiana.

Daily limits	
Black Bass ("green trout") (*Micropterus salmoides*)	15 daily
Walleye (*Stizostedium vitreum*)	2 daily
Striped Bass (*Morone saxatilis*)	2 daily
White Bass ("bar fish") (*Morone chrysops*)	25 daily
Yellow Bass (*Morone mississippiensis*)	50 daily
Crappie ("white perch", "speckled perch", "sac-a-lait") (*Pomoxis annularis* and *P. nigromaculatus*)	50 daily
Sunfish ("perch", "bream", "goggle-eye", bluegill") (*Lepomis macrochirus* and *L. microlophus*)	100 daily

Source: Jackson and Timmer 1975.

They are quite sensitive to temperature changes. Unless they migrate to warmer water, a sudden, prolonged cold spell will kill the species (Gautreaux 1974). Their favorite habitats are warm shallow bays, cuts, passes, bayous, and lagoons; rarely do they venture more than a mile offshore (Rosko 1975). Rogillio (1975) reports that spotted seatrout tolerate varying salinities and are most abundant in water with salinities ranging from 15 to 31 parts per thousand (ppt). "Specks" remain in estuarine water bodies nearly all their lives.

Studies by Rogillio (1975) show that the most abundant size class for this species is 30.5 centimeters (12 inches), with larger trout being caught in February, May, June, and November. When the estuary salinity drops below 5 ppt, or the temperature is belows 7.2°-10°C (45°-50°F), the fish will move for a brief period into the offshore beach zone (Tabb 1961). A slightly better catch occurs in summer, but April and March are the best months (Rogillio 1975). In winter, maximum catches occur from October to November. Sportsmen catch "specks" year round. "Specks" are plentiful, fight well and provide considerable excitement when caught.

Table 58. Salt-water finfish caught by marine recreational fishermen in Louisiana and Mississippi, 1975.

Species	Mississippi Estimated number[a]	Mississippi Estimated weight[a]	Louisiana Estimated number[a]	Louisiana Estimated weight[a]
Bass, Black sea	b	b	b	b
Bluefish	16	53	265	712
Catfishes	221	222	1,490	1,379
Cobia	b	b	b	b
Croakers	759	552	4,486	5,393
Dolphins	b	b	b	b
Drum, Black	b	b	553	1,616
Drum, Red	258	1,443	3,645	12,385
Eel, American	20	23	b	b
Flounders	126	221	333	649
Groupers	b	b	b	b
Grunts	b	b	b	b
Jacks	b	b	83	1,774
Kingfishes	444	393	b	b
Ladyfish	b	b	b	b
Mackerel, King	b	b	38	1,051
Mackerel, Spanish	225	555	147	384
Mackerels and Tunas	b	b	b	b
Mullets	698	774	b	b
Perch, silver	b	b	443	288
Pompanos	---	---	b	b
Porgies	b	b	b	b
Puffers	b	b	b	b
Seatrout, Sand	336	422	719	1,257
Seatrout, Spotted	1,375	2,728	11,005	23,545
Sheepshead	37	73	229	663
Sharks	20	159	123	3,487

(continued)

Table 58. (concluded)

Species	Mississippi Estimated number [a]	Mississippi Estimated weight [a]	Louisiana Estimated number [a]	Louisiana Estimated weight [a]
Skates and Rays	b	b	b	b
Snappers, Red	b	b	848	3,129
Snappers	b	b	b	b
Snook	---	---	---	---
Spot	---	---	---	---
Triggerfishes	---	---	b	b
Weakfish	---	---	---	---
Miscellaneous	359	557	507	2,214
Total	5,133	9,883	25,492	61,541

Note: Row totals are given for species groups reported caught on at least 30 questionnaires throughout the region. An entry in a State column reflects a species group reported caught on at least 10 questionnaires throughout the State; however, the column total contains the total catch for all species groups reported caught within the State waters. A dash represents no reported catches of a species group in a State.

[a]In thousands.

[b]Represents a species group reported caught on less than 10 questionnaires in a State.

Source: United States Department of Commerce 1977.

Largemouth Bass - Micropterus salmoides

Largemouth Bass are found in freshwater habitats, but few people recognize that the marshes from Canada to Mexico, are an excellent site for "hooking" a 2.3 kilogram (5 pound) or better largemouth bass (although most of the bass caught are generally 2 pounds or less). Even though largemouth bass sometimes coexist with salt-water species, they can tolerate only low salinities. When caught in brackish water, they are probably foraging for food. They prefer fresh water and are often caught around water hyacinth (Eichornia crassipes), among trees and stumps that have fallen into and across the region's waterways, in the cuts that connect marsh ponds or in the pipeline and location canals associated with the petroleum industry. Wherever caught, largemouth bass are the number one game fish in the freshwater marsh (Jackson and Timmer 1975).

A successful bass angler recognizes that the metabolic rate of a bass is controlled by its environment, with its body temperature adjusting to its surroundings. Bass will not feed in relatively cold or hot water; they become lethargic and semi-dormant. They are most active in water bodies with a temperature ranging between 60° and 80°F (15.5°-26.6°C). The shallow water marshes are warm the year-round and support fish populations that are highly active and constantly seeking food (Perry et al. 1969).

Table 59. Coastal Louisiana charter fishing fleet.

Area	Boat	Boat size	Passenger capacity	Areas fished	Charter dive parties
Hopedale	Cosandstra	21'	3	Inshore	No
Hopedale	Logie Joe	28'	6	Offshore	No
Empire	Capt. Bob	38'	16	Offshore	Yes
Empire	Capt. Don	36'	16	Offshore	Yes
Empire	Lene	34'	6	Offshore	Yes
Empire	Cougar	47'	20	Offshore	No
Empire	Early Bird	46'	20	Offshore	No
Empire	Hickory Wild	34'	6	Offshore Inshore	Yes
Empire	Miss Mississippi	60'	60	Offshore	No
Empire	Pat Al	46'	40	Offshore	
Empire	Sandy	40'	6	Offshore	No
Empire	Superfish	31'	6	Offshore	No
Empire	Dolphin	27'	6	Offshore	No
Buras	TAJ 2	40'	6	Offshore	No
Buras	Miss Kelly	38'	6	Offshore	No
Venice	AW Heck	31'	6	Offshore	Yes
Venice	George Anthony	50'	28	Offshore	No
Venice	Pompano	46'	6	Inshore Offshore	No
Grand Isle	Bogalee	50'	6	Offshore	Yes
Grand Isle	Kelty-O	42'	20	Offshore	No
Grand Isle	Magnum	35'	6	Offshore	No
Grand Isle	Miss Alison	42'	6	Offshore	No
Grand Isle	Sea Hawk	47'	15	Offshore	No
Grand Isle	Shark	42'	6	Offshore	No
Grand Isle	Wahoo	50'	6	Offshore	No
Grand Isle	X-Rated	42'	6	Offshore	No
Grand Isle	Sausage Time	32'	6	Offshore	Yes (exclusively)
Grand Isle	Blue Jay	59'	30	Offshore	Yes (hook & line also)
Grand Isle	None	23'	4	Inshore	No
Grand Isle	Lavida Marie	30'	6	Offshore Inshore	No
Grand Isle	White Lightening	28'	4	Inshore Offshore	No
Bayou Fourchon	Flying Fish Too	62'	42	Offshore	No

(continued)

Table 59. (concluded)

Area	Boat	Boat size	Passenger capacity	Areas fished	Charter dive parties
Bell Pass	Sailfish	50'	20	Offshore	No
Bell Pass	Silkie	49'	6	Offshore	No
Bell Pass	Starfish	50'	20	Offshore	No
Bell Pass	Swordfish	50'	20	Offshore	No
Cocodrie	AL JO	45'	6	Offshore	Yes
Cocodrie	Pedroi	52'	12	Offshore	Yes
Cocodrie	Sportsman I	26'	5	Inshore	No(Duck Hunting Also)
Cocodrie	Sportsman II	20'	4	Inshore	No
Intracoastal City	Angela Rose	38'	6	Offshore Inshore	Yes
Intracoastal City	Southern Clipper	56'	19	Offshore	Yes
Intracoastal City	Yama 3	52'	6	Offshore	Yes
Grand Chenier	Betty C	40'	6	Offshore	No
Grand Chenier	Blue Marine Marlin II	34'	6	Offshore	Yes
Grand Chenier	Sunrise II	65'	30	Offshore	Yes
Cameron	Gulf Queen	58'	18	Offshore	No
Cameron	Kitty G	36'	6	Offshore	Yes
Cameron	Pirate	38'	6	Offshore	No

Source: Reggio 1979.

Largemouth bass fishing is a year-round sports activity. The best period is from March to October, and only dedicated fishermen fish the late summer and winter months. In late summer, water hyacinths render outboard navigation almost impossible. In 1973, this weed covered more than 4,750 square kilometers (1,800 square miles) of water surface in Louisiana (Davis 1976). It takes a highly motivated fishermen to plow his boat through the thick vegetative mat into his favorite "pot" or "honey" hole.

In winter, cold weather and duck hunting sideline most bass anglers. To the bass fishermen, a cold front means that water will be pushed out of the marsh. About two days after a front moves through, fishing is considered excellent. Excellent fishing conditions exist until the winds shift to the south and drive water back through the network of natural and manmade waterways, into the marsh. Bass that were crowded into ponds when the water levels were lowered, can, with the rising water, move back into the marsh to feed (Duffy 1976a).

Pompano

While not caught in the marshes, pompano (Trachinotus carolinus) are one of the prized fish among Gulf anglers. To many fishermen, pompano is a gourmet item "the best eating of all fish taken from Louisiana waters" (Kalman 1971:23). Until the petroleum industry began to drill offshore, pompano, cobia, and red snapper were rarely caught (Vanpelt 1949). The offshore structures provided artificial reefs. Each new platform added to the salt-water species feeding ground. The Louisiana coastline gradually has become one of the world's finer offshore fishing provinces (Kalman 1971). In the process, pompano and other salt-water species were added to the unbelievable catches of red snapper (Lutjanus capechanus) king mackerel (Scomberomorus cavalla), and Atlantic croakers (Micropogon undulatus) caught around the "rigs".

Like the king mackerel, pompano are winter migrants. They arrive in November with the first cool weather (Duffy 1976a). They remain offshore until early spring, then virtually disappear from the area. The most successful pompano fishermen secure their boats to platforms so that they can cast directly under the rig's superstructure. The lures are allowed to sink from 4.4 - 15.2 meters (15 to 50 feet). The angler always keeps the line taut so that he can feel the pompano nibble the bait. Once hooked, the fishermen must be prepared for the battle that follows. "Only the jack crevalle (Caranx hippos), a notable tough opponent and close relative, rivals the pompano in pound-for-pound fighting ability" (Kalman 1971:23).

Pompano are not limited to any particular depth, water temperature, or current conditions -- all are important factors in their location. Perret et al. (1971) reported that pompano are caught in water with salinities that ranged from 10 to over 30 ppt and in temperatures from 10° - 34.9°C (40° - 94.8°F). One important variable is water clarity. More pompano are harvested on overcast days in turbid water than on bright days when the water is clear (Kalman 1971).

Crabbing

The blue crab (Callinectes sapidus) is one of the more abundant macro invertebrates in Louisiana's coastal waters. It occupies almost all available aquatic habitats. Optimum conditions include shallow water, mud and/or mud-shell bottoms, mollusk beds, tidal exchange, warm temperatures, and mid-to-low salinities (Adkins 1972).

The blue crab is sensitive to changes in salinity and temperature. The greatest numbers are caught in waters of oligohaline to mesohaline salinity and warm temperatures (Jaworski 1972). In warm weather, with abundant mollusks and other food, a crab can mature in about 12 months. To reach adult size, each crab sheds its shell approximately 18 times and becomes each time, for three days, a soft-shell crab (Gaidry and Dennie 1971). At this stage, the crustacean is considered a seafood delicacy. Crabs hatched in March may go through the various molting stages to become an adult by the end of the summer. Crabs hatched in September will not mature until the following summer. Being poikilothermic, the winter cold retards their rate of growth by interrupting their feeding activity (Viosca 1953).

Work by Perret et al. (1971), Adkins (1972), and Jaworski (1972) reports that the highest catches of crabs per unit of effort occur in winter and early spring. This is because the crabs tend to be concentrated in the tidal channels, especially near oyster beds (Jaworski 1972). Summer months are considered the favored recreational crabbing period because the crabs tend to migrate into the upper estuary where food is more abundant, and where recreational access is also facilitated. In both periods, large numbers of people stationed along the roads bordering the coastal bayous and drainage canals harvest hard- and soft-shelled blue crabs (Duffy 1970). From those areas accessible by road, weekend crabbers rarely catch "less than one bushel (.035 cubic meters) of crabs per day" (Adkins 1972:28).

The estimated recreational blue crab harvest in Louisiana and Mississippi is indicated in Table 60. In Louisiana, the commercial landing records probably underestimate the actual catch (Jaworski 1971), and the sport catch exceeds the commercial catch by four times (Adkins 1972).

Table 60. Estimated catch of shellfish (live weight[a] with shell) by marine recreational fishermen, 1975.

Species	Mississippi	Louisiana
Clams	[b]	[b]
Crabs	430	10,960
Oysters	748	2,833
Shrimp	257	3,129
Miscellaneous[c]	[b]	[b]
Total	1,447	17,409

[a]Thousand pounds

[b]Row totals are given for species groups reported caught on at least 20 questionnaires throughout the region. Any entry in a state column reflects a species group reported caught on at least 7 questionnaires throughout the state; however, the column total contains the total catch for all species groups reported within the state waters.

[c]These species groups were combined to yield a sufficient number of questionnaires with reported catches, so that a total could be presented, and includes mussels, lobsters, conchs, and scallops.

Note: Severe methodological problems caused the standard error of estimates to exceed normal reporting limits. The data above should be used with caution.

Source: United States Department of Commerce 1977.

Although the catch of both hard- and soft-shell blue crab has declined since World War II, the decline of the soft-shell fishery has been the most dramatic (Jaworski 1972). Because blue crabs mature in oligohaline and mesohaline salinities and where Rangia clams are abundant, it is felt that habitat and water quality deterioration in the upper estuaries may be a significant factor in this decline (Jaworski 1971). Hard crabs are no longer caught in the Mississippi River near New Orleans where one of the earliest blue crab fisheries in the United States developed. The commercial hard-crab catch of the lower estuary now exceeds that of the upper estuary and this further suggests that some of the upper estuaries are less productive today than in the past (Jaworski 1972).

As human populations increase in the Deltaic Plain, especially in the New Orleans metropolitan region, it is expected that the recreational crab fishery will intensify. Improved public access will enable the sportsmen to more effectively exploit the blue crab. To avoid eventual conflicts with the commercial fishermen, it may become necessary to zone some of the crabbing areas for recreational use, particularly in the upper estuary during the summer months.

Frogging

Closed only during April and May, the ten-month frog season is one of the State's most popular nocturnal hunting sports (See 'ya... 1972). The size and abundance of bullfrogs (Rana catesbeiana) and the pig frog (Rana grylio), have made Louisiana the "foremost frog-catching State" (Hansen 1971). Unfortunately, the easily accessible spots have been over-harvested and restaurants now import frog legs from India, Japan, and Mexico. Commercial froggers cannot meet local demand. The commercial frogger must take about 46.4 kilograms (100 pounds) per night to make a profit. The recreational sportsman needs less than 10 frogs to have enough legs for a good meal.

Frogs spawn in backwater areas where land clearing and drainage impacts are destroying their habitat. If the situation does not improve, Louisiana may follow California and establish a season and bag limit (Soileau 1977).

Shrimping

Prior to the introduction of the otter or shrimp trawl, almost all of the entire commercial shrimp catch was taken by haul seines (Viosca 1957). For recreational purposes, people used cast-nets. In the past, New Orleans residents spent their summer nights cast-netting for shrimp along the Lake Pontchartrain seawall. "On favorite nights, shrimpers number(ed) in the hundreds and spectators in the thousands" (Viosca 1957:10,11). Use of the cast net has diminished, for small boats are now outfitted to trawl inland waters. In May, boats catch brown shrimp (Penaeus aztecus), while in the August to December season, they concentrate on white shrimp (Penaeus setiferus). Sport shrimpers may use a 4.9-meter (16-foot) trawl and catch 46.4 kilograms (100 pounds) per day without a special license. If the fisherman wishes to catch more than 46.4 kilograms (100 pounds), or use a larger trawl, he must purchase a shrimping license, but he cannot sell his catch (Jackson and Timmer 1975).

Like their commercial counterparts, the sport fishermen must shrimp within the regulated spring season. To improve yields, the State's Wild Life and Fisheries Commission divided the shrimp habitat into zones. Zone I includes the inside waters east of the Mississippi River (except parts of Lake Pontchartrain). Zone 2 includes the estuarine environments between the Mississippi and Atchafalaya Rivers. Zone 3 includes the remaining inside waters westward to the Texas border (Louisiana State Planning Office 1977).

In the Deltaic Region, the shrimp harvest depends on a number of factors. Of particular importance is the amount of area with salinities greater than 10 ppt (Barrett and Gillespie 1973) -- a salinity level that appears to enhance growth and survival. The amount of land available for this sport varies from 0.8 to 1.15 million hectares (2. to 2.85 million acres) (Barrett and Gillespie 1973). The recreational harvest of shrimp in Louisiana and Mississippi is indicated in Table 60.

Some recreational sportsmen have built large, winged "butterfly" nets to help harvest the migrating shrimp (Butterfly... 1974). These wharf-mounted "poupiers", when lowered into a bayou, are an efficient way of catching shrimp and crabs without exerting time and effort in pulling a trawl. During the first few days of the season, the State's estuaries are crowded with sportsmen seeking freezers full of shrimp, crabs, and fish (Adkins 1972).

The shrimp resources of the Deltaic Plain Region are very intensively harvested by both recreational and commercial fishermen. Because demand greatly exceeds supply, the retail shrimp price is very high and shrimping effort has increased. At present the white shrimp have been overfished in most estuaries, and the brown shrimp often migrate out of the estuaries before reaching sufficient size for exploitation. As in the case of the blue crab, future conflicts between the recreationalists and the commercial fishermen may necessitate allocation of the available resource base (Carroll 1976).

Boating

Louisiana Legislative Act No. 321 makes it mandatory that all boats equipped with or propelled by machinery, be registered, regardless of size, type, or horsepower (Duffy 1975b). In 1968, there were 47,350 boats registered in the Deltaic Plain. By 1978, the number increased to 101,698 -- a net change of 115 percent. The largest number are registered in Jefferson (23,747), Orleans (13,802), and Terrebonne (11,226) Parishes (Table 61). In addition, there are at least another 50,000 boats registered in the parishes that are located within two hours driving time of the Deltaic Plain marshes and offshore areas.

The boats registered in the 14 parishes that comprise the Deltaic Plain have, since 1968, accounted for as much as 51.3 percent of the State's boat population (Table 61). In addition, it is estimated that there is an equal number of bateaux, pirogues, and non-registered motorized boats. Assuming that each boat (regardless of size or registration) is used by at least three people, more than 600,000 people can gain access to the on-and-offshore fishing and hunting areas.

Louisiana is ranked the eighth State in the Nation in outboard motor sales. By comparison, Mississippi is thirtieth (Table 62). The New Orleans and Baton Rouge metropolitan areas are among the top 15 boat markets in the United States (Table 63). Sales in these urban markets contribute to the State's ranking and account for about four percent of the national outboard motor sales, five percent of outboard boat sales, and six percent of boat trailer sales.

Table 61. Number of motorboat registrations in the Deltaic Plain 1968[a] - 1978.

Parish/County	1968	1973	1978[b]	Net change
Louisiana				
Iberia	2,960	3,303	5,125	+75.51
Jefferson	10,065	15,396	23,747	+135.93
Lafourche	3,796	5,627	9,154	+141.14
Livingston	1,394	2,363	4,500	+222.81
Orleans	10,909	10,100	13,802	+26.51
Plaquemines	1,676	2,242	3,183	+89.91
St. Bernard	2,347	3,562	5,576	+137.57
St. Charles	960	1,535	3,346	+248.54
St. James	471	891	1,432	+204.03
St. John the Baptist	424	818	1,583	+273.34
St. Mary	4,124	5,461	7,577	+83.72
St. Tammany	2,065	3,270	7,465	+261.50
Tangipahoa	1,309	2,023	3,982	+204.20
Terrebonne	4,980	7,267	11,226	+125.42
Deltaic Plain Total	47,350	63,858	101,698	+114.77
State Total	c	138,218		c
Percent		46.20		

[a]1969 data are unavailable.
[b]Only through 6/31/78.
[c]Data not available.

Source: Louisiana Wild Life and Fisheries Commission 1978.

To accommodate these recreational vessels, boat-launching facilities are located throughout the Deltaic Plain. There are at least 90 boat ramps (Table 64) and berths for more than 4,760 vessels within the 11 parishes inventoried recently by the Corps of Engineers (Table 65). Sites range from small, roadside ramps which are able to accommodate no more than 5 to 10 automobiles, to large, well-maintained launching facilities with parking for more than 100 cars and trailers (Louisiana Wild Life and Fisheries Commission 1972c). New ramps are constantly added to the inventory (Table 66). The long-range plans of the Corps of Engineers include construction of eight new ramps at ten of its facilities.

In addition to these existing or proposed launching facilities, there are a number of private marinas with space for 300 or more boats. Along the south shore of Lake Pontchartrain, there are boat berthing facilities for 1,178 vessels (Table 65). Many marinas are capable of launching four to six vessels at a time.

Table 62. Geographic distribution of outboard motor sales on the State level.

1977 rank of states	Outboard motor sales 1977	1976	1975
1. Florida	7.5%	8.7%	8.3%
2. Texas	6.3	7.5	6.9
3. Minnesota	6.2	4.8	5.6
4. California	5.5	5.9	4.4
5. Michigan	5.2	5.3	5.3
6. Wisconsin	5.2	4.3	5.5
7. New York	5.1	5.0	5.6
8. Louisiana	4.4	4.0	4.4
9. Illinois	3.9	3.5	3.9
10. Washington	3.5	3.2	2.7
30. Mississippi	0.5	0.5	0.5
Total	53.3	52.8	53.1

Source: International Marine Expositions, Incorporated (MAREX), Market Research Department 1978.

From these locations sportsmen can launch their aluminum, fiberglass, steel, or wooden boats to travel into the marsh to fish, hunt, trap, or pleasure ride. To the serious sportsmen these vessels are a necessity and represent a considerable investment. Fishing boats often cost more than $5,000 and are powered by engines capable of providing quick access to any potential hunting or fishing site. Outfitted with built-in live wells, bait boxes, depth finders, troll motors, tackle boxes, speedometers, tachometers, rod boxes, gas tanks, citizen band radios, and storage areas, the recreational sportsman's boat is designed to meet the recreation challenge. Prior to the post World War II period of affluence, "swampers" and "marsh folk" used much simpler craft. With increased prosperity and leisure time, boats are designed to fulfill almost any need felt by its owner.

Launching sites provide not only a place to put a boat into the water, but they furnish weekend crabbers and cane-pole fishermen with recreational space. Such persons do not use boats; they take advantage of the fishing in the vicinity of the launching facilities. In the warm months, they line the roads. When land fishermen are combined with boat-oriented sportsmen, the sites and roadsides become highly congested.

A 1970 study discloses that the average salt-water fisherman will make 12 trips a year into the marsh at a cost of $13.50 each trip. Thus, each fisherman adds $163 per year to the local economy (Louisiana Wild Life and Fisheries Commission 1970a). Inflation and the rapid change in gasoline prices are increasing this figure. A 3 percent inflation rate would increase the cost to $20.22 per trip, or $266.64 per year -- a figure that compares favorably with recreational boating costs in other areas (Volker 1976).

Table 63. The top fifteen outboard boat metropolitan marketing areas in 1977.

	Share of the marine market	Effective buying income
Minneapolis-St. Paul, MN	3.19%	1.03%
Dallas-Ft. Worth, TX	1.99	1.34
Nassau-Suffolk, NY	1.92	1.54
Houston, TX	1.81	1.25
Detroit, MI	1.67	2.46
Milwaukee, WI	1.54	.71
Chicago, IL.	1.31	4.04
Tampa-St. Petersburg, FL	1.12	.61
Atlanta, GA	.94	.89
Philadelphia, PA	.94	2.45
Baton Rouge, LA	.92	.17
New Orleans, LA	.87	.52
Phoenix, AZ	.86	.57
Los Angeles-Long Beach, CA	.83	3.82
Seattle, WA	.79	.75

Source: International Marine Expositions, Incorporated (MAREX), Market Research Department 1978.

In 1975, Louisiana's marine fishermen spent $40.1 million on sport fishing (Table 68). The sport is extremely popular, but current boating facilities will not meet the expected 1985 demand; only twenty-six percent of the anticipated demand for boating facilities is now available. New facilities must be built to accommodate the expected increase in demand (Grimes and Pinhey 1976). The most critical region will probably be the metropolitan New Orleans area and all facilities within a 2-hour drive.

State Parks

In the Deltaic Plain, leisure-time pursuits are oriented traditionally towards the area's coastal wetlands. This region has long been recognized as one of the more productive wildlife habitats on the North American continent and serves the recreational needs of many fishermen and hunters. The marsh, however, is not theonly recreational resource. Within the 14 parishes, there are nine State parks and commemorative areas and one National park (Table 69). Available visitation statistics reveal that the facility at Grand Isle registered the largest number of visitors in the 1977-1978 reporting period. Fairview, Riverside, Fontainebleau, and Fort Pike each reported more than 190,000 visitors (Table 70).

To improve the State park system, the State Parks and Recreation Commission has developed a three phase plan. The first phase, known as the "Now" plan, is designed to improve existing facilities, or initiate new parks through additional acquisitions, such as the Slidell State Park or McElroy Swamp State

Table 64. Existing water-oriented recreation land and facilities[a], 1979.

Parish	Acreage	Boat ramps (no.)	Marinas (berths)	Beach area (acres)	Picnic area (acres)	Picnic tables (no.)	Camping area (acres)	Tent camping (pads)
Jefferson	246	1	885	12.3	49.5	188	---	---
Lafourche	410.5	27	39		27.5	88	8	---
Livingston	107	6	161	0.2	10.5	65	5	---
Orleans	3,368	3	1,853	---	58.6	260	12	---
Plaquemines	86	3	704		3.5	29	---	---
St. Bernard	14.7	15	229	---	---	---	---	---
St. Charles	78	9	---	---	12	84	30	51
St. James	21	5	---	---	9	12	---	---
St. John	131	3	20	---	1.5	4	---	---
St. Tammany	6,030.5	19	758	22.6	640.5	1,702	694	688
Tangipahoa	1,223	3	---	0.8	86.5	274	132	90
Total	11,715.7	94	4,649	36	899.1	2,706	881	829

(continued)

Table 64. (concluded)

Parish	Trailer camping (spurs)	Horseback trails (miles)	Hiking and nature trails (miles)	Bicycle trails (miles)
Jefferson	---	--	--	-
Lafourche	35	--	--	-
Livingston	110	--	4	-
Orleans	250	5	12	6
Plaquemines	---	--	--	-
St. Bernard	---	--	--	-
St. Charles	---	1	1	-
St. James	---	--	--	-
St. John	---	--	--	-
St. Tammany	1,550	53	9.8	-
Tangipahoa	425	--	47.3	9
Total	2,370	59	47.3	9

[a]Material from the New Orleans-Baton Rouge Metropolitan Area Urban Study conducted by the United States Army Corps of Engineers, New Orleans District and does not include the parishes of Iberia, St. Mary, and Terrebonne.

Source: United States Army Corps of Engineers 1979.

Table 65. Partial inventory of boat berthing facilities in the Deltaic Plain[a].

Parish/waterbody[b]	Less than 16'	16' to 28'	28' to 40'	Greater than 40'	Dry storage	Total
Orleans						
Bayou Bienvenue	0	132	84	84	25	325
Lake Catherine	2	31	18	0	16	67
Chef Menteur Pass	5	125	20	0	16	166
Irish Bayou	22	19	0	0	0	41
Lake Pontchartrain (South Shore)	34	170	675	264	35	1,178
Rigolets Pass	0	57	15	2	0	74
				Parish Total		1,851
Plaquemines (East Bank)						
Meyer's Canal	0	55	35	24	0	114
				East Bank Total	114	
St. Bernard						
Bayou Laloutre	0	34	4	0	132	170
Bayou Terre Aux Boeufs	0	20	0	0	0	20
Bayou Yscloskey	0	7	0	0	32	39
				Parish Total		229
St. John						
Galva Canal	0	20	0	0	0	20
				Parish Total		20

(continued)

Table 65.

Parish/waterbody[b]	Less than 16'	16' to 28'	28' to 40'	Greater than 40'	Dry storage	Total
St. Tammany						
Bayou Bonfouca	0	10	4	0	0	14
Bayou Castine	0	91	42	7	0	140
Bayou DeZaire	0	36	10	2	0	46
Bayou Liberty	0	65	77	6	0	148
Lake Pontchartrain (North Shore)	2	80	41	6	0	129
Rigolets Pass	0	15	60	0	0	75
Tchefuncte River	0	20	120	18	44	202
				Parish Total		754
Jefferson						
Bayou Barataria	0	132	208	45	86	471
Caminada Bay & Pass	0	108	16	0	113	237
Bayou Fifi	0	20	82	7	12	121
Bay St. Honore	0	39	0	0	20	59
				Parish Total		888
Lafourche						
Bayou Lafourche	3	0	0	0	0	3
Oil C. Canal (Off Bayou Lafourche)	0	0	4	0	32	36
				Parish Total		39
Plaquemines (West Bank)						
Adams Bay	0	0	0	0	18	18
Battistella Canal	0	40	40	0	0	80
Empire Lock	0	0	0	0	85	85
Grand Bayou	0	14	6	0	120	140
Bay Pomme d'Or	14	135	81	40	0	270
				West Bank Total	707	

(continued)

Table 65. (concluded)

Parish/waterbody[b]	Less than 16'	16' to 28'	28' to 40'	Greater than 40'	Dry storage	Total
Livingston						
Blood River	4	53	24	7	20	108
Tickfaw River	5	32	13	3	0	53
				Parish Total		161
				AREA TOTAL[1]		4,763

[a]Material from the New Orleans-Baton Rouge Metropolitan Area Urban Study conducted by the United States Army Corps of Engineers, New Orleans District and does not include the parishes of Iberia, St. Mary, and Terrebonne.

[b]Two new marinas are proposed (one on the Tchefuncte River and one on the North Shore of Lake Pontchartrain) and they will provide an additional 347 wet slips and 270 dry spaces. One of the existing marinas has an expansion under construction and will provide 70 wet slips when completed. Six of the existing marinas have definite plans for expansion in the future and will provide approximately 400 new wet slips and expanded dock facilities at one of these marinas when completed. Five other marinas have indefinite plans for expansion in the future.

Source: United States Army Corps of Engineers 1979.

Table 66. Boat ramp construction in the Louisiana portion of the Deltaic Plain in 1976.

Body of water	Location	Parish
Intracoastal Canal	Three miles south of Crown Point, La. Hwy. 45	Jefferson
Lake St. Catherine[a]	Fort Pike, U.S. Hwy. 90	Orleans
Intracoastal Canal[a]	West side of the lower Atchafalaya River, approximately 3.5 miles south of Beswick	St. Mary
Delcambre Canal[b]	Adjacent to Delcambre	Iberia
Commercial Canal[b]	East back of Commercial approximately 5 miles south of New Iberia	
Amite River[c]	Port Vincent, Hwy. 42	Livingston

[a]Boat ramp constructed by the Louisiana Wild Life and Fisheries Commission under accelerated public works program.

[b]Boat ramp constructed by the Louisiana Wild Life and Fisheries Commission under the Bureau of Outdoor Recreation Program.

[c]Boat ramp constructed by the Louisiana Department of Highways under the accelerated public works program.

Source: Hidalgo 1979.

Preservation Area. There are 12 Deltaic Plain sites within the "Now" development phase (Table 71). The second priority is called the "Next" development phase; there are nine sites in this category (Table 72). These facilities are designated to receive funds for capital improvements such as beach restoration, trail systems, fishing piers, and other items that will improve the facility. The "Future" phase is the last element in Louisiana's development plan. Two sites are involved in this phase: New Orleans East State Park and Jean Lafitte National Historical Park and Preserve (Table 73). The latter will consist of approximately 20,000 acres (8,100 hectares). Other areas outlined by the National Park Service to be added to the Federal facilities in Louisiana include: Big Oak Island, historical resources within the French Quarter and Garden District of New Orleans, the Chalmette National

Table 67. Proposed water-oriented recreation facilities at Corps of Engineers projects.

Site	Parish	Proposed implementation year	Total site size (acres)	Boat ramp (lanes)	Beach area (acres)	Picnicing (tables)	Tent camping (tent pads)	Hiking trails (miles)
Bayou Lafourche	St. Tammany	1995	7	4	3	--	--	--
Twin Rivers	St. Tammany	1985	2	2	--	--	--	--
Madisonville	St. Tammany	1990	4	4	--	--	--	--
Lee Landing	Tangipahoa	2010	7	2	--	7	--	--
Manchac Landing	St. John	1990	4	4	--	--	--	--
Lake Villa Landing	Jefferson	2010	4	4	--	--	--	--
Frenier Beach	St. John	1985	298	7	36	217	50	--
Pointe Aux Herbes	Orleans	1995	69	7	12	70	--	--
Poydras	St. Bernard	1990	16	--	--	--	--	12
Fort St. Mary	Plaquemines	1995	6	--	--	--	--	4

Note: acre divided by 2.471 = hectare.

Source: United States Army Corps of Engineers 1979.

Table 68. Estimated expenditures[a] by marine recreational fishermen, 1975.

Category	Mississippi	Louisiana
Tackle	$ 1,849	$ 8,661
License Fees	196	947
Access Fees	20	308
Boat Launch	228	1,071
Charter Rentals	3,157	1,845
Boat Fuels	1,474	6,125
Fishing Bait	416	2,201
Food Costs	1,322	5,660
Lodging Costs	640	1,767
Travel Costs	1,023	5,692
Other Costs	1,996	5,874
Total	$ 12,321	$ 40,151
Number[b] of fishing households	135	319

[a]Thousand dollars.
[b]Thousands.

Source: International Marine Expositions, Incorporated (MAREX), Market Research Department 1975.

Campsite Leases

Louisiana is allowed by law to transfer State-owned lands to other agencies for recreational purposes. The Office of State Parks has received more than 3,238 hectares (8,000 acres) of State-owned property. The only stipulation is that the land remain open to the public. As part of the State Lands Division program, there are a number of areas that contain small campsites leased to the public. There are 13 of these areas in the State. Each site must have water frontage, road access, and high user demand to qualify. Seven of these facilities are in the Deltaic Plain. They involve 552 individual campsites comprising 894 hectares (2,209 acres) (Table 74).

Natural and Scenic Rivers

Louisiana's natural and scenic rivers system was established by Act 398 of the 1970 legislature. At that time there were 38 rivers and streams included in the system. By 1976, the State's legislative delegates added five additional streams. Within the Deltaic Plain, there are 20 rivers that are designated "natural and scenic rivers". The largest number is within St. Bernard Parish. The parishes north of Lake Pontchartrain are also well represented (Table 75). These rivers are very strong recreation and tourist attractions, especially if primary transportation is available.

Table 69. Louisiana's State parks and State commemorative areas and National Park Service facilities in the Deltaic Plain.

Park or commemorative area	Description
Bogue Falaya State Park	The 5.3 hectares (13-acre) park features picnic areas and a natural beach on the waters of the spring-fed river from which it derives its name.
Cypremort Beach	This 914.4-meter (3,000-foot) man-made beach provides picnicking, swimming, sunbathing and fishing. It is the accessible beach available to the people of Iberia, St. Mary and Vermilion beach.
*Edward Douglass White	This park includes the 130-year old homestead of the former statesman and Chief Justice of the United States Supreme Court. The white frame raised cottage of Creole origin has been restored, including furnishings of the time White was a young boy, and is located on 2.4 hectares (6 acres) of land.
Fairview Riverside State Park	The park consists of 39.7 hectares (98 acres) of picturesque moss-draped oaks and woodlands near the banks of the Tchefuncte River.
Fontainebleau State Park	The park covers over 1,093 hectares (2,700 acres) on the north shore of Lake Pontchartrain. Nature trails, the ruins of a planation brickyard and sugar mill, and an alley of live oaks lining the entrance road are popular assets of the park.
Ft. Macomb	This historic monument was built originally to protect New Orleans from sailing vessels entering Lake Pontchartrain through Lake Borgne. This fortress and Fort Pike sealed off all passages into the Lake.
Fort Pike	The Fort, set on a 51-hectare (125-acre) site, was constructed shortly after the War of 1812 to defend navigational channels leading into the City of New Orleans.
Grand Isle East State Park	The 57-hectare (100-acre) site offers access to the Gulf of Mexico and its beach, and fishing jetties afford seashore recreation opportunities.

(continued)

Table 69. (concluded)

Park or commemorative area	Description
St. Bernard State Park	The park encompasses approximately 142 hectares (350 acres) on the Mississippi River. A network of man-made lagoons offers opportunities for canoeing and fishing. The park can be a stop-off point for visits to many natural and historic features of the region, including the Chalmette National Historical Park, located in Arabi, Louisiana.
Chalmette National Park	The 57-hectare (141-acre) site includes the most important portion of the American defense line where Andrew Jackson's militia stood against General Pakenham's soldiers in the War of 1812. The now inactive Chalmette National Cemetery is also part of the park.
Jean Lafitte Park and Reserve	Title nine, section 901 of the National Parks and Recreation Act of 1978 states that "in order to preserve for the education, inspiration, and benefit of present and future generations significant examples of natural and historical resources of the Mississippi Delta region and to provide for their interpretation in such manner as to portray the development of cultural diversity in the region, there is authorized to be established in the State of Louisiana the Jean Lafitte National Historical Park and Reserve. The park shall consist of (1) the area of approximately twenty thousand acres generally depicted on the map entitled 'Barataria Marsh Unit-Jean Lafitte National Historical Park and Preserve'...; (2) the area known as Big Oak Island; (3) an area or areas within the French Quarter section of the City of New Orleans as may be designated by the Secretary of the Interior for an interpretive and administrative facility; (4) the Chalmette National Historical Park; and (5) such additional natural, cultural, and historical resources in the French Quarter and Garden District of New Orleans, forts in the delta region, plantations, and Acadian towns and villages in the Saint Martinville area and such other areas and sites as are subject to cooperative agreements in accordance with the provisions of this title" (United States laws, statutes, 1978, n.p.).

Source: Louisiana State Parks and Recreation Commission 1976.

Table 70. Number of visitors at selected Deltaic Plain parks, 1977-1978.

Park	Total visitors
Bogue Falaya (St. Tammany)	54,759
Cypremort (St. Mary)	77,036
E. D. White (Lafourche)	2,797
Fairview Riverside (St. Tammany)	288,862
Fontainebleau (St. Tammany)	195,787
Ft. Pike (Orleans)	262,710
Grand Isle (Jefferson)	415,764

Source: Hidalgo 1979.

Trails

Created in 1974 by Executive Order No. 68, the Louisiana Advisory Council was entrusted with the responsibility of promoting the development of statewide trail activities. All types of trails are considered, including bicycle, hiking, nature, canoe, scenic highway, historical routes, and those trails designed for the handicapped (Louisiana Department of Culture, Recreation & Tourism 1977b). By 1979, at least 185 kilometers (115 miles) of trails within the Deltaic Plain were inventoried by the Corps of Engineers (Table 74).

In the Deltaic Plain, the Honey Island Swamp Nature Trail on the Pearl River Wildlife Management Area provides hikers with an opportunity to enjoy wildlife in a bottomland forest. The hiker has an opportunity to bird watch, penetrate a portion of a forest ecosystem without danger or fear of becoming lost, and to photograph nature (Murry and Moreland 1977).

There are also four scenic roads within the Deltaic Plain. Scenic Route 1 is 36 miles (58 kilometers) long and follows a route along La. 1 at Paincourtville, then westerly and southerly via State Highway 70 to a junction with U.S. 90 at Morgan City, with a spur connection from a point south of Pierre Part to Lake Verret. The trip traverses a region that shows the contrast between sugar-cane farming, commercial fresh- and salt-water fishing, and the economic impact of the oil industry.

Table 71. Louisiana State Parks plan "Now" [a] development and acquisition phase summary for the Deltaic Plain.

Site[b]	Acres (hectares)
Fort Pike State Commemorative Area	125 (50.6)
St. Bernard State Park	456 (184.5)
Grand Isle (East) State Park	100 (40.5)
Grand Isle (West) State Park	40 (16.0)
Fontainebleau State Park	2,755 (1,114.9)
Fairview Riverside State Park	90 (36.4)
Slidell State Park[c]	Not provided
Tickfaw State Park[c]	700 (283.2)
Edward Douglass White State Commemorative Area	6 (2.4)
McElroy Swamp State Preservation Area[c]	2,000 (809.3)
Isles Dernieres State Preservation Area[c]	1,000 (404.6)
Lake Fausse Point State Park[c]	8,800 (3,561.3)

[a]In addition to improvements to developed holdings, "Now" phase development includes a significant amount of new development as a means of beginning to overcome existing deficiencies and meeting future needs for available State recreation land.

[b]Boque Chitto is shown as a proposed St. Tammany parish park in the Louisiana State Parks and Recreation Commission's Parks Plan (1977) but does not appear in the Gulf South Research report, as part of the Deltaic Plain. The land is contemplated as a resource-oriented State park on the Boque Chitto River, designed as an intermediate point for float trips down the River. The River's course includes part of the Deltaic Plain.

[c]Proposed new State parks.

Source: Gulf South Research Institute n.d.

Table 72. "Next"[a] development and acquisition phase summary for the Deltaic Plain.

Site	Acres (hectares)
Fort Pike State Commemorative Area	125 (50.6)
Fontainebleau State Park	2,755 (1,114.9)
Fairview Riverside State Park	99 (40.1)
Fort Jackson[b]	50 (20.2)
Pearl River Waterway State Park[b]	400 (161.9)
Chappepela State Park[b]	900 (364.2)
Amite River State Park[b]	Not Provided
Edward Douglass White State Commemorative Area	6 (2.4)
Lac Des Allemands State Park[b]	850 (344.0)

[a]"Next" phase improvements to developed holdings involve capital improvements which are mainly continuations of work begun in the previous phase. Capital improvements to these sites include such items as beach restoration, bikeways and trail systems, redesign of access and circulation, interpretive facilities, fishing pier, cabins and camping facilities, swimming pool, and general site improvements which serve the entire area.

[b]Proposed new State parks.

Source: Gulf South Research Institute n.d.

Scenic Route 2 is 83 miles (134 kilometers) long. The trip follows La. 31 through Breaux Bridge and St. Martinville to New Iberia, then via Louisiana highways 182, 14, 83, and 319, through Weeks Island to Cypremort Point on Vermilion Bay. The trip has been designed to allow the traveler to view sugar-cane plantations, antebellum homes, examples of Acadian vernacular architecture, pepper fields, a salt mine, and one of the Deltaic Plain's few accessible beaches.

Scenic Route 7 follows 437 miles (703 kilometers) of Louisiana's highways. This "trail" follows the Mississippi River from Venice to the Louisiana-Arkansas state line, and is part of the route designated by the Federal Highway Administration and the National Park Service as the "Great River Road" that extends from Canada to the Gulf of Mexico. The southern section passes through areas planted in sugar cane or orange orchards. Along the route, the traveler views antebellum homes, petrochemical industrial complexes, commercial fishing, trapping, and oyster enterprises as well as the numerous support services

Table 73. Louisiana State parks plan "Future"[a] acquisition phase summary for the Deltaic Plain.

Site	Acres (hectares)
New Orleans East State Park	Not provided
Jean Lafitte National Historical Park and Preserve	8,000 (3,238)[b]

[a]The "Future" development phase consists of the acquisition and development of new sites and development of an existing holding in the present park system.

[b]This figure is based on Gulf South Research Institute's report, The National Parks and Recreation Act of 1978. Title IX - Jean Lafitte National Historical Park, 92 stat. 3534, Public Law 95-625 -- Nov. 10, 1978 states that the "Baratari Marsh Unit" will encompass approximately 20,000 acres (8,093.88 hectares).

Source: Gulf South Research Institute n.d.

associated with the on-and-offshore petroleum industry. The trip also allows the traveler to see the contrast in the natural environment. Natural levees, swamps, and marshes are all visible elements.

Scenic Route 9 involves 88.5 kilometers (55 miles) through the Florida parishes. The trip follows a course from Pontchatoula along State Highway 22 and U.S. 90 through Madisonville and Mandeville to a point near Fontainebleau State Park. The "automobile trail" passes through pine forests in an area sometimes referred to as the "Ozone Belt". The journey skirts the north shore of Lake Pontchartrain and allows the traveler to view one of the larger estuarine (brackish water) lakes in America (Louisiana Department of Culture, Recreation & Tourism 1977a).

RECREATION ACTIVITY FOR 1970 AND PROJECTED TO 1985

Resource Base Recreation

Resource base recreational activities include crabbing, crawfishing, fishing, and hunting. In 1970, there were 8.0 million user days associated with this activity. A 2.3 million increase is expected by 1985, with the largest growth occurring in Jefferson Parish -- another indicator of the urbanization taking place within the Parish (Table 76).

Swimming

In 1970, there were 10.2 million user days of pool and beach swimming in the Deltaic Plain. By 1985, user day activity is expected to increase to 13.3 million -- an increase of 2.9 million. The largest number of user days is expected to occur within the New Orleans' metropolitan area. The expected population growth in St.

Table 74. State Lands Division campsite leases in the Deltaic Plain[a].

Name of area	Parish	No. of sites[b]	Acres/hectares	
Bird Island Chute Area	Iberia Parish	150	1,280	(518)
Cocodrie Area	Terrebonne Parish	43	500	(203)
Lake Dautrieve Area	Iberia Parish	6	3	(1.2)
Bayou Dularge Area	Terrebonne Parish	59	160	(65)
Lake Fausse Point Area	Iberia & St. Mary Parishes	60	20	(8.1)
Grand Avoille Area	St. Mary Parish	14	6	(2.4)
Lake Fausse Point Area	Iberia & St. Mary Parishes	220	240	(97)
TOTAL		552	2,209	(894)

[a]All lands under the jurisdiction of the State Lands Division remain open to the public. In addition, the agency has areas around the State that contain small campsites leased to the public.

[b]The sites are approximately 0.2 hectares (0.5 acres) in size and are leased by public bidding for a ten-year period.

Source: Louisiana Department of Culture, Recreation & Tourism. Office of Program Development 1977a.

Bernard and St. Tammany parishes is reflected in the increase in user days (Table 76).

Water Activities (Non-Fishing)

In 1970, 3.3 million user days were spent in water activities, boating in particular. In 1985, the Deltaic Plain is expected to support 4.3 million user days. Jefferson parish is expected to register the greatest growth in this recreational category (Table 76).

Walking and Picnicking

In 1970, there were 7.9 million user days of walking and picnicking in the Deltaic Plain. More than half of this activity was confined to Jefferson and Orleans Parishes. By 1985, the number of people engaged in these activities is expected to increase to 10.2 million user days (Table 76).

Table 75. Louisiana natural and scenic rivers all or partially within the Deltaic Plain.

River	Parish
1. Pushepatapa Creek	(Washington & St. Tammany)
2. Bogue Chitto River	(Washington & St. Tammany)
3. Tchefuncte River	(Washington, Tangipahoa & St. Tammany)
4. Tangipahoa River	(Tangipahoa)
5. Chappepella Creek	(Tangipahoa)
6. Tickfaw River	(St. Helena & Livingston)
7. Blind River	(St. James, Ascension, Livingston & St. John)
8. Bayou Des Allemands	(Lafourche & St. Charles)
9. Bayou Penchant	(Terrebonne)
10. West Pearl River	(Washington & St. Tammany)
11. Bayou Trepagnier	(St. Charles)
12. Bayou La Branche	(St. Charles)
13. Bayou Dupre	(St. Bernard)
14. Lake Borgne Canal	(St. Bernard)
15. Bashman Bayou	(St. Bernard)
16. Terre Beau Bayou	(St. Bernard)
17. Pirogue Bayou	(St. Bernard)
18. Bayou Bienvenue	(St. Bernard)
19. Bayou Chaperon	(St. Bernard)
20. Holmes Bayou	(St. Tammany)

Source: Louisiana Department of Culture, Recreation & Tourism. Office of Program Development 1977a.

Playing Outdoor Games

More user days of recreational activity are associated with outdoor games than any other type of recreational enjoyment. Tennis, golf, and softball are common outdoor games. In 1970, the Deltaic Plain's outdoor game facilities supported 14.9 million user days. By 1985, the region will need enough facilities to support 19.1 million user days. The highest demand areas will probably be in Jefferson, St. Bernard, St. Charles, and St. Tammany Parishes (Table 76).

Watching Outdoor Events

Outdoor events in 1970 involved 11.7 million user days, By 1980, this activity is expected to involve 15.0 million user days. People within the Deltaic Plain spend most of their free time playing outdoor games, but they also enjoy watching these events (Table 76).

Camping

Without an abundance of camping facilities in the Deltaic Plain region, it is not surprising to note that only 1.7 million user days were involved in this activity. By 1985, the number of user days is expected to increase to 2.2 million (Table 76). In 1979, the Corps of Engineers inventoried 357 hectares (281 acres) of camping acres in the 11 deltaic parishes covered in the survey (Table 74).

Table 76. User days of high quarter[a] participation by recreation activity for 1970 and projected for 1985 by parish in the Deltaic Plain.

Parish	Swimming[b]		Water activities non-fishing		Resource base recreation[c]		Walking and picnicking	
	1970	1985	1970	1985	1970	1985	1970	1985
Iberia	389,511	402,791	125,857	130,098	303,451	313,674	297,978	308,018
Jefferson	2,307,759	3,690,107	745,675	1,192,333	1,797,871	2,874,796	1,765,450	2,822,955
Lafourche	462,949	556,008	149,586	179,655	360,662	433,161	354,159	425,350
Livingston	248,539	376,866	80,307	121,771	193,626	293,599	190,135	288,305
Orleans	4,162,608	4,132,705	1,345,006	1,335,344	3,242,900	3,219,604	3,184,422	3,161,546
Plaquemines	169,989	194,912	54,926	62,979	132,431	151,847	130,043	149,109
St. Bernard	353,274	716,790	114,148	231,606	275,220	558,418	270,257	548,349
St. Charles	199,219	304,892	64,371	98,516	155,202	237,528	152,404	233,245
St. James	133,008	133,556	42,977	43,154	103,621	104,048	101,752	102,171
St. John	160,045	229,693	51,713	74,218	124,684	178,944	122,436	175,717
St. Mary	406,228	518,557	131,259	167,554	316,474	403,985	310,767	396,700
St. Tammany	438,222	997,644	141,596	322,355	341,399	777,219	335,242	763,204
Tangipahoa	455,432	486,353	147,157	157,148	354,806	378,895	348,408	372,063
Terrebonne	509,608	631,278	164,662	203,976	397,012	491,800	389,853	482,932
Total	10,396,391	13,372,152	3,359,240	4,320,707	8,099,359	10,417,518	7,953,306	10,229,664
Change		2,975,761		961,467		2,318,159		2,276,358

(continued)

Table 76. (concluded)

	Playing outdoor games		Watching outdoor events		Camping	
	1970	1985	1970	1985	1970	1985
Iberia	559,145	577,983	438,760	453,542	66,660	68,905
Jefferson	3,312,799	5,297,165	2,599,545	4,156,672	394,942	631,513
Lafourche	664,565	798,152	521,482	626,308	79,227	95,153
Livingston	356,780	540,992	279,964	424,515	42,534	64,496
Orleans	5,975,442	5,932,517	4,688,915	4,665,231	712,375	707,257
Plaquemines	244,020	279,797	191,482	219,556	29,091	33,357
St. Bernard	507,126	1,028,955	397,941	807,418	60,458	122,669
St. Charles	285,979	437,674	224,407	343,442	34,094	52,178
St. James	190,934	191,721	149,825	150,443	22,763	22,856
St. John	229,746	329,725	180,281	258,735	27,390	39,309
St. Mary	583,142	744,391	457,590	584,122	69,520	88,744
St. Tammany	629,069	1,432,122	493,629	1,123,783	74,996	170,733
Tangipahoa	653,774	698,161	513,015	547,845	77,941	83,233
Terrebonne	731,544	906,203	574,041	711,095	87,213	108,035
Total	14,924,065	19,195,558	11,710,877	15,062,707	1,779,204	2,288,438
Change		4,271,493		3,351,830		509,234

[a]Summer is the high quarter for all activities, except hunting.
[b]Includes pools and beaches.
[c]Includes crabbing, crawfishing, fishing and hunting.

Source: Louisiana Department of Culture, Recreation & Tourism 1977a.

TOURISM IN LOUISIANA'S DELTAIC PLAIN

In the 1960's, the State of Louisiana began to recognize the economic profits to be realized from the travel and convention trade. By catering to out-of-state travelers or tourists, the State Department of Culture, Recreation and Tourism was able to dramatically increase tourist expenditures in Louisiana. In 1970, less than $200 million was spent on travel-related recreation. By 1978, 3.8 million out-of-state visitors spent $2.25 billion, or 1,025 percent more than in 1970 for transportation, lodging, food, entertainment, and other miscellaneous items (Louisiana Office of Tourism 1979). The dollar increase in 1978 over 1977 was 2.8 percent, and averaged approximately $592 per tourist/year.

In serving the in- and out-of-state traveler, Louisiana businesses employed workers and paid $1.26 billion in wages and salaries in 1976 (United States Travel Data Center 1978). This additional employment and multiplier effect, as well as direct tourist expenditures cited above, results in a significant material contribution to local economies. In fact, during 1976, travel-generated revenue accounted for 11.2 percent of all local tax receipts in Louisiana as compared to 2.1 percent for the Nation (United States Travel Data Center 1978).

Over the past few decades both agriculture and manufacturing have lost some of their economic viability. Since 1950, income from farm operations in the Deltaic Plain no longer dominates the regional economy. Dislocations in agriculture have resulted in fewer farms, a smaller labor force, and income stabilization. In manufacturing, the availability of abundant, inexpensive boiler fuels, water transport, low-cost labor, and general lack of environmental restrictions were primary inducements for industrial location in the Deltaic Plain. The steady decline in hydrocarbon production, however, is prompting some energy-intensive manufacturing companies to reassess the economic advantages of siting in southeastern Louisiana. To offset the decline in these traditional growth sectors of the economy, tourism is now being promoted vigorously. At present, tourism is Louisiana's third largest industry, after mining (including the oil industry) and agriculture (LeBlanc 1977, Louisiana State Planning Office 1977).

Much of the tourist trade in the Deltaic Plain is associated with New Orleans' attractions, including Mardi Gras, Jazz and Heritage Festivals, Spring Fiestas, the Sugar Bowl, and Super Bowl games. Advertising themes and marketing campaigns in domestic business and consumer magazines have focused on the city of New Orleans as a cultural and festive attraction, and because of its hotel/motel accommodations, convention facilities, French Quarter attractions, and other tourist services, the city clearly dominates the regional tourist market. Smaller communities, especially those which offer resource-based activities like hunting and fishing, compete less successfully for a share of tourist traffic.

Tourist attractions outside metropolitan New Orleans are largely under-developed. For the traveler who intends to drive through the region and spend several days in the Deltaic Plain, there are several noteworthy attractions: the parks along the north shore of Lake Pontchartrain as well as the sailing opportunities on the Lake Pontchartrain-Lake Borgne system. Another attractive area which was also previously discussed is the Grand Isle area of lower Jefferson Parish. Salt-water fishing, especially for spotted seatrout, and sunbathing are particularly important along this beach environment which is an uncommon landscape in deltaic Louisiana. As evidenced by the out-of-state fishing license sales (Table 56) and by the growth in charter boat traffic (Table 59) especially to artificial reefs created by offshore rigs, salt-water fishing is a growing tourist attraction for vacationers.

Although there is general recognition of the Deltaic Plain's unique natural environments, cultural history, seafood cuisine, and other bayou attractions, these resources have not been fully exploited by tourists or by State planning agencies. A visual introduction to deltaic environments may be gained by driving the Interstate-10 route between New Orleans and Baton Rouge. Creation of visitor centers, theme parks, and participatory exhibitions similar to those in South Florida would improve the public access to these resources. Perhaps the most forward-looking proposal to develop resource-based tourism in the Deltaic Plain is the Atchafalaya Fish, Wildlife, and Multi-Use Area. In addition to its function as a floodway for the Mississippi River, the area would be maintained as a natural swamp area for public hunting, fishing, birdwatching, hiking, camping, canoeing, boating, and nature study.

State Travel Industry

According to the Department of Culture, Recreation and Tourism, the term "tourism" generally refers to out-of-state visitors who travel into Louisiana for pleasure and vacations, or to that portion of convention or business trips that is recreation oriented. In 1977, Louisiana hosted an estimated 13.1 million vacationers, conventioneers, and business travelers. These people spent more than $230 million on lodging and $620 million for food and entertainment (Table 77). Seventy-

Table 77. Types of visitor expenditures in the greater New Orleans area, 1978.

Activity	Percent of dollar spent
Food/Drink/Entertainment	42
Lodging	32
Retail Sales	14
Transportation/Sightseeing, Etc.	8
Miscellaneous	4

Source: New Orleans 1979.

four percent of the visitor's dollar involves these three expenditures. Further analysis reveals that 45.7 percent of visitors travel to and through the State to visit friends and relatives, whereas business trips and conventions comprised 22.4 percent of the traffic. Moreover, 94.6 percent of these travelers stayed overnight. However, only approximately 25 percent of the 13.1 million people could be categorized as tourists (United States Travel Data Center 1978).

Opportunities exist for continued growth of tourism in Louisiana, and by 1987 the minimum tourist expenditure is expected to be $5 billion per year (Louisiana Department of Culture, Recreation and Tourism 1978). This growth is expected to produce 100,000 new jobs in direct and indirect employment. Tourist money brought into the State is recycled within the local economy almost four times before it is absorbed by savings, purchase of out-of-state goods and services, and taxes. State officials have estimated that through the recycling process, more than $80 billion is collected in state and local taxes. This revenue is a powerful incentive to develop and promote Louisiana's tourist attractions (Louisiana Department of Culture, Recreation and Tourism 1977).

Travel Expenditures within the Deltaic Plain

In 1976, Louisiana ranked 21st among all States in travel expenditures, and the $1.8 billion spent in Louisiana amounted to only 1.7 percent of the United States' total. That expenditure marked the first time tourist income in Louisiana totaled more than one billion dollars.

All 64 parishes in Louisiana benefit from tourism, but the Deltaic Plain accounted for 69.5 percent of the State's total expenditures in 1976 (Table 788). The Deltaic Plain Region was responsible for approximately $1.26 billion in tourist-related sales in 1976, and this total has increased annually.

Table 78. Economic impact of travel in the Deltaic Plain parishes for 1976 (by expenditures).

Parish (ranking expenditures in State)	Total expenditures ($1,000)	Travel payrolls ($1,000)	Travel employment (jobs)	Travel receipts ($1,000)	Local tax receipts ($1,000)
Orleans (1)	$ 984,363	$229,713	39,999	$38,627	$27,438
Jefferson (2)	162,131	38,671	6,347	6,362	3,187
St. Mary (9)	26,857	6,738	1,014	1,054	539
St. Tammany (11)	21,203	4,162	759	832	591
Tangipahoa (12)	14,911	3,002	566	585	283
Lafourche (13)	13,342	2,841	493	524	259
Terrebonne (16)	11,886	2,973	411	466	244
Plaquemines (17)	9,942	2,859	359	390	26
Iberia (20)	6,645	1,267	222	261	117
Livingston (29)	3,033	517	89	119	59
St. Bernard (30)	2,877	517	88	113	82
St. Charles (35)	2,203	451	82	86	23
St. John (48)	1,103	233	47	43	11
St. James (64)	11	1	0	0	0
State Totals	$1,814,444	$415,424	71,243	$71,200	$44,767
Deltaic Plain Total	$1,260,507	$293,945	50,476	$49,462	$32,859
Percent of state	69.5	70.8	70.9	69.5	73.4

Source: United States Travel Data Center 1978.

Orleans and Jefferson parishes rank first and second in total expenditures (Table 79). In 1976, 54 percent of the State's tourist dollars were spent in Orleans Parish alone. Crawford and Nebel (1977) report that the largest single expenditure was for food and drink (Table 80). The United States Travel Data Center (1978) reported $162 million in tourist-related sales in Jefferson Parish. Coupled with Orleans Parish's total of $984 million, the two parishes were responsible for 63 percent of Louisiana's travel expenditures (Table 78).

The remaining Deltaic Plain parishes added 6.3 percent, with St. Mary (9th), St. Tammany (11th), Tangipahoa (12th), Lafourche (13th), Terrebonne (16th), Plaquemines (17th), and Iberia (20th) ranking in the top 20. These seven parishes were responsible for $104.8 million in sales. The remaining five parishes in the Deltaic Plain, i.e., Livingston, St. Bernard, St. Charles, St. John, and St. James, each produced less than $5 million. St. James Parish ranked last in the State, receiving only $11,000 (Table 78).

Travel-generated wages and salaries in the Deltaic Plain

Travel expenditures contribute to business receipts which are used to pay employee salaries and wages. In 1976, $415.4 million in wages and salaries was attributable to the Louisiana tourist industry (Table 79). In other words, 23 cents of every tourist dollar spent went to salaries.

Table 79. Economic impact of travel in the Deltaic Plain parishes in 1976 (by percent of State).

Parish	Total expenditures	Travel payrolls	Travel employment	Local tax receipts
Iberia	0.37	0.30	0.31	0.26
Jefferson	8.94	9.31	8.91	7.12
Lafourche	0.74	0.68	0.69	0.58
Livingston	0.17	0.12	0.13	0.13
Orleans	54.25	55.30	56.14	61.29
Plaquemines	0.55	0.69	0.50	0.06
St. Bernard	0.16	0.12	0.12	0.18
St. Charles	0.12	0.11	0.11	0.05
St. James	0.00	0.00	0.00	0.00
St. John	0.06	0.06	0.07	0.03
St. Mary	1.48	1.62	1.42	1.21
St. Tammany	1.17	1.00	1.07	1.32
Tangipahoa	0.82	0.72	0.79	0.63
Terrebonne	0.66	0.72	0.58	0.55
Percent of state	69.49	70.75	70.84	73.41

Note: Figures here show the economic value of travel in the Deltaic Plain as a percentage of the economic value of travel in Louisiana.
Source: United States Travel Data Center 1978.

A 1977 study reports that air transportation, lodging, food, and drink generated the greatest personal income in the New Orleans area (Table 81). Eating and drinking establishments benefited most from this tourist traffic. Although there are no substantiating data, part of the attractiveness of the New Orleans area restaurants may be due to fresh seafood cuisine.

Table 80. Traveler expenditures by industry, New Orleans SMSA, 1972 ($000).[a]

Industry[b]	Expenditures
Air Transportation	$ 67,111
Taxicab companies	4,767
Automotive dealers	16,240
Gasoline service stations	25,925
Intercity highway passenger transportation	2,536
National Railroad Passenger Corporation	245
Hotels, motels, & tourist courts	61,434
Camps & trailer parks	489
General residential contractors & operative builders	5,099
Amusement & recreation services, including motion pictures	30,720
General merchandise & miscellaneous retail stores	68,372
Eating & drinking places	105,372
TOTAL	$387,912

[a]Thousands of dollars.
[b]Passenger ship service to the Port of New Orleans did not begin until 1973.

Source: Crawford and Nebell 1977.

Travel employment in the Deltaic Plain

Travel expenditures in Louisiana were responsible for 71,243 jobs; 50,476 or 70.8 percent of these jobs were located in the Deltaic Plain (Table 78). Orleans and Jefferson led all the other parishes with a combined total of 46,346 jobs or 65 percent of Louisiana's travel-related employment. With the exception of St. Mary (1,014), St. Tammany (759), and Tangipahoa (566), the remaining Deltaic Plain parishes each had fewer than 500 people employed in the travel/tourist industry.

Table 81. Traveler-generated personal income by industry New Orleans SMSA, 1972.

Industry[a]	Personal income
Air Transportation	$ 16,530,000
Taxicab companies	1,252,000
Automotive dealers	1,576,000
Gasoline service stations	2,298,000
Intercity highway passenger transportation	1,131,000
National Railroad Passenger Corporation	109,000
Hotels, motels, & tourist courts	18,575,000
Camps & trailer parks	104,000
General residential contractors & operative builders	682,000
Amusement & recreation services, including motion pictures	8,935,000
General merchandise & miscellaneous retail stores	9,571,000
Eating & drinking establishments	25,016,000
TOTAL	$ 85,779,000

[a]Passenger ship service to the Port of New Orleans did not begin until 1973.

Source: Crawford and Nebell 1977.

St. James is the only parish in the state with no employment in the tourist industry (Table 78). Like St. John Parish, St. James Parish is largely agricultural and lacks coastal tourist attractions.

Because small communities often do not provide the full range of tourist services and facilities, they seldom share in the diversity of tourist-related employment, as do larger cities such as New Orleans. The New Orleans area is assumed to be representative of potential employment opportunities (Table 82). It can be demonstrated that many tourist-related jobs tend to be located principally in major cities. On the other hand, small communities benefit from additional jobs in gasoline stations, retail stores (especially convenience stores), eating and drinking establishments, bait shops and other activity-support services.

Table 82. Travel industry employment by occupation
New Orleans SMSA, 1972.

Industry[a]	Employment
Air transportation	1,509
Taxicab companies	311
Automotive dealers	227
Gasoline service stations	626
Intercity highway passenger transportation	129
National Railroad Passenger Corporation	8
Hotels, motels, & tourist courts	4,888
Camps & trailer parks	31
General residential contractors & operative builders	112
Amusement & recreation services, including motion pictures	1,769
General merchandise & miscellaneous retail stores	2,266
Eating & drinking establishments	7,903
TOTAL	19,779

[a]Passenger ship service to the Port of New Orleans did not begin until 1973.

Source: Crawford and Nebell 1977.

Travel-generated tax revenue within the Deltaic Plain

In 1976, the travel industry was responsible for $71.2 million in State tax revenue (Table 78). According to the United States Travel Data Center (1978) these receipts were responsible for 4.3 percent of all State tax revenue in the United States for 1976. Each travel dollar generated 3.9 cents in taxes. Traveler generated sales tax receipts by industry are indicated in Table 43. Federal receipts are limited to air travel and fuel sales, whereas state and local tax receipts are generated from the full range of industries except for air transportation.

Following the pattern established by expenditures, payrolls, and employment, more State tax revenue is produced by Orleans Parish than any other. In 1976, the

Table 83. Traveler-generated sales tax receipts by industry, New Orleans SMSA, 1972 ($000).

Industry	Local	State	Federal	Total
Air transportation	$ 0	$ 0	$5,369	$ 5,369
Automotive dealers	379	567	0	956
Gasoline service stations	582	2,738	1,369	4,689
Hotels, motels, and tourist courts	2,219	1,725	0	3,944
Camps and trailer parks	14	14	0	28
Amusement & recreation services, including motion pictures	830	871	0	1,701
General merchandise & miscellaneous retail stores	1,857	1,947	0	3,804
Eating and drinking places	2,847	2,985	0	5,832
TOTAL	$8,728	$10,847	$6,738	$26,313

Source: Crawford and Nebell 1977.

Parish's tourist industry added $38.6 million to Louisiana's treasury. Jefferson contributed $6.3 million. Together, they were responsible for 63.19 percent of Louisiana's travel-related tax receipts. With the exception of St. Mary Parish, the remaining Deltaic Plain parishes added less than $1 million each to the State's travel-related tax revenue (Table 78).

In local taxes, the United States Travel Data Center (1978) reported that $44.7 million were collected in Louisiana from travel (Table 78). Approximately 2.4 cents per travel dollar went to city, town, and parish governments. This is above the national averge of .08 cents per travel dollar.

Government officials in Orleans and Jefferson Parishes collected $30.6 million in local taxes in 1976, the highest in the State. New Orleans received 61.29 percent of the total and Jefferson accounted for 7.12 percent (Table 79). A healthy tourist industry is an important factor in the monetary structure of these parishes. With the exception of St. Mary (1.21) and St. Tammany (1.31), the remaining Deltaic Plain parishes were each responsible for less than 1 percent of the total (Table 79). Local tax receipts from these 10 parishes totaled only $1.1 million.

New Orleans - City for Tourists and Conventions

New Orleans' tourist and convention trade serves as an indicator of the rapid expansion of the hospitality industry. New Orleans' charm, restaurants, music, and historical ambience were largely ignored until the early 1960's when the city's business community discovered the dollar value of tourism. Rather than being a leader in the tourist industry, New Orleans was an upstart. It lacked proper exhibit areas, sufficient hotel rooms, and a well-financed agency in charge of promoting the city. To improve visitor promotions, The Greater New Orleans Tourist and Convention Commission was established. The Commission developed its budget through a continuous membership campaign and dramatically increased the money spent by the Chamber of Commerce on tourism/convention-related advertising. The promotions were focused on the city and its special events-- including the Sugar Bowl, Mardi Gras, and Spring Fiesta. Out-of-town visitors began to increase and more than 2.5 million people travelled to and through the Greater New Orleans areas in the fiscal year 1969-1970 (New Orleans 1973). Accompanying the rise in visitors was increased spending. The 1969-1970 fiscal year totaled $223 million in revenues.

To build a strong tourist trade, New Orleans began to promote conventions. The combination of the family tourist and convention trades would create jobs, investment opportunities, and new demands for goods and services. The Tourist and Convention Commission organized a sales force and began to seek convention bookings.

During the 1960 to 1970 period, convention attendance improved (Table 84). The results were impressive. Tourist/conventioneers provided $190 million annually to the local economy of New Orleans during this 10 year period (New Orleans 1970). This money helped revitalize the central business district and environs. Most big cities' downtown areas are no longer viable economic entities; they have been recycled into office complexes. Downtown New Orleans, however, is expanding -- an anomaly during the period of "flight to the suburbs". Convention bookings increased in value from $7.5 million in 1961 to nearly $90 million in 1969 --a 1,100 percent increase. Convention attendance also quadrupled -- from 57,948 delegates in 1960 to 262,472 in 1969-1970.

In 1981, the Shriners of North America convention will bring more than 50,000 Shriners and their families to the city -- just 7,948 short of the 1960 total convention attendance (Kiefner 1979). A record number of groups held their conventions in New Orleans. By 1970, the city's promotional program had brought New Orleans out of the tourist doldrums. Few American cities can match the building boom that added nearly 10,000 rooms between 1963 and 1978 . By 1978, the greater New Orleans area had nearly 20,000 rooms that could be used by conventioneers.

In a relatively short period of time, the travel/convention industry became an important segment of the New Orleans economy (Table 85). Food, refreshments, air travel, and lodging generated 61 percent of traveler-generated business receipts. After 1970, tourism became New Orleans' number two industry, with only the port producing more revenue. After 1972, New Orleans began to attract conventions with 20,000 or more delegates each. The hotel/motel expansion provided the necessary rooms, and the Superdome and Rivergate exhibition centers offered additional space to improve the city's attractiveness to these mega-conventions. In 1975, New Orleans booked more conventions than any other city in the Nation (New Orleans 1975).

Table 84. New Orlean's conventions statistics, 1960-1978.

	Number of conventions	Attendance	Revenues
1960	--	57,948	$ --
1961	--	56,613	--
1962	--	70,340	--
1963	--	86,083	--
1964	--	106,942	--
1965	--	120,000	--
1966	--	170,000	--
1967	--	189,500	--
1968	--	221,855	--
1969-70	590	262,472	44.6 million
1970-71	707	263,184	50.0 million
1971-72	715	276,454	55.3 million
1972-73	610	323,920	64.8 million
1973-74	769	367,100	73.4 million[a]
1974-75	788	383,664	99.7 million[b]
1975-76	n.d.	427,170	111.0 million[b]
1976-77	764	497,976	129.4 million[b]
1977-78	753	523,000	136.0 million
TOTAL	5,696	4,404,221	$764.2 million

[a]Based on 1966 International Association of Convention and Visitors Bureaus Delegate Expenditures Survey.

[b]Based on 1974 International Association of Convention and Visitors Bureaus Delegate Expenditures Survey.

--No data published in Annual Reports New Orleans.

Source: New Orleans 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978.

Not only has the convention trade expanded, but so has the number of outstanding festivals and key events that contribute to increased domestic tourist traffic (Table 86). The Jazz and Heritage Festival, Spring Fiesta, Sugar Bowl, Mardi Gras, Super Bowls, and special exhibitions such as the Tutankhamen traveling exhibition at the New Orleans Museum, attract huge crowds from out-of-state. Most of these guests stay in New Orleans overnight, eat at one or more of the city's restaurants, and buy souvenirs. In 1976, New Orleans' travelers spent $561 million, an increase of $193 million over 1972 (New Orleans 1977). By 1976, there were approximately 46,500 jobs attributable to the travel and hospitality industry of the New Orleans area which amounted to 65 percent of all these job types in the State.

Devaluation of the dollar and direct European air service have increased the flow of foreign tourists into the Greater New Orleans region. International visitors from Canada, France, England, West Germany, Australia, Japan, Switzerland, The Netherlands, Mexico, and Belgium (Table 87) have added to the tourist traffic. Like all tourists and conventioneers, these travelers are a part of a travel trade that helps support the economic well-being of the City of New Orleans.

Resource-Based Tourism in the Deltaic Plain

As indicated above, tourism in the Deltaic Plain focuses on attractions in the Greater New Orleans area and much economic benefit accrues to Orleans and Jefferson parishes. Tourism based on unique natural environments and renewable resources of the coastal wetlands appears to be underdeveloped. This is reflected in the number of out-of-state fishing and hunting licenses issued in the Deltaic Plain Region (Tables 50 and 56). Although improvements in surface transportation as well as the dredging of hydrocarbon-industry canals and initiation of charter boat services have facilitated public access, there is a general lack of on-site improvements, especially with regard to visitor stations, boardwalks, and so forth.

The proposed Atchafalaya Fish, Wildlife and Multi-Use Area and developing the Atchafalaya wilderness center in the Atchafalaya River Floodbasin along the western margin of the Louisiana Deltaic Plain could provide some badly needed resource-based tourism. Current estimates suggest that the value of the Floodway's fish, wildlife, and related recreation resources is $97 million/year. Over 300 species of birds inhabit this wetland, including thousands of wintering ducks and coot as well as the largest North American population of American woodcock. Moreover, at least 90 species of fish, crawfish, crab, and shrimp support sport and commercial fisheries in this river-estuarine swamp. During the 1971-1974 period, recreation in this 443,000-acre swamp averaged 702,000 visitor-days annually, for an average of $138 per visitor-day (United States Department of Interior 1977). With public purchase and multiple-use management, this wetland system could be an important tourist attraction much like the Florida Everglades.

RECREATION ALONG THE MISSISSIPPI GULF COAST

Unlike Louisiana's deltaic plain, Mississippi's coastal counties are not characterized by extensive tracts of marsh. Although there are 26,062 hectares (64,398 acres) of tidal marshes fringing coastal lowlands (Christmas 1973), leisure-time pursuits are oriented traditionally towards the area's beaches. The marshes serve as a nursery area and natural habitat for many species of fish and waterfowl, contribute to the seafood industry, and are available for recreational and aesthetic enjoyment (A Report of the Mississippi Marine Resources Council 1973). It is the beach, however, that attracts recreational interest. The "Coast's" 41.8-kilometer (26-mile) man-made, white sand beaches are the focal point of the recreational landscape; salt-water fishing and general resort activities are the prevalent attractions.

The indigenous population as well as tourists and travelers recognize the value of the beach as a recreational resource. Developed originally to protect the seawall and U.S. Highway 90, the beach is a multi-purpose water-related resource (Cartee and Williams 1978). The beach overshadows the marsh in importance, yet part of the recreational activity that takes place on the beach is a result of the wetland habitat.

With 90 percent of the State's beaches, two-thirds of the marinas, and one-fourth of Mississippi's boat launching ramps on the Gulf Coast, the importance of the coastal recreational activities is obvious (Tatum et al. 1969). Salt-water

Table 85. Travel-generated business receipts by industry New Orleans SMSA, 1972 ($000).

Industry[a]	Receipts
Air transportation	$ 61,742
Taxicab companies	4,767
Automotive dealers	15,294
Intercity highway passenger transportation	2,536
National Railroad Passenger Corporation	245
Hotels, motel, and tourist courts	57,490
Camps and trailer parks	461
General residential contracts and operative builders	5,099
Amusements & recreation services, including motion pictures	29,019
General merchandise and miscellaneous retail stores	65,070
Eating and drinking establishments	99,540
TOTAL	$361,599

[a]passenger ship service to the Port of New Orleans did not begin until 1973.

Source: Crawford and Nebell 1977.

activities dominate other activities, with freshwater fishing, boating, and water skiing occupying a secondary level on the list of recreational preferences.

The absence of significant freshwater recreational opportunities is counterbalanced by the availability of public parks and other outdoor facilities (Table 88). Buccaneer, Gulf Marine, and Shepard State Parks (Mississippi State Parks 1978), as well as DeSoto National Forest (the largest forested area in Mississippi under single ownership), Little Biloxi, Red Creek, and Pascagoula Game Management Areas (Table 89); the Pearl, Wolf, Biloxi, Tchoutacabouffa and Pascagoula Rivers; Airy and Big Biloxi and Tuyachanie Lakes; and Davis Bayou and the offshore islands (East and West Ship, Horn, and Petit Bois) that make up the Gulf Island National Seashore, all provide numerous fresh and salt-water recreational activities. Nevertheless, it is the beach that dominates the recreational activity. With 295 hectares

Table 86. Origin of domestic tourist traffic into Louisiana. States with 50,000 or more tourists, 1978.

State	Number of tourists[a]
Alabama	149,534
Arkansas	86,659
Florida	159,310
Georgia	62,039
Illinois	53,011
Mississippi	202,661
Ohio	54,391
Texas	319,512

[a]Data from tourist information centers.

Source: Hidalgo 1979.

Table 87. Origin of foreign tourists into Louisiana. Countries with 1,000 or more tourists, 1978.

Country	Number of tourists[a]
Australia	5,491
Belgium	1,353
Canada	40,557
Denmark	1,027
France	9,838
Germany	10,319
Iran	1,832
Israel	1,771
Italy	1,328
Japan	2,679
Mexico	7,593
Netherlands	2,873
New Zealand	1,722
Puerto Rico	1,555
South Africa	1,040
Sweden	2,584
Switzerland	3,121
United Kingdom	15,405
Venezuela	1,701

[a]Data from tourist information centers.

Source: Hidalgo 1979.

Table 88. Mississippi's State parks, National seashore and forest, and lakes.

Park	Nearest town	Description
STATE PARK		
Buccaneer	Waveland	Camping, lodge, swimming, picnicking, and fishing available.
Gulf Marine	Biloxi	Camping, fishing, and picnicking available along with piers and docking over the Gulf of Mexico.
Shepard*	Gautier	Campground, visitor's center, swimming pool, tennis courts, and nature interpretive center are part of the park facilities.
GULF ISLAND NATIONAL SEASHORE		
Davis Bayou	Ocean Springs	55 trailer hook-up sites, 26 tent showers, boat launching ramps with access to Gulf channels. Picnicking and fishing available.
Ship Island	Pascagoula	Primitive camping allowed on eastern end. Guided tour of Fort Massachusetts. Boats run once daily, twice on weekends. April 1 - Labor Day.
Horn Island		Wilderness Areas.
Petit Bois Island		Wilderness Areas.
NATIONAL FOREST		
DeSoto		The National Forest provides a protective habitat for wildlife, a resource base for the forest industry, a protected watershed, and facilities for camping, picnicking, and hiking.

(continued)

Table 88. (concluded)

Park	Nearest town	Description
LAKES		
Airy Lake	Biloxi	Boating, picnicking, and fishing on lake, but no motors allowed.
Big Biloxi	Gulfport	Camping, boating, picnicking, and fishing available. Nature trail around lake.
Tuxachanie	Gulfport	Hiking trail and picnicking available.

Source: Mississippi State University 1978.

(730 acres) of man-made beach property, plus 738.1 hectares (1,824 acres) of associated offshore islands, the areaprovides swimming, sunbathing, and other salt-water recreation (Tatum et al. 1969).

There are little published data on recreation in Mississippi's coastal counties. Much of the available data, particularly with regard to hunting and fishing, are not available by county. A study by Tatum et al. (1969) represents the only available source on projected recreation demand. Implementation of coastal zone management plans, which have already been drafted, will probably alleviate much of this poorly understood recreation demand.

Mississippi's Recreation-Oriented Beaches and Wetlands

Mississippi's coast is rimmed by an attractive beach. This linear strand, classified as an alluvial coast (terraced deltaic plain) (Upshaw et al. 1966) was first settled in the early 1700's. The Mississippi coastal economy has depended, over the years, on a diversity of activities, ranging from agricultural and livestock production, forestry and fisheries to shipbuilding, naval stores and tourism (Christmas 1973). Fisheries, shipbuilding, manufacturing, and tourism continue to play an important economic role along the coast today.

The accessible beaches provide an attractive site for shoreline recreation. From Galveston to Mobile, the only salt-water beach of any size is along the Mississippi Gulf coast (Tatum et al. 1969). The cities of Bay St. Louis, Waveland, Pass Christian, Long Beach, Gulfport, Biloxi, Ocean Springs, Gautier, Moss Point, and Pascagoula offer a wide range of year-round recreational activities. When the expanding urban population in the New Orleans' metropolitan area is combined with the Gulfport-Biloxi-Pascagoula-Moss Point population nodes, water-oriented sports become available currently to more than 1.5 million people for day or overnight use. The convenience of the coastal lowlands and the absence of user fees, contribute to the region's recreational appeal. In one season, 124,350 people utilized the region's beaches, with July accounting for 26.5 percent of the users (Table 90).

Biloxi consistently accounts for the largest percentage of beach use. During the height of the season, as much as 51 percent of the people using the beach are

Table 89. Fish and wildlife areas in Mississippi's coastal counties, general description by location, 1977.

Name of area	County	Total acreage	Refuge acreage	Principal game available
Little Biloxi	Harrison, Stone	17,548		Big game (deer and turkey) Upland game (squirrel, rabbit, quail, dove, etc.) Waterfowl
Red Creek	Harrison, Stone Jackson, George	184,129	5,960	Big game (deer and turkey) Upland game (squirrel, rabbit, quail, dove, etc.) Waterfowl
Pascagoula	George, Jackson	32,000		Big game (deer and turkey) Upland game (squirrel, rabbit, quail, dove, etc.) Waterfowl
	TOTALS	233,677	5,960	

Source: Mississippi State University 1978.

concentrated in the Biloxi region. This zone contains most of the hotel-motel properties with easy beach access and all of the major convention hotels. During the peak summer months, the shoreline parallel to Biloxi is convenient for conventioneers. When the hotel-motel facilities are operating at near capacity, so is the beach (Cartee and Williams 1978).

Railroad service from the Mississippi coast to New Orleans made the unbroken beach an attractive site for summer homes. With improved transportation routes, cotton planters, sugar growers and merchants from Natchez to New Orleans built raised cottages and other types of summer homes. As the seasonal population expanded, the region's recreational potential was established. While Louisiana's marshes provides the outdoorsmen with an immense diversity of hunting and fishing opportunities, the Mississippi "Coast" is characterized by a more "social" atmosphere.

Part of the region's charm is the homes that survived the numerous hurricanes that have struck the Mississippi coast. In addition to the large galleries and enclosed verandas of the larger "summer residences", contemporary "cottages" are now a part of the Waveland, Pass Christian, Bay St. Louis, Long Beach, Gulfport, Biloxi, and Pass Christian landscapes. Improved accessibility is intensifying demand for property. Though the destruction associated with Hurricane Camille in 1969 was catastrophic, homes are being rebuilt. Some sites remain vacant, but new recreational dwellings are replacing those destroyed. Real estate values range from $2,460 to $4,101 per meter ($750 to $1,250 per frontage foot). These summer or retirement homes serve as year-round recreational housing for the permanent and transient population. For more than 100 years, the "Coast" has been a recreational resort -- a role it continues to fulfill.

Table 90. Estimated average Mississippi Gulf coast beach utilization levels[a] by months on Mississippi coast: August 1977 to July 1978.

Month	Average users[a]	Percent of total
January, 1978	1,950	1.6
February, 1978	1,975	1.6
March, 1978	10,200[b]	8.2
April, 1978	14,100	11.3
May, 1978	20,200	16.2
June, 1978	18,900	15.2
July, 1978	32,900	26.5
August, 1977	14,400	11.6
September, 1977	4,000	3.2
October, 1977	1,975	1.6
November, 1977	1,900	1.5
December, 1977	1,850	1.5
TOTAL	124,350	100.0

[a]Average use data are not adjusted for inclement weather conditions.

[b]Represents the weighted average of three survey days the latter of which included the Easter vacation period during the late part of the month when counts were markedly higher than the first part of the month.

Source: Cartee and Williams 1978.

The citizens of the region also recognize the importance of recreational activities within the coastal zone (Table 91) and are planning for the wise use of the coastal water resources (Table 92). In order to protect their coast, they want heavy industrial development confined to industrial parks (Table 93), and endorse the purchase of wildlife and fisheries habitats to preserve the region's aquatic and terrestrial game (Table 94). They spend a considerable amount of time out-of-doors and recognize that as the population expands so will the demand for recreational space. It has been estimated that "the recreational participation of the resident population may increase three times by 1990" (King and Associates 1971:27).

Traditionally, these residents have enjoyed their leisure-time. The coastal zone's beach, forests, rivers, and estuarine habitats provide numerous opportunities

Table 91. Citizens' perception of whether recreational activities in the Mississippi coastal area are more important than other uses of waterfront land.

City/Region	% Yes	% No	% Undecided
Bay St. Louis	50.0	43.3	6.7
Waveland	57.1	35.7	7.1
Hancock County (unincorporated areas)	31.5	63.2	5.3
Biloxi	53.7	37.2	9.1
Gulfport	52.1	39.5	8.4
Long Beach	43.3	44.0	12.7
Pass Christian	51.3	38.5	10.3
Harrison County (unincorporated areas)	46.0	42.2	11.8
Moss Point	43.1	48.0	8.9
Ocean Springs	52.2	37.6	10.2
Pascagoula	47.5	40.2	11.7
Jackson County (unincorporated areas)	49.5	40.6	9.9

Source: Minor et al. 1977.

for recreational enjoyment. "These resources have encouraged much interest and participation among the masses in activities more physical than intellectual, more active than passive, more water-oriented than land-oriented, and more provincial than typical of southern and national patterns" (King and Associates 1971:27). The coastal dweller respects the recreational opportunities available to him and he wants it preserved.

Principal Recreation Activities

Along the "Coast" several types of recreational endeavors are available. Boating, fishing, and sunbathing are the most obvious. For the avid sportsmen, hunting, crabbing, golf, picnicking, and camping are also available. For the family, the "Coast" has two theme parks: Eight Flags Over Biloxi and Marine Life. Both offer families an opportunity to enjoy an outing. These theme parks are close enough to New Orleans to warrant advertising on television stations there. This expands their market areas and adds to the region's appeal.

Table 92. Citizens' perception of whether effective guidelines should be established for the use of land and water resources in Mississippi's coastal zone.

Response	% of total responses	Hancock County (%)	Harrison County (%)	Jackson County (%)
Yes	92.3	93.4	92.3	92.0
No	3.7	1.7	3.9	3.8
Undecided	4.0	5.0	3.8	4.2

Source: Minor et al. 1977.

Table 93. Citizens' perception of whether heavy industrial development should be confined to industrial parks established for this purpose along the Mississippi Gulf coast.

Response	% of total responses	Hancock County (%)	Harrison County (%)	Jackson County (%)
Yes	84.7	78.0	86.0	83.8
No	10.0	15.4	8.3	11.8
Undecided	5.4	6.6	5.8	4.4

Source: Minor et al. 1977.

Hunting

The wetlands and the region's wildlife management areas and national forests are valuable wildlife habitats. Game hunted in these areas include: deer, dove, quail, rabbit, squirrel, turkey, waterfowl, woodcock, and furbearers. The three wildlife management areas (Little Biloxi, Pascagoula River, and Red Creek) comprise 945.7 square kilometers (365.1 square miles) of land area in Harrison, Stone, George, and Jackson Counties. The 94,568 hectares (233,677 acres) involved provide the outdoorsman with an opportunity to spend leisure time in a protected sanctuary for game animals.

Although only 3 of the State's 25 wildlife management areas are within the "coastal flatwoods", they account for approximately 20 percent of Mississippi's wildlife management areas, national wildlife refuges, and waterfowl areas. In Mississippi, there are approximately 445,164 hectares (1.1 million acres) of State or

Federally controlled game habitats; 94,567.8 hectares (233,677 acres) in the southern two tiers of counties. Red Creek's 74,516 hectares (184,129 acres) is the State's largest management area and it accounts for 78.8 percent of the "controlled habitat" (Hunt in Mississippi n. d.). Proposed developments along the Jourdan River and in the Stone-Harrison primitive area will further add to the region's recreational inventory (Tatum et al. 1969).

Published data on hunting in Mississippi are available only for the State. No data were collected by individual counties. In Mississippi, a 1976-1977 mail survey revealed that dove, squirrel, and deer hunters were the most numerous. The hunting of game animals involved 464,982 hunters; 118,931 reported they hunted dove; 167,308 were squirrel hunters; and 178,743 hunted deer (146,475 used guns, archery hunters numbered 21,131, and "primitive weapons" (traps and snares) accounted for 11,137) (Table 95).

Dove hunters spent 588,944 days in the field. For their efforts, they bagged 3,415,722 birds. Each sportman averaged 5.8 doves per day and reported a seasonal harvest of 28.7. Dove hunters spent only an average of 4.95 days in the field and the dove kill was excellent. These outdoorsmen were the most successful in Mississippi. Quail hunters totaled 57,974, but each hunter managed to harvest an average of 23.3 birds per season. They rank second to dove hunters (Table 96).

Squirrel hunters spent 1,509,287 days in the field. The 167,308 individuals involved managed to harvest 3,320,510 animals -- second only to dove in number of animals killed. Mississippi's squirrel hunters bagged 2.2 animals per day, spent 9 days in the field, and harvested an average of 19.9 animals during the season (Table 95).

Table 94. Citizens' perception of whether Mississippi should preserve unusual areas where fish and wildlife live and breed by purchasing these areas from private individuals.

Response	% of total response	Hancock County (%)	Harrison County (%)	Jackson County (%)
Yes	70.0	76.9	70.4	67.8
No	17.3	11.0	16.1	20.5
Undecided	12.8	12.1	13.5	11.7

Source: Minor et al. 1977.

In the State of Mississippi in 1976-77, 83 percent of the 178,743 deer hunters used guns; those using other weapons accounted for 18 percent of deer harvested. The 146,475 gun hunters spent 1,410,199 days in the field, or an average of 9.6 days per hunter. The total deer harvest for this period was 83,182; which indicates approximately 2 days in the field for every deer taken. Racoon hunters were more persistent than those after deer and averaged 11.3 days in the field with a total harvest of 291,907, for 287,328 days in the field, or approximately one raccoon per day (Table 96).

There were 21,131 archers who spent 172,176 days in the field. Only 6,314 deer were bagged using a bow. One out every three bow hunters was successful (Table 96).

The smallest number of deer hunters used "primitive weapons". The 11,137 individuals involved in the sport spent a total of 47,835 days in the field. Each sportsman averaged 4.3 days of hunting time. Only 4,375 deer were harvested using "primitive weapons"; - 0.09 animals were harvested per day, with 0.39 per hunter taken during the season (Table 96).

In the 1976-1977 season, the Mississippi mail survey reported 35,699 turkey hunters in the State. These individuals spent 21.766 days in the field. For their efforts, 19,192 birds were harvested. Each hunter spent 5.96 days in the field. Fifty percent of the hunters were successful within the coastal counties. Less than one percent of the State's turkey harvest was taken per day (Table 95).

Game Animal Harvest in Coastal Counties

Deer

In 1965, the three coastal counties in Mississippi accounted for a deer harvest of 222, with 53.2 percent of these animals killed in Harrison County (Table 96).The harvest in this management area was nearly three times that of the coastal counties in 1965, but less in 1975. During the 1976-1977 reporting period, 510 animals were harvested -- a 129.7 percent increase. In the 1976-1977 season, Jackson County hunters harvested 250 deer. Although the 1976-1977 season was one of the best, 1975 was outstanding. The coastal county's hunters harvested 686 -- a 209 percent (464 animal) increase in a decade. On the Red Creek management area, the deer harvest since 1965 averaged about 560 animals (Table 97).

Turkey

The Game Division, Mississippi Game and Fish Commission, reported only 37 turkeys harvested in the Coastal Plain of Mississippi in 1956. By 1976, the quantity increased to 171, and in 1978 turkey hunters killed 193 birds (Table 98). The largest number derived from the public and private hunting areas in Jackson County. In 1978, the Deltaic Plain Region reported an annual harvest of an average of 193 birds, or 2 percent of the State's total. Since 1965, there have been 1,311 turkeys removed from the Gulf Coast's three game management areas (Table 99). The Red Creek management area is particularly productive.

Waterfowl

The coastal lowlands serve as a habitat for waterfowl, as well as for deer and turkey. In 1976-1977, the Mississippi Game and Fish Commission conducted a mail survey of game harvested which was based on a combined total of 270,378 hunting and fishing, and hunting only, licenses sold. The survey revealed there were 36,146 waterfowlers in Mississippi. These duck hunters spent 283,244 total days in the field and harvested 672,814 birds. Each hunter averaged 18.61 ducks during the season. The hunter killed an average of 2.38 per day and spent an average of 7.84 days of the season hunting (Table 95). Since the data are not available by county, the harvest in the Deltaic Plain cannot be determined.

Table 95. Expanded summary, 1976-1977, Mississippi mail survey of game harvest based on 270,378 combination hunting and fishing and hunting only licenses sold.

Species	Total hunters	Percent of total licenses	Total days afield	Total harvest	Average daily bag	Average season bag	Average days afield
Dove	118,931	44.0	588,944	3,415,722	5.8	28.7	4.9
Quail	57,974	2.14	469,122	1,350,548	2.9	23.30	8.0
Rabbit	89,248	33.0	808,762	1,281,138	1.6	14.4	9.0
Squirrel	167,308	61.9	1,509,287	3,320,510	2.2	19.9	9.0
Raccoon	25,407	9.4	287,328	291,907	1.0	11.5	11.3
Woodcock	5,320	2.0	20,864	37,091	1.8	6.9	3.9
Turkey	35,699	13.2	212,766	19,192	0.1	0.5	5.9
Deer							
Gun	146,475	54.2	1,410,199	83,182	0.06	0.56	9.6
Archery	21,131	7.8	172,176	6,314	0.04	0.30	8.1
Primitive Weapons	11,137	4.1	47,835	0.09	0.39	4.30	--
Duck	36,146	13.4	283,244	672,184	2.34	18.6	7.8

Source: Investigations to improve the management of white-tailed deer in Mississippi, Study completion report. 1977.

Table 96. Mississippi coastal counties deer harvest,[a] 1965-1977.

County	Year											
	65	66	67	68	69	70	71	72	73	74	75	76-77
Hancock	21	26	69	81	52	70	37	42	66	152	175	75
Harrison	118	83	94	133	105	126	92	103	68	160	196	185
Jackson	83	152	129	129	179	137	204	168	321	214	315	250
Total	222	261	292	343	336	333	333	313	455	526	686	510

[a]Data are from wardens' reports from public hunting areas only.

Source: Pharris 1979.

Fishing

Most of the fresh and salt-water estuarine-dependent fish species that inhabit Louisiana's marshes are present in Mississippi's bays, marshes, and estuarine environments. These coastal environments serve as a breeding ground and habitat for the principal recreational fish caught along Mississippi's coast. Salt-water angling is excellent. Support facilities are available, but are not sufficient or adequate in number or quality to meet the rapidly growing public need and demand. Within the region there are at least 104 launching ramps and 60 marinas offering storage space for 1,643 boats, but more are needed for residents and tourists as well (Tatum _et al_. 1969, King and Associates 1971).

Freshwater recreational activities such as fishing, swimming, boating, and waterskiing are not as prevalent in the MDPR as salt-water activities. When compared with Mississippi's interior, freshwater fishing acreage in the coastal zone is quite low. There are only about 2.4 hectares (6 acres) for each 1,000 people. In contrast, opportunities for salt-water angling are quite good (Tatum _et al_. 1969) and a license is not required for ocean fishing. The barrier islands offshore are Mississippi Sound's southern boundary. Variable water depth in this relatively narrow zone between the islands and the mainland coast also serves to attract game fish and salt-water anglers.

In the inshore and offshore waters, five man-made fishing reefs are available to the salt-water angler (Table 100). Off Gulfport there is a .04 hectare (0.1 acre) oyster shell reef. Another is off Fort Bayou in Jackson County; it is the largest of the man-made reefs and encompasses 0.8 hectares (2.1 acres). East of Number 4 Beacon off Biloxi is a .2 hectare (0.5 acre) site (Christmas 1973). Since 1973, another reef has been added to the system. These artificial fishing reefs were built primarily through the efforts of the Mississippi Gulf Fishing Banks Inc. It is a non-profit corporation established in 1968, to generate and promote, "recreation and recreational facilities along the Mississippi Gulf coast and particularly to encourage and to promote sport fishing as a recreational resource in the

Table 97. Deer harvest in the Red Creek management area, 1965 - 1976.

Year		Deer harvest
1965		657
1966		527
1967		432
1968		595
1969		576
1970		596
1971		561
1972		535
1973		n.d.[a]
1974		n.d.[a]
1975		n.d.[a]
1976		604
	Total	5,083

[a]No data.

Source: Pharris 1979.

Mississippi Sound and the Gulf of Mexico" (Daniel and Seward 1975:1,2). Since its inception, the group has developed reefs, using tires, auto bodies, oyster shells and sunken Liberty ships. Whatever the material, the reefs primary purpose is to improve the offshore aquatic habitat and thereby the fishing -- one of Mississippi's most popular sports.

Residents may satisfy fresh water fishing license requirements by purchasing the following: a sportsman's license ($24.00); a combination hunting and fishing license ($13.00); combination small game hunting/fishing license ($49.00); an annual fishing license ($4.00); or a 7-day permit ($3.00). Non-residents may purchase a 7-day tourist permit ($7.00), an annual fishing license (cost equivalent to State of residency but not less than $15.00), or a combination hunting and fishing license ($65.00) (Mississippi Game Fish n.d.).

The Annotated Mississippi Code of 1972 identifies game fish as follows: bream, goggle eye (warmouth bass), crappie (white perch), the black basses and all

Table 98. Mississippi's coastal counties turkey harvest[a].

County	Year							
	1956	1961	1966	1974	1975	1976	1977	1978
Hancock	8	6	21	45	17	45	12	38
Harrison	11	44	54	43	23	48	45	73
Jackson	18	33	33	60	48	78	79	82
Total	37	83	108	148	88	171	136	193
State Total	668	1947	3601	4895	5221	7535	8317	9953
Deltaic plain Total	5.53	4.26	2.99	3.02	1.68	2.26	1.63	1.93

[a]Data are from wardens' reports from public hunting areas only.

Source: Pharris 1979.

other members of the sunfish family; wall-eye (jack salmon), sauger (sand pike) and all other members of the perch family; white bass, yellow bass, sea-run striped bass and all other members of the bass family; and tabby and blue catfish when in non-navigable streams or lakes (Mississippi Game Fish n.d.).

The National Survey of Salt-Water Angling (Deuel 1973) reports that, in 1965, there were 1.2 million salt-water fishermen in the eastern Gulf of Mexico -- a region that extends from the west coast of Florida to the Mississippi delta. By 1970, the number of individuals involved in this sport increased to 1.4 million. In 1965, these salt-water anglers caught 104,551,000 fish; five years later, they improved their catch to 188,888,000. Each fisherman, in the 1970 survey, caught an average of 127.8 fish.

Most of these sportsmen concentrated their efforts in the region's sounds, rivers, and bays, where they harvested 146,536,000 fish. The three principal species caught were catfish, croakers, and spotted seatrout. They accounted for 113,632,000 of the 188,888,000 fish harvested -- or 60 percent of the species caught. In fishing for these species, boats, piers, or jetties were generally used. From these structures, 69.01 percent of the salt-water anglers caught 67.79 percent of the fish. Because the data are presented by geographical area, and not by state, Mississippi's participation in this large industry is not precisely known.

To take advantage of the excellent sport fishing available off Mississippi's coast, 36 charter boats are in business. These vessels are docked at Gulfport, Biloxi, Ocean Springs, and Gautier. Charter excursions usually begin around 6 or 7 a.m. and last up to 10 hours. They cost from $100 for a half day to approximately $500 for an extended weekend. These boats can fish within sight of land or range seaward more than 80 kilometers (50 miles) (Etzold _et al_. 1977).

Table 99. Turkey harvest by game management areas, 1965 - 1977.

Management area	Year													
	65	66	67	68	69	70	71	72	73	74	75	76	77	Total
Little Biloxi	a	a	a	a	a	8	16	18	22	17	23	14	118	
Red Creek	106	75	89	105	72	75	95	103	85	76	71	165	72	1,189
Pasca-goula	a	a	a	a	a	a	a	a	a	a	a	a	22	22
Totals	106	75	89	105	72	75	103	119	103	98	88	188	108	1,311

[a]County or area not open.

Source: Mississippi State University 1978.

Table 100. Artificial reefs in or adjacent to Mississippi's coastal waters.

	Latitude	Longitude	
Ship reefs			
FH3	30°09'04"N	88°44'05"W	2 ships
FH6	30°02'35"N	88°42'22"W	3 ships
Car body reefs			
FH5	30°10'31"N	88°50'37"W	
Tire reefs			
FH1	30°04'54"N	88°36'54"W	
FH4	30°10'0"N	88°54'0"W	

Source: Daniel and Seward 1975.

The charter industry is an important part of the recreational/tourist business. Etzold's (1977) dockside interviews reveal that 63 percent of the fishermen utilizing the charter boat fleet were motivated to visit Mississippi's Gulf Coast specifically to go fishing. This was substantiated by a mail survey. The returns indicate that 73 percent of the individuals who used the charter boat fleet were on "The Coast" to fish.

Improvements in the offshore area, an important charter boat business, a productive estuarine habitat, numerous launching ramps, fishing camps (Table 101) and fishing piers make sports fishing a significant local economic component. Fishing is a year-round activity. Heavy use periods are associated with the summer months when fishermen catch primarily spotted seatrout, Atlantic croaker, and southern flounder. Both salt and freshwater fishing are projected to increase by 1985, and will soon be one of Mississippi's more important sports activities (Tatum et al. 1969). This is not true, however, for freshwater fishing in the coastal counties. A 1976 survey of the freshwater fish in the Jackson County brackish water habitats showed a definite low level of adult catchable game fish. The only sites found to have a good bass population were located outside the areas influenced by high salinities. The freshwater species avoid those areas that are continuously exposed to high salinity levels (Fishing in Mississippi...n.d.). Saltwater species, however, often migrate up the rivers and are caught well beyond their natural habitats.

Crabbing

Blue crab (*Callinectes sapidus*) are caught in the back bays and along Mississippi's coast. This recreational pursuit requires a baited line, a trap or nets. Under ideal spring or summer conditions, the Mississippi sportsman can catch enough crab for a good boil. Weekend crabbers are often seen on the piers and wading through the surf at this time.

Boating

Along the Gulf coast, boating is a popular weekend and seasonal sport. The region has at least 60 marinas that serve as anchorage sites. Within the State, in 1977, there were 168,246 boats; 41,822 or 30 percent were in the Deltaic Plain. Most of these vessels serve coast recreational fishermen (Table 102). In 1977, the coastal zone's registered boats accounted for 24.85 percent of the State total.

Boat-launches are located at strategic sites throughout the area. To meet the needs of the Mississippi boating public in 1969, there were 104 launch ramps and 60 marinas (Tatum et al. 1969, King and Associates 1971). These facilities provide easy access into marsh and offshore fishing areas. The ramps range from small to large, well-maintained hoists and ramp combinations. From these locations, Mississippi's water sports can be enjoyed by coastal-oriented sportsmen.

With 303.5 hectares (750 acres) of boating waterways (excluding offshore), 598 parking spaces with a carrying capacity for 897 cars and trailers, 104 launching ramps that can accommodate 5,200 vehicles, and 1,643 boat storage spaces, the Gulf Coast's boat-oriented sports activity is apparent (Tatum et al. 1969). Inland, the development of the State's reservoir system has enhanced boating. Mississippi has excellent potential, with motorboating becoming a popular outdoor activity.

The State Comprehensive Outdoor Recreation Plan (SCORP) (1969) study reveals that, by 1985, there will be over 40 million occasions per year when people will go boating. This more than doubles the 1970 figure. It will increase at a more rapid rate than any other sports activity. The projected increase is more than 150 percent.

Boating Areas

In 1968, boating sites involved less than 4,000 hectares (10,000 acres). The sport is increasing, however, with expected 1985 demand to exceed 121,400 hectares (300,000 acres). The demand is an indication of the surging popularity of boating (Tatum et al. 1969).

Camp Sites and Group Camps

Along the "Coast" there were, in 1968, a small number of campsites, but the area needed more than 4,000. By 1985, the need will increase to more than 9,000 (Tatum et al. 1969). There are numerous hotel/motel accommodations, but for those individuals who like to camp, there is a shortage of adequate facilities.

In 1968, there were fewer than 5 large camps for groups within the three Gulf Coast counties. Since the coast serves a large recreational market, demand for group camps by 1985 will exceed 130 (Tatum et al. 1969).

Trails

In order to meet the demands of the expanding recreation population, the Gulf coast needs to develop nature and hiking trails. In 1968, there were less than 161 kilometers (100 miles) of trails but, at that time, the region needed nearly 2,900 kilometers (1,800 miles). By 1985, the projected demand will require 5,150 kilometers (3,200 miles) (Tatum et al. 1969) -- the equivalent distance from New York to San Francisco.

Table 101. Mississippi coastal fishing camps, 1978.

Camp	Nearest town
Bay Marina	Bay St. Louis
Bayou Caddy Fishing Camp	Bay St. Louis
Pirates Cove	Bay St. Louis
Bordages Brothers Fishing Camp	Lakeshore
Gulf Marina	Bay St. Louis
Joe's Bayou	Bay St. Louis
Kelly's Fishing Camp	Pearlington
La France's Fishing Camp	Ansley
Marina East	Pearlington
Pearl River Marina	Pearlington
Shangrila Fishing Camp	Pearlington
Wicktom's Fishing Camp	Bay St. Louis
Adam's Lake	Gulfport
Bayview Marina	Pass Christian
Bob's Fishing Camp	Gulfport
Camp "4" Jacks	Biloxi
Cox's Fishing Camp	Pass Christian
David Fishing Camp	D'Iberville
Dawnland Farm	Gulfport
Jiggs Fishing Camp	Gulfport
Lakeview Fishing Camp	Handsboro
Liveoak Fishing Camp	Bayou DeLisle
Martin's Bayou	Pass Christian
Popps Ferry Fishing Camp	Biloxi
Ray's Fishing Camp	Biloxi
Lake View No. 2	Gulfport
Helen Richard's Fishing Camp	Gulfport
Wick's Fishing Camp	Biloxi
Barham Marina	Gautier

(continued)

Table 101. (concluded)

Camp	Nearest town
Bayou Heron Fishing Camp	Pascagoula
Clear Water Fishing Camp	Ocean Springs
Cool Point Marina	Gautier
C & J Marina	Ocean Springs
Cumbest Bluff Marina	Wade
Davis Fishing Camp	Wade
Dolphin Marina	Pascagoula
Dumas Fishing Camp	Pascagoula
Otts Fishing Camp	Biloxi
Ferguson's Fishing Camp	Pascagoula
Frazures Fishing Camp	Pascagoula
Fort Bayou Fishing Camp	Ocean Springs
Gautier Marina	Gautier
Hucks Fishing Camp	Gautier
Hudson's Fishing Camp	Pascagoula
John's Bayou Marina	Ocean Springs
Jones Fishing Camp	Pascagoula
Kirkwood's Camp	Wade
Mary Walker Marina	Gautier
Melvins	D'Iberville
Old Shell Landing	Gautier
Pascagoula River Marina	Pascagoula
Point O Pines	Pascagoula
Poticaw Fishing Camp	Ocean Springs
Roberts Fishing Camp	Escatawpa
Rod & Reel Fishing Camp	Ocean Springs
Rouse's Marine	Ocean Springs
Roy's Fishing Camp	Gautier
San Juan Fishing Camp	Ocean Springs
Sioux Bayou Fishing Camp	Sioux Bayou
Tucei's Fishing Camp	Gautier

Source: Veal 1979.

Table 102. Number of certified boats in the Mississippi coastal counties through June 30, 1977.

County	Number
Hancock	3,752
Harrison	18,360
Jackson	19,710
Gulf coast Total	41,822
State Total	168,246
Gulf coast Percent of State Total	24.9

Source: Mississippi State University 1978.

Swimming Pools

The 1968 supply of swimming pools in the three coastal counties was approximately 26,900 square meters (290,000 square feet) -- the largest in the State. Additional hotels and motels and increased tourism will increase the demand to 83,610 square meters (900,000 square feet) by 1985 -- more than three times the 1968 supply (Tatum et al. 1969).

Outdoor Game Fields, Playgrounds, and Picnic Areas

Because Hancock and Jackson Counties are part of the Gulf Coast Standard Metropolitan Statistical Area (SMSA), the SMSA has experienced a large population growth in the last 20 years. In conjunction with this population explosion has been an increase in demand for outdoor game fields. In 1968, the Gulf Coast had less than 50 sport fields. By 1985, the region will require more than 100 (Tatum et al. 1969). Playgrounds must also expand. In 1968, there were fewer than 15. By 1985, the area will require 71. Demand for picnic areas will increase from about 20 areas in 1968 to nearly 260 by 1985.

In 1968, there were approximately 10 tennis courts along the Gulf Coast. Since the late 1960's, tennis has become a popular sport and many hotels and motels are adding courts to their recreational facilities. By 1985, the three coastal counties will need more than 500 tennis courts to meet expanded demand (Tatum et al. 1969).

In 1968, Gulf Coast counties had more golf courses than any other area in Mississippi. There were nearly 200 holes. By 1985, the region will require nearly 1,700. No other area in the State will be able to compete with Gulf Coast golfing facilities. The demand is the result of two factors: tourists and retired citizens.

Park and Recreational Areas

In 1968, there were less than 4,000 hectares (10,000 acres) of park and recreational acreage in the coastal counties. By 1985, the Gulf Coast will require nearly 52,600 hectares (130,000 acres). More than 29 square kilometers (12.7 square miles) must be added to the system yearly. Federal parks must also increase. In 1968, there were less than 400 hectares (1,000 acres) . By 1985, the projected demand is for 13,760 hectares (34,000 acres) (Tatum et al. 1969).

The Offshore Islands - The Gulf Islands National Seashore

The offshore islands within the Gulf Islands National Seashore are characterized by nearly 97 kilometers (60 miles) of sandy shoreline. These barrier islands constitute virtually all of the naturally maintained sandy shoreline on Mississippi's Gulf coast, as most mainland beaches are maintained by periodic dredging. Most Gulf-side beaches are wide and gently sloping and nearshore gradients are steep enough for body surfing and swimming. The beaches parallel to Mississippi Sound, although narrow, are gently sloping offshore.

In addition to beach recreation potential, all four of Mississippi's publicly owned barrier islands (West and East Ship, Horn, and Petit Bois) offer natural history interpretive opportunities that are in strong contrast to adjacent mainland habitat. As the islands are in proximity to several population nodes, they offer the urbanite a chance to visit a wilderness area without traveling a great distance. They are particularly distinctive as they are not linked to the mainland by highways and bridges.

These offshore islands provide "a degree of primitive undeveloped character which is remarkable (almost unprecedented) in a public parkland so close to intensely developed and populated areas" (United States National Park Service 1978a). Portions of Hamand and Petit Bois Islands off the coast at Pascagoula have been incorporated into the national wilderness system. Their wildlife (some listed as endangered), history, beaches, and aesthetic beauty add to the recreational potential of the Gulf coast. Statistics synthesized from material tabulated and published by the Bureau of Business Research, University of Southern Mississippi, indicate that, since 1973, there have been 2,419,538 visitors to the seashore. In 1978, 573,393 individuals used the park's facilities. This represents 23.7 percent of the 6-year total (Table 103).

TOURISM ALONG MISSISSIPPI'S GULF COAST

At present, tourism generates approximately $17.25 million of value, involves 2.9 million out-of-state visitors, but accounts for only 4 percent of the Deltaic Plain's total income. Of the three counties that comprise Mississippi's Gulf Coast, Harrison County is responsible for 85 percent of the region's tourist trade. The main attraction is the white sand beach along the Pass Christian-Biloxi stretch of coast where motels/hotels, restaurants, public parks, and other recreational and tourist facilities are clustered. Except for sunbathing, swimming and salt-water fishing, the Mississippi Gulf coast environment does not attract large numbers of tourists. As in Louisiana, there is a lack of public support facilities in wetland environments which could provide vacationers with opportunities to crab, shrimp, birdwatch, and canoe.

Nevertheless, the tourist or "resort" industry is a small, but significant component in the local economies. Lumbering, seafood fishing, and shipbuilding

Table 103. Gulf Islands National Seashore visitation, 1973 - 1978.

Year	Visitors	Net change
1973	309,122	
		+7,900
1974	317,022	
		+33,998
1975	351,020	
		+113,416
1976	464,436	
		-59,891
1977	404,545	
		+168,848
1978	573,393	
Total	2,419,538	+264,271

Source: Mississippi Gulf tourist industry, a quarterly report, fourth quarter 1975; third quarter 1976; fourth quarter 1976; second quarter 1977; fourth quarter 1977; third quarter 1978.

have dominated the economic activity in Hancock, Harrison, and Jackson counties at various times during the 20th century. Excessive timber exploitation, however, and over-harvesting of the seafood resource base, as well as contract delays and cyclic demand for ships have caused instability in the regional economy. During high unemployment periods, the tourist industry provides badly needed jobs and income.

To counter the over-reliance on a single industry, the State of Mississippi solicited military installations and government contracts, while local development commissions encouraged the location of manufacturing in the coastal zone. The National Aeronautical and Space Administration selected a site in Hancock County to test Saturn boosters, Keesler Air Force Base was located in Biloxi, and the Navy's Construction Battalion Center was built at Gulfport. Port facilities were also improved, and a number of industrial parks were established. Forests were replanted in some areas, and oyster beds were successfully planted in the Mississippi Sound. As a result, the coastal counties now exhibit a more diversified economic structure, and tourism plays a vital role in that regard.

The Mississippi Gulf coast has been a popular resort area since the mid-1800's. In the past, coastal steamships ran regular schedules to Ocean Springs and to nearby communities where luxurious hotels and health resorts catered to vacationers and travelers. As previously discussed in the section on Louisiana recreation, many residents from the New Orleans area maintain summer cottages along the Mississippi Gulf coast. Proximity to Mobile and to Meridian is also important as many visitors are no more than a day's drive from home. Many of these travelers are second or third generation Gulf coast tourists; they come to enjoy the semi-tropical climate and the seaside amenities (King and Associates 1971).

Travel Industry in Mississippi

In 1975, the travel industry contributed an estimated 3.7 percent to Mississippi's total personal income (Table 104). On a county basis, tourism rarely contributes more than 5 percent, and in most cases, less than 4 percent of the total income is derived from travel. Even in the so-called tourist counties, travel-generated income is generally less than 5 percent of the county's total income.

Travel-related employment, in 1975, was estimated at approximately 62,000 jobs. This represented 7.4 percent of Mississippi's total employment, and yet only 3.7 percent of the State's personal income is attributed to the travel industry. The disparity stems, in part, from the labor-extensive, seasonal nature, and lower-paying jobs associated with tourism, which, as a result, is not a major component in Mississippi's economy. This does not hold as true, however, for the Gulf Coast Deltaic Plain Region where tourism provides much needed economic diversity (Table 104).

Table 104. Estimated county personal income attributable to the travel on Mississippi's coastal counties compared to total county personal income, 1975 ($000).

County	Travel-related sales	Estimated travel-related personal income	County[a] personal income	County travel related as percent of county personal income
Hancock	$ 8.0	$ 2.1	$ 57.2	3.6%
Harrison	113.9	29.6	683.6	4.3%
Jackson	63.5	16.5	559.7	3.9

[a]Estimated on the basis that 26¢ of each $1.00 of travel-related sales becomes personal income.

Source: Mississippi Tourism Study Commission 1978.

Travel Industry along the Coastal Counties

Two of Mississippi's top ranked travel-oriented counties are located along the coast (Table 105). In both Harrison County, which ranks second in the State, and in Jackson County, which ranks fourth, travel-related sales comprise approximately 20 percent of total business sales. The coastal zone also benefits from the Coastal Coliseum Convention Center at Biloxi which attracted 226 conventions and grossed $14.8 million in 1978 (Table 106). Although in 1969 Hurricane Camille temporarily disrupted the tourist trade, the region quickly recovered.

County travel projections indicate that Harrison County will host between 6,717 and 7,235 visitors daily in 1980; between 10,010 and 10,947 by 2000; and,

Table 105. The relative importance of travel-related sales and income to the top five travel-oriented counties in Mississippi, 1975.

County	Travel related sales ($000)	Total[a] retail sales ($000)	Travel related as percent of total sales
Hinds	199,373	1,235,800	16.1
Harrison	112,925	524,182	21.5
Lauderdale	63,615	312,030	20.3
Jackson	63,573	352,134	18.0
Forrest	52,561	283,436	18.5

[a]Based on the assumption that 26¢ of each $1.00 of travel-related sales becomes income to residents of Mississippi.

Source: Mississippi Tourism Study Commission 1978.

Table 106. Coastal Coliseum Convention Center.

Year	No. of conventions	Delegates	Earnings
1977	277	66,347	$13 million
1978	226	75,512	14.8 million
1979[a]	205	94,840	19 million

[a]Represents only an estimate.

Source: Deegen 1979.

perhaps as many as 14,659 by the year 2020 (Table 107). In the region as a whole, the average number of daily visitors will increase from 8,807 in 1980, to 13,230 in 2000, an increase of approximately 150 percent over the current level. Since a large but unknown percentage of tourists stay overnight, an expansion of tourist traffic entails construction of additional hotel/motel rooms (Table 108). The number of rooms required to accommodate the visitors can be obtained by dividing the average daily traffic by 1.8. As indicated in Table 108, the need for additional rooms is growing steadily, but compared to the Greater New Orleans area, the need remains relatively modest.

Table 107. Regional distribution of projected visitors to the Mississippi coastal counties on an average daily basis, 1975-2020.

	Hancock		Harrison		Jackson		Average totals
	Low	High	Low	High	Low	High	
1975[a]	278	287	5,361	6,046	1,253	1,299	7,263
1980[b]	319	344	6,717	7,235	1,443	1,555	8,807
1985	359	388	7,541	8,163	1,621	1,754	
1990	398	432	8,364	9,092	1,797	1,954	
1995	437	477	9,188	10,019	1,975	2,153	
2000	477	521	10,010	10,947	2,151	2,353	13,230
2005	516	565	10,834	11,875	2,328	2,552	
2010	556	610	11,657	12,804	2,505	2,751	
2015	594	654	12,480	13,731	2,682	2,951	
2020	633	698	13,303	14,659	2,859	3,150	17,652

[a]Assumes 4 percent of total visitors in Hancock, 77 percent in Harrison, 18 percent in Jackson, and 1 percent in Pearl River in 1975. Effects of 30,000 new visitors are assumed to accrue to Harrison County from the Coliseum in lieu of the 65,000 estimate after four years of operation.

[b]Assumes 3.7 percent of regional visitors to Hancock County, 77.7 percent to Harrison County, 16.7 percent to Jackson County, balance in Pearl River County. All of the 65,000 additional visitors from the Coliseum complex are reflected for 1980 and future years to accrue to Harrison County.

Source: Cartee *et al*. 1973.

Data are available, though somewhat out of date, regarding the projected number of total visitors to the Gulf Coast (Table 109). During the 10-year period between 1980 and 1990, the tourist flow is expected to increase from approximately 3.3 million to 4.1 million, an average increase of only 2.5 percent/year. By the year 2020, however, Cartee *et al*. (1973) project that "the Coast" may have 6.9 million visitors per year.

The role of the Gulf of Mexico in the region's economy was investigated by Daniel and Cartee (1977) whose research quantified the importance of the Gulf to the business, manufacturing, and service sectors of the coastal counties. In order to achieve their objective, they selected income as a measure of the Gulf's economic contribution.

In Hancock County, Gulf-related income in 1974 was estimated to be $2.4 million. Tourism, second only to manufacturing, accounted for 23 percent of this total, or $0.55 million. Completion of Interstate-10, however, which trends north of the existing tourist and travel corridor along U.S. Highway 90, is redirecting traffic flow and potential customers. In the past, major highways funneled traffic through Waveland and Bay St. Louis. Today, Interstate-10 bypasses the area, and the present highway location makes it difficult to view facilities along coastal Hancock County available for tourists choosing places to stop, such as restaurants, hotel/motels, or fishing piers (Daniel and Cartee 1977).

Table 108. Average number of rooms required per day to support the projected average daily visitors on Mississippi's coastal counties, 1975 - 2020[a].

Year	Number of rooms[b] Low	High
1975	4,028	4,323
1980	4,803	5,173
1985	5,392	5,836
1990	5,980	6,500
1995	6,569	7,163
2000	7,157	7,827
2005	7,746	8,491
2010	8,335	9,155
2015	8,923	9,818
2020	9,512	10,481

[a]Includes Pearl River County.

[b]Assumes 1.8 guests per room.

Source: Cartee et al. 1973.

Harrison County is considered the center of tourist activities on Mississippi's Gulf coast. From Pass Christian to Biloxi, the county's 41.8 kilometers (26 miles) of man-made beaches are bordered by hotels, restaurants, motels, golf courses, fishing piers, theme parks, charter and excursion boat marinas, fishing camps, night spots, shopping centers, parks, and historical sites. In the aggregate, they directly or indirectly cater to the tourist industry. In 1974, Gulf-related income was estimated to be $42.5 million; $14.6 million was attributed to tourism, or about 34 percent of the total. Daniel and Cartee (1977) considered the tourism figure to be "a conservative estimate due to the methodology utilized". Only Gulf-related activities were considered. Therefore, many direct, indirect, basic and non-basic components were omitted from their figures.

In Jackson County, Daniel and Cartee (1977) calculated that Gulf-related basic income totaled approximately $250 million in 1974, or almost 84 percent of the county's basic income. Manufacturing was responsible for $244 million, with tourism and recreation ranking second and third, respectively. The tourist industry accounted for $2.1 million, the smallest on the Gulf coast. Less than one percent of the county's Gulf-related income is derived from tourism. Almost all of the county's income comes from the manufacturing sector that centers on the shipbuilding industry at Pascagoula. Despite the size comparability in importance between the economies of Jackson and Harrison Counties, the significance of tourism is dwarfed by manufacturing.

Table 109. Adjusted visitor projections in Mississippi's coastal counties, 1975 - 2020[a].

	Visitors[b]		Annual daily average visitors		Ratio of daily visitors per 100 resident population	
	Low	High	Low	High	Low	High
1975[c]	2,646,762	2,840,566	7,251	7,782	2.52	2.70
1980[d]	3,155,995	3,399,036	8,646	9,312	2.80	3.02
1985	3,542,727	3,835,006	9,706	10,506	2.74	2.97
1990	3,929,460	4,270,977	10,765	11,701	2.69	2.92
1995	4,316,190	4,706,946	11,825	12,895	2.68	2.92
2000	4,702,924	5,142,917	12,884	14,090	2.67	2.93
2005	5,089,694	5,578,887	13,944	15,284	2.61	2.86
2010	5,476,389	6,014,857	15,003	16,479	2.55	2.80
2015	5,863,119	6,450,827	16,063	17,673	2.50	2.75
2020	6,249,853	6,886,797	17,122	18,867	2.46	2.71

[a]Includes estimated effects of Coliseum complex and the Gulf Islands National Seashore, includes Pearl River County.

[b]Represents sum of visitors per day of the year and not the number of different visitors.

[c]Assumes Coliseum will be operable and able to attract about half, or 30,000, of the estimated 65,000 visitors estimated for full operation in its fourth or fifth year after establishment.

[d]Assumes full operation of the Coliseum facility and that the estimated 65,000 new visitors and 227,500 new visitor days will materialize for 1980 and future years.

Source: Cartee *et al*. 1973.

Tourist-Related Sales

To better assess the Gulf Coast's travel and tourist industry, data on travel-related sales were synthesized from material tabulated and published by the Bureau of Business Research, University of Southern Mississippi.

Hancock County

In 1966, total travel-related revenue in Hancock County amounted to $3.5 million (Table 110). Nearly two-thirds of the total came from gasoline sales; followed in descending order by sales from tire, battery, and accessory dealers, eating and drinking places, gift and souvenir shops, lodging and automobile repair and service shops (Cartee *et al*. 1973). The county's tourist-related sales primarily came from a large transient population. These travelers used the region's gasoline stations, patronized the area's drinking establishments, and purchased gifts and souvenirs from the numerous shops that line U.S. Highway 90.

In 1972, total receipts were almost double the 1966 figure as $6.7 million was spent on travel-related activities (Table 111). About a third of this total was attributed to gasoline sales. Several other activities changed their ranking. With

Table 110. Travel-related retail sales for Mississippi's coastal counties, 1966 ($000).

Activity	Hancock	Harrison	Jackson	Total
Lodging				
Hotels, motels, & tourist courts	$ 182.1	$ 9,473.2	$ 1,042.7	$10,698.0
Trailer Parks	--	--	--	--
Eating & Drinking				
Eating places	13.1	385.5	1.4	400.0
Misc. foods	.4	148.3	45.6	194.3
Soft drinks	1.5	341.8	137.0	480.3
Drinking places	306.0	2,584.8	967.0	3,857.8
Liquor stores	98.2	332.0	1.4	431.6
Recreation & Services				
Marina services	--	--	--	--
Gift & souvenir shops	271.7	743.8	121.0	1,136.5
Tire, Battery & Accsessory Dealers	461.2	6,159.4	2,682.6	9,303.2
Gasoline Service Stations	2,023.2	18,729.6	6,940.9	27,693.7
Taxi Cabs	--	493.4	93.0	586.4
Automobile Repair & Service Shops	125.9	1,993.7	377.3	2,496.9
Total[a]	$3,483.3	$41,385.5	$12,409.9	$57,278.7

[a]Totals may not add due to rounding.

Source: Cartee *et al*. 1973.

nearly $2 million in revenue, Hancock's eating and drinking establishments were second. In six years, food and drink sales increased from $13,000 to almost $2 million. During that period, however, Hurricane Camille destroyed or damaged many of the tourist-oriented businesses. The area quickly recovered from the damage and even increased business sales dramatically in a remarkably short period. Automobile-related expenses, food services, lodging, and gift and souvenir shops registered a positive change, with gasoline and seawall taxes remaining constant (Table 112). Lodging receipts increased by a factor of three over 1966, and gift and souvenir shops sales improved by $164,000 (Table 113) (Cartee *et al*. 1973).

By 1978, Hancock County's restaurant receipts totaled $6.1 million, a 37 percent change over 1977. The industry has shown consistent growth since 1966.

Table 111. Travel-related retail sales for Mississippi's coastal counties, 1972 ($000).

Activity	Hancock	Harrison	Jackson	Total
Lodging				
Hotels, motels & tourist courts	$ 598.1	$15,614.9	$ 2,710.9	$ 18,923.9
Trailer parks	21.3	815.2	243.5	1,080.0
Eating & Drinking				
Eating places	1,997.7	22,119.8	12,450.8	36,568.3
Misc. foods[a]	--	--	--	--
Soft drinks[a]	--	--	--	--
Drinking places	169.4	1,593.8	29.3	1,792.5
Liquor stores	390.5	4,768.8	2,733.1	7,892.4
Recreation & Services				
Marina services	62.0	285.7	205.7	553.4
Gift & souvenir shops	435.6	1,812.3	385.8	2,633.7
Tire, Battery & Accessory Dealers	244.1	7,632.9	4,792.5	12,669.5
Gasoline Service Stations	2,149.8	23,215.0	14,976.1	40,340.9
Taxi Cabs	--	473.8	159.8	633.6
Automobile Repair & Service Shops	621.7	7,153.2	3,535.4	11,310.3
Total[b]	$6,690.2	$85,485.4	$42,222.9	$134,398.5

[a]Sub-totalled under eating and drinking places.

[b]Totals may not add due to rounding, and data based on a fiscal year.

Source: Cartee *et al*. 1973.

Sales increased by more than a million dollars per year since 1975. The greatest change occurred between 1977 and 1978 when restaurant earnings improved by 1.6 million (Table 113). Hotel/motel sales also improved. In 1978, one million in sales were attributed to this industry, a 25 percent increase over 1977 (Table 114). Since 1968, industry earnings increased by $647,000, a positive change of $58,818 per year. Although Harrison and Jackson Counties' hotel/motel receipts are much larger, Hancock is handicapped by a lack of available motels. A 1973 study reports that the area was served by 5 motels with 197 combined units (Table 115). Harrison County had 3,421 units, and Jackson's hosteleries accounted for 504 units (Cartee *et al*. 1973).

Table 112. Gasoline-seawall tax collections for the Mississippi coastal counties, 1973 - 1978 ($)

Year	County: Hancock[a]	Harrison[b]	Jackson[c]	Total
1973	230,273	1,356,568	881,290	2,468,131
1974	215,279	1,329,352	882,966	2,427,597
1975	199,546	1,347,199	884,887	2,431,632
1976	232,298	1,390,584	994,292	2,617,174
1977	265,952	1,456,011	1,090,816	2,812,779
1978	266,882	1,524,986	1,069,491	2,861,359
Total	1,410,230	8,404,700	5,803,742	15,618,672
Percent of Gulf Coast Total	9.03	53.81	37.15	99.99

[a]3¢/gallon.

[b]2¢/gallon.

[c]2¢/gallon.

Source: Mississippi's Gulf Coast tourist industry, a quarterly report, fourth quarter 1975; third quarter 1976; fourth quarter 1976; second quarter 1977; fourth quarter 1977; third quarter 1978.

Harrison County

In 1966, travel-related expenditures in Harrison County amounted to $41 million -- the largest on the Gulf Coast (Table 110). More than $18 million was attributed to gasoline service stations. With $9.4 million in revenue, hotels, motels, and tourist courts were second. Automobile repair and accessories accounted for more than $8 million, followed by eating, drinking, gift and souvenir businesses (Cartee et al. 1973). In the 1960's, the availability of overnight lodging was the principal element in the county's tourist trade.

In 1972, travel-related retail sales totaled $85 million (Table 111). The region had clearly recovered from Hurricane Camille. Gasoline receipts contributed $23 million, but no longer accounted for nearly one-half of the total, as they did in 1966. Since 1973, gasoline-seawall taxes have generated more than $1.3 million (Table 113). The county's restaurants, night spots, and liquor stores produced earnings of $22 million. Lodging revenue escalated from $6.2 million, to a 1972 high of $15.6 million (Table 111). In addition, recreation and services, automobile repair, and accessory earnings also increased.

Table 113. Restaurant sales for the Mississippi coastal counties 1973 - 1978 ($000).

	County			
	Hancock	Harrison	Jackson	Total
1973	2,788	29,944	15,886	48,618
1974	2,420	33,605	21,579	57,604
1975	2,880	34,124	25,109	62,113
1976	3,199	39,730	28,789	71,718
1977	4,466	45,800	31,519	81,785
1978	6,121	56,245	35,501	97,867
Total	21,874	239,448	158,383	419,705
Percent of Gulf Coast Total	5.21	57.05	37.73	99.99

Source: Mississippi's Gulf Coast tourist industry, a quarterly report, fourth quarter 1975; third quarter 1976; fourth quarter 1976; second quarter 1977; fourth quarter 1977; third quarter 1978.

In 1978, Harrison County's restaurants reported food sales of $56.2 million, a 23 percent increase over 1977 (Mississippi's Gulf...1978). Between 1972 and 1978, restaurant-related income more than doubled (Table 113). The industry is thriving, with revenue continuing to expand. With restaurant receipts totaling approximately $154,000 per day, 1978 was a record year (Mississippi's Gulf...1978). Also in 1978, the county's innkeepers reported $30.1 million in net income, for 171 percent increase over 1968 (Table 114). Since 1968, the industry's sales improved by $19.0 million. The income from hotel/motel rentals in Harrison County overshadows both Hancock and Jackson Counties. With 83 percent of the hotel/motel sales, and more than 3,000 individual rooms (Table 115), it is apparent

Jackson County

In 1966, travel-related sales totaled $12.4 million. As Table 110 indicates, $6.9 million was from gasoline service stations. Other automobile-related expenses added nearly $3 million. More than 80 percent of the travel-related money spent in the county was related directly to the care, maintenance, and fueling of the automobile. Lodging added one million to the total, with drinking establishments contributing an additional $967,000. Revenue from eating places in Jackson County was almost insignificant; $1,400 in revenue, which is the smallest amount generated by any coastal county in that year. The County, in 1966, served primarily the automobile trade. All other activities included in total travel-related retail sales were secondary (Cartee et al. 1973).

Table 114. Hotel-motel sales for the Mississippi coastal counties, 1973 - 1978 ($000)

Year	County			Total
	Hancock	Harrison	Jackson	
1968	426	11,132	2,155	13,713
1969	575	11,819	2,335	14,729
1970	652	11,212	2,637	14,501
1971	559	14,443	2,673	17,675
1972	604	17,339	2,896	20,839
1973	598	17,833	2,801	21,232
1974	501	18,754	3,318	22,573
1975	403	21,838	3,904	26,145
1976	508	24,673	4,226	29,407
1977	857	26,341	5,657	32,855
1978	1,073	30,171	5,050	36,294
Total	6,756	205,555	37,652	249,963
Percent of Gulf coast Total	2.70	82.23	15.06	99.99

Source: Mississippi's Gulf Coast tourist industry, a quarterly report, fourth quarter 1975; third quarter 1976; fourth quarter 1976; second quarter 1977; fourth quarter 1977; third quarter 1978.

that Harrison County is the nucleus of the Gulf coast's tourist industry (Cartee et al. 1973).

In 1972, total sales reached $42.2 million and more than tripled the 1966 figure (Table 111). In six years the travel industry changed as automobile-related sales declined but still remained the most important travel element. Although automobile-related expenditures totaled $15 million, this represented 55 percent of travel sales -- a reduction of more than 25 percent. Since 1973, gasoline-seawall tax collections have increased (Table 112). Eating places and lodging were responsible for most of the change. They added $15.1 million, or 35 percent of the total which is a considerable change over the 8 percent reported in 1966. The most notable improvement was in the earnings produced from eating establishments. In 1966, restaurants were responsible for $1,400 in sales; by 1972 their income increased to $12.4 million -- an 8,856 percent change (Table 111).

Table 115. Distribution of hotel and motel units for the Mississippi coastal counties, 1972.

County	Number of units	Percent
Hancock	197	4.78
Harrison	3,421	82.99
Jackson	504	12.23
Total	4,122	100.00

Source: Cartee et al. 1973.

In 1978, Jackson County's restaurant sales have continued to expand. More than $35 million was spent on food -- a 13 percent increase over 1977 (Table 113). Since 1975, restaurant revenue increased by 37 percent. In all Gulf Coast counties, 1978 was a record year (Mississippi's Gulf...1978).

Hotel/motel sales declined in Jackson County between 1977 and 1978 (Table 114). In Hancock County, a 25.2 percent increase was reported between 1977 and 1978, and in Harrison a 14.5 percent increase was noted. In contrast, Jackson lost 10.7 percent --the only decline reported at the end of the year. In 1975, the county reported sales of $3.9 million. In 1976, there was an increase to $4.2 million. By 1977, hotel/motel revenue peaked at $5.6 million. Data for 1978 indicate a decline to $5.0 million (Mississippi's Gulf...1975-1978).

Although restaurant and hotel/motel sales were up for the Gulf Coast, the cost of out-of-town lodging and food rose also. The figures for 1978 are somewhat misleading, as real increase can only be determined after considering inflation and price changes (Mississippi's Gulf...1978).

Employment in the Hotel/Motel Business

Only Harrison and Jackson counties will be considered; data on Hancock County are not available.

Harrison County

Data compiled by Cartee (1975) indicate that in Harrison County during the period 1966 to 1973, there was a 31.1 percent reduction in the number of reporting hotel/motel units. In 1966, there were 53 establishments within the county; by 1969, the number reached 57. Between 1969 and 1973, the inventory of properties decreased to 36. During the same period, the number employed in lodging decreased from 1,453 to 1,356, or 6.7 percent. The decrease of 17 in the number of properties reporting between 1966 and 1973 probably stems from the failure to rebuild properties after Hurricane Camille. Because many of the properties that were not rebuilt were the smaller ones, the impact on employment was not as severe as it might have otherwise been (Cartee 1975).

Although the number of lodging facilities and employment in the industry dropped, payrolls increased between 1966 and 1973 by 61 percent. In 1966, wages totaled $769,000; by 1973 payrolls exceeded five million (Cartee 1975).

Jackson County

In Jackson County, the hotels, motels, and tourist courts declined from a maximum of 14 in 1969, to 11 in 1973, which is an 18.2 percent change. Employment declined by almost 53 percent. Payrolls decreased by nearly 22 percent. At the conclusion of 1973, the lodging industry was in a slump. Jackson County lodging payrolls were estimated to total only $750,000 for 1973. Part of the decline can probably be attributed to tourists bypassing Jackson County for the more heavily promoted facilities between Pass Christian and Biloxi.

The Gulf Coast Attractions

Surplus income, coupled with shorter work weeks, are increasing the demand for recreational and tourist alternatives. With more free time, improved mobility, and the Gulf Coast being "one tank full" away from a large population, the coast can meet many of the needs of the Louisiana-Mississippi-Alabama tourist.

Beaches

The Gulf Coast beaches are unique. The region's 42-kilometer (26-mile) beach is the world's longest man-made sand beach. The coastal strand is 91 meters (300 feet wide) from Biloxi to Henderson Point and was created in 1951 by hydraulic dredges operating offshore. This littoral zone and the beaches associated with the offshore islands provide the visual focal point for the tourist industry. Beaches were discussed at length in the section on Mississippi's recreation.

Deep Sea Charter Fishing

To fish offshore, charter boats charge by the person, with an additional rod and reel surcharge, or by the day. Fees vary by season, boats, and amenities available. The 36 boats included in the business are docked at Gautier, Ocean Springs, Biloxi, and Gulfport (Table 116). No licenses are required to fish in salt-

Table 116. Availability of Mississippi coastal counties charter boats.

Town	Marina	Number of boats
Gulfport	Small Craft Harbor	6
Biloxi	Broadwater Beach	10
Biloxi	Small Craft Harbor	11
Ocean Springs-Gautier	Ocean Springs Harbor	2
	Total	29

Source: Etzold *et al*. 1977.

water, so the visitor to the Gulf Coast does not have to pay for the privilege of salt-water fishing. Freshwater anglers must buy a non-resident license, either for a week or a year.

Fishing Piers

Fishing is one of the premier attractions along the Gulf Coast. Individuals staying at one of the lodging facilities across from the beach can often walk to a fishing pier. These facilities are located primarily in Biloxi, Long Beach, Ocean Springs, Gulfport, and Pass Christian (Table 117).

Table 117. Location and type of fishing piers along the Mississippi coast.

Ocean Springs	-	Old Biloxi-Ocean Springs Bridge
Biloxi	-	Old Biloxi-Ocean Springs Bridge
	-	Small craft harbor
	-	Foot of Hopkins Avenue
	-	Foot of Pat Harrison Avenue
Long Beach	-	Fishing pier across from University of Southern Mississippi Gulfport Campus
	-	Rock pile jetties
	-	Small craft harbor
Gulfport	-	Rock pile pier south end of 20th Avenue
Pass Christian	-	Small craft harbor

Source: Gulf Coast Innkeepers Association of Mississippi, Incorporated 1978.

Golf

Golf is one of the Gulf Coast area's larger tourist attractions. There are nearly 20 golf courses along the Coast that offer courses ranging from 3 holes of "fun golf" to 18-hole regulation playing surfaces (Table 118).

Other Attractions

In addition to sunbathing, fishing, and golf, the Gulf Coast offers the tourist many other recreational alternatives. Historic visiting sites include Longfellow House, Old Spanish Fort and Cemetery, Fort Maurepas, St. Michael's Church, Tullis Manor, Spanish House, French House, Beauvoir, and Ballymere. The Mississippi coast's seven outlying islands offer the tourist an opportunity to fish, enjoy the bird sanctuary, beach activities, or a visit to historic Fort Massachusetts on Ship Island.

Tourism in the Future

Although current projections indicate that there will be a modest increase in the annual number of tourists visiting the Mississippi Gulf Coast, this region is not expected to be heavily affected by the travel trade in the future. Whereas Harrison County will experience increased tourist traffic due to the attraction of the beach environment and the Coliseum Convention Center, the beach is only 42 kilometers (26 miles) long and considerable development has already taken place. In contrast, Hancock County's tourist trade appears to be transient and

Table 118. Location of golf courses along Mississippi's coastal counties.

Pascagoula	- Country Club Golf Course
Gautier	- Hickory Hill Country Club
Ocean Springs	- St. Andrew Golf and Country Club - Pine Islands Golf Course - Gulf Hills Inn and Golf Club Course
Biloxi	- Keesler Air Force Base (Military only) - Broadwater Beach Sun Golf Course - Sunkist Golf Course - Hometown Country Club (membership card required) - Biloxi-Hilton Rainbow Bay Golf Course
Gulfport	- Broadwater Beach Sea Golf Course - Tramark Golf Club
Pass Christian	- Pass Christian Isles Golf Club (members and guests)
Bay St. Louis	- Diamondhead Golf Course (members and guests)
Par 3 courses:	
Biloxi	- Broadwater Beach Hotel, Fun Course - Biloxi Par 3
Gulfport	- J&L Golf Course

Source: Gulf Coast Innkeepers Association of Mississippi, Incorporated 1978.

Jackson County has experienced some recent decline. In short, tourism may help broaden the economic base of many of the one-industry communities, but it contributes only 5 to 20 percent of the total regional income.

The Mississippi coast will probably continue to attract tourists from the cities of New Orleans, Meridian, and Mobile. Unless an interstate connector system from Interstate-10 is constructed, much of the regional traffic flow will continue to bypass the Gulf Coast. Development of recreational and nature study facilities on the barrier islands in the Mississippi Sound may diversify the range of interest for tourists on the Gulf Coast of Mississippi.

At present, except for salt-water fishing, resource-based tourism appears underdeveloped and, barring any large-scale development of theme parks and other mega-attractions, it is unlikely that tomorrow's tourist will significantly affect the biological resources of the Deltaic Plain.

DATA GAPS AND RECOMMENDATIONS

Several aspects of recreation and tourism in the MDPR have not been adequately studied. For some problem areas, studies are currently underway or planned, but no results have been compiled.

One issue that warrants further investigation is the relationship between offshore recreational activities and petroleum structures in the Gulf of Mexico. The extent of the use of such structures, the groups who participate, and assessment of the factors involved should be studied.

Particular data gaps that should be addressed through long-range efforts for managing coastal recreation and tourism include the following:

1. record number of recreational projects funded as projects occur,
2. maintain record of number of days of beach use and closure,
3. maintain records of number and diversity of facilities provided,
4. conduct systematic user days surveys, using field measurement and questionnaires periodically,
5. maintain records of per capita hunting and fishing licenses,
6. record number of boats purchased per capita, each year, and
7. maintain records of tourist dollars spent (adjusted for inflation) in each parish or county, each year.

AGRICULTURAL PRODUCTION

INTRODUCTION: THE DELTAIC REGION AT A CROSSROAD

During the initial stages of this Nation's economic history, agricultural activities generated a large surplus of production. The surplus generated an investment fund that was a major source of capital for the development of other economic sectors. Infrastructure financing for roads, schools, public buildings, social services and government itself was generally drawn from taxes paid on the agricultural surplus. In later decades, agriculture continued its contribution to national economic development, although its relative role declined as the sector came to represent a declining share of the Nation's economy. Agriculture made further contributions, however, as resource productivity increased and began releasing land, labor, and capital resources for employment elsewhere. An important part of postwar economic development has been supported by the reduction of the farm sector labor force.

While agriculture has contributed greatly to economic development, it has also interacted with the process. Major changes in agriculture have occurred as a result of the economic growth agriculture has helped to initiate and maintain. Particular characteristics of these changes include the development of advanced management systems and rapidly advancing technology, which place a premium on change and further mechanize processes, and changes in the relative real prices of labor and capital. Collectively, these factors lead toward larger, highly capitalized farming systems. Both machine technology and declines in the real cost of capital relative to labor have encouraged the substitution of capital technology for personnel in farming activities. A further consequence of mechanization is an expansion in farm size and greater crop specialization so that machine technology can be better utilized.

Other forces also encourage the trend toward larger and fewer farms, with some sub-sectors of the agricultural industry becoming highly mechanized. The rapid progress in developing capital technologies that intensify agricultural land use keeps the rising price of commodities pressing the cost of resources upward. Consequently larger farm units are required to attain income levels consistent with current expectations. Public programs, ranging from direct payments for non-production to credit appear to be geared more to large units than to small ones.

The number of farms, the agricultural work force, and the entire population of rural communities continue to decline. These trends result primarily from the decisions of individual farm families as they respond to the forces of economic growth and public policy.

Throughout the region's history, agricultural activities have occupied an important position in the Mississippi Deltaic Plain Region's (MDPR) social and economic environment. The wealth gained from hydrocarbons, commercial fishing and trapping, industrial development and tourism do not overshadow the value of agricultural products. The favorable climate and fertile alluvial soils allow almost every crop indigenous to the western hemisphere to be raised. The region's agricultural activities are, however, subject to the same economic and public policy forces that confront the industry nationwide. How much will these forces change the local agricultural industry? Is the Deltaic Region headed for a structure of industrialized farms? What are the tradeoffs as these and other ongoing trends continue?

The following discussion addresses these questions as well as other characteristics of agricultural production in the Deltaic Plain Region. The compelling conclusion is that agricultural production in the region today is at a crossroad. The vagaries of commodity markets have forced a consolidation of land holdings and a reassessment of the region's future farming prospects. Urbanization and development of the hydrocarbon infrastructure have pre-empted agricultural production on prime alluvial lands, but agriculture continues to contribute substantially to the region's economy.

In the following sections, recent historical trends and future prospects are evaluated. Section II, "Farming and Agricultural Activities", briefly describes the region's production history, the post-World War II movement toward consolidated land holdings, average production expenses and agriculture's contribution to the Deltaic Plain Region's economy. Section III, "Agricultural Products," describes the operational opportunities and constraints of the rich and varied cultural legacy, detailing the range of field and specialty crops and livestock and poultry operations in the area. Section IV, "Agricultural Futures", explores agriculture's role in maintaining the stability and diversity of regional economic opportunities.

FARMING AND AGRICULTURAL ACTIVITIES: IN THE SHADOW OF THE PETROCHEMICAL ERA

For the purpose of discussing agricultural development, the MDPR may be subdivided into several major regions: Acadiana, which includes the Louisiana Deltaic Parishes west of the Mississippi River; the "Florida Parishes", located east of the river and north of Lake Pontchartrain; and the Mississipi coast (Figure 20). Deltaic Plain farming is found primarily in the northern parts of Acadiana, where agricultural lands include the coastal prairie soils in the areas west of Bayou Teche, and recent alluvial soils in the region's eastern section. These alluvial soils are the product of the Mississippi River's sedimentary history and sequential deposition (Corty et al. 1978). In Acadiana, the total land area is approximately 1.5 million hectares (3.7 million acres). Arable land is limited in this region due to poor drainage. In Acadiana, the total land area is approximately 1.5 millioin hectares (3.7 million acres). Arable land is limited in this region due to poor drainage.

The three coastal "Florida Parishes" (Livingston, Tangipahoa, and St. Tammany) have a total land area of nearly 650,000 hectares (1.6 million acres). They are considered part of the Deltaic Plain as land use practices in these parishes influence the regional drainage system. Harrison, Hancock and Jackson Counties in Mississippi also have a combined land area of approximately 650,000 hectares (1.6 million acres) and are geologcially and socioeconomically similar to the "Florida Parishes". In southern Mississippi, an interior region of Pleistocene uplands, characteristic of the "Florida Parishes", is bordered by a narrow coastal Mississippi lowland area (Cross and Wales 1974). Poorly drained, shallow silty soils have restricted farming in both areas, and arable land is limited.

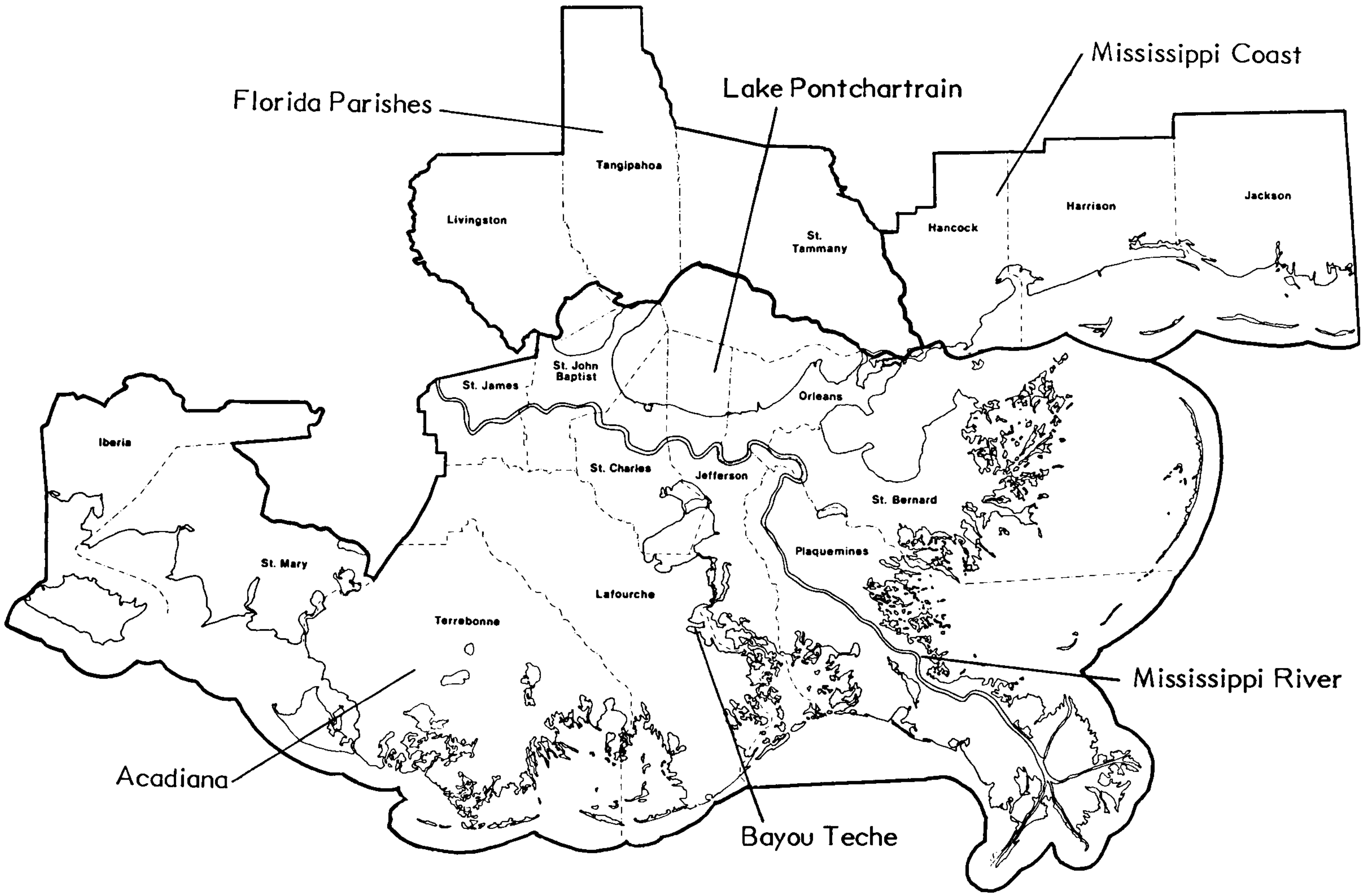


Figure 20. The regional setting.

Physical characteristics and the region's economic history have produced a wide variety of agricultural land uses.

> "The economic forces of economies of scale and comparative advantage working in a given complex of physical and biological factors such as climate, soils, topography and vegetative cover have led to a wide diversity of crop and crop-and livestock systems (Polopolus 1962: 19).

Early travel accounts and archaeological investigations reveal that prehistoric inhabitants depended on the land and water resources of the Deltaic Plain for their subsistence. Europeans recognized both the agricultural potential of the region's rich alluvial soil and the benefits that could accrue from a trade, marketing and financial center (Martin 1882). New Orleans was established as the trade center for the new French colony in 1718.

The area's initial development was closely linked to the development of commercial agriculture. Indigo, cotton, tobacco, and rice were all considered crops that would make the colony prosper (Williamson 1940). Before farms could be established, land was distributed among settlers in an equitable manner. The policy, in general, was to grant settlers their land-holdings free of cost. Laws were created to prevent speculative land holdings. With this newly created colonial legal authority, survey procedures were established to document land holdings, and land holdings were designated to be used for agricultural purposes or forfeited.

Current Deltaic Plain settlement patterns in many areas of Louisiana continue to follow the colonial linear lot settlement patterns along the natural levee crests. The bayous still serve as the settlements' focal points, with individual farmsteads only rarely characterized as dispersed and isolated. Linear grants determined that all settlers initially received bayou frontage, even in villages. Inheritance subdivisions were, and are, divided lengthwise to distribute the different land qualities equally. Heirs have sliced property into ever narrower fronts, or widths, but always retain the 40-arpent depth. Width is the critically variable dimension.

In Mississippi, existing land uses reflect the prevalence of natural hazards, economic development and attitudes toward growth management. Natural constraints to settlement have been reduced with the development of advanced warning systems and financial aid to disaster areas. The coastal meadows and plains in themselves present little constraint to settlement.

The Settlers

Settlers in the new French colony were not wealthy plantation owners. French and German peasant (habitant) farmers had settled along the Mississippi River "coasts" by 1720. The most populous early settlement area, the Cote des Allemands (German Coast) is now part of St. Charles and St. John the Baptist Parishes. Germans who settled the region raised vegetables, an economic imprint that survives. In the Colonial tradition, the German Coast truck gardens continue to supply the New Orleans' market with fresh produce (Knipmeyer 1956). Principal crops are corn, Irish potatoes, shallots, peas, beans and cabbage. Although the practice is no longer followed, rice was initially grown along the natural levee base.

The German migrants were assimilated by the French-Acadians population that moved to coastal Louisiana as refugees from Canada (Leblanc 1967). The Acadians arrived in the 1750's and 1760's. They remain the largest and most influential ethnic group in southern Louisiana (Kniffen 1968).

The Acadians settled north of the German Coast in what are now known as St. James and Ascension parishes--a region still referred to as the Acadian Coast. The major plantation crops in this area were indigo, rice and tobacco, all cultivated for export. Indigo was the region's first and most important export crop. The indigo plant's qualities as a dye product had been known to western Europeans for a century or more and a market in France was opened to the region's planters when a wild species was found in upland Louisiana.

Manufacture of the dye in Louisiana was begun by Father Nicholas de Beaubois, a Jesuit priest. In New Orleans, he developed an extraction process similar to that used today. Following his success, the industry was firmly established, and indigo became one of the Colony's important crops. By 1754, 47 planters produced about 37,000 kilograms (or approximately 82,000 pounds) annually. A caterpillar plague destroyed the crop in 1793 and the cultivation of indigo was practically abandoned (Hansen 1971). Indigo and rice are no longer cultivated, but tobacco continues as a specialty crop. Perique tobacco, a regional specialty, has an international reputation.

French and German peasant farmers began to settle the northern reaches of Bayou Lafourche in 1765. They established a subsistence farm pattern that persists today. With a limited repertoire of farm equipment, and without draft animals, the peasants cleared and planted on previously undeveloped soil (Kniffen 1951). The Islenos (Canary Islanders) settled the Valenzuela section of northern Bayou Lafourche in 1780 at the expense of the Spanish crown. Anglo-American settlements were exerting political and social pressures on the French colony by the 19th century. Both Acadian and Anglo farmers moved south along Bayou Lafourche. One final influx of French colonials came from the West Indies in 1809.

From the head of Bayou Lafourche to its middle reaches, agriculture is characterized by both plantations and small farms. The natural levee from Lockport southward is too narrow to farm effectively. Row crop cultivation is rare along the southern reaches of the Bayou. Cattle are an important addition to the trapper-fisher cultural landscape found along the southern reaches of the Bayou. The plantation landscape predominates from Donaldsonville to Lockport, although the area was first settled by small farmers. As Anglo-Americans arrived, they developed plantations along the Bayou's natural levee crest or front lands. Anglo settlers, unlike the French, built their homes away from their neighbors (Smith 1954). Their settlements, were connected by a highly irregular road network. Today, this settlement pattern's legacy gives the region a confused network of interconnecting links.

French farmers cultivated their land continuously, whereas the Anglo-Saxon hill farmers practiced a modified form of slash-and-burn agriculture. Their land-extensive cultivation practice, based on field rotation to guarantee yearly harvests, allowed the soils to rejuvenate without requiring intensive application of fertilizers or soil builders. The principal crop grown by this slash-and-burn technique was corn. The hill country region experienced sufficient population growth to require more intensive use of land for agricultural production, and the region has undergone several periods of agricultural change over the last 200 years. Tung nuts, strawberries, ornamental trees, beef and dairy cattle, swine, chickens, and thoroughbred horses are all part of the hill country's agricultural history.

A small portion of the Atchafalaya basin is included in the Deltaic Plain. Agriculture has played a minor role in the basin's settlement history. Once the Atchafalaya basin was surveyed, French-speaking people established permanent settlements along the ribbons of dry land within the swamp. They were unable to afford the most desirable agricultural lands, and for the most part moved to isolated tracts (Comeaux 1972).

"Swampers", as they were known, settled basin communities and made their livings as subsistence farmers. They supplemented their diet and income by exploiting the basin's aquatic wildlife. This avocation became the regional specialty. Commercial agriculture was confined to the English-speaking people who settled the ridges and planted sugar cane. After construction of the Atchafalaya spillway, "swampers" abandoned their basin homes and settled in nodes along the floodway guide levees and associated service roads. Agricultural plots were permanently abandoned. Fishing, hunting and trapping became the principal economic activities. Fishing developed into a new type of agricultural activity. Based on the "swampers" crawfish (Procambarus clarkii) harvesting experience, efforts were made to develop commercial crawfish production in fields around the perimeter of the basin (Comeaux 1972). These efforts were successful, and have developed into an important economic enterprise.

Cattle grazing is practiced in the Attakapas prairies east of the Atchafalaya swamp. The prairies were sparsely settled prior to Spanish rule. Afterward, however, this fertile land was rapidly occupied by French, Spanish, Acadian and English settlers. Each group left a distinct imprint on the landscape. The Spanish brought cattle, the French and English developed large plantations, and the Acadians established small farms. Each group brought along a distinct cultural heritage, and a unique way of measuring and dividing units of land. The Acadians settled along the bayous and established linear sugar cane farms. The Spanish permanently established the cattle industry, (Kniffen 1968) which has expanded into the marsh, and today is a major component in the economics of the alluvial wetlands. The third cultural group, the Anglo-Americans, introduced cotton, corn and their own farming techniques.

Since the end of World War II, changes in agriculture's contribution to the Deltaic Region's economy have reflected two significant trends: a major decrease in the number of farming operations and a somewhat smaller decrease in the amount of land used for agricultural purposes. The total number of farms in both Louisiana and Mississippi was reduced as agribusiness firms absorbed small, family-oriented operations. This assimilation process was especially active between 1950 and 1960 (Fielder 1977).

Number of Farms

There were more than 13,000 farms in Louisiana's Deltaic Region in 1945, accounting for 10 percent of the State's farming operations and more than 11 percent of the State's farmlands (Table 119). There were more than 3,300 farms in Mississippi's Deltaic Region in 1945, accounting for 1.3 percent of the State's farming

Table 119. Number, land[a], and value[b] of farms in the Deltaic Plain (Louisiana): 1945, 1954, 1964, and 1974.

Parish	Number	1945 land	Average value	Number	1954 land	Average value
Iberia	1,308	135,698	7,708	1,002	133,410	20.331
Jefferson	320	10,475	7,343	218	21,785	30,592
Lafourche	1,159	222,035	10,461	736	230,790	14,062
Livingston	1,897	82,229	2,198	2,585	102,319	6,143
Orleans	150	4,038	7,741	40	2,422	19,000
Plaquemines	635	41,779	5,210	594	55,239	14,805
St. Bernard	148	18,030	9,197	153	22,578	29,973
St. Charles	369	40,929	7,690	161	64,408	55,210
St. James	318	59,090	8,309	413	70,193	24,498
St. John the Baptist	225	32,575	10,930	141	41,441	21,414
St. Mary	408	104,902	17,587	417	162,162	55,349
St. Tammany	1,321	109,637	4,411	1,405	140,716	11,318
Tangipahoa	4,238	189,621	2,524	3,998	215,458	7,907
Terrebonne	701	116,137	7,662	658	116,627	18,263
State	129,295	10,039.657	3,653	111,127	11,441,343	9,667
Deltaic Plain	13,203	1,141,921	(7,783[c])	12,521	1,379,548	(23,490[c])
Percent	10.21	11.37		11.26	12.05	

(continued)

Table 119. (concluded)

Parish	Number	1964 land	Average value	Number	1974 land	Average value
Iberia	607	133,987	73,413	401	110,391	190,067
Jefferson	78	10,148	119,167	37	7,606	204,348
Lafourche	623	225,010	87,657	356	203,876	304,350
Livingston	1,585	69,585	19,768	479	43,336	90,788
Orleans	43	1,258	33,198	7	38	38,571
Plaquemines	277	57,289	49,371	102	38,169	200,914
St. Bernard	33	15,152	78,273	21	7,488	205,909
St. Charles	104	52,865	105,878	60	57,073	384,378
St. John the Baptist	117	37,878	207,548	48	26,881	719,100
St. Mary	220	123,283	161,628	148	117,530	391,671
St. Tammany	737	90,273	34,835	458	64,969	141,161
Tangipahoa	2,568	196,990	22,300	1,190	149,800	90,126
Terrebonne	408	123,413	109,482	129	60,392	257,558
State	62,466	10,411,045	38,636	33,240	9,133,275	140,754
Deltaic Plain	7,610	1,199,033	(92,496[c])	3,553	934,546	(260,640[c])
Percent	12.18	11.51		10.68	10.23	

[a]In acres (acres/2.471 = hectares).
[b]Includes land and buildings and represents the average dollar value per farm in present value at the time.
[c]Average value of farms.

Source: United States Bureau of the Census 1946a, 1956a, 1966, 1977a.

operations and slightly less than one percent of the State's total farmlands (Table 120).

The Deltaic Plain Region experienced a substantial consolidation of agricultural operations during the period 1945-1974. The number of farms in Louisiana's Deltaic Plain Region decreased by more than 73 percent, or 9,600 farms, by 1974, yet the number of hectares in cultivation decreased by only 18 percent, or just less than 84,000 hectares (207,375 acres). Similarly, the number of farms in Mississippi's coastal counties decreased by nearly 80 percent, or 2,663 farms in the period 1945-1974, yet hectares in cultivation decreased by less than 43 percent or approximately 33,600 hectares (82,990 acres) during this period.

The decline in Deltaic Region farming operations has been relatively consistent with agricultural activity declines in the rest of Louisiana and Mississippi. While the number of Louisiana Deltaic Plain farms accounted for 10.2 percent of all Louisiana farms in 1945, the region's farms accounted for 10.7 percent of all Louisiana farms in 1974. The region accounted for 11.4 percent of total hectares in agricultural production in Louisiana in 1945, and 10.3 percent of total Louisiana agricultural land used in 1974. While the number of Mississippi Deltaic Plain farms accounted for 1.3 percent of all Mississippi farms in 1945, the region's farms accounted for the same percentage of total Mississippi's farms in 1974. The region accounted for slightly less than one percent of total hectares in agricultural production in Mississippi in 1945, and by 1974 the MDPR still accounted for almost 0.8 percent of total Mississippi lands used for agriculture.

Although agricultural lands in the Deltaic Plain Region decreased by nearly 118,000 hectares during the period 1945-1974, the average farm size and value increased dramatically. In Louisiana's Deltaic Plain Region, the average farm size increased from 35 hectares (86 acres) in 1945 to 106 hectares (263 acres) in 1974. In Mississippi's coastal counties, the average farm size increased from 23 hectares (57 acres) in 1945 to 65 hectares (161 acres) in 1974. Changes in average farm size in the Deltaic Plain Region have not differed significantly from changes in average farm size for the entire State of Louisiana or Mississippi. For the State of Louisiana as a whole, the average farm size increased from 31 hectares (78 acres) in 1945 to 111 hectares (275 acres) in 1974. For the State of Mississippi as a whole, the average farm size increased from 30 hectares (74 acres) in 1945 to 108 hectares (266 acres) in 1974.

The mean value of a Louisiana Deltaic Plain farm in 1945 was $7,783 (1967 dollars). The mean value increased to $260,649 by 1974. Farms in St. John the Baptist Parish had a mean value of more than $700,000 (Table 119) exceeding the mean value of farms in all other Louisiana parishes. The 1945 mean farm value for Mississippi coastal county farms was $1,871. This value was $586 less than the State mean farm value. Mississippi coastal county farms increased in mean value to $91,166 by 1974. The largest increase was in Hancock County, where the mean value of farms exceeded $100,000, representing an increase of more than 102 percent from 1945 to 1974 (Table 120). These increases in farm value are to some extent the result of increased farm sizes. In Louisiana's Deltaic Plain parishes, the farms increased in value by about 1,100 percent on a per hectare (acre) basis and by about 1,700 percent in the Mississippi coastal counties. By comparison, overall

Table 120. Number, land[a], and value[b] of farms in the Deltaic Plain (Mississippi): 1945, 1954, 1964, and 1974.

County	1945 Number	1945 land	1945 Average value	1954 Number	1954 land	1954 Average value
Hancock	903	51,761	1,417	711	77,750	7,562
Harrison	1,363	66,249	1,910	1,046	86,149	10,701
Jackson	1,082	75,487	2,286	1,216	98,055	7,475
State	263,528	19,616,533	2,457	215,915	20,702,412	6,130
Deltaic Plain	3,348	193,497	(1,871[c])	2,973	261,954	(8,597[c])
Percent	1.27	.98		1.37	1.26	

(continued)

Table 120. (concluded)

County	Number	1964 land	Average value	Number	1974 land	Average value
Hancock	471	63,557	23,639	216	54,881	104,667
Harrison	500	47,416	21,616	249	25,187	75,867
Jackson	556	55,689	20,715	220	30,439	92,964
State	109,141	17,751,607	24,322	53,620	14,300,498	101,102
Deltaic Plain	1,527	166,662	(21,990[c])	685	110,507	(91,166[c])

[a]In acres (acres/2.471 = hectares).
[b]Includes land and buildings and represents the average value per farm in dollar values at that time.
[c]Average value of farms.
[d]1972 dollars

Source: United State Bureau of the Census 1946a, 1956a, 1966.

farm value increased by over 3,300 percent in Louisiana's coastal parishes and nearly 4,900 percent in Mississippi's coastal counties.

Agricultural Land Ownership

Despite the introduction of agribusiness operations and consolidation of smaller holdings, Deltaic Plain Region farm ownership patterns have remained relatively stable in the period 1945 to 1974. Individual or family-owned farms accounted for 85 percent of all farms in the Deltaic Plain Region in 1974 (United States Bureau of the Census 1977a, 1977b) while partnerships accounted for 9.7 percent of the region's farms in that same year. The corporate farm owner, not even enumerated in the 1945 agricultural census, accounted for 4.8 percent of all farms in the Deltaic Plain Region in 1974. The only significant decrease over the period was among farms in the "All Tenant" category, primarily individual or family-run subsistence operations. The subsistence-oriented operation almost vanished in the period 1945-1974 (United States Bureau of the Census 1977a, 1977b).

Farm Production Expenses

Farm production expenses include all farming operation and maintenance costs, excluding expenditures for land and building improvements. Expenditures for land and building improvements are considered fixed costs by the United States Bureau of the Census (1977a, 1977b), and are, therefore, not considered to be operating expenses. In the following discussion, the Bureau of the Census accounting system is accepted, although expenditures for land are recognized as perhaps the single most expensive item on the typical farmer's annual budget. Labor, machinery operations and rentals, liming, seed and feed purchases, livestock and poultry purchases and animal health care are the major expenditure categories for Deltaic Region farming operations. Detailed information concerning typical operating budgets was not available for the Deltaic Plain Region before the 1974 agricultural census. It is important to note that historical trends indicate a definite move toward more consolidated agricultural land holdings and higher costs per farm as a consequence (Section III, Agricultural Products).

Farmland in the Louisiana coastal parishes carries the highest production costs in the State. For the State of Louisiana as a whole, mean production expenses per farm amounted to approximately $22,300 in 1974. In Louisiana's Deltaic Plain, only Jefferson, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles and St. Tammany Parishes were below the State mean. The remaining Deltaic Plain parishes were above the State mean, with St. Mary Parish reporting a mean per-farm production cost of $115,730, and St. James reporting per-farm production costs in excess of $90,000 in 1974 (United States Bureau of the Census 1977a, 1977b).

Mississippi's 1974 mean production expense was approximately $19,300 per farm. Farms in Hancock, Harrison and Jackson counties averaged well below the State's mean production expense, ranging from just under $6,000 in Harrison County to just over $9,200 in Hancock County (United States Bureau of the Census 1977a, 1977b). Mississippi farm production costs are, on the average, much lower than those found in the Louisiana deltaic parishes. These mean cost differences reflect vast differences in farm sizes, ownership patterns, and operations between the two States.

All of these calculations indicate that total production expenses per farm have increased substantially over the period 1945-1974. At the same time, average farm size has increased and the average production expenses per hectare (acre) have increased more than four-fold over the 20-year period 1954-1974. Nearly half of these production cost increases may be explained by inflation as measured by the United States Department of Commerce Consumer Price Index. Overall, the trend toward consolidated land holdings and higher production costs per farm has been accompanied by a substantial increase in the cost of producing agricultural commodities per hectare (acre).

In 1974, major operating costs for agriculturalists in the Louisiana Deltaic Plain Region were for hired labor ($19.5 million), and feed for livestock and poultry, ($24.5 million) (United States Bureau of the Census 1977a). Machinery leases and rentals added another $1.5 million, and gasoline cost the farmers $5.1 million (United States Bureau of the Census 1977a). Lime and liming material added $4.5 million to the production costs, and purchase of livestock and poultry in 1974 added $6.6 million to the total production expense among Louisiana Deltaic Plain farmers. Seeds, bulbs, plants, and trees cost $1.5 million. Animal health care was the smallest expenditure category, with costs totaling approximately $504,000 (United States Bureau of the Census 1977a, 1977b). Contract labor totaled $835,000 (United States Bureau of the Census 1977a, 1977b) and all other production expenses (fertilizer, transport, water, equipment repair, etc.) contributed $44 million to Deltaic Plain farm production costs in Louisiana. Nearly $120 million was spent in 1974 in Louisiana Deltaic Plain farming operations, producing a total of almost $230 million in agricultural commodities (United States Bureau of the Census 1977a).

Mississippi production expenditures in the coastal counties accounted for less than one percent of the State's farm production expenditures in 1974. Coastal county farms spent $5.1 million producing a total of $6.1 million in agricultural commodities (United States Bureau of the Census 1977b). In Louisiana, St. Mary Parish spent more on hired labor ($4.1 million) and commercial fertilizers ($1.3 million) than the three Mississippi coastal counties spent on all farm production expenses. Production expenses for the family-operated small holdings that are typical in Mississippi are generally much less than expenses incurred by the corporate operations that are typical of much of Louisiana.

Farm Machinery and Equipment

Equipment and machinery values among Deltaic Plain Region agriculturalists represent a sizable capital investment. Such capital requirements have contributed increasingly to the consolidation of land holdings and to a decline in the number of the region's farms in the face of uncertain market conditions. The average equipment value per farm for Louisiana Deltaic Plain parishes was estimated at $22,893 in 1974, while the Statewide average was an estimated $23,037 per farm. In Mississippi coastal counties, the average equipment value per farm was estimated at $11,058, while the statewide average was an estimated $17,432.

There is a wide range in average equipment values per farm. Sugar cane producing parishes and those parishes with dairy operations generally have the highest average values, with St. Mary ($66,341), St James ($62,183), and Terrebonne ($40,398) Parishes leading the sugar cane producers (United States Bureau of the Census 1977a). Tangipahoa Parish, noted for its livestock and dairy operations, had an average equipment value of $153,541 per farm in 1974. On the other hand, none of the Mississippi coastal counties had an average equipment value per farm in excess of $15,000. Harrison County, and St. Bernard, Orleans and Livingston Parishes each had an average equipment value below $10,000 per farm in 1974 (United States Bureau of the Census 1977a).

Market Value of Agricultural Products Sold: Regional Distribution

Agricultural production in the Deltaic Plain Region has undergone a remarkable transition in the period 1945-1974. Inflationary pressures notwithstanding, the average market value of agricultural commodities produced by each farm in the region has increased dramatically. Despite the decrease in the number of farms, 1974 regional sales represent a 625 percent increase over 1945 sales. Approximately two-thirds (400 percent) of this increase is due to inflation (University of New Orleans 1977). Farmers in Louisiana's Deltaic Plain parishes have contributed much more heavily to this increase than have farms in Mississippi's coastal counties.

In 1945, the 13,203 Louisiana Deltaic Plain farms produced $30.5 million (1967 dollars) in agricultural commodity sales (United States Bureau of the Census 1977a). The average value of commodities produced per farm was approximately $2,300. In 1974, 3,553 Louisiana Deltaic Plain farms produced $229.6 million in agricultural commodity sales. The average value of commodities produced per farm was approximately $64,600. In 1974, Iberia, Lafourche, St. James, St. Mary and Tangipahoa were the most productive parishes in terms of the value of products sold. These five parishes had a sales total of $186 million (United States Bureau of the Census 1977a). The importance of these parishes can be better understood by considering their portion of the region's agricultural income. In terms of market value, these five parishes accounted for 81 percent of the Deltaic Plain's agricultural products sold (United States Bureau of the Census 1977a). All except Tangipahoa are sugar cane producing regions. Tangipahoa has a diversity of agricultural activities.

In 1945, the 3,348 Mississippi deltaic plain farms produced slightly more than $2 million in agricultural commodity sales (United States Bureau of the Census 1977a). The average value of commodities produced per farm was approximately $617. In 1974, 685 coastal county farms produced approximately $6.1 million in agricultural commodity sales (United States Bureau of the Census 1977b). The average value of commodities produced per farm was approximately $8,800. Although Jackson County was the most productive of the three counties, commodity sales there approximated only $170,000 more than in Hancock County and only $433,000 more than in Harrison County. In the three coastal counties, the $6.1 million in sales represents less than half of one percent of the State's total. In the Louisiana Deltaic Plain parishes, however, the 1974 sales volume represented more than 19 percent of the State's $1.2 billion in agricultural sales, while the number of deltaic farms represents just over 10 percent of the total number of farms in the State.

Changes in the distribution of farm income during the period 1945-1974 reflect a great increase in commercial operations in Louisiana. The shift in farm income distribution among Mississippi coastal county farms was less dramatic. More than half of all farms in the region sold products valued at less than $1,000 in

1945, but by 1974 the agricultural census did not even report farms in this sales volume category (United States Bureau of the Census 1977b). By 1974, the median sales volume category for the Louisiana Deltaic Plain farms was $2,000-$2,499, while for coastal county farms in Mississippi, the median sales category was $1,000-$1,499. More than 25 percent of Louisiana's Deltaic Plain parish farms had sales of $40,000 or greater in 1974, while only 6 percent of Mississippi's coastal county farms had sales volumes of that magnitude.

In 1974, there were 468 farms in Louisiana's Deltaic Plain with agricultural sales in excess of $100,000. More than half were located either in Iberia, Lafourche, St. James, St. Mary or Tangipahoa Parishes. The three Mississippi coastal counties had 10 farms with sales over $100,000. Jackson County, with five of these, and Harrison with four account for all but one of these high volume operations. Hancock County has only one farm with sales in excess of $100,000.

Production Trends By Area and Commodity

Production trends for agricultural commodities in the Deltaic Plain parishes are rather distinct when compared with statewide production trends. While the Deltaic Plain parishes have approximately 11 percent of Louisiana's farms, the region is responsible for 33 percent of the State's sugarcane and other field crops. Well over half of the fruit and nut production in Louisiana is from farms in the Deltaic Plain parishes, while 75 percent of Louisiana's tobacco farms are located in the region. Approximately one-third of the State's dairy farms are located in the Deltaic Plain parishes, and 27 percent of the poultry and egg businesses are also found there. Almost one-fourth of the animal specialty farms (e.g. thoroughbred horses) are located in the Deltaic Plain parishes.

In Mississippi's coastal counties, farms depend primarily on three categories of products: cash grains, livestock and dairy products. While farms in these coastal counties account for less than one percent of Mississippi's farm total, a disproportionately large number of dairy operations, truck farms and farms producing horticultural specialties are located in the coastal region (Table 121).

Land Use

Historical changes in agricultural land uses reflect changing market conditions that have forced a shift in emphasis among agricultural production alternatives. The current distribution reflects a reduced proportion of harvested croplands within the region, a slight decrease in the proportion of irrigated farmlands and fallow croplands in the region, and a substantially greater share of agricultural lands classified in the residual land use category ("All Other Uses") which includes rural house lots, roadways and wasteland. The proportion of land devoted to pasturage has decreased from 31.4 percent to 13.5 percent in relation to other agricultural uses in the period 1945-1974 (Table 122).

There were approximately 172,000 hectares (426,000 acres) within Louisiana's Deltaic Plain used for harvested crop lands in 1945. These lands accounted for more than 37 percent of the total Louisiana Deltaic Plain Region's agricultural production lands in 1945. By 1974, there were approximately 101,000 hectares (250,000 acres) of harvested croplands in the region, but these lands amounted to only 27 percent of the region's agricultural lands. Iberia, Lafourche and St. Mary parishes had almost 60 percent of the region's harvested cropland. These three parishes are important sugar cane producers.

Table 121. MDPR agricultural products compared with State totals (number of farms, 1974[a]).

Commodity	Louisiana MDPR	Louisiana State	MDPR as % of State total	Mississippi MDPR	Mississippi State	MDPR as % of State total
Cash grains	44	6,707	0.7	68	5,920	1.15
Cotton		2,000		1	5,261	0.02
Tobacco	15	20	75.0			
Sugar, potatoes, hay & other field crops	624	1,887	33.0	7	703	1.00
Vegetables & melons	90	278	32.0	6	231	2.60
Fruit & nuts	80	138	58.0	2	48	4.17
Horticulture specialties	65	175	37.0	8	109	7.34
General						
Crops	6	326	1.8	4	833	0.48
Livestock	480	4,539	10.6	93	8,596	1.08
Livestock	480	4,539	10.6	93	8,596	1.08
Dairy	397	1,442	27.5	30	1,337	2.24
Poultry & eggs	124	461	26.9	5	1,917	0.26
Animal specialties	51	206	24.8	8	108	7.4
Not classified	27	335	8.1	6	912	0.66
Total	2,004	18,542	10.8	· 238	26,056	0.91

[a]Data not reported prior to 1974 Census of Agriculture.
[b]MDPR farms as a percent of the State total.

Sources: United States Bureau of the Census 1977a.
United States Bureau of the Census 1977b.

Table 122. Historical changes in MDPR lands used for agricultural production - selected years, 1945 - 1974.

Land use	1945 LA	1945 MS	1954 LA	1954 MS
Harvested croplands				
Acres	426,241	36,948	349,988	33,005
Hectares	172,497	14,953	141,638	13,357
% of MDPR agricultural land	37.3	19.1	25.4	12.6
Failed croplands				
Acres	2,944	336	18,627	2,941
Hectares	1,191	136	7,538	1,190
% of MDPR agricultural land	0.3	0.2	1.4	1.1
Idle or fallow croplands				
Acres	41,304	5,863	72,803	10,085
Hectares	16,715	2,373	29,463	4,081
% of MDPR agricultural land	3.6	3.0	5.3	3.8
Pasturage[a]				
Acres	358,488	74,453		
Hectares	145,078	30,131		
% of MDPR agricultural land	31.4	38.5		
All other, i.e. house lots, roads, wastelands, etc.				
Acres	127,733	6,060	129,378	10,871
Hectares	51,693	2,452	52,359	4,399
% of MDPR agricultural land	11.2	3.1	9.4	4.1
Irrigated farms[b]				
Acres			117,405	
Hectares			47,513	
% of MDPR agricultural land			8.5	
Total agricultural production lands				
Acres	1,141,921	193,497	1,379,548	261,954
Hectares	462,129	78,307	558,295	106,011
% of MDPR agricultural land	100	100	100	100

(continued)

Table 122.

Land use	1964 LA	1964 MS	1974 LA	1974 MS
Harvested croplands				
Acres	294,190	22,397	250,493	23,809
Hectares	119,057	9,064	101,373	9,635
% of MDPR agricultural land	24.5	13.4	26.8	21.5
Failed croplands[a]				
Acres	2,848	251		
Hectares	1,153	102		
% of MDPR agricultural land	0.2	0.2		
Idle or fallow croplands[a]				
Acres	58,577	5,566		
Hectares	23,706	2,253		
% of MDPR agricultural land	4.9	3.3		
Pasturage[b]				
Acres			125,766	21,444
Hectares			50,897	8,678
% of MDPR agricultural land			13.5	19.4
All other, i.e. house lots, roads, wastelands, etc.				
Acres	184,244	7,706	288,232	19,511
Hectares	74,563	3,119	116,646	7,896
% of MDPR agricultural land	15.4	4.6	30.8	17.6
Irrigated farms				
Acres	83,897	200	62,068	1,911
Hectares	33,953	81	25,119	773
% of MDPR agricultural land	7.0	0.1	6.6	0.1

(continued)

Table 122. (concluded)

Land use	1964 LA	1964 MS	1974 LA	1974 MS
Total agricultural production lands				
Acres	1,199,033	166,662	934,546	110,507
Hectares	485,242	67,447	378,206	44,722
% of MDPR agricultural land	100	100	100	100

[a]Data not reported for 1954 or 1974.
[b]Data not reported for 1945 or 1964.

Source: United States Bureau of the Census 1956a, 1956b, 1966, 1967, 1977a, 1977b.

In Mississippi, harvested croplands have increased in proportion to the total coastal county lands used for agricultural production. In 1945, the coastal counties' 15,000 hectares (37,000 acres) of harvested cropland accounted for approximately 19 percent of Mississippi's Deltaic Plain Region agricultural lands. In 1974, the coastal counties' 9,600 hectares (24,000 acres) of harvested cropland accounted for more than 21 percent of Mississippi's Deltaic Plain agricultural lands. Harrison and Jackson Counties, with virtually equal amounts of harvested croplands between them account for all but seven percent of the coastal counties' harvested croplands.

The relative proportion of agricultural lands in irrigated farms, never a substantial component of the Deltaic Plain, decreased in the period from 1954 to 1974. Irrigated farmland in the Deltaic Plain encompasses harvested cropland, cropland used only for pasture, cropland not harvested and not pastured, and improved pasture.

In 1954, the first year for which irrigated farm lands were enumerated, irrigated farms in Louisiana's Deltaic Plain parishes occupied approximately 47,500 hectares (117,405 acres), or 8.5 percent of the region's agricultural lands. By 1974, irrigated farm lands had decreased to 25,100 hectares (62,000 acres) comprising 6.6 percent of Louisiana's Deltaic Plain Region agricultural lands. In the period from 1945 to 1974, the total land in irrigated farms increased in the State of Louisiana as a whole.

Data concerning irrigated farms in Mississippi's coastal counties were first recorded in the 1964 Census of Agriculture, when 81 hectares (200 acres) were reported as land in irrigated farms. Hancock County's 769 hectares (1900 acres) in irrigated farms in 1974 represents more than 99 percent of the coastal counties' irrigated farmlands in 1974.

Failed croplands in the Deltaic Plain Region have never accounted for a significant portion of regional agricultural land uses, although the 1954 Census of Agriculture identified an unusually high total of 8,700 hectares (21,600 acres) of failed croplands.

Idle or fallow croplands have retained their relatively small share of regional agricultural land uses throughout the post-World War II period. The region's share of statewide totals for idle or fallow lands has decreased, however, indicating that the extent of fallow lands outside the region has increased when compared with the Deltaic Plain Region (Table 122).

AGRICULTURAL PRODUCTS: THE SETTLER'S LEGACY

Deltaic Plain Field Crops

The Mississippi Deltaic Plain Region is an extremely valuable agricultural area producing approximately $236 million of commodities in 1974 (United States Bureau of the Census 1977b). In total, these products represented 9.8 percent of the farm commodity value in Louisiana and Mississippi (19 percent of Louisiana and 0.5 percent of Mississippi). Field crops, including sugar cane, soybeans, field corn, rice, hay, and sorghum, are major income-producing commodities within the Deltaic Plain and at the State level.

By 1974, soybeans had become Louisiana's number one crop in terms of value of production. This crop is increasing as former pasture, rice, and sugar cane fields are converted to more profitable soybeans. Sugar cane production remains high in the Deltaic Plain and is one of the region's principal crops. Although the number of sugar cane growers and mills has decreased, the average amounts of land in cultivation have remained relatively stable. Field corn production is being phased out; the Deltaic Plain produced less than three percent of Louisiana's and Mississippi's field corn in 1974. Rice production has steadily decreased in the Deltaic Plain since 1945 to the point that, in 1974, less than one percent of Louisiana's total rice came from the region. Hay production in the MDPR increased rapidly from 1945 to 1954, more than doubling the land area planted. Since 1954, however, the acreage used for hay production has remained relatively constant. Sorghum is not widely planted in the MDPR; the relative contribution to total statewide production is small, amounting to less than seven percent in 1974.

Sugar Cane. Sugar cane was introduced into Louisiana in 1751 when a small quantity was planted and cultivated near New Orleans. Although planters tried unsuccessfully to manufacture sugar, the original cane crops were used primarily for chewing. Development of a process for granulating sugar in 1794 allowed sugar cane to become a commercial crop in Louisiana. With the establishment of the industry, indigo production was abandoned in favor of sugar cane (Sitterson 1953, Taggart and Simon 1957, Hansen 1971).

Along the Mississippi River, the form and intensity of land use competition with sugar cane are perhaps most visible. Louisiana's rapid industrial growth is located primarily on former sugar land along the River between Baton Rouge and New Orleans. While industry is a welcome addition to the local economy, prime agricultural land has been converted to other uses at an alarming rate. On the East Bank, there is only one major sugar producer between Baton Rouge and New Orleans.

Along the River north of New Orleans, there are more than 100 industrial plants, either in operation or under construction. Fewer than a third of these existed in 1950 and well over half of the new plants have opened since 1960. The majority are large petrochemical installations whose principal products are plastics and agricultural chemicals. It is neither difficult, nor unreasonable, to foresee the day when sugar production along the Mississippi River will cease. Some major sugar producers who own or control several thousand acres are strongly opposed to the conversion of the riverine sugar lands to industrial uses. These producers, located mainly on the West Bank, have sufficient capital to stay in the business for several more years. The rapid decline of sugar prices that began in 1976, coupled with inflationary pressures, maintenance costs, expenditures for equipment, and changes in the local labor market may drive these individuals out of the sugar industry.

The pattern of land use competition in Lafourche Parish and in the Teche area is similar to that along the Mississippi River, but on a much smaller scale. Industrial activity is developing slowly. The two major urban centers in the Teche area, New Iberia and Lafayette, are spreading into former sugar land. The same is true for the cities of Houma and Thibodaux in the Lafourche area. In both areas, another source of land use competition is hydrocarbon development, in the form of oil and natural gas wells, pipeline pumping stations, and natural gas processing plants. Individually, these uses occupy relatively small plots of land. Together, although precise estimates are not available, the total area involved is substantial. Few farmers refuse to sacrifice a portion of their cropland to gain the potential income from an oil or gas well or the proceeds from a long-term oil lease.

Suburban expansion is active throughout the sugar region and the population of the entire Mississippi Deltaic Plain Region is growing at an annual rate of approximately five percent (University of New Orleans 1977). Competitive land uses include new highways, commercial and industrial developments, and, most of all, other agricultural crops, particularly soybeans. Soybeans are often used in rotation with sugar, yet soybean production has become so profitable that regrowth forest is being cleared and sugar lands are being converted to beans. Production costs and the initial capital investment for soybeans are only a fraction of those needed for sugar. Compared with sugar production, labor costs for soybeans are lower, less specialized machinery is needed, and production and handling technologies are more advanced.

Taking fields out of sugar production has resulted in sugar mills closing and has reduced regional milling capabilities. For example, there are no longer any mills in Terrebonne Parish; in Lafourche, one mill closed permanently in 1978, and another was closed for at least one year. Although a number of mills are increasing their capacities to handle additional cane, the geographic distribution of the remaining mills makes it difficult for farmers to economically transport their harvest to processing mills. Many mills are using equipment manufactured before the turn of the century. In 1970, a boiler cost $150,000; less than 10 years later the price exceeds $2 million. With this order of cost increases, many mills are being forced to close. Farmers' transportation patterns are altered (Herline 1978a), and the cost of transporting cane from the field to the mill becomes excessive. Farmers must abandon the industry, produce another agricultural crop, or sell out. Growers who continue to produce cane often haul their product 40 kilometers (25 miles) to a mill.

Sugar production suffers from lagging technology; there is a long history, however, of technological improvements involving cane varieties, herbicides and pesticides, and use of fertilizer. Planting, harvesting, and handling techniques have developed at a slower pace. Enormous advances were made in the last 15 to 20 years in reducing production costs. The principal impetus behind these advances was the rapid growth of the Florida sugar cane industry. The Florida industry has more modern equipment and enjoys lower production costs.

Every phase of sugar production could be carried out mechanically, yet in the Deltaic Plain some jobs are still done by hand. Machines save money on labor, but add high equipment costs for the sugar farmer. Farmers must make their operations efficient to obtain the highest possible yield per acre to cover operating expenses.

A recent interview with sugar cane farmers graphically reports the problems facing sugar producers.

> "Right now we're on a year-to-year basis, holding on, hoping things will get better. But a tractor costs $28,000, and a planter is $9,000. That's $35,000 just to plant your cane. The small farmer hasn't got a

chance. We're losing all the production on Bayou DuLarge -- it's just too far to haul -- and the new trucking laws are just making it too expensive. On a tandem 18-wheeler, 86,000 pounds are allowed with a farm permit, but the load limit also specifies a maximum of 37,000 pounds under each axle...it is a real problem to get even distribution with cane and the fines are tremendous" (Herline 1978a: 10-B).

Sugar farmers must look for some way to make a profit. To hedge against low sugar prices, some are converting lands to crawfish ponds. Others are growing soybeans and rice on land that is normally fallow. Some think that gasohol may solve their problems. The industry is in a state of crisis.

Total production of sugar cane increased gradually from initial commercial operations to 1950, with average yields ranging from 14,515 to 18,144 kilograms (16 to 20 tons) per acre (Polopolus 1962). The so-called "Noble" cane was preferred until the catastrophic arrival of the mosaic disease in 1926, when production declined dramatically. Sugar planters and sugar factories failed. With the introduction of the Java P.O.J. variety, sugar again prospered.

Since 1950, the number of sugar cane growers and mills has decreased, as has the amount of land planted in cane. Low sugar prices, rising land and equipment costs, scarcity of labor, milling problems, and government regulations are all contributing factors to industry problems (Herline 1978a).

Land planted in sugar cane varied from a low of 108,900 hectares (269,092 acres) in 1945 to a 1964 high of 128,764 hectares (318,177 acres) (United States Bureau of the Census 1946; 1956, 1966). Sixty-eight percent of Louisiana's total deltaic plain cropland is utilized for sugar cane production. Production remains high, with yields varying within the Louisiana Deltaic Plain from 16,329 to 27,216 kilograms (18 to 30 tons) per acre. The Louisiana Sugar Experiment Station at Louisiana State University and the United States Department of Agriculture Experiment Station at Houma constantly strive for varietal improvements, attempting to prevent sugar industry disasters. No sugar cane production is reported in the Census of Agriculture for the three Mississippi coastal counties.

<u>Soybeans</u>. Production of soybeans in the MDPR has increased steadily since 1945. Yields and acreage assigned to soybean production will continue to increase as farmers become familiar with proper growing and harvesting practices. Soybeans are now planted extensively in the coastal lowlands. Most soybean land is former pasture, rice, or sugarcane acreage. From 1945 through 1954, production increased from 62 cubic meters (1,748 bushels) to 956 cubic meters (27,130 bushels), approximately a fifteen-fold increase. From 1964 to 1974 soybean production increased nearly 22-fold, to 21,908 cubic meters (621,682 bushels). From 1964 to 1974, soybean acreage increased from 574 hectares (1,418 acres) to 9,984 hectares (24,670 acres) (United States Bureau of the Census 1977a).

Soybeans yield approximately two cubic meters per hectare (24 bushels per acre). One bushel (.035 cubic meters), the measure used in the national market, sells for $7 to $10. Soybeans offer coastal farmers an attractive return. Farmers in the Teche area parishes find soybean production economically attractive because the equipment required is the same as that needed for rice. The Iberia Parish rice-growing areas are being converted to soybeans, or rotated with rice. Rotation reduces the red rice plague, a weed that cannot be controlled with a herbicide in rice production years and is a nuisance. It can be sprayed and controlled in soybean years, however, so that the two crops are highly compatible.

In 1974, the three coastal counties in Mississippi produced 13,006 cubic meters (369,080 bushels) of soybeans, amounting to 4,140 cubic meters (117,478 bushels) more than the Louisiana Deltaic Plain parishes. Growth trends in the past ten years indicate the increasing importance of soybeans as a production crop, with soybean fields covering over 100 square kilometers (38 square miles) of cropland in Mississippi (United States Bureau of the Census 1977b).

Field Corn. Corn is grown best on soils that are well drained. In the deltaic parishes, these soils are generally used for the more profitable sugar cane cultivation. Corn cannot be justified economically unless there is a strong farmers' market demand for tablefood and livestock feed.

For efficient corn production, large-scale tracts must be cultivated. Deltaic Plain corn can be sold as grain for livestock and/or processed as silage. High costs associated with mechanized harvesting, storage problems and excessive rainfall during critical stages of growth discourage corn production. Wide and high furrows result in relatively low plant population density, and weed and insect control require considerable technical knowledge.

Corn production is being phased out throughout the entire Deltaic Plain Region. In 1945, there were 11,473 farms producing corn in the Mississippi Deltaic Plain, 6,728 in 1954, 2,096 in 1964, and only 426 in 1974 (United States Bureau of the Census 1946a, 1946b, 1956a, 1956b, 1966, 1967, 1977a, 1977b). There were only 3.7 percent as many farms in 1974 as in 1945 producing corn for all purposes. The amount of land planted in corn is also declining; there was only 3.9 percent as much land planted in corn in 1974 as there had been in 1945. The Louisiana Deltaic Plain parishes have declined in importance for corn production, from producing nearly 16 percent of the State's corn in 1945 to producing only about 3 percent in 1974. The contribution of the three Mississippi coastal counties to statewide corn production has remained small, always less than three percent (United States Bureau of the Census 1946b, 1956b, 1967, 1977b).

Historically, Iberia, Lafourche, St. Mary, Tangipahoa, and Terrebonne Parishes have been the most important Louisiana Deltaic Plain corn producers accounting for up to 76.5 percent of the land planted in corn. While all parishes had substantial reductions in the amount of corn farming activity, Terrebonne and St. Mary Parishes have declined even more rapidly. Iberia, Lafourche, St. Tammany, and Terrebonne Parishes now account for over 80 percent of the Louisiana Deltaic Plain corn production.

The trend toward reduced corn production is repeated in the three Mississippi counties. From 1964 to 1974, there appeared to be a levelling off or even a slight increase in grain corn production in this area. Harrison County was the leading corn producer in 1945, but Jackson County has been the leader since 1954.

Rice. Rice, classified as a cereal crop, is one of the world's most important foods. Rice is well suited for Louisiana's warm, humid climate and it is the only cereal that can grow in areas of excessive precipitation on poorly-drained soils (Louisiana Agriculture Progress and Opportunities...1926).

Rice was introduced into Louisiana in the early 1700's. By 1726, rice was being commercially exported to Europe. Louisiana was producing 50,000 barrels a year by 1866. Irrigation projects, begun in 1880, so stimulated rice production that by 1914, production reached four million barrels a year. In 1887, an extensive colonization project in southwestern Louisiana brought several hundred midwestern farmers of German, Swedish, and Danish descent to settle 607,041 hectares (1.5 million acres) in the Louisiana Rice Belt (Hansen 1971).

Practically all of Louisiana's irrigated land is used for rice production. Climate is a minor factor, but the need for irrigation restricts rice crops to areas in which there is a plentiful water supply as well as fertile soil. The southwestern Louisiana prairies offer favorable soil conditions. Although large streams are few, cheap canal irrigation is available (Lee 1960).

The Teche area is part of Louisiana's rice belt. Land use competition is developing between rice and sugar cane within the region (Polopolus 1962). On many farms, rice is being planted in sugar fields as well as occupying newly-cleared land. Initial capital investment for rice farming is comparable to that required for soybean production-- and much less than that required for sugar farming. New rice varieties mature in a short enough time to permit harvesting two crops per year from the same field. This is in distinct contrast to the 14 months required between the planting and harvesting of sugar cane. In addition, fallow rice fields can be flooded to provide proper conditions for harvesting a crawfish crop.

No rice production is reported in the Mississippi coastal counties. On the Louisiana Deltaic Plain, Iberia, St. James, and St. Mary Parishes grew rice on a total of 4,653 hectares (11,745 acres) in 1945-- more than 84 percent of the area planted in rice in the Louisiana Deltaic Plain (United States Bureau of the Census 1946a). By 1964, the land planted in rice in these three parishes had decreased to approximately 3,500 hectares (8,728 acres)-- but accounted for nearly 95 percent of the total rice lands in the region. In 1974, only Iberia and St. Mary Parishes reported rice production. In these two parishes, a total of 2,254 hectares (5,569 acres) were planted in rice (United States Bureau of the Census 1977a). The Deltaic Region's total rice production has decreased steadily since 1954 and, by 1974, accounted for less than one percent of the total Louisiana rice production.

Hay. Production of hay in the Louisiana Deltaic Plain parishes is hampered by the 152 centimeters (60 inches) of precipitation received each year. Cutting and baling hay is difficult as precipitation precludes adequate drying time. In spite of this environmental constraint, the region's hay production has increased since 1945. Nearly 9 percent of Louisiana's hay harvest came from the Deltaic Plain in 1945 and over 12 percent in 1974. In Mississippi, the three coastal counties have also slightly increased their hay production, accounting for just under one percent of the State's total production in 1974. The total Mississippi Deltaic Plain hay cropland was 9,876 hectares (24,404 acres) in 1945, 20,213 hectares (49,947 acres) in 1954; 16,930 hectares (41,833 acres) in 1964, and 18,028 hectares (44,548 acres) in 1974 (United States Bureau of the Census 1946a, 1946b, 1956a, 1956b, 1966, 1967, 1977a, 1977b).

Sorghum. Sorghum is not a major crop in the Deltaic Plain. Only 1,097 hectares (2,710 acres) were planted for all purposes except syrup in 1974 and only 180 hectares (445 acres) for grain (United States Bureau of the Census 1977a, 1977b). These figures represent a slight increase in cultivated land area since 1945. Sorghum production has increased throughout Louisiana and Mississippi, as it has in the Deltaic Plain. The relative contribution of the Deltaic Plain production to statewide efforts is small, less than seven percent for any of sorghum's use categories in 1974.

Forestry Products Produced from the Farm

Forestry is one of the Deltaic Plain Region's most important primary industries. Forestry production is concentrated along the Mississippi Gulf Coast and in the "hill country" north of Lake Pontchartrain. The industry has faced a number of challenges in the past decade-- the recent housing boom and its extraordinary demand for lumber products, and environmental protection questions concerning the forest management practices, including harvesting and processing procedures. Finally, recent shortages in lumber and wood products posed questions concerning the Nation's ability to meet increased demands for forest products. This is a critical problem because it takes 15 years to grow pulpwood and 40 years for sawtimber trees (Corty and Main 1974). A sudden increase in demand cannot be easily balanced by increasing supplies.

The Deltaic Plain's principal tree crop is pine, with the heaviest concentration of commercial pine forests located in Livingston, Tangipahoa, and St. Tammany Parishes. Softwood forests are a predominent landscape feature north of Lake Pontchartrain, where 75 percent of the forest lands are located (Sternitze 1965, Louisiana Forest Facts 1974, Louisiana Forest Types 1974). There were 64 tree farms in the deltaic parishes reporting a harvest valued at $646,000 for 1974. Sales represented 10.8 percent of the State's tree farm sales. The number of farms harvesting timber has declined since 1945, but log value has increased over this period (United States Bureau of the Census 1946a, 1946b, 1956a, 1956b, 1966, 1967, 1977a, 1977b). The Mississippi coastal county tree farms produced a harvest valued at $12,000 in 1974 (United States Bureau of the Census 1977b).

Truck Farms

Truck farming is practiced in Louisiana on a relatively small scale. Production is based on demand and climatic conditions. Crops grown include peas, cabbage, cauliflower, brussel sprouts, mustard, parsley, spinach, onions, tomatoes, squash, garlic, and shallots. Strawberries and melons are also grown in small restricted parts of the Deltaic Plain Region.

Several Deltaic Plain areas are noted for truck crop production: Bayou Blue in Terrebonne and Lafourche Parishes, the east and west bank levee lands in St. James and Plaquemines Parishes, and an area of small farms north of Lake Pontchartrain. This latter area provides fresh vegetables to the New Orleans market.

Mounting labor costs and the temptation to sell land for urban expansion have reduced overall truck farm production in the period of 1945 through 1974. The practice of growing vegetables for the fresh produce market survives, but is declining (Quiroz 1978).

Vegetables, Sweet Corn, and Melons Harvested For Sale. In Louisiana, there has been a marked decline in the production of vegetables, sweet corn, and melons (Woolf and Rachal 1965). In 1945, the Deltaic Plain parishes had more than 11,300 hectares (87,964 acres) producing these farm products. This land accounted for more than half of the State's total vegetable, sweet corn, and melon fields (United States Bureau of The Census 1946a). There were only approximately 1,120 hectares (2,768 acres) of vegetables, sweet corn, and melons harvested among Louisiana's 14 Deltaic Plain parishes in 1974. These lands accounted for 33 percent of the State's total land planted to such crops (United States Bureau of the Census 1977a). In Mississippi's three coastal counties, there were an additional 153 hectares (377 acres) that accounted for 3.5 percent of the State's land used to produce these agricultural products (United States Bureau of the Census 1977b).

In 1945, Lafourche, St. John the Baptist, and Tangipahoa had the greatest amounts of cultivated land area in the region. They were still important in 1974, but cultivated land area was substantially reduced. In that year, no parish planted vegetables, sweet corn, or melons on more than 223 hectares (550 acres). While all parishes except St. Mary had planted more than 263 hectares (650 acres) in 1945, the 1974 data show a drastic decline in lands used for these crops (United States Bureau of the Census 1977a).

Irish Potatoes. Louisiana farmers planted 971 hectares (2,399 acres) in Irish potatoes for 1974. One hundred one hectares (250 acres) were located in the coastal lowlands. This represents a considerable decline from the 1945 State total of 22,166 hectares (54,772 acres). 1974 Irish potato production amounted to 7,615 cubic meters (216,098 bushels). Lafourche and Terrebonne Parishes planted 576 hectares (233 acres) in potatoes, producing 477 cubic meters (13,539 bushels), or 93 percent of the Deltaic Plain parishes' crop. The remaining 12 parishes in the Deltaic Plain produced an additional 36 cubic meters (1,024 bushels).

The deltaic plain parishes produced 6.7 percent of the 1974 State total. Ten years earlier, the deltaic region produced 33.3 percent of the State harvest. Total Louisiana production was only 4,927 cubic meters (139,822 bushels) in 1964 - the lowest production output reported in the agricultural census. Production has not increased since 1964.

The Deltaic Plain, at one time, produced substantially more Irish potatoes than it does today. There were more than 30,000 cubic meters (856,881 bushels) harvested in 1945 from the 14 Deltaic Plain parishes. The declining production pattern was established by 1954, when only 5,180 cubic meters (147,005 bushels) were harvested (United States Bureau of the Census 1946a, 1946b, 1956a, 1956b, 1966, 1967, 1977a, 1977b).

In the Mississippi coastal counties, the Irish potato is not an important agricultural commodity. Only 16 cubic meters (444 bushels) were produced in 1974. The potato crop was, however, more important earlier. The 1945 Census of Agriculture reports 300 hectares (742 acres) planted in potatoes, producing approximately 2,512 cubic meters (71,286 bushels). Potato production in the entire Deltaic Plain Region has declined since 1945. In both Mississippi and Louisiana, potato production serves only the local market, and there are no exports reported.

Strawberries. Strawberry cultivation in the "Florida Parishes" was introduced by the Illinois Central Railroad. The railroad provided agricultural experts to determine the single most favorable crop for the area. Through experimentation, it was found that the soil and climate were ideally suited for growing strawberries (Darrow 1966, United States Department of Agriculture 1978). In 1866, plants were furnished to farmers for test purposes. Production soon increased to the point that the railroad introduced express service to northern city markets. By 1900, train loads of berries were shipped north daily during the season (Hansen 1971).

In the early 1940's, there were 2,680 farms involved in the strawberry industry in Livingston, St. Tammany, and Tangipahoa Parishes. These farms produced more than 6.7 million liters (7.1 million quarts) of strawberries from 2,361 hectares (5,206 acres). By 1974, the number of farms involved in strawberry production, and the amount of land planted in strawberries had declined. Only 81 farms harvested strawberries from 118 hectares (291 acres) in 1974. Livingston and Tangipahoa Parishes produced the entire harvest, which accounted for almost 94 percent of the entire Louisiana strawberry crop (United States Bureau of the Census 1946a, 1956a, 1966, 1977a).

New high-yield strawberry plants produce a large volume of fruit early in the season. Farmers can deliver shipments to northern and eastern markets in April and May (Hawthorne *et al*. 1961). Louisiana's berries are the first to reach these markets and they command premium prices.

Mississippi's coastal counties reported small quantities of strawberries produced throughout the period of 1945 through 1974. Until after the 1964 Census of Agriculture, the region had never harvested more than a total of two hectares (five acres), and the yield per hectare (acre) was always small. By 1974, the State had nine farms producing strawberries from almost eight hectares (19 acres). By 1974, all of the strawberry production in Mississippi was taking place within the three coastal counties (United States Bureau of the Census 1946b, 1956b, 1967, 1977b).

Tomatoes. Tomatoes are grown throughout the deltaic plain. They are the specialty of farmers in Plaquemines and St. Bernard Parishes, who grow the small, spicy Creole variety. This tomato is considered a delicacy and is prized for its tangy taste. Plaquemines and St. Bernard are the principal tomato producing Parishes; they have consistently planted the greatest amount of land between 1945 and 1974. The amount of land used for tomato cultivation has declined throughout this period.

Projected market price has been the single-most important factor in determining whether or not a farmer will produce tomatoes in sizable quantities. Another significant factor is the cost of hand labor involved in tomato picking. This labor is often not available at a price that smaller truck farming operations can afford. The result has been that the number of farms and lands harvested in the Deltaic Plain declined from 428 farms utilizing 259 hectares (639 acres) in 1945 to 34 farms utilizing 59 hectares (147 acres) in 1974. The 1974 lands represented 35.5 percent of Louisiana's total tomato production lands (United States Bureau of the Census 1977a).

Tomatoes are not a major crop in the Mississippi coastal zone. The census reports no production for the region.

Hot Peppers. Louisiana hot pepper production is concentrated in Iberia and St. Mary Parishes (Woolf and Rachal 1965). Iberia is the only Deltaic Plain producer. Four farms are responsible for less than half of the Iberia parish lands harvested in 1974. The Parish's farmers planted the largest amount of land devoted to the production of Cayenne, Tabasco, and Lafayette sport peppers for use primarily in hot pepper sauces and pepper products (Dauzat and Law 1976, Ries 1968). No pepper production is reported for the Mississippi coastal counties.

Fruit and Nuts

The principal products in this category include tung nuts, citrus fruits, and pecans. Tung nut oil was used extensively as a paint base until the advent of acrylic and latex-based paints in the 1960's. There was a dramatic increase in citrus production in Louisiana's Deltaic Plain parishes over the period between 1964 and 1974. Deltaic Plain pecan trees have significantly diminished in production over the period of 1945 to 1974. The region's production decreased sharply, not only by volume, but also by proportion of State production. In 1945, the region's pecan groves accounted for eight percent of total State production, but in 1974, the crop amounted to less than one percent of total State yields.

The Deltaic Plain Region's fruit and nut harvest changed considerably between 1945 and 1974. There were almost 9,700 hectares (23,913 acres) of land planted in fruit orchards in Louisiana's coastal parishes in 1945. The 1,943 farms involved were responsible for 46 percent of the State's orchard land. By 1974, land planted in orchards had declined to 387 hectares (956 acres). In the Census of Agriculture from 1945 to 1964, St. Tammany Parish recorded the greatest number of acres planted in orchards. Harvests among parishes varied from 4.1 to 10.4 million kilograms (9 to 23 million pounds) of tung nuts. By 1974, only 57 hectares (141 acres) were planted in tung orchards. The only parishes that continue to market fruit and nuts are Plaquemines, St. Tammany, and Tangipahoa (United States Bureau of the Census 1946a, 1956b, 1966, 1977a).

Among Mississippi coastal counties, there were a total of 494 hectares (1,221 acres) planted in fruit and nuts in 1974, which represents a reduction from the 4,465 hectares (11,092 acres) reported in 1954. Harrison County recorded the greatest number of farms and acres. In the past, the three coastal counties were responsible for ten percent of the State's land used for orchard crops (United States Bureau of the Census 1946b, 1956b, 1967, 1977b).

The potential for citrus is promising throughout the region. The oranges that are grown in Plaquemines Parish are the region's best known (Hansen 1971, Hawthorne et al. 1960). Growers continue to plant trees throughout the southern portion of the Deltaic Plain, re-establishing a crop that was once an important regional agricultural commodity. Serving almost exclusively a local and regional market, the crop is a viable addition to the coastal parishes' farming operations.

Louisiana's citrus industry is located primarily in Plaquemines Parish, where 87.5 percent of the State's total crop is produced. Orange growing was introduced to this area in about 1850. Large-scale operations, however, are a twentieth-century phenomenon. The Louisiana sweet orange is the principal variety grown. Mandarins, tangerines, kumquats, Satsumas, and grapefruit are also grown (Hansen 1971).

Scattered orchards are located along the numerous bayous that criss-cross south Louisiana. Because citrus trees freeze easily, orchards are planted as near the bayou as possible to take advantage of the moderating effect of the water on the climate. Orchards planted on levee backslopes suffer frostbite and freeze more often than those adjacent to water surfaces. The northern cultivation limit is near the coast, but extends inland along streams. Severe freezes in 1963, hurricane winds, and flood waters in 1964, 1965, and 1969 destroyed or severely damaged most of the groves. After storm damage, it takes approximately ten years to re-establish orchards and for new trees to reach fruit-bearing age. Plaquemines Parish's 18 farms in 1964 produced only 240,778 kilograms (5,898 field boxes). In 1974, they harvested 2,095,564 kilograms (51,332 boxes), which represents almost a nine-fold increase in that period (United States Bureau of the Census 1946a, 1956a, 1966, 1977a). Mississippi's coastal counties were responsible for a small citrus harvest in 1945. No harvest has been recorded since 1945 (United States Bureau of the Census 1946b, 1956b, 1967, 1977).

The pecan is the principal Louisiana-Mississippi orchard tree. Although cultivated, the trees still grow wild in bottom lands. More "natives" reach the market than the cultivated variety.

The first instance of scientific pecan cultivation in Louisiana was in 1846, when the trunk grafting of 16 trees of a variety later named "the Centennnial" was accomplished in St. James Parish. Others copied this practice. In 1878, in Madison Parish, 20 hectares (50 acres) of cotton land were converted to pecan groves. This orchard, the region's oldest planted, is still bearing today (Hansen 1971).

While pecans are profitable, growers are faced with problems of insect pests and bacterial and fungal diseases. The Federal government recognized these hazards and established research stations in soil chemistry, entomology, and bacteriology. In spite of production problems, pecans offer attractive returns for growers. The several years that are required for saplings to mature and produce profitable yields are probably the chief factor limiting increased pecan cultivation (Hansen 1971).

The Deltaic parishes reported almost 55,000 pecan trees in 1945. The greatest number were in St. Tammany, St. Bernard and Iberia Parishes. All parishes reported pecan harvests. The region produced almost 315,000 kilograms (691,990 pounds), or 8.8 percent of the State's crop. The crop began to decline by 1954 (Polopolus 1962), when only 14,857 kilograms (32,753 pounds) were produced. By 1974, production was limited to St. Tammany and Tangipahoa Parishes, which harvested only 2,422 kilograms (5,339 pounds) from nine farms. Deltaic Plain trees now produce less than one percent of the State's harvest (United States Bureau of the Census 1946a, 1956a, 1966, 1977a).

In Mississippi's coastal counties, pecan harvests have ranged from 2.3 percent of the State's total harvest to as much as 25 percent. The area produced its largest crop in 1945 when the coastal zone had 1,677 farms producing pecans from more than 118,000 trees. The region produced 816,475 kilograms (1.8 million pounds) in 1945. The number of farms involved in the industry declined to 1,529 in 1954, and the number of trees harvested was reduced to approximately 94,000 which yielded nearly 82,500 kilograms (181,845 pounds) of pecans. Though less than the 1945 harvest, the 1954 crop was still 10.4 percent of the State's total crop. The 1964 harvest increased slightly to 82,918 kilograms (182,801 pounds). By 1974, the number of farms, trees, and quantity harvested had declined considerably. The region reported 40 farms with 8,231 trees, and only 21 farms harvested a crop (United States Bureau of the Census 1946b, 1956b, 1967, 1977b).

Louisiana's deltaic parishes at one time constituted a major pear-producing region. In 1945, the area harvested 26 percent of the State's pear harvest. Deltaic parish farmers produced more than 6,700 cubic meters (190,000 bushels) from 18,242 farms in 1945. Nine years later, farms reporting pear orchards decreased to 1,907, producing a crop of 70 cubic meters (1,999 bushels). This yield represented 14 percent of the State's crop. The 1964 Census of Agriculture reported a further decline in pears harvested. By 1974, there were no farms, trees, or harvest reported in the deltaic parishes (United States Bureau of the Census 1977a). Pears are no longer recorded as a commercial crop.

Mississippi coastal counties reported 34,018 farms with 149,665 trees in 1945. These orchards produced 510 cubic meters (14,460 bushels). The highest production year on record was 1945. Farms, trees, and harvest declined afterward. The 1974 census recorded no production along the coast. The 1974 State crop was quite small; only 89 kilograms (200 pounds) were reported. This is a marked change from the 1945 State total of 9,500 cubic meters (268,519 bushels) (United States Bureau of the Census 1977b).

In the peak production year for tung nuts, 1964, St. Tammany and Tangipahoa Parishes harvested a total of 13,608,000 kilograms (30 million pounds). The tung industry lost its importance with the introduction of latex paint products, and commercial tung nut operations had disappeared by 1974. The harvest decreased from 13,608,000 kilograms (30 million pounds) to nothing between 1964 and 1974. The 66 farms and 1.3 million trees involved in production in 1964 were no longer harvested and the industry collapsed (United States Bureau of the Census 1977a).

Pears, pecans and tung nuts were at one time important commercial crops in the Deltaic Plain. Production of these commodities has been dramatically reduced since 1964. Tung production is an outstanding instance in which one technological improvement, the invention of latex paint products, resulted in totally abandoning a once successful industry. The deltaic parishes in Louisiana had harvested almost 82 percent of the State's tung crop in 1964, the year that marked the decline of commercial tung production.

Livestock

Dairy cattle, beef cattle, and poultry farming are all important agricultural activities in the Deltaic Plain Region. Swine and sheep contribute to regional agricultural production in a less significant manner. Thoroughbred horse breeding is a local specialty that has acquired an international reputation.

Two important technological innovations have had a direct influence on livestock production's dramatic gains in the period 1945 through 1974. First, animal husbandry and scientific breeding applications perfected in the latter part of the nineteenth century helped to develop an animal stock that is particularly well-suited to the deltaic region's ecological conditions. Second, reclamation techniques in the early part of the twentieth century converted unused wetlands to prime pasturage.

Cattle and Calves. For more than 200 years, the Nation's marshlands were thought to be of little economic value; they were considered unusable for commercial purposes. Nevertheless, in New England and the Middle-Atlantic States, many wetland grasses were harvested for livestock. Lamson-Scribner (1896) reported mid-Atlantic hay production of up to 367 kilograms per hectare (one ton per acre), with hay stacks dotting the coastal lowlands. For more than half of the twentieth century, marsh in the Deltaic Plain was not developed for its intrinsic value. It was reclaimed instead to accommodate an expanding population (Allan and Anderson 1955). The agricultural lessons learned on the eastern seaboard were apparently forgotten or ignored.

Today, the alluvial wetlands are recognized as a valuable and highly productive ecological zone where productivity can easily outstrip the best cultivated land. It is a renewable resource--one that may be maintained with minimum capital expenditures (Hawkes 1966) and is abundant in the Louisiana-Mississippi Deltaic Plain Region.

Available high ground in the Deltaic Plain is traditionally used for the production of agricultural crops, with cattle grazing only a few isolated tracts. Commercial cattle operations were not started until the great land reclamation efforts of the early 1900's (Okey 1918). These projects were considered the salvation of the wetlands; they would open the marshes to settlement. Unlike wetland reclamation in the Netherlands, continuous grazing and farming were practiced in Louisiana, and the fertility of the reclaimed wetlands was exhausted. The peats and mucks subsided as much as 2.54 centimeters (one inch) per year, creating complicated engineering problems. The "ballyhooed" projects were abandoned or used only as pasture (Harrison and Kollmorgan 1947; Harrison 1961). The small-scale plots associated with the natural levee farms were quite successful while the efforts at reclaiming large tracts of Louisiana's alluvial wetlands were largely unsuccessful. The smaller reclaimed tracts were ideally suited for livestock, encouraging marsh dwellers to drain and reclaim areas for use as pasture. Contemporary maps include great numbers of reclaimed real estate tracts that have been ignored in the literature, due to their small size. Individually, they may appear unimportant, but collectively, these plots probably make Louisiana's reclaimed land equal to that in the Netherlands.

Local boat builders constructed a "cattle boat" to utilize available marsh grasses. These boats are unique to the Deltaic Plain. The vessel allows stockmen to maximize available pasture by literally "shipping" their herds from one grazing site to another (Waldo 1965).

Deltaic Plain residents continue to graze cattle following the tradition of their forefathers. Today, many individuals have other primary occupations but maintain a small cattle herd as well (Murra 1967). Cattle raising is a cash-and-carry business with strong cultural connections, serving as a link to the past.

The animal that has most aided the coastal cattlemen is the Brahman, "Indian," or Zebu variety, *Bos indicus* species (Cavendish 1948). These humped animals are well adapted to the severe weather and insect conditions of the coastal lowlands (Ward 1914, Cobb 1946). Their size, disease and insect resistance, mothering and foraging ability, calf crop, straight-barreled body, longevity, and thin rind have made the Brahman-hybrid a favorite among coastal cattlemen

(Massey 1969, Russel 1959). There are not many beef breeds that can survive in the marsh, but the Brahman-hybrid is making profitable use of these grasslands (Guillot 1977). In the pastures associated with the "hill country," or the crests of the natural levees, breeds vary according to the individual cattle raiser's preferences.

The Brahman was introduced into the United States in 1849 and imported into Louisiana in 1861. An animal stock capable of surviving in a subtropical climate was developed through selective breeding for more than 100 years (Parr 1923, Clark and Baker 1958). This work took place at the LSU Agricultural Experiment Station at Jeanerette in Iberia Parish (Vernon et al. 1959). Part-Brahman range herds are now found in the coastal marsh and fringe areas extending from New Orleans to Brownsville, Texas (Black 1935, Rhoad and Black 1943).

Ranchers in 1950 began to maximize the use of the Chenier Plain to construct cattle walkways. These elevated "trails" allow local cattlemen to utilize all of their property, not just a portion of the available land (Williams 1952, Shiflet 1960). On the Deltaic Plain, the natural levees serve the same function as the cattle walkways. They provide a place for cattle to rest, leave their young, escape mosquitoes, and allow cattlemen to work their livestock in any season. The natural levees may not traverse the best rangeland, and additional walkways are constructed on the Deltaic Plain to improve accessibility and guarantee uniform land use (Williams 1952).

The wetlands' ecological characteristics, especially salinity, grazing plant populations, and climatological variations, play an important part in livestock management techniques. Paille fine, common reed, marshhay cordgrass, and seahorse saltgrass are the most nutritious and abundant grazing plants. The alluvial wetlands, characterized by these species, are classified as excellent, good, fair, and poor - depending on how the climax vegetation has deteriorated in relation to its potential (Williams 1955). For example, 1.2 to 1.6 hectares (three to four acres) of excellent range or 2.0 to 2.8 hectares (10 to 12 acres) of poor range will provide enough fodder to support one cow. Consequently, range conditions serve as a guide so that cattle growers can adjust their grazing procedures to maximize beef production. Since animals are selective grazers, they constantly eat the most palatable, nutritious grasses and leave the less palatable to increase. Proper grazing is the key to successful management. To use the marsh successfully, the stockman must maintain vigorous and productive forage plants. Otherwise, overgrazing destroys the better pastures and permits deterioration of the resource.

Coastal cattle growers rely on supplemental feeding or improved pastures to guarantee an adequate year-round food supply. Paille fine marshes, also locally called "canouche," are not considered good grazing areas during winter. Herds are fed diet supplements, or moved to highland ranges. Stock can be grazed during the winter in the giant cutgrass (*Zizaniopsis michaclae*) and common reed marshes. Some supplemental feeding is desirable in cold periods so that all necessary vitamins are provided.

Salt marsh ranges hold up well from mid-October to mid-April, but the summer mosquitoes force ranchers to move their herds inland. In summer, cattle feed on fresh-marsh range, improved pastures, or in the rice and piney woods areas that make up the marsh fringe (Williams 1955).

Cattle growers use rice fields for grazing in rotation with their marsh pastures to add weight and improve their livestock. This is an effective management practice and reduces some of the problems associated with over-grazing. Seasonal grazing of the marshlands, along with rice is more profitable than rotating rice farming with cattle. This is due primarily to the limited costs associated with marsh grazing. There were nearly 1.2 million cattle in Louisiana in 1974, and ten percent of the State total grazed in the Deltaic Plain parishes (United States Bureau of the Census 1977a).

While livestock sales in the Deltaic Plain have increased by more than 500 percent since 1945, the revenue from the sales showed little proportional change when considered in relation to changes in the State's cattle and calf sales: 10.5 percent for 1945; 9.2 percent for 1954; 7.3 percent for 1964; and 10.2 percent for 1974.

Similarly, while there was a marked change in the actual cattle and calf inventories for both the State and the region, the region's inventory of cattle and calves varied little when considered as a percentage of the State's inventory: 11.1 percent for 1945; 10.9 percent for 1954; 9.9 percent for 1964; and 10.8 percent for 1974.

The 1974 inventory reports 105,583 animals grazing in Lafourche, Livingston, St. Tammany, and Tangipahoa Parishes. Eighty-one percent of the Deltaic Plain Region's livestock were in these four parishes (United States Bureau of the Census 1977a). The "hill country" is particularly important because the breeds used differ from those found in the region settled by French and Germans. There were no cattle or calves in Orleans, St. Bernard, or St. Mary Parishes' farms in 1974.

In Mississippi, Hancock, Harrison, and Jackson Counties reported a decrease in their cattle and calves inventory from 2.4 percent of the total in 1945 to less than one percent in 1974. Head count in 1945 was nearly 40,000; in 1974, it was less than 15,000 (United States Bureau of the Census 1977b). Small-family cattle and calf operations fared as badly as the region's small-family row-crop operations.

In 1945, there were 145,078 hectares (358,488 acres) of pastureland within the parishes that make up the Louisiana Deltaic Plain in 1945 (United States Bureau of the Census 1946a). Nine percent of Louisiana's pastureland was in the region. By 1974, only 50,897 hectares (125,766 acres) were used for pasture within the coastal lowlands, amounting to three percent of Louisiana's total pasture lands.

There were 3,158,250 hectares (7,804,035 acres) of pastureland in Mississippi in 1945. Only 30,131 hectares (74,453 acres), or less than one percent of the State total, were in the coastal counties. The region never accounted for more than two percent of the State's land utilized for pasture. In 1974, almost 8,600 hectares (21,144 acres) were used for pasturage, much less than the 1945 total. Hancock County's 4,728 hectares (11,683 acres) represented 55 percent of the region's total (United States Bureau of the Census 1977b).

Dairy Cattle. Dairying is an established Louisiana Deltaic Plain industry. It has developed in response to large urban markets in Baton Rouge and New Orleans. The number of dairy cows declined from 225,452 in 1945 to 118,149 in 1974, while the dollar value increased from $5 million in 1945 to $24 million in 1974. The deltaic parishes produced 41 percent of the State's milk (by value) in 1945. The region recorded 27 percent of the State total in 1974. The decline in the number of dairy farms from 1,459 in 1945 to 408 in 1974 reflects the trend toward larger and more efficient operations. The capital required to expand operations has been an important factor in forcing small dairymen out of business (Roberts and Alexander 1969). In the Deltaic Plain, the two most important parishes for milk production are Iberia and Tangipahoa. Tangipahoa produced 26 percent of the State's sales and 87 percent of the deltaic parishes' sales. Tangipahoa is one of the more important milk producing regions in Louisiana (Polopolus 1962).

Hancock, Harrison, and Jackson Counties have typically been dairy producers for the Mississippi Gulf Coast and the New Orleans-Baton Rouge metropolitan areas (Ashley and Alexander 1970). In the coastal counties, there were 355 farms, milking 7,258 cows, to produce milk valued at $314,279 in 1945. This represented approximately two percent of Mississippi's production. The 1974 census records 32 farms milking cows. The greatest number were in Hancock County. Dairy cattle within the coastal zone produced milk valued at $1,978,000, 1.6 percent of the Mississippi total (United States Bureau of the Census 1977b). Since 1945, the number of farms and dairy herd size has declined, as a result of competing land-use pressures.

Hogs and Pigs. While the coastal zone is an important livestock producing area, it is not a major swine producer. The 1974 inventory reports 4,120 of these animals in Deltaic Plain parishes. This was 7.4 percent of the Louisiana total (United States Bureau of the Census 1977a). In the Mississippi Gulf Coast counties, 1,716 swine were recorded in 1974. Mississippi produces more than three times as many swine as Louisiana, yet the Gulf Coast's share is only equal to less than 0.5 percent of the Mississippi total.

Louisiana's 1945 swine inventory included 801,145 animals, with 67,736 or 11.8 percent of the State total in the deltaic parishes. The number of swine on Deltaic Plain farms has decreased steadily between 1945 and 1974. Sales declined also during this period. The same pattern of decline occurred in Mississippi's coastal zone (United States Bureau of the Census 1977a, 1977b).

Sheep and Lambs. The five parishes of Iberia, Lafourche, Livingston, St. Tammany, and Tangipahoa and all Mississippi coastal counties reported sheep and lambs in the 1974 census. The combined inventory was 1,009 animals. The 658 animals in the deltaic parishes represented 7.6 percent of the State total. The 351 animals in Mississippi's coastal counties represented 7.6 percent of Mississippi's inventory. The two regions in 1945 had a total population of 37,971 sheep and lambs. At that time, the Mississippi counties, with 19,445 animals, accounted for 21.5 percent of the State inventory (United States Bureau of the Census 1977a, 1977b).

Poultry. The average American consumes 276 eggs and 44 pounds of chicken each year. The Louisiana poultry business is only a small component in this industry. Louisiana ranks 16th nationally in broiler and egg income and produced more than $100 million in revenues in 1977. Revenue for 1978 is expected to exceed $120 million, well above the $71 million reported in the 1974 census (Herline 1978b).

Broiler and egg production, and merchandising of these products, are highly competitive, and are dominated nationally by a few firms. Production and merchandising are conducted on a contract basis between major processors and individuals who raise the birds or gather the eggs for a fixed rate per pound or per dozen. The Louisiana industry operates under the processor-farmer contract system (Herline 1978b).

The Louisiana broiler and egg industry is centered in and around Hammond in Livingston Parish. Broiler firms raise their flocks in lots of 10,000, 20,000 or 30,000 birds. It is not unusual for a single broilerhouse to produce 300,000 to 400,000 birds each year. Some processing plants handle between 8,000 and 10,000 birds per hour. This production capability has attracted many farmers to the broiler industry. The processor supplies farmers with baby chickens, feed, technical supervision, and even medication and vaccines. Such detailed management control offers farmers attractive profits on a minimum investment. Many farmers are involved in both broiler and egg production (Herline 1978b).

One of the Nations' larger egg operations is located near Walker in Livingston Parish. It processes approximately 4,000,000 eggs a week. The firm maintains 240,000 layers on the premises at the Walker plant (Herline 1978c). Livingston Parish is one of the country's largest producers and shippers with 1974 sales reported at $12 million.

Louisiana had 8,806 farms engaged in the multimillion dollar poultry industry in 1974. In the Deltaic Plain, 703 farms (eight percent of the State total) were in the poultry business; 224 farms reported sales that totaled $19.5 million. The industry was concentrated north of Lake Pontchartrain. Livingston, St. Tammany, and Tangipahoa had 99.8 percent of the coastal poultry operations. In these parishes, there were 2,347,098 animals or 99.7 percent of the deltaic parishes inventory. There is one processor preparing between 225,000 to 250,000 broilers each week (Herline 1978d).

Mississippi's 1974 poultry inventory totaled 52.9 million chickens-- 40.9 million more than in Louisiana. Harrison County was the principal producer. Poultry farms in Harrison generated $251,000 in sales. The coastal region is not a major poultry industry contributor. The area has never reported more than 2.5 percent of the State's inventory, and after 1945, sales have never exceeded one percent of the State total (United States Bureau of the Census 1977b).

Thoroughbred Horses. Cattle and poultry are the two leading agricultural industries north of Lake Pontchartrain. The area is also famous for breeding and training thoroughbred horses. St. Tammany is ranked nationally as the third largest thoroughbred breeding area (Lyman 1978). Most Louisianians are unaware of this nationally significant industry, as pastures are away from major roads and are not readily seen. There are approximately 70 thoroughbred horse farms in a 80 square kilometer (50 square mile) area of northwest St. Tammany Parish (Kolb 1977).

The mosquito problem is acute south of the Lake. Sleeping sickness is a serious threat to horse breeding and is extremely contagious. Breeders locating their farms north of Lake Pontchartrain, where the region is ideally suited for this industry, and mosquitoes (that affect animal health) are not a problem (Lyman 1978). In the "Florida Parishes", dangerous swamp diseases are rare. The Gulf winds do not bring swamp and marsh insects to that region, and the thoroughbreed industry was established there.

The industry owes its existence to the agricultural failures of Comte Louis Eugene Henri Alexandre Chenel de la Chauviniere, a member of the French nobility (Lyman 1978). He established a successful tung plantation near the town of Folsom. The scarcity of cheap labor and the development of latex paint brought about the demise of his tung orchards. Red Erwin bought the failing tung plantation in 1958 and converted it into the region's first horse breeding ranch (Lyman 1978). He is credited with establishing the thoroughbred industry in St. Tammany Parish.

Land use changed from row crops and tung orchards to stables. Real estate values escalated. The original Chenel plantation is not recognizable - 6,070 hectares (15,000 acres) were sold to horse breeders. Six separate stables occupy the land. Farmers in the area puchased land for less than $1500 per hectare ($600 per acre) in the early 1960's. Today, the market value for some of this land approximates $12,500 to $25,000 per hectare ($5,000 to $10,000 per acre) for unimproved rural property, and as much as $150,000 per hectare ($60,000 per acre) for select homesites (Kolb 1977).

In Louisiana, 377 (10.9 percent) of the farms that report a horse and pony inventory are in deltaic parishes. It is significant that 256 farms, each with an inventory of 1,258 horses are located in Livingston, St. Tammany, and Tangipahoa Parishes. In sales, Jefferson and St. Tammany recorded $427,000, 80 percent of deltaic parish sales in 1974. In Mississippi, 199 head, or 1.4 percent, of the State total are located in deltaic counties (United States Bureau of the Census 1977a, 1977b).

Deltaic Plain Specialty Crops

The region's most notable agricultural production specialties include tobacco, shallots, and nursery crops. The "perique" tobacco variety is grown only one place in the world: St. James Parish. Shallots sell from November to April throughout the major United States markets. Nursery crop production has grown dramatically as regional demand for urban landscaping has increased.

Tobacco. An overseas market for the region's tobacco was developed in Louisiana's colonial days. British tobacco dealers were the principal customers. Recently, American tobacco manufacturers discovered the value of locally grown "perique" as a pipe tobacco blend and now purchase most of the harvest. Some of this tobacco is smoked in its unblended form, but most of the crop is added to other tobacco pipe mixtures to produce a special aroma and flavor (Hansen 1971).

The 1974 Census of Agriculture records tobacco cultivation in only three Louisiana Parishes: Lafayette, Rapides, and St. James. A total of 66,183 kilograms (145,906 pounds) were harvested from 81 hectares (201 acres) on 25 farms. St. James Parish in the Deltaic Plain produced 61,800 kilograms (136,241 pounds) from 75 hectares (186 acres) on 20 farms. In St. James Parish where "perique" is cultivated, it is thought that the peculiar combination of calcareous loam soils, plots located on a "point" surrounded by swamp, climatic conditions, and special cultivation and curing techniques produce this unique tobacco. Producing perique is a labor-intensive, family-farm operation. Seeds are sown in hot beds in early December. Seedlings are transplanted to the fields when they are three to four inches high in early March. "A 1972 cost estimate . . . showed that a St. James tobacco farmer had to spend $1,329.07 per hectare ($537.87 per acre) to care for the tobacco he planted" (Louisiana Tobacco 1973:7). Plants are not allowed to mature. They are 'topped' to redistribute growth to the bottom of the plant. Suckers are removed by hand. A choice plant is allowed only 10 to 15 leaves for harvest. After harvesting by hand, leaves are stemmed and dry-cured. Leaves are then cured under pressure - a process that completely changes the tobacco's color, aroma, and flavor.

> "In the early days the dry-cured leaves were wrapped in mulberry bark to preserve the quality and probably to impart an added bark flavor. Old-timers believe that excessive pressure applied by tightly wrapping the bark package with rope led to the development of the present method of processing the dry-cured leaves under pressure. It was observed that under pressure the tobacco changed, becoming darker in color and taking on new characteristics. The idea of applying pressure by leverage was then conceived. Long poles loaded with rocks and blocks at one end afforded the pressure to the tobacco box at the other end. This method was employed until about thirty years ago when a certain farmer with an unusally large crop was short of pressure equipment. Necessity became the mother of invention, so the farmer cured his surplus tobacco in whiskey barrels, using vices or jackscrews to create the desired pressure. This method, with some modifications, is the current practice" (St. Pierre 1941:45).

The procedures for properly planting, cultivating, curing and processing perique are not adequately documented. These 'trade secrets' belong to the perique growers of St. James Parish.

Shallots. Eleven deltaic parish farms with 118.6 hectares (293 acres) reported sales of more than $2,500 in shallots (green onions) in 1974. Lafourche Parish, with 102 hectares (252 acres), leads the deltaic parishes in shallot production. Seventy-six percent of the State production comes from the deltaic parishes. Shallots sell from November to April throughout the major United States' markets (Hansen 1971). Lafourche, Plaquemines, and St. Bernard Parishes are the only areas reporting sales of $2,500 and over (United States Bureau of the Census 1977a). All three are regions where there is a tradition of truck farming since colonial days.

Nursery Crops. Within the last two decades, marketing of ornamental and floricultural products has become a big business in the Deltaic Plain "hill country" (Harper et al. 1957). The rapid expansion of this agricultural specialty is practically unnoticed by those outside the industry.

Nurserymen have developed their businesses gradually, generally starting their nurseries after working as hired laborers for older nurserymen. This experience allows them to begin their operations with limited capital.

Development of greenhouse operations varies from that of nurseries. Most floricultural producers are well established. They maintain their operations as a family business. New growers entering the market are not as common as in the nursery field.

St. Tammany has historically been the leading nursery area generating $2.6 million in sales in 1974 (United States Bureau of the Census 1977a). The 41 farms in the parish represent 41 percent of the State's nurseries, and generate 34.6 percent of the State's production value (United States Bureau of the Census 1977a).

The industry has changed in the past 20 years. Statewide, there were 471 farms reporting income from nursery and greenhouse products in 1959. These ornamental horticultural farms sold products valued at $2.9 million dollars. In the deltaic plain, only St. Charles, St. James, St. John the Baptist, and St. Mary Parishes did not produce nursery items in 1954. By 1974, the deltaic parishes involved were Iberia, Jefferson, Plaquemines, St. Tammany, Tangipahoa, and Hancock County in Mississippi (United States Bureau of the Census 1977). Louisiana's deltaic parishes produced 44.3 percent of the statewide nursery and greenhouse products by value. In Mississippi, Hancock County was responsible for less than one-half of one percent of the State's nursery business and was the only producer in the coastal zone (United States Bureau of the Census 1977b).

The farms involved are not only producing ornamental horticultural crops on a commercial basis, they are also involved in the production of "patio" trees. The term is used by nurserymen to describe any plant grown in the form of a small tree with a single trunk and a single "head". Such plants are used in containers as movable and seasonal centers of interest or planted out of doors as permanent accent plants (Brown 1973). New home construction in the Deltaic Plain is an active industry, with landscaping following house completion. The ornamental nursery business appears to have a healthy future.

In the floriculture specialty, foliage plants are marketed year-round, while production of cut-flower and holiday plants are timed for specific dates. Nearly all Louisiana cut-flower and flowering pot-plant operations are scheduled to be ready for marketing at Easter, Mother's Day, All Saints' Day, and/or the Christmas holidays (Harper *et al*. 1957).

Unique Harvesting Activities

The bayous and swamps in the Deltaic Plain Region offer a variety of unique commodities for regional and international markets. Use of Spanish moss, turtles, crawfish, and alligators for commercial purposes has been the legacy of the diverse ethnic origins of colonial settlers in the unique deltaic plain environment. Continued commercial development of these resources will depend to a great extent on the application of farsighted management techniques.

Spanish Moss. Referred to as "Spaniard's beard" since colonial days, Spanish moss (*Dendropogon usneodies*) is a symbol of the deep South. The "epiphyte" is neither Spanish nor moss, but a member of the pineapple family. Found from Texas to Virginia, the air-breathing plant occupies open-crown trees such as cypress or oak (Spanish Moss...1974).

The durable plant has played a utilitarian role since prehistoric times. Indians used it to stuff pillows, plaster huts, swaddle infants, and administer sweat-bath treatments to the sick. They even devised a method of spinning and weaving it into mats. More recently, moss was used as a livestock feed, woven into saddle blankets, as nogging in home construction, as stuffing in furniture and mattresses, and mixed with clay to make bricks (Horn 1977).

Moss gins once dotted the Louisiana Deltaic Plain, particularly in the communities that flank the Atchafalaya Basin. In 1941, there were 26; today, one remains at Labadieville on Bayou Lafourche. Trees which pickers once regularly harvested are no longer covered with new coats of moss. The problem appears to be air pollution, and the industry has suffered. If moss can be re-established, a market exists.

Turtles. Early Louisiana travelers observed turtles in Louisiana, but they were apparently rare. Their food value, both for the flesh and eggs was prized by early settlers. It seems unlikely that turtles were a commercial crop until about 1900, when the common snapping turtle (*Chelydra serpentina serpentina*) and the alligator snapping variety (*Macroclemys temminicki*), locally called "loggerhead", were taken live to market. By 1922, more than 5,400 kilograms (12,000 pounds) of turtle were annually removed from the Atchafalaya Basin. Turtle was also harvested from other swamp areas in the Deltaic Plain.

Sale of baby green turtles (*Pseudemys scripta elegans*) as pets and novelties became more important than catching wild turtles for food in the 1930's. Swamp dwellers began raising turtles in impoundments constructed expressly for this purpose. These farms raised turtles for food and to meet the demand of the expanding pet market that began with the 1933 Chicago World's Fair. Most ponds are concentrated near Pierre Part, outside the Deltaic Plain. There are, however, a few turtle ponds in Lafourche, St. Mary, and Terrebonne Parishes. The impoundments are several feet deep and located along the edge of a swamp or at the base of the natural levee.

Ponds improved turtle availability, until it was found that baby green turtles raised in these impoundments are carriers of Salmonella, a bacterium that causes fever, stomach cramps, diarrhea, nausea, and occasional vomiting. Sea-Grant-supported research resulted in a treatment technique for turtle eggs that kills the *Salmonella* bacterium. Turtle farming is now a reviving industry throughout the deltaic plain, both for food consumption and for the pet market.

Until recently, the international market for turtles was supplied primarily by harvests from the Miskito kelp beds off the north coast of Nicaragua. Poor management of the turtles' traditional feeding grounds in the West Caribbean has brought the deltaic plain region's turtle industry to a new level of prominence.

Crawfish Farming. Only two Louisiana crawfish species are available in abundance and are of sufficient size to be commercially harvested. They are the "swamp" and "river" types (*Procambarus clarkii* and *P. acutus*) (LaCaze 1976, de la Bretonne and Fowler 1976). These crustaceans, when newly hatched, can survive salinities up to 10 parts per thousand (ppt). They prefer fresh to brackish water. Landed totals for 1974 were more than 3.2 million kilograms (seven million pounds), valued in excess of two million dollars. Crawfish are collected from natural water areas and cultivated in ponds. Crawfish ponds are conspicuously concentrated in the Bayou Teche and Bayou Lafourche areas (Gary 1974). Approximately 14,200 hectares (35,000 acres) of ponds are used for crawfish culture, although the number of ponds varies from year to year, depending on the number of rice farmers who flood their fields for crawfish production. More than 1,000 persons harvest crawfish for commercial purposes. Additional employment is involved in the processing and services aspect of the industry (Gary 1974, 1975). The Atchafalaya Basin is the principal crawfish area. The annual harvest is approximately 6.8 million kilograms (15,000,000 pounds) (Louisiana Department of Wildlife and Fisheries 1978).

Crawfish is more than a food item in Louisiana; it is a way of life (The Crawfish Industry...1974). Found in almost every ditch, the crustacean is utilized for food, bait, income, recreation, weed control, and as a literary topic. The erratic, cyclical fluctuations in supply once made consumers' satisfaction unpredictable. Nowhere else are crawfish produced and consumed as in French Louisiana. Sea-Grant research has strengthened the industry since 1964. Although diehard 'Cajuns' continue to prefer the "wild crawfish", aquacultural research has created a stable industry.

There are about 100 species in North America with 29 being found in Louisiana. Only the "swamp" and "white river" types are important commercially. Neither require a swamp or river environment, although these habitats are preferred. Both are harvested in the Atchafalaya Basin. Crawfish is the most important commercial Basin commodity (Comeaux 1972).

Water requirements for crawfish are well known. Crawfishermen predict the relative abundance of the harvest prior to a given season by noting water levels. If swamp water rises in late fall and is maintained through the winter, a good catch is predicted. Low water during the fall and winter means a poor season.

Crawfish farms were established to counteract this variability. They began about 1950, by accident, when a rice farmer found the land he had flooded over the winter to attract waterfowl had produced a bumper crop of crawfish. The amount of land flooded for crawfish increased from 810 hectares (2,000 acres) in 1959 to nearly 16,200 hectares (40,000 acres) in 1978. Thirty-four processing plants operate during the season. This delicacy is valued so highly that even though south Louisiana produces 99 percent of the Nation's yield, 85 percent of the crop is consumed in the State. Demand always exceeds supply.

Alligator Farming. With the recent change in laws governing the alligator's status in Louisiana, the industry is going to change (The Alligator...1972). In addition to wild swamp and marsh alligators, a few individuals have started commercial alligator farms. The largest farm is near Ponchatoula. This alligator farmer markets quality hides and receives top prices. In 1976, 300 skins were sold at $59.05 per meter ($18.00 per foot) - a yield of $30,603 (Munson 1977).

AGRICULTURAL FUTURES: A DIVERSITY OF ECONOMIC OPPORTUNITIES

Lands suitable for urban development are scarce in the Deltaic Plain Region, and recent historical trends indicate that the region's agricultural sector is likely to be subject to continuing pressure in the future. Two separate but related concerns will become increasingly important in shaping the character of agricultural production in the Deltaic Plain Region. The first concern, in light of past trends, is that agricultural production will be responsive to future market changes. The second concern is somewhat more general, addressing the role that agriculture will play in an increasingly hydrocarbon-based economy.

How Will Agricultural Production Respond to Market Changes?

The major production trends identified in previous sections can be understood as responses to changing market conditions. A brief summary of these trends follows:

(1) There has been a major decrease in the number of farming operations and a somewhat smaller decrease in the amount of land used for agricultural purposes.

(2) To a large extent, small family-owned operations have been replaced by large corporate holdings.

(3) Farmlands in the coastal parishes of Louisiana carry the highest production costs in the State, while Mississippi's coastal farms carry relatively low production costs.

(4) In general, capital requirements have contributed increasingly to the consolidation of land holdings and to a decline in the number of farms in the face of uncertain market conditions.

(5) In addition to generating an overall decline in the lands used for agricultural purposes, market conditions have forced a shift in emphasis among alternative agricultural land uses. There has been a reduction of harvested croplands and irrigated farmlands planted in corn and rice.

(6) Rising costs for land and equipment, coupled with low sugar prices, have contributed to a decline in sugar production. Labor scarcity, milling technology and government regulations have been significant sources of cost increases.

(7) Forestry management practices have been unable to keep pace with urbanization's increasing demands for lumber products.

(8) Animal breeding techniques, land reclamation procedures, and other alluvial wetlands agricultural research refinements have given the Deltaic Plain Region a competitive advantage in wider regional and national markets.

(9) The demand for specialty crops and agricultural production activities unique to the Deltaic Plain Region has remained robust, while supplies of specialities have varied considerably according to fluctuations in climate, labor availability and markets for more heavily emphasized commodities.

To increase agriculture's responsiveness to market conditions, the advantages and disadvantages of directing these trends must be carefully weighed. Specifically, public and private sector representatives should cooperate in evaluating the potential impacts to agricultural production of:

A. Consolidation of land holdings;

B. Mechanization of cropping and animal husbandry activities;

C. Resource management improvements;

D. Continued research and development for wetlands agriculture.

What Will Be The Role of Agriculture in An Increasingly Hydrocarbon-Based Economy?

Adjusting the agricultural industry's ability to respond to market changes on the basis of controllable future trends will, to a large extent, shape agriculture's role in the regional economy. Leaving agriculture's fate in the hands of inexorable market forces could, however, diminish the economy's stability in light of an ever more volatile international energy market. Moreover, the public has a wide range of social and economic requirements that may best be met by maintaining diversity at the expense of short-term profitability. Explicit planning goals for agriculture's future should be established, with the industry's present economic contribution serving as a point from which to begin to optimize the use of prime alluvial agricultural lands in the Deltaic Plain Region.

Present forms of institutionally-derived opportunities and constraints for agriculture's future should be carefully examined. In what ways does Louisiana's Napoleonic Code provide disincentives for maintaining non-liquid capital assets such as real property? What roles should the States assume in providing financial support for Deltaic Region farmers? Is this support limited to endorsing federal price subsidies, or can the State governments create favorable property tax assessment rates for agricultural lands? Can the States underwrite reclamation activities in order to create additional prime agricultural lands? Would the States lease State-owned lands at favorable rates for agricultural activities? Are there other such fiscal tools at their disposal to help define more specifically agriculture's role in the regional economy?

Finally, agriculture's role will be significantly influenced by the way in which public and private sectors support the pursuit of diverse economic activities. For every hydrocarbon development proposal, and for each significant increment of expansion in the petrochemical service base, an environmental assessment must account for the effect on the region's long-term stability and the degree to which an increased commitment to hydrocarbon development affects the region's ability to continue its pursuit of renewable resource development through agricultural production.

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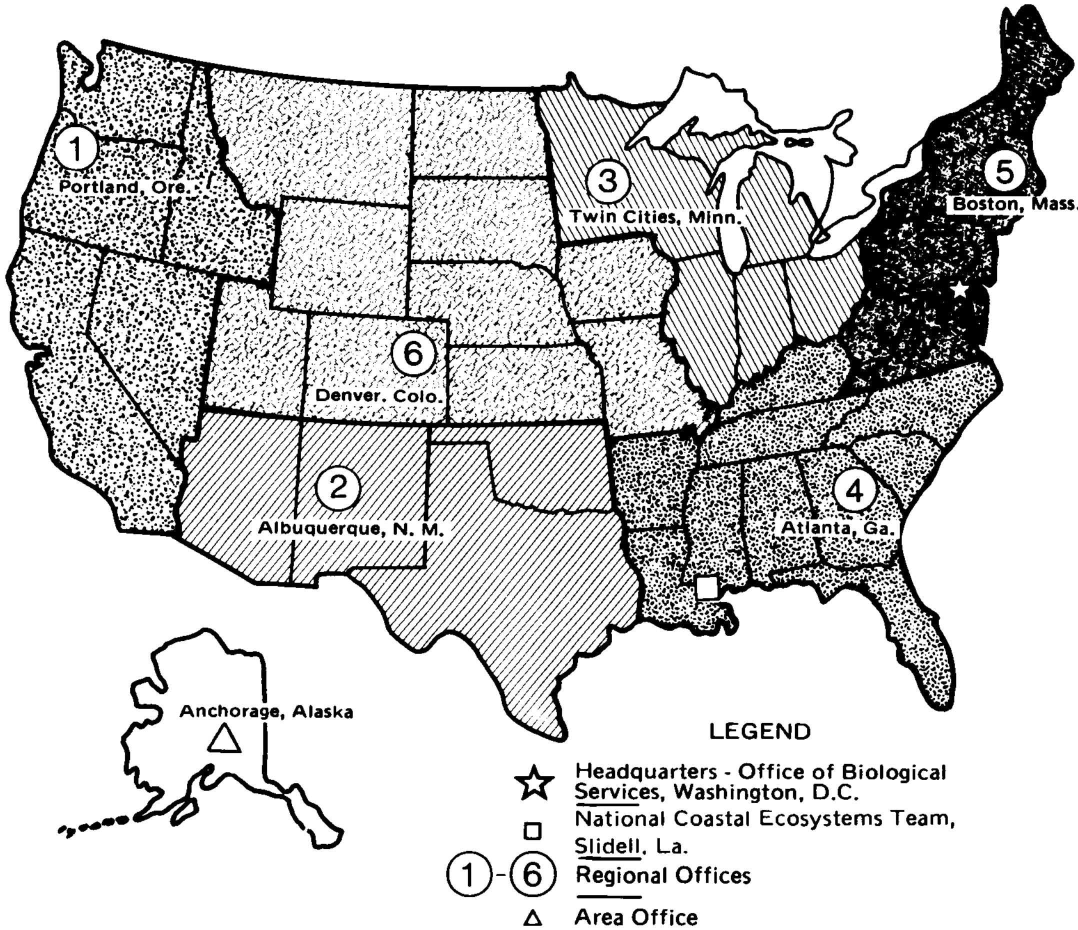

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