

U.S. Army Corps
of Engineers
New Orleans District

ADAPTATION TO THE DYNAMIC COASTAL AREAS AFFECTED BY THE ATCHAFALAYA BASIN OUTLETS: AN HISTORICAL GEOGRAPHY ANALYSIS, SOUTH CENTRAL LOUISIANA

FINAL REPORT

April 2005

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

COASTAL ENVIRONMENTS, INC.
1260 Main Street
Baton Rouge, Louisiana 70802

Prepared for

U.S. ARMY CORPS OF ENGINEERS
New Orleans District
P.O. Box 60267
New Orleans, LA 70160-0267

Unclassified. Distribution is unlimited.

20060707145

ADAPTATION TO THE DYNAMIC COASTAL AREAS AFFECTED BY THE ATCHAFALAYA BASIN OUTLETS: AN HISTORICAL GEOGRAPHY ANALYSIS, SOUTH CENTRAL LOUISIANA

By
Donald W. Davis
George J. Castille, III

With contributions by
Gerald Morrissey and Kevin Robinson

Final Report

Prepared For
U.S. Army Corps of Engineers
New Orleans District
Under Contract No. DACW29-97-D-0017
Delivery Order No. 2

April 2005

Coastal Environments, Inc.
1260 Main Street
Baton Rouge, Louisiana 70802



George J. Castille, III, Ph.D.
Principal Investigator

ABSTRACT

Coastal Environments, Inc. conducted an historical geography of the central Louisiana coast. This investigation included historical research, fieldwork, interviews of residents, and report preparation. The investigation was designed to examine human responses to physical change along that part of the Louisiana coast between Bayou Lafourche and Freshwater Bayou Canal, an area that includes the mouth of Atchafalaya River. A geographical approach was used, emphasizing documentation of historical settlement over the last 150 years, physical diversity, and economic adaptation. Based primarily on physical characteristics, the study area was divided into three regions: Terrebonne Basin, Lower Atchafalaya River, and Teche-Vermilion Basin. The primary focus of the study was identification of the major environmental changes within the study area during the twentieth century and analysis of human adaptations to those changes. A secondary focus of the investigation was the procurement of photographic images depicting the range of physical and cultural settings occurring within the study area. Selected illustrations from the report are to be integrated into a summary report designed for public consumption.

The investigation revealed a great diversity in both physical and cultural settings. The physical changes range from rapid land loss in Terrebonne Basin to rapid land gain at the mouth of the Atchafalaya River. These changes are due to natural processes and to human alteration of the environment. Primary human influences include construction of flood prevention levees, creation of the Atchafalaya Floodway, and canal construction. Despite rapid land loss within the eastern portion of the study area, settlement patterns reflect the human tendency to gravitate toward areas of economic activities. Construction of hurricane protection levees and pump drainage districts have created enticing zones of settlement within flood prone areas. For settlement along the Louisiana coast, the economic draw has been dominated by two distinct natural resources: 1) fisheries and 2) oil and gas extraction. In recent years, wetland recreational pursuits have increased such that recreational camp construction is now the most noticeable cultural change along the coast.

As part of this analysis, future trends were examined relative to potential changes in the physical landscape, the economy, and to settlement patterns. Alternative solutions were offered for anticipated physical and cultural changes. One of the most relevant findings is that existing policies encourage settlement in areas where flood or storm damage risk is increasing.

TABLE OF CONTENTS

ABSTRACT iii

LIST OF TABLES xi

PREFACE AND ACKNOWLEDGEMENTS xiii

CHAPTER 1: INTRODUCTION 1
- Purpose of Study 1
- Regional Approach: Subdividing the Study Area 1
- Investigation Themes: 2
  - Physical Changes 2
  - Human Modifications to Environment 2
  - Cultural Adaptations 3
- Methodology 3

CHAPTER 2: PHYSICAL SETTING 5
Geological Background: Influence of the Mississippi River 5
- Atchafalaya River and the Raft: ca. 1800 – 1870 6
- Period of increased Atchafalaya flow: ca. 1870 – 1930 6
- Modern Atchafalaya Floodway: 1930 – Present 6

Role of Natural Levees 7
Other Physical Features 8
- Coastal Prairie Terrace 8
- Cheniers 9
- Barrier Islands 9
- Barrier Reefs 9

Physical Changes that Occur along the Coast 10
- Land Loss and Vegetation 10
  - Land Subsidence and Sea Level Rise 11
  - Submergence 12
  - Erosion 13
  - Direct Removal of Substrates 13
  - Coastal Habitat Zonation 13
  - Beaches and Barrier Islands 14
  - Marshes 14
    - Saline Marsh 15
    - Brackish Marsh 15

Intermediate Marshes 16
Fresh Marsh 16
Cheniers 17
Backswamp 18
Natural Levees 18
Affects of Coastal Land Loss on Wildlife and Fisheries 19
Summary of Vegetation Changes 20
Hurricanes 20
Physical Characteristics Unique to Major Regions 21
Terrebonne Basin 21
Lower Atchafalaya 22
Teche-Vermilion Basin 22
Salt dome Islands 23
Belle Isle 23
Cote Blanche Island 24
Weeks Island 25
Avery Island 25
Jefferson Island 26

CHAPTER 3: CULTURAL SETTING 27
Cultural Settlement Patterns 27
Parish Incorporation 27
Parish Boundaries 28
Areas of Initial Settlement 28
Settlement along Natural Levees 28
Isle de Jean Charles 29
Mauvais Bois 30
Settlement along the Coastal Barrier Islands 31
Isle Dernieres and the 1856 Hurricane 32
Surviving the Storm 33
The Cheniers 34
People, Cattle, and Cheniere Au Tigre 34
Agriculture, Levees and Drainage: Terrebonne Parish 37
The Human Mosaic: A Kaleidoscope of Cultures 40
Infrastructure: Modern Transportation Arteries 45
Natural Waterbodies 45
Canals 45
Drainage and Reclamation Canals 46
Transportation Canals 46
Trapping Canals: A Trapper's Access to the Marsh 50
Logging Canals: The Spokes of a Wheel 51
Oil Field Canals 52
Roads 53
Railroads 53
Resource Extraction 54
Fisheries Resources 54

Shrimp 59
Ecology 59
Shrimping Techniques 60
Shrimp Drying 61
Platform Communities 61
A Typical Shrimp Drying Village: A Community on Stilts 62
Modern Processing 63
Yields 64
Oysters 66
Oystermen and Early Techniques 67
Shipping and Processing 68
Problems in the Oyster Industry 71
Distribution of Oyster Leases 73
Pathogens—Bacteria and Viruses 79
Menhaden 80
Blue Crabs 81
Distribution of Marsh Structures during the 1930s 82
Fishing Ports 83
Wetlands Trapping and Hunting in French Louisiana 83
Muskrat and Nutria 83
The American Alligator 89
Trapping, a Seasonal Occupation 90
The Modern Trapping Industry 92
Logging 93
Mineral Extraction (Oil, Gas and Sulfur) 94
Oil and Gas Activities within the Study Area 94
Oil and Gas Activities: Terrebonne Parish 95
Infrastructure and Community Impacts 105
Direct Impacts from the Offshore Oil and Gas Industry 108
Port Facilities 109
Port Fourchon and the Louisiana Offshore Oil Port 110
LOOP Facility 111
Deep Water: The Savior of Louisiana's Offshore Industry 112
Current Recreational Pursuits 116
Fishing 116
Crabbing 120
Shrimping 120
Hunting 120
Hunting Clubs 121
Modern Camps and Camp Communities 124
Refuges 127
Eco-tourism 127
Urban Growth 128
Morgan City 128
Sawmills 130

Oil and Gas Exploration 130

CHAPTER 4: CONSTRUCTION PROJECTS, POPULATION GROWTH, AND IMPACTS 135
Mississippi River Levees 135
Earliest Artificial Levees along the Mississippi River 135
Expanding the Mississippi River Levee System 139
Government Intervention Prior to the 1927 Flood 141
The 1927 Flood 144
Levees along Bayou Lafourche 146
The Atchafalaya Basin 148
The Atchafalaya River Raft 148
Construction of the Atchafalaya Floodway 149
Other "Public Works" Projects 151
Hurricane Protection Levees 152
Localized Canal Construction 152
Forced Drainage 153
Land Reclamation in Coastal Louisiana 157
New Orleans – A Reclaimed City 157
Reclamation Beyond New Orleans 158
Swamp Land Acts of 1849 and 1850 158
Destruction of Coastal Oyster Reefs 160
Beneficial Use of Dredge Spoil 162
Recent Changes 162
Urban Growth 162
Recent Trends in Population Distribution 163
Population Density 165
1990 Population Distribution 166
Population and Land Forms 167
The Lure of Pump Drainage 167
Observations of Individuals Who Live in the Study Area 169
Legal Issues 170
Summary of Changes that Occurred within the Study Area 170

CHAPTER 5: SUMMARY AND CONCLUSIONS 173
Changes that have Occurred 173
Natural Physical Changes 173
Human Induced or Influenced Changes 174
General Cultural Patterns, their Influence, and Adaptation to Change 175
Trends for the Future 178
Continuing the Status Quo 178
Physical Changes by Region 179
Other Alternatives for the Future 180
Manipulation of Atchafalaya River Flow 180
Other Mississippi River Diversions 181
Salt Water Control Structures 182

Maintain Coastal Barrier Islands/Reefs 182
Aggressive Approach to Human Occupation in Threatened Areas 182
Conclusion 183

REFERENCES CITED 185

FIGURES CITED IN TEXT 229

APPENDIX A: INTERVIEWS A-1

APPENDIX B: COMMERCIAL FISHING LICENSE TYPES FOR PARISHES WITHIN THE STUDY AREA, 1992 ..... B-1

LIST OF TABLES

2-1. List of Recorded Storms that Have Impacted the Study Area 21

3-1 Top Ten Countries Contributing to Foreign-Born Population of Louisiana 43

3-2. Inventory of Transportation Canals 48

3-3. Inventory of Logging Canals Built Between 1880 and 1930 52

3-4. Harvest and Value of Catch in Louisiana, 1890 56

3-5. Estimated Harvest and Value of Selected Louisiana Fisheries in the 1980s 58

3-6. Louisiana Shrimp Harvest, 1880 to 1929 64

3-7. Value of Fish and Other Aquatic Products Taken with Various Apparatus in Louisiana, 1890 65

3-8. Shrimp Licenses Issued in Louisiana's Delta Plain 66

3-9. Yield Comparisons for the Production of Oysters in Louisiana 69

3-10. Economic Value of Shellfish and Selected Animal Hides in Louisiana, 1991 70

3-11. Extent of the Wholesale Oyster Trade and the Canning of Oysters and Shrimp in Louisiana, 1890 72

3-12. Oyster Beds of Plaquemines, Lafourche, and Terrebonne Parishes in 1899 72

3-13. Louisiana's Commercial Oyster Industry, 1913-1914 74

3-14. Oyster Producing Regions, 1914-1920 76

3-15. Leased Oyster Water Bottoms, 1914-1924 78

3-16. Locations of Marsh Buildings Visible on USGS Topographical Quadrangle Maps from the 1930s 84

3-17. Louisiana Oil and Gas Fields by Parish, 1993 96

3-18. Oil and/or Gas Fields and Wells Documented in the Study Area through 1993 97

3-19. Total Number of Oil and/or Gas Fields and Wells within the Study Area, 1917 through 1940 102

3-20. Oil and/or Gas Fields in the Study Area with More than 100 Wells 102

3-21. Total Oil and/or Gas Fields and Wells by Parish in the Study Area, 1993 103

3-22. Fishing Licenses Issued in Louisiana's Delta Plain 118

3-23. Report of Licensed Louisiana Hunting Clubs, 1929-1930 123

3-24. Waterfowl Hunting in Louisiana's East Coastal Zone, 1977-1978 Season 123

3-25. Hunting Licenses Issued in Louisiana's Delta Plain 125

3-26. Waterfowl Hunting Data for Louisiana, 1990-91 125

4-1. Floods of Notable Importance on the Mississippi River 137

PREFACE AND ACKNOWLEDGEMENTS

In April 1997, the New Orleans District of the U.S. Army Corps of Engineers issued to Coastal Environments, Inc. (CEI), a request for a proposal relative to Delivery Order No. 2 of Indefinite Quantities Contract No. DACW29-97-D-0017. The Request was for a historical geography study of the coastal areas affected by the Atchafalaya Basin outlets. A proposal was submitted in May of 1997. The subject of this geographical study was human adaptations to the changing natural environment in the study area. The primary focus of the study was the major environmental changes and resulting human adaptations of the twentieth century. The results of the investigation were to be summarized in a technical report. Also required is a brief, non-technical summary report written in lay language, to be made available for general public consumption.

Michael E. Stout of the NOD Planning Division served as Contracting Officer's Representative. Several meetings were held with various Corps personnel, including Michael Stout, Howard R. Bush, and Troy Constance. Jane Kulick served as liaison with the Contracts section of the Corps. As a result of early planning discussions involving CEI and Corps personnel, an outline of study was developed. Because one of the main products of the investigation was to be a well-illustrated summary for public consumption, an emphasis was placed on acquisition of photographs illustrative of the physical and cultural diversity within the study area. Several previous investigations, including those by Malcolm Comeaux (1972), Nicholas Spitzer (1979 and 1985) and Jon Gibson (1982) were suggested as potential models for the research. A common characteristic of each of these reports is that it is well illustrated.

The investigation was conducted in three phases. The first phase involved historical and geographical research. In September 1997, an Interim Report was submitted that summarized the status of research to that date. The second phase included fieldwork and the final phase was report preparation. Primary researchers included George Castille, Don Davis, William Reeves, and E. Burton Kemp. These individuals examined historical photographic files at the NOD Corps of Engineers, newspapers, various libraries within the study area, and archives. An attempt was made to locate sources of historic photographs that depicted activities conducted within the study area over the last 100 years. Important historical photographs were found at a variety of locations, most notably the archives at the Morgan City Library and the archives of the University of Louisville in Kentucky. The University of Louisville collection represents the most significant new source because it includes photographs of activities from throughout the study area during the 1940s. Don Davis was responsible for obtaining most of the historical photographs used in the report,

including the Louisville collection. Ory Miguez of Franklin provided several aerial photographs of oyster reefs and Hurricane Audrey damage. Data sources also included the computer files and records of the Louisiana Department of Wildlife and Fisheries (LDWF) in Baton Rouge and the LDWF oyster lease records in New Orleans.

During the latter stages of the historical investigation, field trips were conducted by George Castille, Don Davis, and William Reeves. The field trips were performed to locate additional data sources, to assess the condition of the study area, to photograph relevant physical and cultural features, and to locate individuals who were willing to be interviewed. During these field trips, every major road within the study area was traveled. Upon completion of the field trips, a photo flight was conducted to examine and photograph physical and cultural features that were not readily visible from the ground. George Castille was responsible for most of the contemporary and aerial photographs illustrated in the report. Interviews were conducted of selected individuals who were knowledgeable of the changes that have occurred within the study area. Approximately 25 individuals were found who were willing to talk and 13 individuals were actually interviewed. Audiotapes of these interviews were transcribed and included as an appendix to the report.

Several individuals were responsible for preparation of this report. Chapters 1, 2 and 4 were written primarily by George Castille, with assistance from Don Davis. Chapter 3 was written primarily by Don Davis, with help form George Castille. William Reeves helped in the collection of historical information. Burt Kemp acquired the historical photographs from the New Orleans District Corps of Engineers. Sherwood Gagliano assisted in planning meetings and helped establish the research framework used during the investigation. Kevin Robinson wrote the section on vegetation changes. Gerald Morrissey wrote the section on population trends. Cherie Schwab assisted with report layout and figure mounting. Lori Cunningham performed GIS data presentation and map plots. Lisa Songne helped with report editing and bibliographic references.

CHAPTER 1

INTRODUCTION

Purpose of Study

The purpose of this investigation is to identify modern cultural adaptations to dynamic changes that have occurred along the Louisiana coast between Bayou Lafourche (Lafourche Parish) and Freshwater Bayou (Vermilion Parish). The study area includes portions of Lafourche, Terrebonne, St. Mary, Iberia, and Vermilion parishes. This region is bounded on the east by Bayou Lafourche, on the west by Freshwater Bayou Canal, and it extends out into the Gulf to include Marsh Island and all of the barrier islands eastward to the mouth of Bayou Lafourche (**Figure 1-1**). From east to west, the northern boundary parallels the Gulf Intracoastal Waterway (GIWW) between Larose and Houma, then follows Bayou Black to Gibson, then Hwy 90 to Morgan City, then the south bank of Bayou Teche to Jeanerette, then angles southwestward, crossing the communities of Delcambre, Henry, and Esther, and finally meets Freshwater Bayou Canal at the intersection with Schooner Bayou. In terms of physical change, the area includes some of the greatest extremes in land loss and land gain along the Louisiana coast. In the eastern Terrebonne marsh, subsidence and erosion are occurring at a rapid rate. At the mouths of the Atchafalaya River and Wax Lake Outlet, developing deltas represent the fastest growing land areas along the Gulf coast. With the exception of the Five Islands (Jefferson, Avery, Weeks, Cote Blanche, and Belle Isle), virtually all of the study area lies below 25 ft (7.6 m) elevation above Mean Sea Level (MSL).

Regional Approach: Subdividing the Study Area

For convenience, the study area was divided into three major subareas or regions (**Figure 1-1**). The division was made primarily according to recent and anticipated changes with regard to erosion/subsidence, water salinity, and the dominant geological processes. The Terrebonne Basin is experiencing rapid land loss and saltwater intrusion. Very little freshwater is entering the region from the outside. The exception is leakage associated with the Atchafalaya River through the GIWW. The Lower Atchafalaya region includes the lower portion of the Atchafalaya River below Morgan City and Wax Lake Outlet. This area extends from the Atchaflaya River on the east to Bayou Sale on the west and includes the developing deltas at the mouth of the Atchafalaya River and Wax Lake Outlet. The term "Atchafalaya Basin" is not used here because the major part of the basin is north of Morgan City and is excluded from the study area. The Lower Atchafalaya area is undergoing land gain as a result of sediments being continuously deposited by the Atchafalaya River. Atchafalaya River water is also spilling over into the GIWW and other natural and man-made channels in the vicinity. This spillover is causing some sedimentation and an influx of freshwater into the

marshes to the west, and to a lesser extent, east of the river's mouth. The Teche-Vermilion Basin is experiencing land loss, but to a much lesser extent than Terrebonne's marshes. Land loss is slowed primarily in conjunction with freshwater seepage from the Atchafalaya River, primarily via the GIWW. In addition, long-shore currents insure the bays west of the Atchafalaya, including East Cote Blanche, West Cote Blanche, and Vermilion, are predominantly fresh.

The terms "area" or "region" are used interchangeably when referring to these three subdivisions. "Terrebonne Marsh" or "Terrebonne" are also occasionally used. The three regions correspond roughly to similar spatial subdivisions defined by other coastal scientists who are examining the long-term changes along the Louisiana coast (Coast 2050 Planning Document 1997). If one were to travel the length of the study area from east to west, several distinct changes or differences in the landscape would be apparent. These differences reflect both the physical and cultural diversity of the area. The three regions are highlighted in order to identify those factors that are significant in sculpting the landscape in the past and those that will be important for predicting future change.

Investigation Themes

While conducting this investigation, emphasis was placed on examining three underlying themes. Each theme helps to explain the changes that have occurred within the study area. These themes are:

1. physical or natural changes to the environment;
2. human modifications to the environment; and
3. cultural adaptations to changes in the environment.

Physical Changes

Physical changes refer to those natural processes that shaped the landscape from prehistoric times to the present. Physical processes within the disciplines of geology, biology, or similar fields explain the physical environments encountered by early European explorers. This coastal region was created primarily by the work of the Mississippi River and its distributaries. Depositional processes account for almost all of the soils east of the Prairie Terrace. Along the coast, barrier islands were formed when the riverine deposits were reworked by marine processes.

Human Modifications to Environment

By the end of the eighteenth century, human alteration to the environment had begun to modify the landscape and influence the natural processes already at work. By dredging canals, early inhabitants began to alter the flow of water, and in so doing, altered the local landscape. The impact of these modifications has increased exponentially as one moves from the eighteenth century to the present. For example, the Atchafalaya River flow was relatively small during the late eighteenth century because a huge natural raft blocked the upper part of the river. When engineers removed the raft during the middle of the nineteenth century, the resulting increase in flow stimulated massive deposition within the lower

Atchafalaya Basin. Eventually the zone of intense deposition moved out into Atchafalaya Bay, where it is now creating a large land mass. While some scenarios predict the Mississippi River would have shifted its course into the bed of the Atchafalaya River, it is interesting to consider what the study area might look like today if the raft had never been removed.

Cultural Adaptations

The final theme is cultural adaptation. This theme includes the investigation of human responses to both natural and human alterations to the environment. As shoreline retreats and marsh subsides, how are marsh inhabitants adapting to these changes? For example, the potential for flooding, particularly in the southern half of the study area, has always been great. In response to the flooding potential, coastal residents commonly: 1) construct pump drainage impoundments around residential areas, and/or 2) raise houses on pilings to get above the projected flood levels as required by their flood insurance.

For this investigation, physical and cultural changes are viewed from the perspective of geography. The primary issue of interest is the relationship between humankind and the environment. Geography, in its simplest definition, is the study of the relationship between humankind and the physical landscape. While some of the subthemes deal with sociological, geological, or anthropological data, the geographical perspective provides a convenient philosophical and methodological umbrella.

Methodology

During this investigation, a variety of information sources were consulted. Most of the material consulted consisted of published and unpublished technical reports. Also examined were local historical studies, many of which were specific to a particular place or period of time. Several archives were visited and a concerted effort was made to locate historical photographs of the study area, particularly those depicting commercial and recreational activities of the twentieth century. Local newspapers and newspaper files in local libraries were examined in an effort to find historical descriptions of localities or events. Several field trips were made to obtain first-hand information on physical and cultural diversity. During the field trips, a photographic record was made of selected physical and cultural locales considered representative of the local geography. A photo flight was made of the entire area in order to photograph localities not readily accessible by land and to obtain aerial views of large features that are not readily visible from the ground. As a supplement to the fieldwork, 13 individuals were contacted and interviewed to obtain the "local perspective" on changes that have occurred along the Louisiana coast (**Appendix A**).

CHAPTER 2

PHYSICAL SETTING

Geological Background: Influence of the Mississippi River

The physical character of the study area is directly related to its geologic history. Virtually all of the study area was formed either directly or indirectly by sediments deposited by the Mississippi River over the last 8000 or 9000 years (**Figure 2-1**). These deposits came from one of several deltas of the Mississippi River. The indirect deposits were the result of both alluvial and marine processes that reworked the sediments. Most obvious is the formation of barrier islands and coastal ridges or cheniers that resulted from the action of long shore currents and wave action.

The most recent forces to have significant impacts have been the Bayou Lafourche course of the Mississippi River and the Atchafalaya River. Although the main channel of the Mississippi River abandoned its Bayou Lafourche course around 1 A.D., Bayou Lafourche continued to serve as an active distributary until around 1900 A.D (Weinstein and Gagliano 1985). As a distributary channel, Bayou Lafourche continued to dump fresh water and sediment into the coastal lowlands, particularly during periods of high water along the Mississippi River. This ended when the head of Bayou Lafourche was dammed in 1904.

The second major force is the Atchafalaya River. Although the Atchafalaya carries flow from both the Red and Mississippi rivers, this was not always the case. In prehistoric times, the Red and Mississippi rivers followed two separate independent courses located east of the old Bayou Teche channel. The Red River, during that time, flowed directly into the Atchafalaya River and thence to the Gulf. About 500 years ago (ca. A.D. 1500) a meander belt of the Mississippi migrated westward. It intercepted the Red River in the general vicinity of Old River, about 20 miles (32 km) north of the distributary mouth of the ancestral Bayou Fordoche (Fisk 1952:17, 65). This resulted in the Red River flowing into the Mississippi River through the upper/northern side of the loop or bendway, which was known as upper Old River. Some of the water carried by the Mississippi then flowed into the Atchafalaya River via the lower/southern segment of the loop/bendway (lower Old River). Diversion of water into the Atchafalaya River, especially during high water periods via upper and lower Old River, caused a reduction in the downstream flow in the Mississippi River. This diverted flow remained small during early historic times because a large log raft obstructed the upper Atchafalaya River. After the removal of the raft during the 1860s, Mississippi River waters began to increasingly divert into the Atchafalaya River.

Atchafalaya River and the Raft: ca. 1800-1870

Although the initial shift of waters from the Mississippi and Red Rivers likely resulted in enlargement of the Atchafalaya River, this flow gradually declined in the eighteenth and early nineteenth centuries due to blockage of the channel by a large raft of driftwood located near present-day Melville. At that time, the Atchafalaya received flow from both the Red River and the Mississippi. During the mid-nineteenth century, flow down the Atchafalaya River was altered by two events: 1) dredging of Shreve's Cutoff, which caused the upper Old River channel to be abandoned and increasingly forced the Red River's flow into the Atchafalaya River, and 2) removal of the Atchafalaya River raft between 1840 and 1870. Flow from the Mississippi into the Atchafalaya gradually increased after 1870. It was ultimately placed under control of the U.S. Army Corps of Engineers with the completion of the Atchafalaya Basin Floodway during the 1930s and Old River Control Structure during the 1950s (Comeaux 1972; Elliott 1932). Additional discussion of the raft removal and its impact on the Atchafalaya River can be found in Chapter 3.

Period of Increased Atchafalaya Flow: ca. 1870 - 1930

With increased flow came an increase in the sediment load of the Atchafalaya River. Within the lower part of the Atchafalaya Basin was a huge lake, known today as Grand Lake/Six Mile Lake and known during early historic times as Lake Chitimachas. During the late nineteenth century, increased deposition occurred in upper Grand Lake and in many other smaller lakes located within the middle portion of the Atchafalaya Basin. Where the Atchafalaya entered Grand Lake, a huge inland delta formed that expanded slowly southward toward the Gulf. By the middle of the twentieth century, most of Grand Lake/Six Mile Lake was filled by Atchafalaya River sediments.

Modern Atchafalaya Floodway: 1930-Present

With creation of the Atchafalaya Floodway during the 1930s and subsequent construction of the Old River Control structure, the Atchafalaya River was guaranteed a year-round diversion of about 30 percent of the Mississippi River (**Figure 2-2**). Construction of the east and west guide levees further restricted the areas that could be flooded and, therefore, restricted the areas of potential sediment deposition. After most of the inland areas of potential sediment deposition were filled with sediments, the area of major deposition shifted to the mouth of the Atchafalaya River on Atchafalaya Bay. About 1970, the first islands of the infant Atchafalaya delta began to appear above the water surface in Atchafalaya Bay.

In recent years, sediments carried into Atchafalaya Bay have increased as potential inland deposition areas have filled in. As long-shore currents carry fresh water westward, they also carry the suspended sediments, which are deposited in coastal bays and estuaries west of the Atchafalaya River mouth.

The Role of Natural Levees

> Man-made modifications in Louisiana wetlands, . . . are the result of flood protection, deforestation, deepening channels, and the cutting of navigation and drainage canals ... Reclamation and flood control as practiced in Louisiana have been more or less a failure, destroying valuable resources without producing the permanent compensating benefits originally desired. Reclamation experts and real estate promoters have been killing the goose that laid the golden egg . . . our future conservation policy should be a restoration of those natural conditions best suited to an abundant marsh, swamp, and aquatic fauna, but under some degree of control at all times, to the end that the state and nation may enjoy a more balanced diet, healthful recreation, and enduring prosperity [Viosca 1928].

Early investigators discovered Louisiana's alluvial wetlands are a product of the wandering distributaries and alluvial processes of the Mississippi River. This swath of coastal property provides a habitat for more than two-thirds of the Mississippi Flyway's wintering waterfowl, a large portion of North America's fur and alligator harvest, more than 20 percent of the country's commercial fisheries, approximately one-third of the country's natural gas and nearly one-fourth of its petroleum. The world's greatest pipeline network moves these mineral fluids to processing plants that support a national and international industrial infrastructure. Of these industries, the role of fisheries is probably the least well known. The economic value of commercial and recreational fisheries in the Gulf of Mexico is considerable. Four of the country's top ten fishing ports, by weight, are in Louisiana–Cameron, Dulac, Intracoastal City, and Empire/Venice. Nationwide, these ports process over a million pounds (454,000 kg) of shrimp, oysters, blue crab, and menhaden–the principal species caught (Weber et al. 1992).

The cumulative deltaic processes that characterize the central Louisiana coast and associated estuarine environments resulted in a landscape dominated by broad, gently sloping natural levees that are the regions' principal high ground (**Figure 2-3**). Flanking each natural bayou and river is a pair of natural levees. No elevations are more than 25 feet (7.6 m) above sea level. The crest or highest elevation of a natural levee is near the stream bank and the wide backslope is the elevated portion that slopes away from the channel and eventually grades into the surrounding marsh or swamp. The backslope grade is generally so slight that it is not easily recognized. The height and width of natural levees is directly proportional to the size of the stream that created them. Over bank flow is invariably away from the river. Moreover, during a flood, the velocity declines away from the main channel, permitting the heavy and coarser sediments to be deposited on the bank near the river and finer sediments farther from the main channel. Through recurring floods, the riverbanks are elevated higher and higher producing an easily defined system of natural levees (Ellet 1852; Morehouse 1910). In addition, frequent flooding diverts sediments into the surrounding lowlands, often through crevasses, elevating the surface at a rate that counteracts subsidence and sea level rise (Conrad and Brasseaux 1994). The highest natural levee crests can be found along Bayou Teche, where crest elevations range from about 25 ft (7.6 m) near New Iberia to about 15 ft

(68.6 m) near Franklin. Most natural levee crests in the study area do not exceed 15 ft (68.6 m) in elevation.

The height and width of these topographic elements are directly proportional to the size of the river, stream, or bayou that create them. Stream patterns are complex and so are levee patterns. Within the distributary networks that shaped the delta plain, are natural levee configurations that can be utilized to distinguish and classify, by time periods, a stream's evolutionary history. Many levees are not continuous; local subsidence disrupted their continuity creating isolated levee segments (**Figure 2-4**). Others disappeared beneath the wetland surface. Regardless, these features furnished the essential "high ground" for colonization. In the delta plain, elevations above sea level are not great. Differences are slight, but vital from the standpoint of human occupancy. Floods were, therefore, a perpetual dilemma to be endured (Conrad and Brasseaux 1994). Between natural levee ridges are broad areas of low elevation that are referred to as interdistributary basins. These low marshy or swampy areas are broken by occasional ponds, lakes and shallow streams. Annual floods nourished the land; but they were an aggravating part of living within the Mississippi's floodplain. To neutralize these seasonal disasters, natural levees were augmented by engineered structures high enough to counteract floodwater, or at least minimize its effects. Actually, artificial levees are the only practical technique that can be implemented to resolve flood-control problems. The system became so efficient it deprived the wetlands of valuable sediment and contributed directly to Louisiana's high rate of wetland loss. In addition, between 1950 and 1980 the suspended load of the river has decreased by 50 percent (Keown et al. 1986; Meade and Parker 1985). Since the latter half of the nineteenth century the suspended load has decreased by a total of nearly 80 percent (Kesel 1989).

Other Physical Features

Within the study area, at least 80 percent of the land can be characterized as interdistributary swamps or marshes that are separated by natural levee ridges representing abandoned distributary channels of the Mississippi River. Areas that do not fall under this classification include: 1) the active Atchafalaya River and its deltas, 2) the small section of Coastal Prairie Terrace located at the northwestern end of the study area, 3) the four salt dome islands, 4) the barrier islands, and 5) the cheniers southwest of Vermilion Bay (see Figures 2-3 and 2-4). Along the Louisiana coast, three distinctive barrier features have been identified: barrier (shell) reefs, barrier islands, and cheniers. The barrier system is important because "disappearance of Louisiana's barrier systems will result in the destruction of the large estuarine bay systems and the acceleration of wetland loss" (Williams et al. 1992:2). Because they rarely project above high tide, barrier reefs fall into a special category and have not been considered for land loss/gain calculations. Additional information on these areas and features is provided in the remainder of Chapter 2.

Coastal Prairie Terrace

The Prairie Terrace is a relatively flat region of southwest Louisiana that is about five to ten feet (1.5 to 3 m) above sea level. Within the study area, Prairie Terrace soils occur only in northern Vermilion Parish and the extreme western end of Iberia Parish. The terrace

soils provide a good foundation for rice cultivation, and more recently, for crawfish farming. Because of its elevation and its inland location peripheral to the present study, the Prairie Terrace is a land form that is only minimally involved in either past or future changes related to land loss, salinity, or water flow patterns. For these reasons, only minimal research was conducted on the terrace region.

Cheniers

Cheniers are abandoned beach ridges formed by nearshore transport and deposition of fine sediments originating from the different delta systems of the Mississippi River (**Figure 2-5**). Cheniers consist of long, narrow, sandy shell ridges that run parallel to the coast and support live oak dominant forest communities. These ridges are formed when shoreline erosion concentrates the coarse materials within mudflats. Over time, wave action pushes the material into beach ridges. As the shoreline aggrades from additional longshore drift sediments, these ridges are left as stranded ridges that often are 4 to 5 feet (1 to 1.5 m) above sea level (Dunbar et al. 1992). The main difference between barrier island ridges and chenier ridges is location: barrier islands are in open water whereas cheniers are surrounded by land. Barrier islands may become cheniers if aggradation of the shoreline occurs.

Cheniers play an important role in the coastal zone's delicate balance of nature. Cheniers limit saltwater intrusion by acting as storm barriers. Marshes located north of cheniers are fresher than those located gulfward. In addition to being storm water barriers, cheniers function as vital resting and feeding grounds for trans-gulf-migratory birds returning north (Craig et al. 1987). No documentation was found indicating losses or changes occurring to cheniers within the study area.

Only two significant cheniers are located within the study area. These are Cheniere au Tigre, a relatively large ridge located along the Gulf shore, and Belle Isle, a relatively small ridge located inland about five miles (8 km) to the north of Cheniere au Tigre.

Barrier Islands

Barrier islands offer protection to extensive estuary systems by reducing both the offshore waves and saltwater intrusion entering from the Gulf of Mexico. These islands, located in the Gulf of Mexico, were formed by the erosion and reworking of sediments deposited by the Mississippi River in the old Terrebonne basin (Isles Dernieres and Timbalier Island) and Barataria Basin (Timbalier Island) deltaic systems. These islands are currently experiencing high erosion rates. The disappearance of barrier islands has resulted in acceleration of wetland loss and inland habitat change (Williams et al. 1992). Additional information on barrier islands is provided below in the discussion of land loss and coastal vegetation.

Barrier Reefs

Barrier or shell reefs are another natural coastal barrier feature that occurs within the study area. Shell reefs are features that may or may not be exposed above the surface of the

water. Reefs accumulate in areas where oyster growth remains favorable over many years. Through subsidence, active oyster colonies can form shell deposits measuring up to 15 or 20 ft (4.6 or 6 m) thick. During the nineteenth century a wide oyster reef system extended from east to west across the mouth of Atchafalaya Bay. This reef complex was known as the Point au Fer Reef and it consisted of a broken chain of oyster reefs that stretched about 30 miles (48 km) from Point au Fer to Marsh Island. Additional reefs occurred along the south side of Marsh Island. Unlike barrier islands that were composed mainly of sand, shell reefs contained little sediment. Most were unvegetated because growth was dependant upon access to water, so oyster reefs rarely projected above high tide. These features were stable and resistant to wave erosion. During the early twentieth century, the Point au Fer Reef was considered the biggest hindrance to oyster production in the Vermilion Bay area because the reef system trapped Atchafalaya River fresh water on the north and effectively kept salt water out of the coastal bays (Payne 1920).

Physical Changes that Occur Along the Coast

As elsewhere along the Louisiana coast, erosion and subsidence occur throughout the study area. However, near the mouth of the Atchafalaya River, the deposition rate exceeds the rates of erosion and subsidence. As a result of the tremendous amount of sediment being carried down the Atchafalaya River and the predominantly east-to-west flowing long-shore current, the area immediately west of the Atchafalaya mouth is not eroding as fast as the area to the east. One of the obvious impacts of land changes is in the distribution of vegetation, particularly in areas near the coast. In coastal areas where surface elevation range is small, vegetation patterns are closely linked to water salinity, hydrology, physical features (landforms such as natural levees), and subsurface geology. Vegetation patterns are important keys to understanding land loss along coastal Louisiana.

Land Loss and Vegetation

Most of coastal Louisiana within the study area was created over the past 7000 years by sediment deposition from active outlets of the Mississippi River. During this time, the Mississippi River extended five major delta complexes into the Gulf of Mexico, gradually abandoning one after another for a shorter route of steeper gradient. Each of the river diversions initiated a cycle of growth followed by a phase of decline and breakup with waxing and waning of river outflow and sedimentation. These processes created a continuous progradation of land, resulting in a network of alluvial natural-levee ridges along active and abandoned distributaries, vast interdistributary swamps, marshes, lakes, and bays, relic beach ridges, and a string of barrier islands (Craig et al. 1987; Gagliano et al. 1981).

In coastal Louisiana, lands built by Mississippi River deltaic processes may be divided into seven hydrologic units. These are defined as "natural watersheds" in which an estuarine bay can be found. The study area, also referred to as the central Louisiana coast, encompasses most of three hydrologic units: (1) Teche-Vermilion Basin, (2) Lower Atchafalaya, and (3) Terrebonne Basin. Within these regions are different plant communities controlled by factors such as salinity regimes and elevation in relation to sea level. Plant communities in coastal Louisiana change with increases in elevation relative to sea-level.

Marshes are located at or near sea level; the adjacent swamps border natural levee ridges. Coastal cheniers are stranded beach dunes surrounded by marshes. Cheniers within the study (e.g., Cheniere au Tigre) are west of Vermilion Bay (see Figure 2-3). The two barrier island systems in the study area, Isles Dernieres and Timbalier Island, are composed of beaches and dunes on the Gulf side and marshes on the bay side.

At present, Louisiana is losing wetlands faster than any other state in the Union (**Figure 2-6**). The main loss is occurring in coastal marshes. Loss of these marshes is having a direct affect on the habitats and productivity of wildlife and fisheries within these coastal marshes. This section includes a description of habitat communities that occur within the central Louisiana coast, a discussion of the causes and rates of land loss, and a discussion of the changes in habitats and the affects on wildlife and fisheries productivity.

Since the early 1900s, the recent historical trend of land building in the Deltaic Plain and Chenier Plain has been reversed. Louisiana is losing coastal wetlands at an alarming rate. The causes of these losses are the result of natural and human-induced factors. Natural land loss is the result of subsidence, decay of abandoned river deltas, shoreline erosion, and subsurface geologic control (i.e., faulting). The human role in coastal land loss stems from flood-control practices, impoundments, dredging and subsequent erosion of engineered channels, deposition of spoil upon wetlands, and land reclamation projects.

Data from a 1970s study conducted by Coastal Environments, Inc., determined that coastal land loss between 1890 and 1978 accelerated geometrically. Land loss rates have increased from 6.7 mi^2/yr (17.3 km^2/yr) in 1913 to 28.1mi^2/yr (72.8 km^2/yr) in 1967 to a projected 39.4 mi^2/yr 102 km^2/yr) for 1980 (Wicker et al. 1992). Land loss research conducted by the National Wetland Research Center for 1956 to 1990 determined that land loss rates were approaching 39.4 mi^2/yr (102 km^2/y). From 1978 to 1990, it was determined that loss rates were decreasing to 34.9 mi^2/yr (90.4 km^2/yr) for the 1978 to 1990 time period. Specifically, loss rates for the 1956 to 1978 and the 1978 to 1990 time period were 1.3 mi^2/yr (3.4 km^2/yr) and 0.5 mi^2/yr (1.3 km^2/yr) for the Teche-Vermilion area, 0.1 mi^2/yr (.26 km^2/yr) and 0.1 mi^2/yr (.26 km^2/yr) for the Atchafalaya area, and 9.3 mi^2/yr 24 km0.1 mi^2/yr (.26 km^2/yr) and 10.2 mi^2/yr (26.4 km 0.1 mi^2/yr (.26 km^2/yr) for the Terrebonne area (Barras et al. 1994).

Between 1930 and 1990, the coast of Louisiana lost more than 800,000 acres (324,000 ha) of land due to a culmination of individual and multiple impacts. These impacts are both natural and human induced. The three major causes are erosion, submergence, and direct removal of wetland substrate. The total acreage lost due to these impacts is summarized in a report by Penland and others (1996).

Land Subsidence and Sea Level Rise

In Louisiana, the recent deltaic deposits of sands and muds are naturally compacting, consolidating, and sinking under their own weight (typically 0.7 ft (.2 m) a century, but up to 4 ft (1 km) a century. When subsidence is considered with sea level rise, it has been determined that relative sea level rate increases could range from 0.6 ft to 9.0 ft (.18 m to 2.7 m) over the next century (Gagliano and Van Beek 1970; Penland et al. 1988). Also,

withdrawal of oil, gas, water, salt, and sulfur near the surface contributes to local subsidence. These factors, along with worldwide sea-level rise, are affecting the ability of coastal Louisiana to stay above water. Typically, the root zone of wetland plants maintain a near sea level position by accumulating organic matter from surrounding marsh plants and trapping sediments at rates faster than subsidence. The direct supply of sediments needed to keep up with local subsidence has been eliminated by the construction of levees along the Mississippi River and its distributaries (Baumann and DeLaune 1982; May and Britsch 1987).

Submergence

In addition to subsidence, the submergence of coastal areas is a leading factor in land loss. Submergence is caused by flood-control practices (i.e., flood control levees, and drainage canals) and collapsing of wetland substrates. Flood control practices have been extensively used in coastal Louisiana since the settlement of Europeans in south Louisiana. These flood control measures have resulted in an extensive network of drainage ditches and flood control levees. Dredge-material disposal, associated with drainage ditch and canal construction, results in spoil ridges along these drainage networks. Consequently, these ridges restrict overland flow of sediments and freshwater. Ditches and canals are also responsible for changing water circulation that accelerates saltwater intrusion. These activities changed marsh zones by displacing brackish marshes with salt marshes, displacing intermediate marshes with brackish marshes, and displacing freshwater swamps and marshes with slightly saline environments.

Flood-control levees have also been constructed throughout low-lying south Louisiana (**Figure 2-7**). These practices resulted in an almost total shutdown of overbank flooding, which historically supplied sediments and freshwater to surrounding swamps and marshes. This influx of freshwater and sediments drained into salt marsh environments, pushing salient marsh vegetation zones toward the Gulf of Mexico. Today, the Mississippi River is one of the largest contributors of these processes. Most of the sediments from the Mississippi River are being deposited in the deep portion of the Gulf of Mexico. These sediments, therefore, contribute very little to marsh creation or maintenance. Construction of levees and revetments along the Mississippi River reduced natural river diversions or crevasses that would result in new marsh creation. Currently, the only year-round outlet of the Mississippi River, other than its mouth at the Gulf of Mexico, is the Atchafalaya floodway.

In addition to flood-control practices, submergence of coastal Louisiana is being influenced by the collapse of wetland substrate. This collapse is a product of waterlogging of soils during impounding, subsidence events, and land reclamation projects. Deposition of dredged material during the construction of channels often impounds and waterlogs marsh soils. Waterlogged soils cause plant dieback. This leaves the marsh more vulnerable to erosion. Land reclamation involves draining wetlands for agricultural, industrial, and urban development. Forced drainage in these areas causes shrinkage and oxidation of these organic soils. Shrinkage of marsh soils involves a lowering of soil levels relative to the elevation of surrounding marsh. Most land reclamation projects failed because of poor drainage, deterioration of levees, and seepage. These failed projects resulted in creation of large, open-water lakes after the water level returned to its pre-drainage state.

Erosion

According Penland and others (1996), erosion of wetlands is the second largest factor for coastal land loss in Louisiana. This study delineated five causes of erosion: (1) storm-induced shoreline erosion, (2) disrupted longshore sediment transport caused by engineered structures, (3) natural scouring of the landscape produced by overland water flow, (4) navigational scour caused by boat wakes, and (5) erosion of drainage channels by drainage transport. Of the areas being eroded, coastal marshland is lost faster than the more elevated natural levees, cheniers, and barrier islands. In some areas, the surrounding marsh has been eaten away; as a result, tree-covered natural levee ridges are washing into the Gulf (**Figure 2-8**).

Direct Removal of Substrates

The third most important reason for coastal land loss is direct removal of wetland substrates during construction of channels, sewage ponds, and borrow pits. Channels are dredged for access, mineral production, and oil and gas pipelines. Navigation channels were dredged for recreation and commerce. Drainage channels were dredged for flood control and forced drainage.

An example of the complex interactions that occur on the coast is the actual loss of wetlands during the construction of canals. Wetland loss is much more than the actual acreage of wetlands removed by the dredging process. Wetland loss also includes those wetlands covered by dredge material from the canal. In fact, the area covered by dredge spoil is at least twice the area of the canal itself. The spoil ridge then becomes an upland habitat. Commercial and recreational boat wakes can also erode the canal bank and marsh edges. Increasing canal depth additionally allows saltwater to encroach into less saline environments resulting in the death of plants that hold marsh substrates together. Consequently, the plant community changes to a more saline-tolerant type. Canals allow inland storm waters to drain more quickly, furthering the erosion rates of the canal banks and adjacent marsh. Dredge material, placed along canal banks, restricts the movement of sediment and overland flow. As a result, there is a decrease in the marsh's ability to hold back saltwater. Overall, canals greatly contribute to marsh erosion and to shifts in marsh zonation.

Coastal Habitat Zonation

The south-central coastal Louisiana region can be subdivided into six major physiographic landscapes: (1) beaches and barrier islands, (2) marshes, (3) abandoned beach ridges (cheniers), (4) backswamp, and (5) natural levees. Vegetation provides and important key to our understanding of these features and how they have been modified in recent years. As one researcher put it, the magnitude of change can be understood "only through a complete understanding of the distributional patterns and the environmental conditions necessary for optimum plant growth" (Chabreck 1982).

Beaches and Barrier Islands

The habitat communities of Isle Dernieres and Timbalier Island consist of beaches, dunes, high marsh, and low marsh (**Figure 2-9**). Beaches are an accumulation of wave-washed, loose sediment extending from the outermost breakers and the landward limit of swash and wave action. Organic debris accumulates in the far reaches of wave action. Within this organic buildup, sea rocket (*Cakile sp.*) and seaside goldenrod (*Solidago sempervirens*) sprout from rhizomes (underground stems) and seeds.

Barrier island dunes, located adjacent to beaches, are shaped by winds. They are built and stabilized by rapidly colonizing plants. Further, they are subject to frequent storm overwash with sand deposition and salt water flooding. Dominant plants that facilitate dune building include: wire grass (*Spartina patens*), beach morning glory (*Ipomoea pescaprae*), sea oats (*Uniola paniculata*), and seashore paspalum (*Paspalum vaginatum*). Once established, these dune plants diminish wind velocities; as a result, blowing sand deposits accumulate in the grass. These dune plants have the ability to grow upward with the accumulating sand.

High marshes are located on the dunes' bayside. These marsh areas are characterized by soils with high salt concentrations because of a lack of "flushing" of saline waters after spring tides and high water events. Plants that can tolerate salt thrive. Examples include smooth cordgrass (*Spartina alterniflora*), wire grass (*Spartina patens*), salt grass (*Distichlis spicata*), and black rush (*Juncus roemarianus*).

Low marshes occur on the edges of barrier islands adjacent to bay waters. Smooth cordgrass (*Spartina alterniflora*) and black mangrove (*Avicennia germinans*) can flourish from mean sea level to the upper level of neap tides. Roots from this plant community stabilize the shoreline from erosion (Craig et al. 1987; Leatherman 1982).

Isle Dernieres is one of the fastest eroding barrier systems in the United States. Between the 1890s and 1988, the island decreased in width by 2612 feet (796 m), an erosion rate that averaged 28 feet (8.6 m) per year. The island has lost 78 percent of its size in the past 100 years. It decreased from 8728 acres (3532 ha) in the 1890s to 1905 acres (771 ha) in 1988, for an average loss rate of 69.7 acres (28.2 ha) per year.

Timbalier Island consists of Timbalier and East Timbalier islands. Erosion rates on these islands are not as great as those of Isle Dernieres. Timbalier Island is migrating to the west; erosion on the east is countered by accretion on the west. The bay and gulf side of East Timbalier Island are migrating landward at a consistent rate. The combined area of the two islands has decreased from 4144 acres (1677 ha) in 1887 to 1927 acres (780 ha) in 1988. These high loss rates are the result of storm surges from Hurricane Danny and Juan in 1985, where 1767 acres (715 ha) were lost (Williams et al. 1992).

Marshes

Louisiana's coastal marshes are subdivided into four vegetative types that generally occur in bands parallel to the coastline. Each type of zone exhibits characteristic water

salinity tolerances. These vegetative marsh types include saline, brackish, intermediate, and fresh. With the advent of natural degradational processes (i.e., erosion and subsidence), and the destructive activities of humans (levee construction, canal dredging, and stream channelizing), the wetlands of the Louisiana central coast are experiencing an increase of saltwater intrusion (**Figure 2-10**). These influxes of saline waters resulted in changes in the vegetative zones along the coast.

As the salinities of an area increase through saltwater intrusion, plants that are intolerant to these higher salt concentrations usually die and are gradually replaced by species that are adapted to these new salinity regimes. Areas that exhibit high organic matter content within the substrate (i.e., fresh and intermediate marshes) are sometimes lost because of a lack of plant roots to hold them together during this transition period. Tidal-water currents moving through the marsh pick up this loose organic matter and flush it out through tidal channels. Marsh elevations drop due to the sediment loss, and plants are unable to reestablish themselves. The results are open ponds and lakes where productive marshes once lay (**Figure 2-11**). Those areas that have a gradual change in salinities can adapt by a gradual species change, therefore avoiding unvegetated areas susceptible to tidal action. The long-term results have been inland shifts of saline marshes into fresh marshes (Chabreck 1982).

In a 1982 study, Chabreck and Linscombe compared 1968 and 1978 vegetative type maps of coastal Louisiana to determine any changes in the size of the vegetative types, and to determine areas that had shifted to less saline or more saline conditions. This study found that 458.5 mi^2 of coastal marsh in south-central coastal Louisiana had changed in the 10 year period between 1968 and 1978. According to Chabreck and Linscombe (personal communication October 1997), more recent research data on the changes in marsh vegetative types will be available sometime in 1998 after publication of this document. The following is a description of species, the physical and chemical parameters that exist, and the specific changes that occurred in the 10-year period within each vegetative type.

Saline Marsh

Saline marshes, bordered by the Gulf of Mexico, are subject to high water salinities and daily tidal fluctuations. These marshes are dissected by embayments and tidal channels, which expose it to rapid tidal action. Water salinities average 18.0 ppt (ranging 8.1 to 29.4 ppt) and the soils exhibit a lower organic content (mean = 17.5 percent) than fresher marshes. Saline marshes exhibit the lowest plant diversity of all the marsh types. Dominant species include smooth cordgrass (*Spartina alterniflora*), saltgrass (*Distichlis spicata*), black rush (*Juncus roemarianus*), wiregrass (*Spartina patens*), and salt wort (*Batis maritima*) (Chabreck 1970; Craig et al. 1987).

Brackish Marsh

Brackish marshes, located further inland from saline marshes, are also subject to tidal action. Soil and water conditions regulate plant growth with water salinities appearing to be the largest factor in determining plant species composition. Water salinities average 8.2 ppt (ranging 1.0 to 18.4). The dominant plant of brackish marshes is a salt tolerant grass called

wiregrass (*Spartina patens*). Additional associated species include: saltgrass (*Distichlis spicata*), three-cornered grass (*Scirpus olneyi*), salt marsh bulrush (*Scirpus robustus*), dwarf spikesedge (*Eleocharis parvula*), widgeon grass (*Ruppia maritima*), seashore *paspalum (Paspalum vaginatum*), black rush (*Juncus roemarianus*), coastal water hyssop (*Bacopa monnieri*), smooth cordgrass (*Spartina alterniflora*), and big cordgrass (*Spartina cynosuroides*).

Intermediate Marshes

This community normally lies between fresh marsh and brackish marsh, but sometimes can be located along the Gulf of Mexico shoreline (**Figure 2-12**). Intermediate marsh occupies the least acreage of all the marsh types. It is influenced by an irregular tidal regime and is dominated by narrow-leaved, persistent species. Intermediate marsh exhibits a higher organic content in the soils, averaging 33.9 percent. The average salinity for this area is 3.3 ppt (ranging 0.5 to 8.3 ppt). Intermediate marshes are dominated by wiregrass (*Spartina patens*). Other species include: roseau cane (*Phragmites communis*), bulltongue (*Sagittaria lancifolia*), coastal water hyssop (*Bacopa monnieri*), spikesedge (*Eleocharis sp.*), three-cornered grass (*Scirpus olneyi*), giant bulrush (*Scirpus californicus*), common three-square (*Scirpus americanus*), deer pea (*Vigna luteola*), seashore paspalum (*Paspalum vaginatum*), switch grass (*Panicum virgatum*), bearded sprangletop (*Leptochloa fascicularis*), camphor weed (*Pluchea camphorata*), water millet (*Echinochloa walteri*), fragrant flatsedge (*Cyperus odoratus*), alligator weed (*Alternanthera philoxeroides*), southern naiad (*Najas guadalupensis*), big cordgrass (*Spartina cynosuroides*), and gulf cordgrass (*Spartina spartineae*).

Fresh Marsh

Normally, fresh marshes are located at the northern extremes of marsh zones and sometimes adjacent to or intermixed with forested wetlands (swamps), but they can occupy adjacent coastal bays, where freshwater is entering the bay (e.g., Atchafalaya Bay). The primary factors affecting the distribution of plant species are the duration and frequency of flooding, which are influenced by the variable site-to-site microtopography. Additional factors affecting the patterns of plant species distribution include substrate, salinity, current flow, competition, and allelopathy. Dominant plants in fresh marshes include *maidencane (Panicum hemitomon*), spikesedge (*Eleocharis sp.*), bulltongue (*Sagittaria lancifolia*), alligator weed (*Alternanthera philoxeroides*), wiregrass (*Spartina patens*), roseau cane (*Phragmites communis*), coastal water hyssop (*Bacopa monnieri*), coontail (*Ceratophyllum demursum*), fragrant flatsedge (*Cyperus odoratus*), water hyacinth (*Eichhornia crassipes*), pickerelweed (*Pontedaria cordata*), arrow arum (*Peltandra virginica*), pennyworts (Hydrocotyle sp.), common duckweed (*Lemna minor*), water milfoils (*Myriophyllum sp.*), white waterlily (*Nymphaea odorata*), *cattail (Typha sp.*), bladderworts (*Utricularia sp.*), deer pea (*Vigna uteola*), and southern *wildrice (Zizaniopsis mileacea*) (Chabreck 1970; Craig et al. 1987).

Because of slow drainage rates, high organic matter content (mean: 52.0 percent), and high water levels, a significant portion of fresh marsh is floating and is referred to as flotant by Russell (1942). Of the marsh types, fresh marsh has the highest plant diversity and

highest percentage of soil organic matter content. Flotant marsh has the highest organic content of all (Craig et al. 1987).

In a 1979 study, Craig and others compared a coastal zone wetland loss map by Gagliano and van Beek (1970) with a coastal vegetation zone map by Chabreck and others (1968), in order to determine an annual land loss between 1890 and 1960 for each marsh type within individual hydrologic units. It was determined that in the Terrebonne Basin, a total of 450 acres (182 ha) per year in saline, 452 acres (187 ha) per year in brackish, and 417.5 acres (169 ha) per year in fresh marsh were lost annually. In the Atchafalaya River Basin, 1.7 acres (0.7 ha) per year of saline, 9.9 acres (4 ha) per year of brackish, and 106 acres (43 ha) per year of fresh marsh were lost. These numbers did not include the land building processes of the Atchafalaya Delta. For the Vermilion Basin, a total of 13 acres (5.3 ha) per year of saline, 403 acres (163 ha) per year of brackish, and 27 acres (11 ha) per year of fresh marsh were lost.

After comparing the 1968 and 1978 vegetative maps, Chabreck and Linscombe noted changes for the Terrebonne and Vermilion/Teche basins. No changes in vegetative types were noted for the Lower Atchafalaya area. The marsh types in this basin were maintained by the large amounts of freshwater moving through the basin.

In contrast, the Terrebonne Basin experienced a 210.3-sq. mi. (554.7 sq. km) shift to higher salinity marshes and a 129.4-sq. mi. (335.1 sq. km) shift to less saline marshes. This represents a net increase of 80.9 sq. mi. (209.5 sq. km) of saline type marshes. The shift to more saline types occurred in the central and eastern portions of the hydrologic unit. The highly saline waters entering the Houma Navigation Canal played a major role in these changes. The shift to more fresh types occurred west of this hydrologic unit because of the low saline fresh waters being discharged by the Atchafalaya River.

The Vermilion-Teche region experienced a net increase of 40.5 sq. mi. (104.9 sq. km) of less saline marshes. The hydrologic unit had an increase in 63.4 sq. mi. (164.2 sq. km) of more saline marshes, and an increase of less saline marshes in 103.9 sq. mi. (269.1 sq. km). Increases in less saline marsh types occurred in the east because of the freshwater outflow of the Atchafalaya River. Changes to more saline types occurred in the west. They are at least partially due to the increase of saline waters entering the area through the Freshwater Bayou Navigation Canal (Chabreck and Linscombe 1982).

Cheniers

As noted previously, cheniers are abandoned beach ridges formed by nearshore transport and deposition of fine sediments originating from the different delta systems of the Mississippi River (**Figure 2-13**). Dominant plants in this community are: live oak (*Quercus virginiana*), sugarberry (*Celtis laevigata*), swamp red maple (*Acer rubrum var. drummondii*), sweet gum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), palmetto (*sabal minor*), and prickly pear cactus (*Opuntia sp.*).

Backswamp

In addition to changes in the marsh, fresh water swamps are experiencing declines due to the deaths of cypress trees from saline waters and from humankind's alterations to the environment (**Figure 2-14**). Swamps are woody communities that have saturated or inundated soils for most of the growing season. They are located on the edges of fresh marshes and bottomland hardwood forests, and in depressions, old oxbows, and scour channels. The typical plant community contains dominant species such as bald cypress (*Taxodium distichum*) and tupelo *gum (Nyssa aquatica*), and co-dominant species such as swamp blackgum (*Nyssa sylvatica var. biflora*), swamp red maple (*Acer rubrum var. drummondii*), black willow (*Salix nigra*), pumpkin ash (*Fraxinus profunda*), green ash (*Fraxinus pennsylvanica*), water elm (*Planera aquatica*), water locust (*Gleditsia aquatica*), Virginia willow (*Itea virginica*), and buttonbush (*Cephalanthus occidentalis*). Because of low light conditions and long hydroperiods, the composition of understory vegetation is very sparse (Craig et al. 1987; Wicker 1980).

Since bald cypress and tupelo seedlings can neither survive long submergence, nor can their seeds sprout underwater, establishment of young trees can only occur under long drought conditions. The productivity of swamp forests increases with periodic flood events or increases in water flow, and decreases with reduction in water flow or stagnation (Craig et al. 1987). Swamp areas that are enclosed by spoil and flood protection levees experience an extended hydroperiod. This can result in a decline in cypress productivity and possibly death of the forest. The opportunity to reforest is lessened because tupelo and cypress seedlings cannot survive higher than normal water levels. Swamps that have been levied, drained, cleared, and then left abandoned to natural reforestation processes (i.e., abandoned farmlands) are invaded by overcup oak (*Quercus lyrata*) – water hickory (*Carya aquatica*) communities, which suppress re-establishment of cypress swamps (Craig et al. 1987).

In Craig et al.'s (1979) study of land loss in coastal Louisiana, the annual loss of swamp forest was determined for the 1890 to 1960 time period for the Terrebonne, Atchafalaya, and Vermilion Basins. During that time period, a total of 170 acres (69 ha) per year was lost in Terrebonne Basin, a loss of 17 acres (7 ha) per year occurred in the Atchafalaya Basin, and a total of 37 acres (15 ha) per year was lost in the Vermilion Basin.

Natural Levees

Natural levees throughout the study areas support bottomland hardwood forest communities (**Figure 2-15**). These communities occupy broad floodplain areas that flank river systems (i.e., Atchafalaya River, Bayou Teche, Bayou Black, Bayou du Large, Bayou Grande Caillou, Bayou Petit Caillou, Bayou Terrebonne, and Bayou Pointe au Chien). Many of these natural levee communities mark the location of old Mississippi River channels, and are dominated by live oaks (*Quercus virginiana*). Topographic variations of the floodplain, soil drainage characteristics, and duration and depths of seasonal flooding govern plant communities assembled in these areas.

In the northern portion of the study area, natural levees have higher elevations than do those to the south. Levees in the northern portion are dominated by live oaks (*Quercus virginiana*), water oak (*Quercus nigra*), *sugarberry (Celtis laevigata*), American elm (*Ulmus americana*), honey locust (*Gleditsia triacanthos*), and green hawthorn (*Crataegus viridis*). Ranked from highest elevation to lowest elevation, the plants that occur in the southern section include: live oak (*Quercus virginiana*) at the highest elevation, tooth-ache tree (*Zanthoxylem clava-hercules*), sugarberry (*Celtis laevigata*), green hawthorn (*Crataegus viridis*), opopanax (*Acacia farnesiana*), marsh elder (*Iva frutescens*), and eastern baccharis (*Baccharis halimifolia*) on the lowest elevations (Wicker 1980).

Since Europeans began settling the coastal areas of Louisiana, natural levees have changed. In many cases, they were the only places that were high enough to grow crops and avoid rain- and storm-induced flooding. These natural levee systems were altered because of the limited available cultivatable lands. Once these natural levee areas sink to near sea-level position, more flood- and saltwater-tolerant plant communities replace the higher-elevation plant communities.

Affects of Coastal Land Loss on Wildlife and Fisheries

Marshes and swamps of south Louisiana are vital to the survival of many estuarine-dependent species of the Gulf of Mexico region. The organic matter produced by decaying marsh plant provide an essential source of nutrition for microorganisms that, in turn, provide the vital resources for the diets of marine life (Industrial Economics, Inc. 1996).

The vast areas of coastal Louisiana are very important to fish and wildlife. Louisiana is the United States largest producer of commercial, estuarine dependent fish and shellfish. During the 1989-1992 period, Louisiana contributed an average of 1.13 billion pounds (51.3 million kg) of commercial fish and shellfish worth $276 million (McKenzie et al. 1995). More than 75 percent of fish and shellfish commercially harvested in Louisiana are dependent on coastal wetlands. Coastal Louisiana provides breeding, spawning, feeding, and nursery grounds for commercially important species such as white shrimp (*Penaeus aztecus*), brown shrimp (*Penaeus setiferus*), menhaden or "pogie" (*Brevoortia patronus*), American oyster (*Crassostrea virginica*), and blue crab (*Callinectes sapidus*) at some stage in their life cycles. Additional estuarine-dependent finfish species, such as spotted trout (*Cynoscion nebulosus*), largemouth bass *(Micropterus salmoides*), and red snapper (*Lutjanus campechanus*) are fished for by recreational sportsmen.

The loss of marshes and the conversion of fresh and intermediate marshes to more salient types have a direct link to the reduction of catches of commercial species. It has been identified that the amount of land-water interface is the greatest factor influencing the biological productivity of wetland habitats. This interface provides protection and access of food resources for nekton. As coastal marshes break up, the fisheries industry will experience a short-term increase in harvests because of the increase in land-water interfaces. Once coastal marshes break up to a point where the amount of land-water interface declines, fishery productivity will begin a long-term decline. Cavit (1979) found that menhaden catches were greater in marsh areas that had the highest ratio of marsh to open water.

Since 1880, Louisiana has been the leader in shrimp catches with an average annual harvest of $100 to $140 million. This is the largest source of income in the Louisiana commercial fishing industry. Despite moderately stable commercial shrimp harvest, the average harvest per fisherman has been on the decline (Davis 1982). According to Craig and others (1979), a cumulative 20-year wetland loss in coastal Louisiana had resulted in a 6.31 million pound loss in harvests. Evidence suggests decreases in marsh habitat resulted in a decrease in estuarine-dependent fishery production. According to Turner (1982), the expected 1 percent annual loss of wetlands over a 20 year period could result in a 1.1 billion dollar economic loss to the commercial fishing industry assuming that a 1 percent decline in fishery harvest is equivalent to a 1 percent loss in wetland habitat.

Conversion of marshes toward more saline types will also adversely affect wildlife populations. The abundance of migratory ducks, nutria, and alligators is greatest in fresh marsh areas. Declines in fur and alligator populations can be expected as land loss and saltwater intrusion continues to reduce the amount of fresh marsh available in coastal Louisiana (Fruge 1982).

Summary of Vegetation Changes

Louisiana's coastal zone has always been in a state of change. Human influence on the environment has only accelerated these changes by altering the natural hydrology of southern Louisiana. These alterations to the natural hydrology have often resulted in major changes, such as land loss, habitat replacement, and loss of productivity of fish and wildlife species dependent on coastal marshes. Land degradation will continue unless large-scale marsh replenishment projects, such as freshwater diversion, are introduced. Additional action, such as blocking and/or filling pipeline canals, installing gates or water control structures on navigation canals, and removing spoil levees could greatly enhance the natural hydrology in coastal Louisiana. Such steps would help to preserve one of this country's great natural resources.

Hurricanes

In addition to these long-term changes, many areas along the coast may undergo rapid deterioration as a result of tropical storms and hurricanes. These occasional events may create lakes by destroying marshland. In a matter of only a few hours, strong storms can create lakes in areas that were originally solid marsh (**Appendix A-4**). Storms may initiate rapid decay of marsh and swamplands when storm driven tidal surges introduce salt water into areas that were fresh. Strong storms, some with sustained winds of 120 miles per hour or greater, often push a surge of water onto the shore and into any channels that are open to the Gulf or coastal bays (**Figures 2-16** and **2-17**). It is not unusual for a hurricane storm surge to raise the water level ten feet (3 m) or more. Such a storm surge, coupled with wind and waves, can devastate buildings located on or near the shore (**Figure 2-18**). In areas repeatedly impacted by storms, it is unusual to find houses more than 75 years old still standing (**Figure 2-19**). Some of the storms that have had a major impact on the study area are presented in **Table 2-1**

Table 2-1. List of Recorded Storms that Have Impacted the Study Area.

Isle Dernier storm of Aug 10-11, 1854.
1860 - 3 storms hit within 7 weeks; the last Oct 2, 1860
Sept 1865
Oct 1886
Oct 1888
Sept 1893
Oct 1893
Sept 1909
Sept 1915
Aug 1918
Sept 1920
Aug 1926
1933
1940
1956 Flossie
June 1957 Audrey
Oct 1964 Hilda
Sept 1965 Betsy
Sept 1971 Fern
Sept 1974 Carmen
Sept 1977 Babe
July 1979 Bob
1985 Danny
1985 Juan
1991 Andrew
(Wurzlow 1984:42-44, Kniffen and Hilliard 1988)

Although tropical storms and hurricanes can have a huge impact on a particular area, these changes are infrequent and localized. Long-term hurricane impacts are not as significant as erosion, subsidence, or human landscape modification.

Physical Characteristics Unique to the Three Major Regions

While the marine- and land-related processes are present to varying degrees throughout the study area, there are some regional differences. These differences can be explained geologically.

Terrebonne Basin

The Terrebonne Basin differs from the other two in two major ways: 1) the physical setting is dominated by remnants of an old Mississippi Delta that left behind numerous distributary channels, and 2) the land loss rate is higher here than in the other two areas.

The distributary channels are all remnants of two old Mississippi River deltas that flowed into the Gulf during prehistoric times. The natural levee ridges of these old channels

provide the highest relief in an area that is otherwise dominated by low-lying marsh and swamp.

Only one of these old distributary channels, Bayou Black, is located inland and does not extend toward the Gulf. The other channels, including Bayou du Large, Bayou Grand Caillou, Bayou Petit Caillou, Bayou Terrebonne, and Bayou Pointe au Chien, all radiate gulfward from the Houma area. Each distributary is flanked by natural levees that provide a foundation for settlement. Interdistributary basins are dominated by marsh near the Gulf; the vegetation changes to swamp toward the northern part of the region.

Land loss is much greater in the Terrebonne Basin than in the Lower Atchafalaya and Teche-Vermilion areas. This land loss is most readily visible near the coast where historic maps indicate landholdings that were surveyed during the early nineteenth century but are now submerged beneath the coastal bays (**Figures 2-20** and **2-21**).

The Terrebonne Basin also differs from the other two in that an easily discernible barrier island chain occurs along the coast. While the Point au Fer oyster reefs and Marsh Island serve as effective coastal barriers, they have not migrated nor have they been altered to the extent that Isle Dernieres and Timbalier Island have. Even as early as the 1890s, some astute observers had noticed the rapid deterioration of the barrier islands along this section of the coast:

> The topographical changes in the region between Timbalier and Terrebonne bays are quite extensive and rapid, and islands were observed there in all stages of destruction, some of them cut into pieces, others barely showing above the water, and still others whose former positions were marked merely by shoals or by dead brush projecting above the surface. It appears probable that these changes might have produced considerable alteration in the [region's] hydrographic character . . . [Moore 1899:73].

Lower Atchafalaya

The Lower Atchafalaya area is unique because it is now the only area of coastline aggradation in Louisiana. The Atchafalaya River supplies more fresh water and more suspended sediment than any other stream between the Mississippi and Sabine rivers. Despite regional subsidence and erosion, the massive quantity of sediment being deposited is creating deltas at the mouths of Atchafalaya River and Wax Lake Outlet (**Figures 2-22** and **2-23**). As a result of Atchafalaya River flow, salinity in Atchafalaya Bay is much lower than in the coastal bays to the east, particularly during high water periods. The drifting westward of fresh water has also meant lower salinities in East Cote Blanche Bay, West Cote Blanche Bay, and Vermilion Bay. This region is dominated by riverine and delta formation processes.

Teche-Vermilion Basin

Of the three sub-regions, the Teche-Vermilion Basin is perhaps the most diverse in terms of physical characteristics. The Bayou Cypremort and Bayou Sale distributaries and

interdistributary basins are similar to those found in the Terrebonne Marsh area, except that the freshwater influx from the Atchafalaya River spillover is much greater. Consequently, the land loss due to erosion and subsidence is confined to the western end of the region. As a result of the flow of Atchafalaya River water into the area, the coastal bays are gradually filling and are now shallower than they were during the nineteenth century. Low salinities and high sediment load have discouraged oyster growth in the coastal bays since the middle of the nineteenth century. Virtually no oyster leases have existed within Vermilion Bay during twentieth century. With the removal of Wax Lake Outlet weir in 1995, the amount of freshwater in Teche-Vermilion area will probably increase slightly and perhaps reduce land loss in the Freshwater Bayou area.

A second regional difference is the presence of the Bayou Teche ridge to the north, which is much broader and higher than the distributary ridges in the Terrebonne region. Because of its high elevation and fertile soil, the natural levee ridges along Bayou Teche were one of the first areas to be settled during the eighteenth century, and the banks of Bayou Teche support some of the largest communities with the study area. A third difference is the presence of the Prairie Terrace within the northwest portion of the Teche-Vermilion region. This terrace provides a broad elevated surface for both habitation and cultivation, and is particularly suited for rice production. Due to its elevation, it is not likely to experience rapid increases in salinity or vegetation changes as is occurring within the coastal marshes. A fourth difference is the presence of chenier ridges in the marsh immediately west of Marsh Island. The final distinguishing characteristic of the Teche-Vermilion region is the presence of the Five Islands that are described below.

Salt Dome Islands

Dozens of salt domes are scattered throughout the study area, but only five protrude above the surface of the ground. Those that reveal a surface expression are usually called "islands" because they rise above the surrounding marsh or swamp terrain of the coastal zone. Salt dome islands are one of the unique features in the coastal landscape and four of the "Five Islands" are located within or immediately outside the Teche-Vermilion Basin. Belle Isle is located near the mouth of Wax Lake Outlet and is therefore located in the Lower Atchafalaya region. Within the study area, the Five Islands are the only natural features with elevations greater than 25 ft (7.6 m) above MSL. Because of their varied habitats, the presence of salt, and the unusually high elevations, the Five Islands served as magnets for human activities during prehistoric and historic times. The earliest Anglo settlers on each of the islands established some form of plantation, and sugar cane was the most common crop. Today, agricultural activity can be found only on Avery Island. All of the islands are surrounded by oil and gas fields.

Belle Isle

Belle Isle is located near the mouth of Myrtle Bayou, one of the distributaries of the Atchafalaya and about eight miles (12.8 km) from the mouth of that river. A network of bayous and sea marsh surrounds it. The island, that is, the portion above the sea marsh, has an area of about 360 acres (146 ha). In 1899 about half of the island was in cultivation. The

island is a roughly triangular area with a single range of hills along its north-west side. The highest point is on the westernmost point of the island and is about 80 ft (24 m) above sea level.

The accidental discovery of rock salt in an artesian boring on Jefferson Island, and the ever increasing difficulty of mining salt on Avery Island, due to water in the mine, caused systematic explorations for salt on the other exposed salt domes. In November 1896, Capt. A. F. Lucas explored for salt on Belle Isle. In December he discovered salt in a hole at a depth of 373 feet (114 m) (Letter from Capt. A. F. Lucas). In 1897 and 1898 the Gulf Company bored additional holes. In August they started a shaft and salt was found within 103 feet (31 m) of the surface. Salt mining operations began soon after this discovery (Harris and Veatch 1899:221). Serious mine accidents occurred in 1968 and 1979, both of which resulted in deaths. The mine was closed in 1984 (Kupfer 1998:5; USMSHA 1980; **Figure 2-24**).

Cote Blanche Island

About 1846, John Middleton Huger bought Cote Blanche Island, which was at the time operated as a sugar plantation, for $240,000. He envisaged making a resort of it, but failed. In his description of Cote Blanche, the late James P. Kemper, who spent part of his boyhood on the island, wrote:

> There was a long beach fronting the island. There was an almost perpendicular bluff 50 or more feet high from the top of which Marsh Island as well as the mainland could be seen across the bay. From the top of Oak Hill, Bayou Cypremort could be seen with its houses, fields and adjacent swamps and marshes, interspersed with lakes and bayous, and the other four hilly islands stood out boldly against the sky. It was a natural cyclorama of beauty the picturesque ness of which was all but incomparable. From the summit of Oak Hill itinerant artists could sketch a complete circle from one spot" [Vertical file "Cote Blanche History", clipping, no date, or newspaper, Franklin Public Library].

During a trip to the island in 1888, a visitor described the sugar plantation and noted that the bluff was 60 or 70 feet high (Louisiana Planter and Sugar Manufacturer 1888:30). At that time overland access between the island and the road along Bayou Cypremort was via a timber causeway through the marsh. Today the only vehicular access is by a private cable ferry (**Figure 2-25**). Only a few camps and the salt mine facility remain on the island.

Cote Blanche is nearly circular and in 1899 it covered an area of 1400 acres (567 ha). The highest elevation is about 100 feet (30 m). Immediately after the discovery of salt on Avery Island in 1862, numerous shallow pits were sunk on the island in a vain search for salt (Harris and Veatch 1899:230). Salt was discovered later, but mining did not begin until the twentieth century. On the south side the waves of Cote Blanche Bay have formed a bluff that was about 50 feet (15 km) high in 1899 and is only about 20 ft (6 m) high today **(Figure 2-26)**. The presence of this wave-formed bluff is probably the reason that this island

appeared on early Spanish maps. The gradual erosion of Cote Blanche is symptomatic of the amount of land loss that has occurred along this section of the Louisiana coast. Of the Five Islands, Cote Blanche has been impacted most by land loss.

Weeks Island

The island overlooks, on its western side, an arm of Vermillion Bay called Weeks Bay. Originally called Grande Cote, the island is almost circular and is the largest of the five islands. The area as shown by the land office records is about 1900 acres (769.5 ha). At 171 ft (52 m) it is the highest in elevation.

Following the discovery of salt on Jefferson Island in 1895 and on Belle Isle in 1896, Mr. F. F. Myles undertook the exploration of Weeks Island as a private enterprise. Salt was discovered and in July 1898, a shaft was started on the site of hole No. 24 where the salt approached nearest the surface (Harris and Veatch 1899:231-236). In addition to a salt mining operation, this island is now the location for a US Strategic Oil Reserves storage facility and a small oil/gas processing plant (**Figure 2-27**).

Avery Island

Petite Anse Island, Thomas Island, Marsh's Island, Salt Island or Avery's Island, as it has been called in succession, is situated in Iberia Parish about 10 miles (16 km) south-southwest of New Iberia and three miles (4.8 km) from the shores of Vermilion Bay. Like the other four islands, Petite Anse is entirely surrounded by marsh and swampland. The western side of the island is skirted by the Bayou Petite Anse. Avery Island was important first as a sugar plantation, and after 1862 it was important for rock salt production. Communication with the outer world by water was greatly hindered by the bar at the mouth of Petite Anse Bayou. This was partially overcome in 1880 by the digging of a canal from the lower part of the bayou across the marshes to the Gulf. In 1886 a branch of the Southern Pacific Railroad was completed from New Iberia to the island.

The area of Avery Island is about 1640 acres (664 ha) or about 300 acres (121.5 ha) less than Weeks Island. The island is somewhat oval, longest along its northwest and southeast diameter and has a marked indentation in the southwestern part. Its greatest length is two and three-eighths miles (3.3 km) and the narrowest place is barely a mile and a half (2.4 km). The highest point on the island is 152 feet (46 m). Several lakes or ponds are scattered over the surface of Avery Island. Some of these ponds are old collapsed or water filled mine shafts.

The aboriginal inhabitants of this country knew of the existence of brine springs and possibly rock salt on Petite Anse long before European settlers arrived. John Hayes rediscovered the springs in 1791 while hunting. At the time of William Darby's visit (about 1817) salt production from the springs had been going on for a number of years and had supplied, to a large extent, the demands of the settlements of Attakapas and Opelousas. The first mine shaft was dug in 1862. Quarrying of salt has been virtually continuous to the present, with a small break during the Civil War (Harris and Veatch 1899:237-43). This

island is important today because of continued salt production, oil and gas production, and the production of pepper sauce (**Figures 2-28, 2-29,** and **2-30**).

Jefferson Island

Like Avery Island, this island has had a great variety of names: Cote Carline, Depuy's Island, Miller's Island, Orange Island and Jefferson's Island. It is situated very near the line between Vermilion and Iberia Parishes immediately outside of the study area. Unlike the other islands, Jefferson Island rises out of a prairie, the sea marsh being two miles (3 km) and the Gulf nine miles (14 km) away. Touching the island on the northwestern side is Lake Peigneur, a water body about two miles (3 km) long. Surrounding the island are flat prairie lands used for the cultivation of rice.

The area of this circular protuberance in the prairie is about 300 acres (121.5 ha). It is very regular with a maximum diameter of about a mile. Facing the lake is a little wave-formed bluff about 30 feet (9 m) high. With this exception the slope from the highest point, which has an elevation of 75 feet (23 m) above the lake just behind the Jefferson residence, is very gradual.

In 1894 Mr. Jefferson let a contract for drilling a well near his home and this resulted in the discovery of rock salt at a depth of 334 feet (102 m) early in the summer of 1895. Mining operations began soon after (Harris and Veatch 1899:254-5). In 1980 an oil-drilling rig punctured one of the salt mine caverns while drilling in Lake Peigneur (**Figure 2-31**). Water from Lake Peigneur flowed into the puncture and flooded the maze of caverns and shafts within the salt dome, putting an end to the mining.

The Five Islands have always been important to both local and regional commerce. The history of each one follows a parallel pattern of agriculture, then salt production, and finally oil and gas exploration. At least as early as the 1940s, the Corps dug canals to the major islands to provide outlets for various exports. During the 1940s, the Corps dug a channel from the Intracoastal Waterway to the north end of Avery Island, a distance of 6.1 miles (9.8 km). A second channel, known as Avery Canal, was 40 ft (12 m) wide and 5 ft (1.5 m) deep. It extended from the Intracoastal Waterway to Vermilion Bay, a distance of 2.4 miles (3.9 km). A third channel, 80 ft (24 m) wide and 9 ft (2.7 m) deep, followed Bayou Carlin from its mouth at Bayou Petit Anse to Lake Peigneur, a distance of 7.6 miles (12 km). The project was completed in 1949 (U.S. Army Corps of Engineers 1995: 11).

CHAPTER 3

CUTURAL SETTING

The study area contains such a wide variety of environments that it is difficult to generalize about cultural development for the entire region. Nevertheless, there are some physical characteristics that are found throughout the entire region that have resulted in common cultural practices, particularly with regard to the exploitation of natural resources. The purpose of this chapter is to address three major topics: 1) the settlement patterns and types of economic exploitation, 2) human alteration to the natural environment and the impacts of these alterations, and 3) recent changes that may influence future settlement.

Cultural Settlement Patterns

The settlement of south Louisiana reflects a unique adaptation to a region that is dominated by land that varies only a few feet in elevation. The imprint left on the landscape reflects the local adaptations made by the people who settled and the availability of exploitable resources. As a whole, the region has seen a shift from an economy that once was dominated by agricultural products grown on natural levee ridges to an economy dominated by wetlands exploitation of oil and gas, and to a lesser extent, coastal fisheries. While the early settlers were more concerned with their physical surroundings than with political boundaries, much of the data collected for this study was organized according by parish. For this reason, the settlement pattern discussion is prefaced by a brief examination of the parish subdivision within the study area.

Parish Incorporation

Louisiana civil divisions have undergone a number of changes as the Louisiana region underwent its changes in ownership. Following the Louisiana Purchase in 1803, Louisiana was politically divided into 12 counties, primarily along traditional ecclesiastical boundaries. Lafourche and Attakapas parishes roughly comprised the present day central coast area. In 1807, the first Territorial Legislature redrew the 12 counties into 19 parishes. In 1811, Attakapas Parish was divided into St. Mary Parish and St. Martin Parish. At that time the parishes of Lafourche Interior, St. Mary, and St. Martin made up the present central coast area. In 1812, Louisiana was admitted to the Union as the eighteenth state.

Twenty-one additional parishes were organized between Louisiana's entrance into the Union and its secession. Among them, Terrebonne Parish was created from a part of Lafourche Interior Parish in 1822 and Vermilion Parish was created from a part of St. Martin Parish in 1844. The last remaining parish in the study area, Iberia, was organized in 1866 out

of parts of St. Mary and St. Martin (**Figure 3-1**). The last Louisiana parish was added in 1912.

Parish Boundaries

The traditional ecclesiastical regions that the original parishes had been drawn after were geographically vague. As the population and number of parishes grew, so did the need to clearly define the parish boundaries. During the pre-Civil War period of Louisiana's statehood, legislation was passed to provide for state and parish surveyors to map parish boundaries. In 1835, parish governments were given autonomy to negotiate boundary agreements with neighboring parishes, when such agreements could be reached. These efforts, coupled with changes to the state constitution in 1845 making parish creation more difficult, began to stabilize Louisiana civil divisions (Goins and Caldwell 1995).

Despite the trend of boundary stabilization, boundary disputes persisted. Of particular importance to the central coast area were the boundary disputes between Lafourche (Interior) and Terrebonne Parishes. The creation of Terrebonne Parish in 1822 was not specific regarding the newly created boundary with Lafourche Interior, leading to legislative intervention in 1848 and 1850, followed by Louisiana Supreme Court decisions in 1882 and 1897. The Legislative Acts inadvertently determined a conflicting boundary line between the parishes, leaving the issue unresolved. In 1882, the Louisiana Supreme Court fixed the boundary along Bayou Blue and Bayou Point au Chien; however, the streams did not provide a definitive boundary. The Supreme Court decision of 1897 upheld the earlier decision, yet it, too, was not completely decisive, having possibly been based on inadequate information. Newton and Easterly concluded in their 1977 book that, "Having stood since 1882 and without having been contested since 1897, the boundary should be considered fixed" (Newton and Easterly 1977).

Areas of Initial Settlement

Within the study area, most early settlement occurred on the more elevated lands that could be found in the southwestern prairie terrace, natural levee ridges, chenieres, and barrier islands. Of these areas, the southwestern prairie and inland natural levee ridges were located farthest inland and, therefore, offered the best protection from hurricane winds and storm surges. The following section examines a few selected settlements associated with some of the landscape features that attracted early settlers in the region.

Settlement along Natural Levees

Of all the physical landscape features located within the study area, natural levees are by far the most important for human habitation and agricultural use. Virtually every natural levee ridge that protrudes above the surrounding marsh or swamplands has been inhabited to one degree or another. By the end of the nineteenth century, small farms and/or plantations had been established along every major distributary channel within the study area. The most important settled ridges included Bayou Pointe au Chien, Bayou Terrebonne, Bayou Petit

Caillou, Bayou Grand Caillou, Bayou du Large, Bayou Black, Bayou Boeuf, Atchafalaya River, Bayou Teche, Bayou Sale, and Bayou Cypremort.

All major urban developments are located on natural levees, and prior to the influence of the oil and gas industry, the highest and widest natural levees supported the communities with the largest populations. Lower and narrower natural levees did not provide sufficient land for urban spread. The widest and highest natural levees were all located toward the northern edge of the study area. Because of this fact, most of the major communities (i.e., those with a population greater than 1000 in 1990) are located within a five-mile zone along the northern periphery of the study area. Chauvin (population 3375) and Dulac (population 3273) are the only sizeable communities further south. A greater emphasis was placed on examining the communities located farther south because they are at greater risk from storm surges, flooding, land loss, and other environmental dangers. The greatest concentrations of population are in urban centers along Bayou Teche (e.g., Jeanerette, Franklin, Patterson, Centerville, etc.), along the lower Atchafalaya River (Morgan City and Berwick), and at the confluence of bayous Black, Grand Caillou, and Terrebonne (Houma) (**Figure 3-2**). Of these urban areas, Morgan City is the most important to this investigation because of its proximity to the Atchafalaya River and the extensive flood protection measures required to accommodate its growing population.

Because of their proximity to the Gulf of Mexico and to areas of greatest land loss, the smaller occupied natural levee ridges in Terrebonne Parish, and to a lesser extent in St. Mary Parish, are much more symptomatic of the problems associated with rapid physical change along the Louisiana coast. As the ridges were settled, they were transformed into development corridors and served as the nodal points for wetlands-related industries (Gagliano and Roberts 1990). Settlement along natural levees is almost always linear, with house sites lining both banks of the bayou that served as the main transportation route. For many small natural levee ridges, a single road on one side of the bayou eventually supplemented water travel. For larger ridges, roads were built on both sides. Isle de Jean Charles and Mauvais Bois are two examples of small natural levee settlements that have been affected by changes in the local environment. Both are marginal in the sense that the natural levees were not substantial enough for growth into major development corridors.

Isle de Jean Charles

> During the four years I passed in Montégut, I went repeatedly to Jean-Charles. This humble community has been a new experience in my priestly life, an experience I will never forget. I found at Jean-Charles an entirely different world, different in scenery, different in language, different in its way of life. It was a way of life abundant in contrasts, a life shrouded in mystery and melancholy, a life of serenity and desillusion [sic], a life of isolation and deep fraternity, a life of hte [sic] past solidly anchored in ancestral traditions [Pelletier 1972].

In south Louisiana's wetlands many distributary ridges/levees have partially subsided such that only segments project above the surrounding marsh. The isolated remnant remains

as "high" ground and is often called an island or chenier because it is cut off from easy access by land. The community of Isle de Jean Charles contains over 100 people and it occupies one of these small, isolated natural levee segments along Bayou St. Jean Charles (**Figures 3-3** and **3-4**). Three families settled the "island" in the mid-1800s: Walker Lorvin, Jean Charles, and Jean Marine Naquin (Guidry n.d.). Until 1953, Isle de Jean Charles was completely cut off except for travel by boat or pirogue. In that year the spoil dredged from a canal became the foundation for a road that connected the island to the mainland. Prior to construction of this road, everything on the island had to be hauled by boat or pirogue through available natural waterways or canals. With the road came electricity, telephone connections, television, and the automobile. The road changed the character of Jean-Charles. But the language of choice continued to be French. That the community was isolated can be demonstrated by the fact that no structures appear on Isle de Jean Charles on the Lake Felicity 1944 USGS quadrangle map. The map appears to have been drafted without the benefit of aerial photography that would have revealed that the community did indeed exist, and the failure of the USGS surveyors to locate the community indicates that it was unknown to them.

Isle de Jean Charles can be classified as a ribbon settlement. Each side of the narrow Bayou St. Jean Charles are rows of houses, all of wood and painted white or cream with a few covered by brick veneer. Many of the homes are surrounded by a picket fence, with low shrubbery in front. Chickens abound, and a few pigs and a cow may also be noted on the property. These homes are simple, neat and orderly, originally furnished with homemade tables, chairs, cabinets and armoires. Prior to 1950, there was no electricity, no running water, no screens on the windows, and no gas, although bottled propane was available. Enormous oak trees join their limbs to form a canopy of a dark green arch of foliage with Spanish moss hanging towards the ground.

Although the names of most of the families are French, the community of Isle de Jean Charles has a strong Native American influence (**Figure 3-5**). Isle de Jean Charles, lower Bayou Pointe au Chien, and lower Bayou Terrebonne are three areas where the Houma and related groups have settled.

Within the last 20 years, a forced drainage system has been established for a portion of Isle de Jean Charles (Kemp and Mashriqui 1994). However, the drainage is little more than a pump sewer collection system without a levee enclosure; limited protection from flooding is provided by several spoil ridges flanking canals. Although once somewhat insulated from coastal storm surges by the vast expanse of marsh to the south, the community is now much more vulnerable because much of the surrounding marsh has turned to open water (**Figure 3-3**).

Mauvais Bois

As with Bayou St. Jean Charles, Bayou Mauvais Bois is another relatively small distributary channel. Due to gradual subsidence and modern canal construction, a section of the natural levee ridge has become separated from Bayou du Large with which it was originally connected. Along this small ridge a settlement known as Mauvais Bois developed.

Mauvais Bois occupied a levee remnant approximately 6 miles (9.7 km) long and 200 to 250 ft (61 to 76 m) wide. The ridge never supported more than eight families, but was nevertheless an important settlement site. Subsistence was based on agriculture and seasonal fishing and trapping. Dispersed farmsteads fronting on the bayou averaged five arpents (960 ft or 288 m) wide, with a maximum depth of 2.5 arpents (480 ft or 146 m). Farmers cultivated corn, sugar cane, and rice, and maintained vegetable gardens. Cattle ranged the open marsh. At one time a small road provided vehicular access, but vehicular access was severed in recent years due to local subsidence and canal construction. Unlike some isolated wetlands communities, Mauvais Bois was too small to have a school, store or church.

Supplies were obtained from the community of Theriot. The 15-mile (24 km) journey was through a series of bayous, lakes, and hand-dug pirogue trails called *trainasse*. Trips for supplies, recreation, and church attendance were made about once every three to four weeks and such trips often required a full day. After powered skiffs were introduced, the round trip time was shortened, and the need for basic subsistence food crops disappeared. Many community residents became commercial fishermen and trappers; out-migration soon followed. Nonetheless, occupational specialties were maintained. Powered skiffs, rural electrification and shell roads marked the demise of this year-round community. The residents moved closer to their required amenities. Today, these folk or their descendants spend their leisure time in their former homes, which they call "camps." The community has been transformed and is no longer a permanent settlement (**Figure 3-6**). It has, however, not lost its usefulness as many people still use it for raising cattle, trapping, and a variety of recreation pursuits.

Settlement along the Coastal Barrier Islands

> I employ myself this Day in writing and in walking about and examining the Island its soil and situation; the soil is very poor. Low sandy poor marsh not even fit for Pasture being almost barren producing only a few water bushes with very little grass of any kind. In length this Island is about eight or nine miles Easterly and westerly and from three to four in breadth northerly and southerly divided nearly equally by a Bayou which we call fishermens Bayou. [from the Landreth expedition in 1819, Newton 1985:87].

Louisiana no longer has a single barrier island that is more than 12 miles (19 km) long. Nevertheless, Last Island (*Isle Dernieres*), Timbalier, Grand Isle, Grande Terre, and the Chandeleur chain fringe the coast and protect the delicate, saltwater-sensitive alluvial wetlands. Last Island, Cheniere Caminada, Grand Isle, and Grande Terre have colorful histories. Unlike other barrier islands, they were never overwhelmed by commercial development, but were colonized by a modest population. Currently, Grand Isle is incorporated as a municipality. Even so, it does not support an extensive array of hotels, motels, high-rise buildings, condominiums, apartments, townhouses, and single-family residences. The other islands metamorphosed from settlement nodes back to their natural states, with little trace of human occupancy (**Figure 3-7**). Small villages, recreational hotels, pirates, smugglers, and bootleggers, along with scattered trapper-fisher-hunter camps were a vivid part of their history and folklore. In the end, the folks living on these narrow strands

were at risk, as the islands are in a constant state of change—often the result of the passage of a cold front or hurricane.

Isle Dernieres and the 1856 Hurricane

> . . . no ordinary island, but the proudest summering place of the Old South . . . a private little world dedicated to fine living. Here . . . wealthy planters and merchants, who bore the most illustrious names in all Louisiana, brought their families to escape the summer heat and to live according to the unchanging code of French and Spanish ancestors [Deutschman 1949:143].

Isle Dernieres is perhaps one of the best examples of a community that developed in an area that was at risk to hurricanes (**Figure 3-8**). In the early 1850's Last Island, located at the southern edge of Terrebonne Parish, was described as "thirty miles long and half a mile in width" (New Orleans Daily Delta 1850:2). At that time a half dozen-summer cottages made up the Village Bayou. An 1850 description notes:

> The houses are fine, particularly those of Lawyer Maskell and Captain Muggah. These houses serve for the reception of visitors during the summer season, at which time the enjoyers of elegant leisure flock to the isle in great number, and not as a dernier resort, but for the veritable purpose of enjoying themselves [*New Orleans Daily Delta* 1850:2].

Last Island was one of Louisiana's first coastal recreation sites. Families came to swim, fish, hunt, and enjoy the tranquility (Liddell 1849). It was a delightful place where one could enjoy the sea breeze (Wales 1854). The extensive beach served as a shell road where "one's buggy whirls over it with a softness, and airy, swinging motion, that is perfectly intoxicating" (*The Daily Picayune* 1852:1). The Village Bayou on the bay side provided a safe spot for packet steamers and sailboats to land. There was considerable interest in the region, because as early as 1848 Louisiana's legislative delegation requested a lighthouse be placed at the west end of the island to improve the navigation of the state's western coast (Johnson 1848).

Two hotels, the Ocean House and Captain Muggah's Hotel (The Muggah Billiard-House), provided guestrooms. The Ocean House was equipped with a bar, amiable accommodations, billiard table, and tenpin alley. Beach cottages built by Captain Muggah also served hotel guests (Pugh 1881). A public livery was available to stable and store resident's horses and buggies. Resort visitors were largely wealthy Lafourche and Attakapas planters.

The resort's light frame structures were erected on posts stuck in the sand. They were not built to withstand the force of a hurricane (Silas 1890), but no one asked if *Isle Derniere* was a safe place. Visitors were only concerned about enjoying the island's relaxed atmosphere. Consequently, in the legends of coastal Louisiana, Creole aristocracy danced until they died in the Last Island hurricane of 1856. On that eventful Sunday, more than 400

people attended an evening ball in the Village Bayou, unaware of the hurricane about to make landfall. Late in the evening:

> . . . the wind blew a perfect hurricane; every house . . . giving way, one after another, until nothing remained. . . . everyone sought the most elevated point on the island, . . . at the same time [trying] to avoid the fragments of buildings, which were scattered in every direction . . . Many ... were wounded; some mortally. The water . . . commenced rising so rapidly from the bay side, . . . there could no longer be any doubt . . . the island would be submerged. The scene at this moment forbids description. Men, women, and children were . . . running in every direction, in search of some means of salvation. The violence of the wind, together with the rain, . . . , and the sand blinded their eyes, prevented many from reaching the objects they had aimed at [Ludlum 1963:166].
>
> The waters carried a depth of several feet of sand and debris on some parts of the island, and . . . so changed [the island's] surface . . . those formerly acquainted with it, could no longer recognize it [*The Daily Picayune*, August 16,1856:1]
>
> It was a gloomy sight, not a house or shelter standing. The hull of the steamer and a number of sailing boats stranded on the island near where the hotel had stood, and some 260 or 300 people had been drowned.
>
> . . . every one was busy all day looking for and burying the bodies which had been drowned, others collecting provisions and getting something to eat, others fixing up things to make it a little more comfortable [Ellis n.d.: 8].

Surviving the Storm

The steamer *Star* made semi-weekly trips from the railroad station at Bayou Boeuf/Morgan City, down the Atchafalaya River through Four League Bay to the resort. On the Sunday morning of the storm of 1856, the *Star* approached the island after a difficult journey from Morgan City, requiring two men to steer the vessel. She was anchored in the Village Bayou behind the Captain Muggah's Hotel. During the storm part of the pier collapsed; the steamer parted her moorings and slowly drifted towards the island. Soon the steamboat's chimneys, pilothouse, and hurricane deck were gone. Only the hull remained (Ellis n.d.). The wreck floated towards the island and lodged in a turtle enclosure for the remainder of the storm (*The Daily Picayune*, August 19, 1856).

Approximately 250 to 275 people survived the disaster in the hull of the wreck (*The Daily Picayune*, August 14, 1856). Without the *Star's* superstructure firmly trapped in the sand, more would have perished. Initial newspaper narratives claimed from 260 to 300 people died (Ellis n.d.). Entire families were swept off of the island. Some died, while others, buoyed by debris, were rescued 15 miles (24 km) from the resort (Schlatre 1937). As

more survivors were located, the final death toll was put at about 140. Property losses were estimated at more than $100,000 (Ludlum 1963).

One small hut survived (Cole 1892). Otherwise, the *Isle Dernieres* was in a shambles and no attempt was made to rebuild the recreational resort (Deutschman 1949). The Village Bayou and the 1856 hurricane became part of south Louisiana's folk history. The story became a blend of fact and fiction. Numerous imaginary embellishments added to the Last Island legend, crystallized in Lafcadio Hearn's *Chita.*

In 1855 the Gulf House Hotel was constructed on Caillou (Cat) Island. The hotel was within three hours of Last Island and "provided . . . every convenience" (*Thibodaux Minerva*, July 14, 1855:2), but because of Last Island's location the Gulf House was spared major hurricane damage. Last Island absorbed the 1856 storm's winds, waves, and high water. The island served as a natural defense against the hurricane's destructive force, thereby, protecting bay side residents from the storm's full force. These folks were inconvenienced, but not killed (*New Orleans Christian Advocate*, August 23, 1856).

Although Last Island never regained its glory as a resort, in the marsh north of the island many citizens of Houma and its environs built recreational dwellings in the community of Sea Breeze which was located near the southern terminus of the Bayou Terrebonne natural levee. A storm in 1909 raised havoc with this site, but by 1915 it was again a thriving community with an annual regatta attracting more than 70 boats (*Houma Daily Courier*, July 4, 1915). Late twentieth century maps and aerial photographs show the site as open water; it is another example of land loss epitomized in coastal Louisiana (**Figures 2-20** and **3-9**).

The Cheniers

Although they are located further inland than barrier islands, cheniers are almost always located within marshlands and are therefore isolated. Until modern road construction, most cheniers were accessible only by boat. Only two easily recognizable cheniers are located within the study area. Of these, only Chenier au Tigre was large enough to support permanent human settlement (Figure 3-10). Wild cattle often roamed the wetlands. Consequently, an isolated section of the marsh was named *Ile des Vaches*–Cow Island.

People, Cattle, and Chenier Au Tigre ("Tiger Island")

The first reference to *Chenier Au Tigre* comes from the Spanish explorer, Don Josi de Evia, who in 1785 drafted a map of the region from Vermilion Bay westward. In 1819, while looking for Naval stores, Colonel James Cathcart explored the *Chenier Au Tigre* region and left accounts in his diary (Newton 1985). This is one of the region's largest *chenieres*. The term "cheniere" is derived from the Acadian word *chene*, meaning "oak," and describes groves of live oak on these isolated ridges. *Chenier Au Tigre* parallels the Gulf of Mexico in the southeast corner of Vermilion Parish. It is isolated from the mainland by marsh and is from 200 feet (61 m) to nearly a quarter of a mile (.40 km) wide and extends in length about 5 miles (8 km) from east to west (Bailey 1934; Bradshaw 1997a).

During the Texas Revolution in 1815, *Chenier Au Tigre* was a training base. For about six months soldiers loyal to the Lone Star State lived on the ridge and explored the surrounding marsh landscape. Some of these soldiers would later return with their families. The first permanent settlers, the Dyson family, arrived in the mid-1840s. They were later joined by the Whites, Sagreras, Rodriques, and Choates. By the turn of the century, there were between 25 and 30 families at *Chenier Au Tigre*, living as cattlemen, hunters, trappers, and small farmers (Bradshaw 1997a).

The "island" was home to a relatively large population and had a one-room schoolhouse, a church (St. Francis Chapel, administered from the St. John Church at Henry), a cemetery, a post office, numerous homes and a hotel complex that often had from 75 to 100 guests (**Figures 3-11** and **3-12**). From 1913 to 1958 Semmes Sagrera owned and operated Sagrera Health Resort, often called a hotel, where guests came to bathe in the Gulf of Mexico and pray. "The hotel consisted of two wings with a screened porch facing the Gulf. Each wing held eight rooms with two double beds each. Each room had a dressing table, chairs, a kerosene lamp (in 1926 replaced by a one-bulb electric light powered by a generator), bowl and pitcher, as well as a covered chamber pot. There were five cottages not attached to the hotel, a dance hall, and a pier extending into the Gulf" (Bradshaw 1997a:6). On Saturday nights the dance hall hosted as many as 400 people who enjoyed the Cajun music and danced the Cajun two-step. Many of these folks "rented sleeping space on the dance floor, and had to move their bedrolls and belongings to the rafters until the dancing was done" (Bradshaw 1997a:6)

For 40 years this facility served as a recreation site. A wide-variety of boats carried passengers and cargo to the *Chenier*. These boats, the *Della D, Miss Abbeville, Harvey Lee,* and *Wild West*, made regular trips to the *Chenier* and charged from $.50 to $1.00 passage. Once at the landing visitors were met by wagons pulled by oxen or mules to carry baggage and supplies. Later a model T truck or car provided transportation. Schooners such as the *Martha White* or *Etta* delivered supplies (Vermilion Historical Society 1983). Visitors to the hotel paid $1.00 a day for room and board. The hotel's menu was based on homegrown produce and freshly caught shrimp, fish, crabs and oysters. Every morning a 600-foot, ox-drawn seine hauled in the day's requirement of shrimp, fish and crabs. Croaker, flounder, redfish, drum, speckled trout and alligator gar were also caught on long lines. This catch was necessary since the hotel often had more than 100 guests (Bradshaw 1997a).

In addition, Texas longhorn cattle grazed the marsh and *Chenier*. A Texan who introduced cattle into the area in the late 1800s established the territory's ranching tradition. Along with the Texas livestock, settlers from the "prairies" around Hayes, Mamou, and Ville Platte brought additional breed stock, none of very good quality (Dennett 1876)

In fact, cattle grazed the prairie prior to the arrival of the Acadians (**Figure 3-13**). The Avoyelles Native Americans had introduced cattle into the area with brands on file in St. Martinville that date back to the 1730s. Consequently, on the prairie, stock raising was the occupation of a majority of the inhabitants at this time; cattle drives to New Orleans began in the 1770s (Bradshaw 1997a, Bradshaw 1997c). These animals have continued to increase despite numerous hardships (**Figure 3-14**). Through natural selection as much as planned

improvement, a strain of cross bred cattle has been developed that can endure heat, withstand insects, and, when necessary, can graze belly deep in water (Williams 1955).

The animal that aided coastal cattlemen is the Brahman, "Indian," or Zebu variety. These dual-purpose, humped animals are well adapted to the severe weather and insect conditions of the coastal lowlands. Practically speaking, there are not many beef breeds that can survive in the marshes. The Brahman-hybrid has been most successful in making profitable use of these grasslands.

First introduced in the United States in 1849, the variety was imported into Louisiana in 1861, making the state a pioneer in Brahman use. By 1866 the breed was established in Texas, where extensive tracts of salt grass provided pasturage (Pharr 1923). From this beginning selective breeding has produced an animal capable of surviving in subtropical climates.

Between 1880 and 1930 the marsh was considered free country, so on the cheniers everyone raised livestock. Stockmen drove their cattle along the beach from the Sabine River to Vermilion Bay— a distance of more than 80 miles (129 km). Cattle roamed the open range at will and were rounded up in the spring. These drives, often involving more than 6000 head, were organized each year to move cattle from such isolated spots as Constance Bayou, Dan's Ridge, Eugene Island, Long Island, Oak Grove Ridge, Pecan Island and *Chenier Au Tigre.* Cattle were then shipped by stern wheelers or barges to unloading facilities in Boston, Abbeville or Intracoastal City (**Figure 3-15**). At times the cattle were driven across the marsh directly to market. These drives often took five to seven days. In the fall, the chenier cowboys would drive cattle from their summer pasture to *Chenier Au Tigre* for the winter. This transhumance activity was an annual event (Bradshaw 1997a; Davis 1981). Today, the tradition continues with ranching now an established part of the local culture and involves, in some cases, the third and fourth generation.

Hogs were raised for ham and sausage, often preserved in large tins filled with grease or cured in the Sagrera Hotel's smokehouse. Quilts were made from wool obtained from the region's sheep. Dairy cattle provided milk. Fresh oysters were culled by hand from reefs at Rollover Bayou. All of this food was necessary, not only for the year-round residents, but because meals were also served at the hotel. Dennett (1876:18) describes the Cheniers as being "very fertile, producing cane, sea island cotton, oranges, and bananas."

During the nineteenth century, steamboats such as the *Della D*, traveled from Abbeville through the Vermilion River into Vermilion Bay and into the Gulf of Mexico to Bayou Chenier Au Tigre. The watermen would follow the bayou to the *Chenier.* Large boats, unable to navigate the bayou, would anchor in the Gulf, taking smaller craft to the *Chenier.* These boats made regular trips, often bringing campers who stayed at the site for one or more weeks and camped "in one of three buildings on the east beach . . . The camps rented for seven dollars a week unfurnished. The campers brought their food, bedding, stove, pots and some brought chickens and ducks in wire cages in order to have fresh meat since there was no refrigeration" (Vermilion Historical Society 1983:40). During the twentieth century, the landscape around the *Chenier* changed considerably as a result of canal and

drainage ditch excavation. The Chenier became more accessible after the excavation of McIlhenny Canal between 1916 and 1921. This channel provided a more protected inland route between *Chenier Au Tigre* and the communities further north (McIlhenny vs. Broussard 1931:669).

As early as 1870 the Vermilion River was navigable for steamboats as well as schooners and was a major transportation artery for the area. Head of navigation was Pinhook Bridge (Bradshaw 1997). In fact, the Vermilion River was, to many, the region's lifeline. For example, until the 1950s, the only way to get to Pecan Island was by boat from Abbeville, down the Vermilion River, through the Intracoastal Canal, across White Lake then through a series of narrow canals to a landing north of the Island (Bradshaw 1997b).

Families started moving away from the *Chenier* in search of better times during the Depression. People remained on the island until 1957 when Hurricane Audrey destroyed the Sagrera's health resort and displaced the permanent population.

Agriculture, Levees and Drainage: The Terrebonne Parish Experience

Throughout Louisiana's history, agricultural activities have occupied an important position in the social and economic development of wetlands. The wealth gained from hydrocarbons, commercial fishing and trapping, industrial development, and tourism do not overshadow the value of agricultural products from a historical perspective. The favorable climate and fertile alluvial soils allow almost every crop indigenous to the western hemisphere to be raised. Arable land, however, is limited in this region because of poor drainage and the shortage of land with sufficient elevation above common flood levels.

"Terre-Bonne," French for "Good Earth," is perhaps an easy way to introduce the agricultural potential within the region. Historically sugarcane has been the commodity of choice, but string beans, Irish potatoes, sweet corn, shallots, cabbage, sweet potatoes, pecans (native to Louisiana and developed into a profitable enterprise), and tomatoes have also been grown. Add to the list cattle, swine, citrus, pond crawfish and alligator farms and the parish is moderately diversified in its agricultural endeavors. Within the parishes of the study region, most of the land area is made up of non-agricultural wetlands. For example, although the largest in land area, Terrebonne Parish ranks among the smaller parishes in land devoted to crops.

Rice has played an important role in the region's agricultural history (**Figure 3-16**). Within five years after New Orleans was established, rice was being cultivated along the Mississippi River (Glenk 1934a). Therefore, before sugarcane became the dominant crop, rice was often the crop of choice. Rice farming has, consequently, played an important role in the growth and prosperity of the region, particularly since the turn of the century on the prairie. In this region, Cajun farmers planted small crops in places that could not be plowed–along *coulees* and ditches, next to bayous or in ponds. By 1890 Louisiana had become the leading rice producing state in the nation. The crop is now an Acadiana mainstay–established after the railroad cut across the region and encouraged people to settle the land (Bradshaw 1997). Parenthetically, the railroad served as the impetus for the

development of the community of Erath–named after August Erath a New Iberia businessman who was instrumental in having the railroad built from New Iberia to Abbeville.

By 1892, 200 million pounds (90,800,000 kg) of Acadiana rice were being shipped by the Southern Pacific railroad. Rice mills were developed, a system of primary and secondary irrigation canals excavated, and rice fields expanded. During the harvest, entire communities would work bringing rice bundles from the field to the nearest threshing machines where the rice was separated from the straw and sacked (**Figure 3-17**). Mule or horse-drawn wagons made continuous trips from the fields to the threshing machines (Bradshaw 1997).

The earliest farmers migrated from New Orleans to settlements on bayous Black, Teche, Sale, Petit Caillou, and Terrebonne. In Colonial tradition, these peasants raised corn, rice, indigo, cotton, and sugarcane. Cattle, pigs, and chickens were also a part of their subsistence livelihood. Although the most successful commercial crops of the eighteenth and nineteenth century were indigo and cotton, neither is cultivated today. In contrast, the commercial *vacherie*-type cattle raising operation that developed later survives within the study area (Davis and Detro 1977; Knipmeyer 1956).

Sugarcane was introduced into Louisiana at least as early as 1725. By 1733 the colonists had taken up its cultivation for the production of syrup. When Etienne DeBore's granulating process was accepted, the sugar industry was established as a profitable enterprise. DeBore was considered the "Savior of Louisiana." His success stimulated other planters to follow his example, and sugar factories were rapidly established with each succeeding year (Conrad and Lucas 1995; Glenk 1934a, 1934b). By the 1860s more than 85 sugarhouses were operating within Terrebonne Parish and over 200 within the five parishes encompassed by the study area. In Terrebonne Parish there are none today and only two are operating within the study area (**Figures 3-18** and **3-19**). It should be noted many of these were small operations. These early operations crushed cane that was squeezed in a screw press operated by humans or mules with the cane juice being collected in a vat. This juice was then evaporated in a series of large kettles over an open fire. At the completion of the firing process, the skimmings were set aside for fermentation into *tafia,* a low-grade rum. The remaining thick crystalline mass was ladled from the bottom of the kettles into conical molds or hogsheads where it remained until crystallization was complete. Introduction of the steam engine was an important force in the sugar industry. By 1845 there were 72 steam-powered mills in Louisiana. Steam equipment and a number of inventions propelled the industry into the twentieth century. Although change in power sources was significant, perhaps the most pivotal advancement was correlated with refinements in sugar chemistry that insured maximum results in the production of marketable sugar (Glenk 1934b).

Sugarcane quickly superseded cotton to become the region's major crop (Glenk 1934b; Lytle et al. 1960). Not all of these operations were, therefore, small. In fact, at one time the Lower Terrebonne Sugar Refining and Manufacturing Company in Montegut was one of the largest and best-equipped sugar refineries in the world. The company operated its own railroad, 30 miles (48 km) long, with four locomotives and 500 cane cars. It also operated a fleet of 22 barges and a tug (Wurzlow 1976a).

In Terrebonne Parish and throughout the study area, bayous were particularly important to the sugar industry (**Figure 3-20**). They were industry's principal routes of commerce. They not only moved raw and refined cane to market, they also served as conduits for the coal used in the sugar mills that replaced the screw presses. Against the levees "black mounds of coal" were piled until needed for the steam engines used in grinding (Cole 1892: 12). Coal was, in fact, first used as a fuel in the region's sugarhouses about 1850. Bagasse burners were also invented about this time (Glenk 1934b). Sugar remains the most important crop within the study area.

In addition, the farmers became more aware of floods and the problems associated with uncontrolled water. Successful farmers learned the importance of building levees to prevent flooding. Like the citizens of New Orleans and farmers along the Mississippi River, Terrebonne Parish residents realized that levees, pumps, canals, and drainage programs were necessary to guarantee that natural levee land would not flood. It became apparent that water management was necessary to help expand the ten percent of the parish used for crops and pasture (Lytle et al. 1960). To protect the land between Bayous Terrebonne and Lafourche, the legislature in 1847 granted power to assess a tax to the police juries of Lafourche Interior and Terrebonne. If approved locally, the tax would involve improvements to

> ... lands in their respective parishes, lying between the Bayous Lafourche and Terrebonne, from the canal of the Lafourche and Terrebonne Navigation Company, above, to the canal of Mooney on the Bayou Lafourche, and to the lower plantation of Hubert Bellanger, on the bayou Terrebonne, below; the revenue arising from which tax shall be appropriated to keeping open the Bayou l'Eau Bleue, and the various other bayous and canals which it may be found necessary to open or keep open for the purpose of reclaiming or freeing from liability to inundation, the land situated between the two said bayous . . [Louisiana 1927:127-128 as reported in Watkins 1939].

Farming has been practiced throughout the region. From the Isle Dernieres to Gibson many areas that were farmed are now underwater, affected by saltwater intrusion, or so small and isolated they can no longer be used for row-crop agriculture. Most of these tracts are composed of mineral and organic soils firm enough to support cattle, but cannot be farmed by traditional methods (Means 1901; Nesbit 1885).

While many natural levees have subsided in Terrebonne Parish, less agricultural land has been lost in the western portion of the study area. The parishes of St. Mary, Iberia, and Vermilion contained very few distributaries that projected southward toward the Gulf. Relatively minor sugar cane growing areas have been lost along Bayou Cypremort and Bayou Sale (**Figure 3-21**). The abandonment of sugar cane cultivation along some of the subsiding natural levee ridges has encouraged introduction of new agricultural pursuits, such as citrus production along lower Bayou Terrebonne (**Figure 3-22**).

In less than two centuries, the settlers of the wetlands tamed the region's rivers, bayous, creeks, and streams. In the process they altered the natural sediment distribution system. When levees were built to prevent flooding, they also stopped natural sediment

renourishment. Without continued sediments, the marsh and associated alluvial wetlands became sediment starved. During the nineteenth century along much of the Louisiana coast, vegetation growth and periodic sediment deposition were sufficient to keep up with the naturally subsiding ground level. Local land loss increased during the twentieth century as a result of several factors, such as the depletion of sediment sources, continued subsidence, organic soil compaction, and destruction of vegetative cover through saltwater intrusion. The lack of sediment replenishment helped to accelerate the other processes associated with land loss. Farmers concerned about flooding built levees to protect their property, but they also deprived the wetlands of the sediments required to keep pace with subsidence (U. S. Department of Agriculture 1986).

From the first levees to humankind's continued interference with natural processes and hydrology, the study area landscape has been affected. It can be argued that the land loss problem, to some degree, is a human-induced issue. In less than two centuries, the levee builders have changed the character of the region. From a conscious act of controlling floodwaters, the region's settlers unconsciously began to "kill the goose that laid the golden egg." Percy Viosca's prophecy has become reality (Viosca 1928). Too much reclamation, buttressed by too much levee construction, with too much emphasis on immediate results and no apparent concern for the long-term effects has caused too much subsidence, erosion, and saltwater intrusion. These are problems that must be carefully addressed by contemporary society (Davis 1993).

The Human Mosaic: A Kaleidoscope of Cultures

Prehistoric Native Americans established their villages on the area's natural levees, exposed salt domes, beach ridges, and other high-ground features. Of these natural features, natural levees, formed by deltaic distributary channels, were the most common elevated areas to serve as the foci for settlement. Although many natural levee remnants may be too small for modern habitation, they were much more substantial during prehistoric times. Like their European counterparts, prehistoric Native Americans settled on these levee ridges. Since early cultures had to adapt to a changing environment, settlements were rarely continuously occupied. In Louisiana, prehistoric cultures followed the changing pattern of the Mississippi River. As new natural levees were built, and old ones decayed because of the reduction of fresh water and sediments, the Native Americans moved. They had no choice; their subsistence requirements were no longer available. For at least 12,000 years the Native Americans followed the coastal zone's changing topography (Kniffen et al. 1987; Weinstein and Gagliano 1985).

Many relic Native American encampments are distinguished by shell middens–defined as an accumulation of *Rangia* clam shells resulting from subsistence activities. On lower Bayou Lafourche, native-Americans who belonged to the Chitimachan linguistic group were dominant. With time, French settlers displaced the indigenous population. Following the native-American example, these "newcomers" also hunted, fished and tilled the land (Kniffen et al.1987). Today, local native-Americans are rediscovering their ethnic identity as members of the Houma tribe. During the eighteenth century and early nineteenth century, people of

French, German, English, West African, and Spanish descent joined the Native American population.

The first Europeans to traverse the area were explorers, trappers and traders. Farmers soon followed. The earliest arrivals came from New Orleans and the German and Acadian Coasts along the Mississippi River. Antonio de Ulloa, Louisiana's first Spanish governor, forcibly established these settlers at these sites in 1766. Because the Mississippi River constituted the international border between the English and the Spanish, Ulloa required the Acadian immigrants to settle at strategic points along the western riverbank to serve as an unofficial militia. The Acadian immigrants were not willing to serve at the command of the Spanish, as they had come to Louisiana specifically to reunite their extended families, separated during the *Grand Dérangement* of 1755 (Brasseaux 1985). Once these new immigrants had joined their fellow Louisianians in ousting Ulloa during the New Orleans rebellion of 1768, they considered the semi-aqueous real estate an attractive location for their new settlements.

By 1770 at least 14 Acadian families had migrated into the upper Lafourche Valley. They established their settlements on the west bank of Bayou Lafourche between the modern communities of Donaldsonville and Labadieville. They chose to live on the bayou's west bank, because unlike its eastern counterpart, it was not flooded as frequently. Once established, these Acadian pioneers quickly began to rebuild their lives (Brasseaux 1985). In addition, other disenchanted Acadians migrated from the river settlements to the Lafourche wilderness. In 1785 the Spanish monarchy gave a large number of Acadian refugees the opportunity to select their own home sites. Six hundred established themselves along Bayou Lafourche, between modern-day Labadieville and Lafourche Crossing. By 1788 61 percent of the region's population were Acadians (Brasseaux 1985). Further, Creoles and Gallicized Germans were also attracted to the area because of the abundant vacant land. Consequently, by 1812 the settlement pattern currently in existence was established (Davis and Detro 1975; Knipmeyer 1956; Newton 1972).

As Europeans immigrated into the region, they mixed freely with the local aboriginal population. They learned from each other. By example, Native Americans taught settlers how to survive in a new and somewhat hostile environment. In the process, the newcomers adapted local resources to meet their needs. These included food, clothing, shelter and boats. While these elements were essential to survival, these changes in the exiled Acadians' (later referred to as Cajuns) material culture altered only superficially their traditional way of life. As in their homeland, the vast majority of the Acadian immigrants remained subsistence farmers. They were self-sufficient. Their needs were modest and any surplus income was used to improve their surroundings and rarely for conspicuous consumption. This was simply part of their pragmatic cultural heritage (Brasseaux 1985). They did not become large plantation owners. For this reason most of the region's plantations were established by English-speaking immigrants and not the local *habitants* (Labouisse 1985). Indeed, the Acadian was "independent, yet devoted to his family; equalitarian, yet tolerant of slavery; innovative, yet mired in tradition. He was "a man caught between two worlds" (Brasseaux

1985:40). Further, because of the culture's isolation, many of the inhabitants retained their folklore and folkways (Perrin 1985).

French and German peasant (*habitant* and *engages*) farmers imprinted a subsistence pattern on south Louisiana that still persists. Their lands were divided using the arpent or long-lot method of division that allowed property owners waterway access. This system of land division resulted in a distinctive linear settlement pattern along most bayous flanked by arable natural levees. Bayou settlements are characterized by a line of habitations that are located on the highest ground near the stream bank. These lines of houses are fairly continuous, broken only by occasional breaks and small urban centers. On many of the region's bayous, settlement patterns are often as dense as urban row housing. Agriculture is important, but limited by the width of the natural levees. As a result of the limited availability of land along many occupied natural levee ridges, cattle grazing took the place of traditional row agriculture. Boat-oriented businesses and trapping are of primary economic importance (Bourg 1968; Bowie 1935; Knipmeyer 1956; Padgett 1960).

During the late nineteenth and twentieth century, other ethnic groups also immigrated into the region from Ireland, Lebanon, Philippines, China and Vietnam (**Table 3-1**). This ethnic montage became farmers, laborers, oystermen, shrimpers, trappers, truck farmers and entrepreneurs. The territory exhibits, therefore, an atypical ethnic, cultural and settlement heterogeneity, one that has been described as America's first melting pot. Consequently, throughout the region the mixing of races and nationalities resulted in a milieu that is absolutely unique in the United States (Bourg 1968; Bowie 1935; Detro and Davis 1978; Knipmeyer 1956).

With time, Cajuns, Native Americans, Chinese, Germans, Filipinos, Latin Americans, Afro-Americans, and Italians established small ethnic pockets throughout the coastal lowlands. By the mid-1800s Louisiana's alluvial wetlands sustained hundreds of wetland-oriented communities. Ranging from a resident population of 10 to more than 1000, these settlements of foreign-speaking peasants engaged in truck farming, trapping, shrimp fishing and drying, oyster dredging and tonging, raising terrapin, and fishing—all part of an annual–use–cycle designed to maximize the region's harvestable products (Comeaux 1972). Consequently, within Louisiana's marshes and on its barrier islands, numerous ethnic minorities, representing a kaleidoscope of cultures, established settlement clusters. Recent immigrants have added to the ethnic mix. During the 1970s and 1980s, Vietnamese immigrants settled along the coast and established themselves in the fishing industry (**Figure 3-23**). One indication of the size of this new group is the fact that several churches now have services in English and Vietnamese (**Figure 3-24**). The region exhibits, therefore, a distinctive ethnic and cultural heterogeneity (Kniffen and Hilliard 1988:199; Spitzer 1985b:80).

Around 1900, Houma families based in Golden Meadow pushed eastward through Little Lake and Lake Salvador areas where they sought new trapping, hunting and shrimping territory. They eventually settled in the Barataria-Lafitte area in Jefferson Parish or further east in Plaquemines Parish. Further, in the early 1930s several Houma families moved west into St. Mary Parish and established communities that continue to the present (**Figure 3-25**).

Table 3-1. Top Ten Countries Contributing to Foreign-Born Population of Louisiana, by Percent of Immigrants (source: Goins and Caldwell 1995:xxiii).

Year	Country	Percent
1980	Vietnam	10.7
	Germany	6.2
	Cuba	5.6
	Great Britain*	4.9
	Canada	3.1
	Italy	2.7
	Mexico	2.1
	Philippines	2.0
	India	1.8
	Korea	1.8
1940	Italy	36.1
	Germany	9.4
	France	6.7
	Great Britain*	5.8
	Russia	4.4
	Mexico	3.8
	Canada	3.4
	Syria	3.0
	Ireland*	2.6
	Poland	2.1
1910	Italy	39.1
	Germany	17.0
	France	10.2
	Ireland*	7.2
	Great Britain*	5.1
	Austria	2.7
	Russia	2.6
	Canada	2.3
	Mexico	1.9
	Poland	1.4
1890	Germany	29.4
	Ireland	18.6
	France	17.0
	Italy	15.6
	Great Britain*	6.0
	Canada 1	0.5
	Spain	1.8
	Austria	1.2
	Switzerland	1.0
	Mexico	0.8

(continued)

Table 3-1.Concluded.

1870	Germany	30.6
	Ireland*	27.6
	France	20.0
	Great Britain*	6.1
	Italy	3.1
	Spain	1.8
	Cuba	1.6
	Switzerland	1.4
	Canada	0.1
	Mexico/Austria	0.7
1850**	Ireland*	35.6
	Germany	26.2
	France	16.9
	Great Britain*	7.1
	Spain	2.1
	Switzerland	1.1
	Italy	1.4
	Canada	0.7
	Mexico	0.6
	Sweden/Denmark	0.4

* "Ireland" and "Great Britain" refer to the main islands that, until 1921, comprised the United Kingdom. After 1921, "Ireland" refers to both the Republic of Ireland and Northern Ireland, which remain a part of the United Kingdom of Great Britain and Northern Ireland. Great Britain collectively refers to English, Scottish, and Welsh immigrants.

** Free population only.

A few years later, Houma trappers from the Pointe au Chien area were recruited by landowners in St. Bernard Parish to assist in the control of fur bearing animals in the marshlands (Fisher 1965). During and after World War II, many families moved out of the Terrebonne-Lafourche region to the West bank, a metropolitan area across the Mississippi River from New Orleans (Bowie 1935; Bourg 1968). In the coastal wetlands a number of Native American groups continue to dominate the local landscape (Stanton 1971). These groups are most notable at Isle de Jean Charles and the lower extremities of the region's bayous (Swanton 1911, 1952) (**Figures 3-26** and **3-27**). Descendants of the Billiots and Naquins who live on the Isle de Jean Charles ridge recount that at the turn of the century, the natural levee ridges along lower Pointe au Chien were much higher and supported sugar cane fields. Several groups are attempting to obtain official tribal recognition from the U. S. government.

Newcomers helped transform the region's population identity. Recent discoveries of oil and gas reserves offshore have resulted in Mexicans, Indian, and Pakistani laborers being recruited into the area. In addition, others are moving into the area because of the available jobs. From prehistoric Native American sites to the modern city of New Orleans, the coastal lowlands have supported a range of cultures and settlements (Davis and Detro 1975;

Knipmeyer 1956; Newton 1972). The culture continues to be dominated by individuals of French ancestry, but the lines are beginning to blur.

Infrastructure: Major Transportation Arteries

As in most areas of Louisiana, settlement along the central Louisiana coast was influenced by access to transportation routes. With an abundance of natural water bodies, the earliest settlements were established along existing natural bayous and rivers. Through time, alternative routes and modes of transportation were introduced, both to improve travel and to aid the exploitation of the abundant natural resources in the region.

Natural Waterbodies

As in most of south Louisiana, the study area includes a wide variety of natural waterbodies that provided transportation routes for the early settlers (**Figure 3-28**). The largest communities of the nineteenth century were all located along Bayou Teche, which was easily navigable and flanked by some of the best agricultural land in south Louisiana. The variety of lakes and streams did provide an abundance of fisheries resources that were consumed by the local inhabitants. While the Atchafalaya River and Bayou Teche were certainly major routes of communication and transportation, many of the other channels were relatively small and difficult to navigate, particularly for steamboats. Additionally, most bayous were old Mississippi River distributary channels and tended to be oriented north-south. As a result, east-west travel was difficult between the agriculturally rich Teche region and New Orleans to the east. This lack of an inland east-west route was one of the first incentives for constructing canals within the study area.

Canals

To capitalize on the alluvial wetland's renewable and nonrenewable resources, many engineering endeavors aided in the harvest or exploitation process. Canals are the most visible expression of human interest in wetland resource utilization (**Figure 3-29**). They dominate the marsh/swamp terrain and exemplify humankind's ability to alter the natural environment. Dredging activity has had a profound effect, therefore, on this fragile real estate.

South Louisiana's canalization began with the earliest European settlers and continues to the present. Since construction of Louisiana's first drainage project, dredged waterways have advanced unchecked in the economic development and depletion of the wetland's natural riches: timber, fur, hydrocarbons, and even grazing and agriculture. Canals aided wetland transportation immensely; they also created problems (Davis 1973).

To understand the geographic growth and development of canal patterns, canals are divided into five categories: drainage and reclamation, transportation, trapping, logging, and petroleum (Davis 1973). These subdivisions, arranged historically, demonstrate the evolution of resource use and suggest changes that have occurred in the exploitation of south Louisiana's resource base.

Drainage and Reclamation Canals

As early as 1720, two years after the founding of New Orleans, French colonists excavated drainage ditches to improve runoff from the natural levees. When New Orleans was surveyed, each block was ringed with canals (Davis 1986; Lewis 1976; Snowden et al. 1977). They reflected the "Crescent City's" dependence on a drainage network. In actuality, these ditches were part of a great land reclamation enterprise. They were laid out to aid planters and urbanites in draining potential agricultural, pasture, residential, and industrial land. Flood and water control procedures in effect extended cultivated land beyond the natural levee into the surrounding backswamps.

In many cases, original drainage canals evolved into vital transportation links. Like canals elsewhere in the Colonial period, they were multi-functional units serving as both drainage and access waterways. Some of these original "ditches" remain as indispensable transportation arteries, even today (Davis 1973).

Drainage channels were customarily confined to tracts suitable for agriculture, primarily natural levees (**Figure 3-30**). Planters became enthusiastic proponents of these reclamation methods, much as Governor O'Reilly had when he declared in 1770 that every family settling in the province was to construct a levee and finish a highway with parallel ditches toward the levee within three years (Martin 1827). These early regulations guaranteed Louisiana's lowlands would be drained adequately. From 1880 to 1930 the rush to drain land accelerated. Such endeavors were in essence a form of land reclamation and represented the climax of a century of reflection, writing, and experimentation.

Transportation Canals

Louisiana's natural hydrologic regime is predominately aligned in a north-south direction, making east-west movement difficult. To rectify this navigational inconvenience, canals were excavated to increase the natural system's efficiency and reduce travel time.

Prior to the canal era, natural waterways were the principal routes of commerce. For example, the first transportation corridor to serve the western part of the study area was Bayou Teche. One of the earliest vessels to serve this region was the keelboat *Eliza.* Other boats to serve the business interest along the bayou were the *Buck, Plough Boy, Attakapas, Teche, Rachel, Delia, Ross, Peerless, Minnie Avery*, and *Ceres*. Many of these boats carried freight through the Atchafalaya basin to Bayou Plaquemine into the Mississippi River. Others carried sugar, molasses, and similar products to Morgan City. To improve regional connectivity, two canals were built: the Attakapas Canal from Petite Anse prairie to Vermilion Bay and the Grand Cote Canal, from Isle Piquant prairie to Grand Cote Bay (Bergerie 1962).

Maps produced in the mid-1700s clearly show transportation canals linking the wetlands to the Mississippi River. These pathways served as funnels for goods moving into the New Orleans' market and document the early influence of these transportation corridors. French colonists constructed canals to improve their contact with the Gulf of Mexico and to

join the Mississippi with the bayous at the "rear" of their settlements (Surrey 1916). Often excavated by hand, the early transportation routes served the local population well. Since the middle of the nineteenth century, dredges have been used by federal, state, and local agencies to maintain navigation along existing natural waterways and to create new routes by excavating canals in areas where transportation routes were needed (**Figure 3-31**).

By 1830 the coastal terrain was marked by many transportation canals, which connected with the preexisting system of natural waterways, including the Calcasieu and Vermillion rivers, Bayou Teche, the Atchafalaya, lower Bayou Lafourche, and many others. The system was small, but adequate, furnishing local inhabitants with statewide connectivity. Movement of goods by water has long been, therefore, an integral part of the coastal zone's transportation geography. Originally, large pirogues (*pettyaugres*), flatboats (*bateau plats*) and keelboats (locally called *pointu les deux*) were used as commercial cargo carriers through a maze of interconnecting natural waterways. These vessels opened south Louisiana's commercial trade corridors. By the early 1800s more efficient steam navigation began to replace these traditional watercraft. Safe waterways were now essential, as a steamboat was a fragile structure easily damaged. Sawyers and dredges were contracted to keep the principal channels clean. Between 1820 and 1945 numerous transportation-oriented watercourses were built or improved. For example, the Barataria Canal Company, charted by the state in 1829, built a channel from a lock in the Mississippi opposite New Orleans, to Lake Salvador and Bayou des Allemands and through a canal to Bayou Lafourche at Lockport. Leaving Bayou Lafourche, the canal was constructed through lakes Field and Long to Bayou Terrebonne and into Houma and by canal into Bayou Black and to Berwick's Bay (Thomson 1893; Becnel 1989). By 1860 the channel was in need of repair. Eventually, parts of this route were incorporated into the Gulf Intracoastal Waterway.

More fuel-efficient, diesel-powered, pull boats and push boats with screw propellers, tied to a barge or a chain of barges, gradually replaced steamboats. Consequently, by 1900 Louisiana's renewable resources–Spanish moss, oysters, shrimp, cypress logs, cotton, rice, vegetable products, sugarcane, and numerous other commodities–were shipped through a well-defined system of navigable channels (Davis 1985). **Table 3-2** provides a list of some of the early canals dug within the study area. Although most of these early canals have grown drastically, a few have not changed very much since they were first dug. The few canals that have not changed significantly are all located in relatively isolated inland areas or were not used by large boats (**Figure 3-32**).

After World War I and for the next 60 years crude petroleum and refined petroleum products dominated Louisiana's transportation statistics. To counter the German U-boat menace during World War II, the Gulf Intracoastal Waterway was completed in less than a year–providing a safe passage for shipment of goods from source regions along the Gulf of Mexico to eastern markets. When finished, this system in conjunction with the Mississippi River made Louisiana the center for wartime Gulf coast petroleum traffic. In addition, the route served as a safe inland passage for powerboat and sailing enthusiasts. A by-product of this massive engineering effort was the necessity to maintain adequate navigational depths and the federal government's increased involvement in dredging.

Table 3-2. Inventory of Transportation Canals (source: Davis 1973).

Canal	Approx. Date	Purpose
Avery	1850	As one of the oldest privately built canals along the coast, this channel continues to serve the transport needs of Avery Island.
Bayou LaCache	1900	Bush and McGinnis, owners of the Lower Terrebonne Refinery at Montegut, had this bayou channelized to aid in the movement of sugarcane to their mill.
Belle Isle	1912	This channel was dredged for Ned McIlhenny as an access route into Belle Isle and Cheniere Au Tigre. When Cheniere Au Tigre was opened to the public in 1915, Belle Isle Canal was used to gain access to the island. To try and reduce boat traffic, a toll of from $10 to $35 was charged. Now this canal is a part of Freshwater Bayou Gulf Outlet
Billiot	1900	Cut by settlers living on Mauvais Bois, this channel was used as a connection from the ridge to Lake De Cade. It may have been built before 1900, but was so small it did not appear on early maps. It was essentially a pirogue trail.
Boudreaux	1910	This channel, often called St. Martin Canal, was apparently built by the St. Martin family as an access route into Lake Boudreaux from Bayou Petit Caillou. It was an important route for shrimpers working in the lakes and bays west of Bayou Petit Caillou, a function it continues to perform.
Bush	1905	This route, between Bayou Petit Caillou and Bayou Terrebonne, was dredged by Bush and McGinnis so the plantations west of Bayou Terrebonne could use their Montegut refinery. Originally a 40-foot-wide channel, it is now more than 200-feet-wide and used primarily by fishermen and oil support vessels.
Canal St. Jean Charles	1900	Originally built as a trainasse, this channel provided the people living on Isle de Jean Charles with a route to Point au Chien and Bayou Terrebonne. The waterway probably dates back to the 1800's, but due to its size, it was not included on historic maps. Until 1965, when the island community was connected to Point au Chien by road, this canal provided the people of Isle de Jean Charles with a means of moving to and from the Island
Delcambre	1880	This canal was originally built by continuously running cattle along the route between Delcambre and Bayou Carlin and allowing the current to scour the channel. As a result, the canal was used by schooners in the shipment of cattle. Today, it serves the shrimp boats that are based in Delcambre.
Falgout	1905	Falgout Canal was built as a 10-foot-wide channel by the settlers on Bayou du Large and was used an access route into Lake DeCade. Through continuous use, first by people living on Mauvais Bois Ridge, Marmande Ridge and Bayou DuLarge, and later by others, the channel has widened until it is more than 200-feet-wide. As an access route into trapping areas west of Lake DeCade, it became the region's most important canal.

(continued)

Table 3-2.Concluded

Canal	Approx. Date	Purpose
Grand Pass	1890	Originally a pirogue trail, this channel has eroded into a major connection between Caillou Lake and Lake Mechant. It is used primarily by oyster luggers as a short-cut between the two lakes.
Lapeyrouse	1910	The hand-dug channel, for a $.25 toll provided fishermen with a short-cut from Bayou Terrebonne to Madison Bay. People living on Isle St. Jean Charles also used it to trade at Lapeyrouse store.
Last Point	1921	Like McIlhenny and West Cheniere Au Tigre canals, this waterway provided the McIlhenny family with an access route to their camp on Cheniere Au Tigre.
Madison	1890	Built by Madison Belanger as a pirogue trial, this channel subsequently eroded into a significant canal, providing fishermen with a cut-off into Madison Bay. Due to the accessibility of shrimping areas, Chinese fishermen established drying platforms along the waterway.
Marmande	1910	Marmande Canal, originally a trainasse, was dredged to gain access to shell on the ridge. Its secondary purpose was to aid in the movement of sugarcane from the ridge to Theriot. It also may have been used by marsh hunters and trappers as well.
Oaks	1880	This canal, like Delcambre, was built by putting cattle in pens and allowing them to churn up the turf. By extending the "cattle trail" into Vermilion Bay cattlemen south of Erath had a means of moving cattle into the marsh.
Peoples	1895	Often called Liners Canal, this hand-dug watercourse first appears on Hardee's 1895 map and was probably built to serve the transport needs of people living on Mauvais Bois. Connecting Lakes DeCade and Penchant, the canal through time has been used by trappers, hunters, fishermen, the oil industry, and weekend sportsmen.
Rabbit	1920	Constructed by several fishermen, this one-quarter mile channel provided a significant short-cut into fishing, hunting and trapping areas west of Bayou Petit Caillou
Sea Breeze	1920	Sea Breeze Pass was excavated by Yancey Sanders to aid in the shipment of sugarcane to New Orleans.
Weeks	1900	Probably built to provide people living on Weeks Island with a route to and from the island.

Evaluation of transportation canal expansion is difficult, as only a few were built exclusively for commercial traffic. Most were constructed for other purposes, that is, their primary function was to aid in developing agricultural, mineral, forest, and fur resources. They operated, secondarily, as transport couplings. Regardless, they furnished open-ended

links between points and extended for many miles along well-defined right-of-ways. This paradigm, initiated in the early 1700s, persists today (Davis 1973). Although the Gulf Intracoastal Waterway is the best known, many routes predate it; but all serve the same role – connectivity (**Figure 3-33**). Each transportation artery influences the economy, attracts industry, and alters property along the right-of-way. Because of constant use, the sides of many canals eroded to such an extent they became large waterways. In the process, they lost their fabricated character; they are now regarded as "natural." In addition, navigation channel deepening reflects with time the increase shipping demands made in the petroleum industry. Ancillary infrastructure responded accordingly. Ports provided turning basins, tank batteries, off-loading services for liquid as well as bulk commodities, locks to provide safe connectivity and retard saltwater, large onshore storage sites, and adequate quay space as part of the region's socioeconomic infrastructure. In addition, on the Mississippi River large petrochemical complexes were constructed between the late 1960s and mid-1970s. These industries and general technological advancements in bulk shipments transformed the lower Mississippi into a major regional port–New Orleans became the United States' largest port based on tonnage. Rivers, canals, and bayous became secondary links in cargo transport (Becnel 1989). All could be at risk with continued land loss (Williams and Cichon 1994) thereby influencing this country's long-term refinery and associated energy needs and policy.

Trapping Canals: A Trapper's Access to the Marsh

To exploit wetland resources, *habitant* (peasants) dug with "crooked shovels" *trainasse* - a term derived from a French word meaning "to drag," but in the local *patois* signifies "a trail cut through the marsh grass for the passage of a canoe [pirogue]" (Read 1937:74). These paths were hacked out by trappers to gain access to their trapping leases. Though small, the 1.5 m-wide and 15-cm to 30-cm-deep passages are indicative of the marsh dweller's systematic exploitation of the coastal zone's avian, fur- and hide-bearing animals (**Figure 3-34**). In addition, they are preeminent in the harvesting process (Davis 1976).

In some cases, large landowners dredged canals to help improve habitat. The Orange Cameron Land Company constructed navigable canals, 18 feet (5.5 m) wide and 6 feet (1.8 m) deep, to improve accessibility across their 162,000-acre "rat" ranch. In Terrebonne Parish, Brady Canal is named after E. P. Brady, who was president of the Delaware-Louisiana Fur Trapping Company (Arthur 1927).

To trap marsh-dependent muskrat (*Ondatra zibethicus rivalicius*), nutria (*Myocastor coypus*), and alligators (*Alligator mississippiensis*), ditches were methodically chopped through the wetlands, creating a massive array of watercourses. Several of these channels started as small pirogue trails that allowed a trapper to effectively work the wetlands (**Figure 3-35**). Through repeated use, storms, and current flow, a few of these trapping ditches became larger waterways. In south Louisiana's coastal heritage, *trainasse* have evolved into permanent culture traits. More importantly, the elaborate network represents the wetland's earliest large-scale canalization projects (Davis 1976, 1978).

Logging Canals: The Spokes of a Wheel

Intensive bald cypress exploitation began after the Timber Act of 1879 repealed the Homestead Act of 1866. As a direct result of the Act's repeal, vast cypress/tupelo tracts were sold for $.25 an acre to $.50 an acre. Consequently, by 1890 a sizeable percentage of Louisiana's swamps were managed by the forest-products industry. Ingress and timber removal were of paramount concern. Access problems were resolved by excavating canals to the logging sites. Removal of the cut timber was accomplished by using steam engines aboard pullboats that dragged logs into a dredged channel (*Daily Review*, March 5, 1991). "Swampers" worked in waist-deep water in a harsh environment to guarantee the mills a constant supply of timbers. Trees were cut by hand, chain-dogged and pulled to a collection point–called a bay–where the logs were chained together and taken by steamboats to the mill.

To utilize a pullboat effectively, lumber companies dredged primary and secondary watercourses leading to logging sites. These channels were essential to the timber operation. Further, they provided lumbermen with an essential link to their reserves. To remove the harvested cypress, the canal configuration incorporated a series of intersecting channels with fan-shaped cable runs radiating out from points along the access routes. These radial designs were etched into the landscape by the cables required to "snake" the logs into the principal channel. This distinctive design can be detected on aerial photography and is an accurate record of intensive lumbering operations (*Daily Review*, March 6, 1991; Davis 1975).

In the late 1800s lumbering was the single most important industry in Iberia Parish. Three mills in New Iberia could not keep up with the demand for milled cypress, oak, ash, magnolia, sweet gum, hackberry and other varieties. The same was true for other communities within the region. The cypress timber industry, primarily producing shingles, dominated local business interests between 1880 and 1920. In addition, many mill owners supported improved transportation systems to move barges of lumber in tows for the export trade (Fisk 1890). By 1906 the manufacture of cypress lumber, called "forest gold" was the second largest industry in Terrebonne Parish. Sugar was number one (Wurzlow 1976a)

The lumber industry was an important regional economic force. During the early 1900s there were numerous cypress mills of various sizes in Terrebonne Parish, and all were interested in the "wood eternal." The mills included: C.P. Smith and Company, C. M. Boudreaux and Sons, Farquhard Guidry mill, Bonvillain Brothers, Diebert, Stark and Brown Cypress Company, F.E. Shepherd, Goodland Cypress Company, L.S. Boudreaux Shingle and Cross Ties Mill, Gibson Cypress Lumber Company, Caillou Manufacturing Company, and Dulac Cypress Company (*The Southern Manufacturer* 1910; Wurzlow 1976b). The same kind of activity was evident in other parishes as well.

Logging canals remain a part of the swamp morphology. For more than 50 years, the channels were essential to the forest industry; but as swamp timber was depleted, woodcutting operations were terminated. The cypress companies employed no methods of conservation for preserving wood resources. They wanted the resource and the profits; they did not think of the future. Therefore, only canals and pullboat scars remain (Wurzlow 1976b). In a larger sense, these features are an indicator of the once robust cypress trade and the near complete depletion of virgin cypress/tupelo swamps. These canals' persistence is a visible illustration of what will

happen when south Louisiana's hydrocarbon resources are depleted. A list of some of the more important logging canals is provided in **Table 3-3.**

Oil Field Canals

Concomitant with the logging era, oilmen began to appraise the coastal zone's hydrocarbon potential. To exploit the subsurface mineral wealth was a challenge. Many favorable sites remained untested until drilling procedures, equipment, and geophysical expertise were developed to capitalize on the recoverable mineral fluids. Once engineering and logistic concerns were solved, the wetlands became a major hydrocarbon province.

Until the 1930s, coastal Louisiana operators depended almost entirely upon the natural waterways and canals for transportation of oil (Oil and Gas Journal 1937:180). In fact, canals were considered "an asset, in transporting the crude product to the refinery; and southern Louisiana is fortunate in having an intricate system of inland waterways, bayous and canals, which means cheaper transportation" (Branan 1937:7).

Successful use in 1934 of a submersible drilling barge marked the beginning of expanded drilling activity. To maximize the floating unit's potential, the industry needed to dredge canals into exploration and development sites (McGhee and Hoot 1963) (**Figure 3-36**). They were successful. In fact, in most years almost one-third of the United States Army Corps of Engineers dredge and fill permits are issued in Louisiana (Mager and Hardy 1986). It is now difficult to locate a stretch of marsh where canals are absent (**Figure 3-37**). They are in a sense ubiquitous (Turner 1987).

Table 3-3. Inventory of Logging Canals Built Between 1880 and 1930 (source: Davis 1973).

Canal	Company	Location
Ashland	St. Louis Cypress Lumber Company	West of Ashland on Bayou Grand Caillou
Cooke	St. Louis Cypress Lumber Company	From Bayou Black to Bull Run
Cotton	Cotton Brothers Lumber Company	South of Lake Fausse Pointe
F.B. Williams	F.B. Williams Lumber Company	South of Franklin
Hanson	Hanson Lumber Company	Between Big and Little Bayou Black
Hollywood	St. Louis Cypress Lumber Company	Southeast of Houma
Ivanhoe	Hanson Lumber Company	South of Ivanhoe on Bayou Cypremort
St. Louis	St. Louis Cypress Lumber Company	South of Ashland on Bayou Caillou

In that marsh soils are generally unconsolidated, powerful suction dredges, bucket dredges, spud barges, and marsh buggies were quite adept at excavating the required petroleum access, pipeline, and transportation waterways. Dredging contractors opened the coastal lowlands quickly to hydrocarbon development. In the process, operating engineers added to the wetlands an extensive agglomeration of canals. Through additions, the patterns enlarged into a complicated net of coalescing channels. Without any regard for changes in natural drainage, the long-range hydrologic effects have, in many cases, been disastrous.

To develop a hydrocarbon province, a petroleum contractor cuts a series of initial service routes, and then adds supplementary passages as warranted. These tributaries filter into the central traffic corridor, guaranteeing well access. The assemblage ultimately dominates the surface topography, with each appendage representing a new well. It is a one well - one canal system. Constantly influencing larger quadrants, the geometric design grows rapidly. Once in use, the distinctive straight-sided canals often erode into a cuspate form. Some fields become so canalized more than 20 percent of their surface morphology is devoted to these topographic elements. Along with the associated pipeline channels (**Figures 3-38 and 3-39**), the impressive number of these linear features has prompted some individuals to describe the unorganized network as a "spaghetti bowl." These interconnecting routes are now permanent features (Davis 1973; Gagliano 1973) and represent 2.3 percent of the present wetland area (Turner and Cahoon 1987). Exploitation patterns endure, even though resources are depleted; their longevity is a visible reminder of humankind's capacity to change unknowingly the natural system. The function may change, but the "lines" persist. They are an engineering feature that survives.

Roads

During the nineteenth century, roads were common within the study area, but they were not the main means of transportation. Most travel and commerce was carried over water. The most significant east-west route was the Old Spanish Trail, a route used by cattle drivers to take their livestock to New Orleans. This route followed several natural levee ridges within and immediately outside the northern edge of the study area. Today Hwy 90 follows roughly the same route.

Roads did not become serious transportation arteries until the twentieth century. With the exception of urbanized areas, most roads within the study area follow natural levee crests and run parallel to the numerous bayous that extend out into the marsh (**Figure 3-40**). Along the many north-south oriented distributary channels, human settlement has generally concentrated along those portions of the channels that are serviced by roads. The southern termini of these roads are now the usual location for marinas (e.g., Bayou Petit Caillou, Cypremort Point) and for major boat landings. While many camps are constructed along the lower sections of bayous that are not serviced by roads, it is unusual to find houses along the portions of these channels that are not serviced by roads.

Railroads

Like roads, railroads were not a significant means of transportation because of the abundance of available waterways. The major gap in the transportation network was the lack

of a good east-west transportation route between the Teche Region and New Orleans. The Barataria-Lafourche canal system of the 1840s was the first attempt to alleviate this problem (Becnel 1989). The New Orleans to Morgan City Railroad, constructed in 1860, was the second major attempt to solve this transportation problem. Very few railroads extended down the bayous into the marsh because they could not compete with the existing waterway system. Within the study area, most railroads were constructed during the late nineteenth and early twentieth centuries. Railroads are generally confined to the northern third of the study area where natural levees are higher and wider.

Resource Extraction

Although agriculture was the economic engine that drove the area until the end of the nineteenth century, the twentieth century can be characterized by a shift in emphasis toward resource extraction. The first major natural resource to be exploited was wildlife, and in particular, the fisheries industry which began to grow during the middle of the nineteenth century. During the late nineteenth century, timber made a sudden and significant impact on the economy, but the impact declined rapidly during the 1920s. By the 1930s, oil and gas exploration brought about another shift in the local economy that has continued until the present. According to the 1990 census, within the four-parish study area, the combined wages from agriculture, forestry and fishing accounted for less than 1 percent of the regional economy. Mining (oil and gas) accounted for about 12 percent and manufacturing about 17 percent (US Department of Commerce 1995). The fishing industry is therefore an example of a very visible yet economically minor segment of the economy.

Fisheries Resources

During the eighteenth and nineteenth centuries, the Louisiana coast frequently was described as having an abundance of exploitable water resources. One such description was provided in 1819 by surveyor John Landreth:

> I have given a draught (sic) of the coast of the Gulph (sic) of Mexico from Bayou Bufelo (sic) to the Last Islands or Dernier Isle with part of Lake Pelte (sic) . . . Dernier Isle and part of the Isle of wines . . . The soil of this Island if very poor Sandy Barren marsh scarch (sic) fit for anything very little grass of any sort and what there is very poor and coarse . . . a few water bushes and some myrtle are all that grows upon the Island . . . The wild animals on this Island are wild cats and Raccoons . . . but this Island is . . . valuable from the fine fresh sweet water that is found here . . . Dernier Isle is also valuable for its fine fishing . . . its Shores are surrounded with excellent Oysters, and here Green Turtle abounds as much as in any part of the world and wild fowl of the aquatic kind are very plenty . . . [Newton 1985:88].

When the term "fisherman" is used to identify a person's primary source of income in south Louisiana, a wide variety of occupations could be involved. By 1900, there were in south central Louisiana thousands of individuals engaged in plantation agriculture, truck farming, trapping, shrimp seining and drying (Adkins 1973; Love 1967), oyster dredging and

tonging, terrapin "farming," and fishing. Many of these folks lived within the wetlands at their resource exploitation sites and the vast majority would probably refer to themselves as "fishermen" (**Figure 3-41**). Until the introduction of oil and gas exploration during the early twentieth century, the economy within the coastal wetlands had always focused on the region's renewable resource base. In fact, in the later part of the 1800s one hunter could market over 1000 alligator hides (Arthur 1931). Tons of catfish, most of which were caught in hoop nets or on trotlines, were shipped to Midwestern markets—to be sold as tenderloin of trout (**Figure 3-42**). Large turtle pens enclosed herds of diamond-back terrapin being raised by the thousands for restaurateurs. To add to their income base, marsh dwellers often hunted gulls, terns, and white egrets. Feathers from these birds were exported to New York and Paris millinery houses. In winter, market hunters often shipped over 1000 brace of duck a week to New Orleans' markets (*The Daily Picayune*, December 31, 1905). In addition, millions of eggs and shells were collected.

"New Orleans is the great fishing port of the State, as it is of the entire Gulf region. The quantity of fish, . . . entering the city is large and it makes this place rank among the prominent receiving centers for fishery products in the country. The only other fishing settlement of note is Morgan City, at the outlet of Grand Lake" (Collins and Smith 1893:155).

Oysters and shrimp were harvested by the boatload. In fact, fisheries were considered one of Louisiana's most important natural resources. Fishing was so important that in the early 1930s one out of every 40 people had some direct or indirect interest in the state's fishery's resources (Fiedler 1932). Stearns (1887a) work makes it clear that the oyster trade was not a "new" industry in Louisiana. Indeed, as early as 1879 there were at least 120 luggers involved in the industry, employing 4500 watermen. Within Timbalier Bay there were at least 15 boats operating. With oysters harvested from Lake Peliot considered "first-class . . . very fat and salt(y)" (Stearns 1887a:579). The remaining beds produced "summer" oysters, called by restaurateurs "kitchen" oysters, as they cooked well, but were not as rich in flavor as those identified as first-class (Stearns 1887a). At this time, these oysters were brought to New Orleans from naturally growing reefs.

The industry depended on the fishermen, but often these folks could not afford to own their vessels. If this was the case, the packinghouse maintained the boat and equipment and calculated the crews share based on the full market value of the catch. After deducting expenses, the split was usually one-third for the packer, one-third for the captain and a third for the mate. In some cases, the captain received a bonus. In another payment plan, the captain's and mate's share was based on a fixed price per pound, often one-half the market value. In this arrangement the owner assumed all expenses associated with operating the vessel (Louisiana Conservation Review 1937).

Although early fisheries harvest statistics are vague (**Table 3-4**), Louisiana's barrier-island-protected estuaries were responsible for most of the commercial fisheries. In addition to the native French inhabitants who dominated south Louisiana, this industry also supported a large foreign-speaking population (Moore 1899; Stearns 1887; True 1884; Zacharie 1898) (**Figure 3-43**). This extensive "wet land" supported "the greatest natural fish

Table 3-4. Harvest and Value of Catch in Louisiana, 1890 (source: Collins and Smith 1893).

Species	Pounds	Value
Black bass	81,570	$4,219
Bluefish	13,050	843
Bream and sunfish	270,020	15,682
Buffalo-fish	1,180,250	22,940
Catfish	2,674,007	54,726
Channel bass	339,316	11,270
Croakers	158,267	9,279
Drum	18,200	1,352
Flounders	25,625	2,407
Groupers	17,800	178
Mullet	287,750	8,021
Pompano	32,450	4,378
Rock bass	54,200	3,047
Sheepshead	390,817	25,906
Silver perch	140,160	6,206
Snapper, red	240,500	7,215
Spanish mackerel	144,000	14,665
Spots	30,600	1,520
Striped bass	49,950	3,050
Trout	655,670	33,026
Miscellaneous	161,380	9,319
Oysters	5,891,095	299,896
Shrimp	6,662,050	90,519
Crawfish	144,650	7,030
Crabs, hard	850,800	12,815
Crabs, soft	129,900	6,547
Terrapins	58,333	1,543
Turtles	90,793	2,335
Total	**20,789,203**	**$660,134**

hatcheries in the world" (Rinderle 1930:11). The first map to show the distribution and condition of oyster bottoms was compiled in the early twentieth century (Payne 1920; Wicker 1979). In the early 1930s this fishing population marketed their catch largely through 61 wholesale seafood markets in Louisiana—13 in Orleans Parish and 9 in Terrebonne (Fiedler 1932).

Change in the hydrology of the Terrebonne-Timbalier complex in the nineteenth century resulted in saltwater movement inland. As a result, the location of highly productive oyster bottoms advanced into system's upper reaches near the outlets of fresh-water drainage bayous such as Grand Caillou, Petit Caillou, Terrebonne and Pointe-au-Chien (Wicker 1979). Prior to being cut off from the Mississippi River, Bayou Lafourche contributed a significant quantity of fresh water to this estuarine complex. However, "a noticeable deterioration of the reproductive capabilities of eastern Timbalier Bay was observed when this source of fresh water was eliminated" (Wicker 1979:52-53). From Timbalier Bay west to Four League Bay was considered a highly productive oyster area during the late nineteenth and early twentieth

centuries, largely because the land loss there was minimal, consequently, the protected water bodies remained brackish and more stable for oyster production. In flood years, fresh water from the Atchafalaya basin would move into these areas, but was generally of such a short duration that the oyster harvest was not adversely affected. West of Four League Bay the state's most productive oyster leases were in South West Pass; a strong tidal exchange maintained brackish conditions in this channel between Marsh Island and the mainland. By the early twentieth century the oyster industry began to change as private ownership of oyster bottoms and cultivation to improve quality and quantity were being established. The business was becoming a commercial industry and new bedding grounds were being established (Wicker 1979).

Payne provided the following comments recording the local impact of crevasses on the industry: "The oyster industry has been seriously affected by breaks in the levees . . . especially in the . . . marsh . . . The breaks in the levee at Poydras Plantation, about fifteen miles below the city [New Orleans], improved the oyster crop in some parts, although a large area of productive reefs were considerable affected. This however was only temporary for the oysters are now more prolific than ever" (Payne 1924:99)

Today, Louisiana's fishermen annually catch more than one-half billion kilograms of estuarine-dependent fish and shellfish. Shrimp, oysters, menhaden, crabs and crawfish are the backbone of the fisheries industry (**Figure 3-44**). All harvests fluctuate. Crawfish, for example, are dependent upon weather conditions and water levels in crawfish ponds and the Atchafalaya River basin. Cold weather can cripple the growing season. Competition from China has also become an issue. Regardless, in 1997, prices dropped considerably with boiled crawfish selling for less than $1.20 per pound (McClain 1997). Louisiana crabbers, on the other hand, are making themselves an endangered species. There appear to be record numbers of crabs available, but few grow past the minimum size of five inches (10.8 cm) for commercial harvest. According to Jerald Horst, fisheries agent with the LSU Cooperative Extension Service, "the problem is there are too many fishermen who set too many traps . . . which means the catch-per-trap has fallen. So, to bring their total catch up so the can make a living, the fishermen resort to using more traps, which just reduces the catch-per-trap even more, necessitating the use of even more traps" *(The Advocate*, April 14, 1997:3B). It is a vicious cycle, since there is no limit on the number of traps a commercial fisherman may use. In the 1970s the state issued an average of 850 licenses a year, and by the early 1990s the number had increased to nearly 3000. The increase in the number of crab traps has also impacted the shrimping industry because the traps are often placed in areas where shrimpers want to trawl. This increase has also affected the productivity of traps as is reflected in the catch-per-trap data. In 1967-76, crabbers averaged 1.41 crabs per trap. By 1992-1996, the figure had fallen to .41 crabs per trap (*The Advocate*, April 14, 1997). If the industry remains overcapitalized, the fishermen will eventually suffer.

Although the shrimp, crab, and oyster fisheries are well known, there are several other smaller fisheries that are worth noting. For example, a small fleet of tuna boats is now operating out of the lower Dulac area (**Figure 3-45**). These boats only operate in deep water far offshore. One industry that has expanded rapidly along the Louisiana coast is mullet fishing (**Figure 3-46**). Mullet fishermen moved from Florida and Alabama during the 1980s,

in part because changes in fishing regulations reduced their operations in those states. Mullet fishing is conducted from small boats using strike nets. Recent changes in regulations have similarly slowed the growth of the industry in Louisiana through restrictions on net types, the closure of night fishing, and by limiting the season to only about three months in the fall and winter. Although mullet are eaten in Florida and Alabama, they are caught mainly for the roe, which is exported to Asia. Mullet boats look different from other coastal fishing boats because they are not constructed along the same lines as local skiffs or luggers, which are constructed following the Louisiana tradition of boat building. Louisiana mullet boats are built like those used in Florida and Alabama and thus represent a new type of watercraft that was not found in Louisiana prior to about 1970. They come in two basic styles, referred to by some fishermen as the "well boat" and the "sidewinder" (Castille 1993:320-323) (**Figure 3-47**).

With time and increased demand, Louisiana's seafood harvest has escalated in value (**Table 3-5**). Nationally, the state's seafood production is number one by weight and second in value. Although land is being lost to open water at the rate of nearly 30 mi^2 annually (Boesch et al. 1994; Britsch and Kemp 1990; Penland et al. 1990; Turner and Cahoon 1987), the region's water bottoms continue to sustain a large inland fishing fleet. For the five parishes included within the study area, a summary of commercial fishing licenses for the year 1992 is provided in **Appendix B**. Louisiana's commercial harvest is dominated, in terms of weight, by the production of menhaden. This is a fisheries resource used primarily for industrial purposes and as an ingredient in animal feeds (Keithly 1991).

Table 3-5. Estimated Harvest and Value of Selected Louisiana Fisheries in the 1980s (source: Keithly 1991).

Species	Estimated Pounds	Estimated Value
Catfish and bullheads	6,000,000	$2,500,000 to $3,000,000
Black drum	1,000,000 to 9,000,000	$1,900,000 to $2,600,000
Black mullet	2,000,000	$2,000,000
Spotted seatrout	1,000,000 to 2,000,000	$1,000,000 to $2,000,000
Shark	5,000,000	$2,500,000
Snappers	1,500,000	$3,000,000 to $4,000,000
Swordfish*	700,000 to 1,300,000	$2,100,000 to $4,100,000
Tuna**	12,000,000	$16,300,000 to $22,000,000

* While the nation's swordfish industry is several centuries old, significant landings of swordfish in Louisiana are a much more recent occurrence.

** There were virtually no reported tuna landings in Louisiana prior to the mid-1980s.

The economic value of commercial and recreational fisheries in the Gulf of Mexico is considerable. In fact five of the ten largest commercial fishing ports by weight are in Louisiana—Empire-Venice, Cameron, Intracoastal City, Delcambre, Dulac-Chauvin, Morgan City-Berwick. In 1991 they collectively processed nearly 1,092 pounds (495 kg). The catch at Dulac-Chauvin and Empire-Venice was valued at nearly $100 million. The principal catch brought to these ports consists of shrimp, oysters, blue crab, and menhaden (Weber et al. 1992). In fact, the dockside value of Louisiana's edible seafood harvests generally is between $100 million and $200 million (Keithly 1991).

Of the various types of activities occurring within the study area, the people who are at greatest risk from flooding or storm injury are those who are engaged in the fisheries industry. In order to minimize driving time and boat fuel, fishermen generally live as close to the area where they fish as possible and often live near the place where their boats are docked. Where roads occur along bayous, many live directly across the road from their boat dock. As a result, individuals engaged in fishing are the most likely to live outside of areas surrounded by either hurricane protection levees or pump drainage. Unlike recreational camp users who often live in urban areas far inland, the major investments for fishermen (i.e., their boats and home) are always located either on or close to the water.

Shrimp

Shrimp have been a food item and a source of income in coastal Louisiana since the colonial period. As early as 1718 the historian Le Page du Pratz stated 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).

Ecology

Two shrimp species: white (*Penaeus setiferus*) and brown (*P. aztecus*), are harvested in Louisiana. Both species spawn offshore, the white from spring through fall and the brown in March and April and again in September and October. The microscopic eggs hatch within a few hours. In three to five weeks, the post-larvae migrate into Louisiana's estuary nursery grounds. As a result, the economic viability of the shrimp fishery is estuary dependent.

Shrimp survival rates depend upon salinity conditions, water temperature, rainfall, and river discharge (White 1975). Once in the estuary, a wide tolerance to salinity and temperature enables the shrimp to spread over a range of habitats (Barrett and Gillespie 1973; Kutkuhn 1966). Nursery area salinities are influenced by rainfall and river discharge. Higher salinities, identified with low spring rainfall and discharge, benefit brown shrimp production. Low summer rainfall and discharge increase white shrimp yields. High precipitation and river discharge can dilute estuarine salinities to below tolerance limits, restricting nursery areas. Estuarine habitats sustaining this fishery vary from 2 to 3 million acres (.8 to 1.2 million ha) (Barrett and Gillespie 1973). This habitat is confined to the central and eastern portions of the coast; little fishing is done west of Vermilion Bay.

Shrimping Techniques

In the early days, seining crews would drag their nets in water up to their waists to harvest the shrimp. In the regions most convenient to markets, all favorable seining "flats" (shallow water areas) were claimed by fishermen or fishing firms who built houses and wharves at these sites to solidify their hold on the flats and protect them from others (Stearns 1887b). Larger seines, termed haul seines, were also used from boats. The seines used in the Barataria Basin were considered some of the largest in the world and were operated by a single boat with a crew of from 8 to 20 men (Cole 1892; Johnson and Lindner 1934). Using this technique a good seine crew could catch up to 1,985 pounds (900 kg) a day.

Seines were efficient, but the otter trawl, introduced in 1917, revolutionized shrimping. The trawl consists of a bag made of netting spread by a pair of otter boards into a wing configuration designed to direct the shrimp into the net (Lindner 1936; Louisiana Conservation Review 1937). The otter boards or trawl boards are at the extreme end of each wing to hold the bag open. Towlines are attached to the trawl boards and secured to the vessel. This is still the most common type of net used in commercial shrimping.

> . . . 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 . . . , 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. (Padgett 1960:147)

Along with haul seines and otter trawls, coastal fishermen use a rig called a butterfly net (in French *poupier*)--invented to supply smaller and cheaper shrimp to the sun-drying industry (Love 1967). These nets are mounted on boats and wharves, rigged on iron pipe frames from 6 ft^2 to 12 ft^2 and equipped with small mesh bags about 15 ft long.

In Louisiana's inland waters shrimp fishermen preferred sailing luggers until well into the twentieth century. Effective in shallow water, this boat type never diffused from its area of origin--the state's estuarine environments. Prior to motor-powered vessels, no folk boat is more carefully distinguished in French Louisiana than the *esquif* or skiff (Knipmeyer 1956). A skiff is flat bottomed with a pointed bow and blunt stern--an ancient design called by most people a rowboat (a term not used in French Louisiana). Skiffs, propelled by sails and oars, and identified as *peniche*, *chaloupe* and *galere* were the major craft utilized in harvesting shrimp and oysters.

Once trawl-boards became a part of the shrimping fleet, the problem was getting the catch to market. An auxiliary fleet of ice boats were used to move the catch to a canning factory or market and solved the problem of spoilage (Rinderle 1930). In addition, most fishermen operated from a single port and generally worked for only one plant throughout the season. Consequently, fishing grounds constituted those areas that could be reached within a reasonable length of time by the trawler or by an iceboat transporting the catch to market (Louisiana Conservation Review 1937).

Shrimp Drying: An Ancient Chinese Art

Shrimp found in shallow water tend to be smaller than those caught offshore. The majority of shrimp used in the sun-drying process were seined from the protected, shallow water bottoms of Barataria, Timbalier, Terrebonne, Caillou, and Atchafalaya Bays. Prior to availability of ice and modern-freezing techniques, these estuaries served as focal points for settlements. Shrimp caught in these fishing grounds were taken to platforms to be dried, packaged, shipped, and sold (**Figure 3-48**).

Shrimp drying, rooted in Asia, diffused to Louisiana by Chinese immigrants (Adkins 1973; Bonnot 1932; Jordan 1887). In 1871 Chinese began harvesting San Francisco Bay shrimp and quickly expanded platforms throughout the region and beyond (Bonnot 1932; Jordan 1887; Scofield 1919). By 1873 the lucrative business was firmly entrenched in Louisiana's estuaries at Chinese camps located in Barataria Bay (Louisiana Conservation Review 1937; Padgett 1960). The finished product, in fact, was sent to the large Chinese communities in the United States and China.

There are conflicting reports as to the original practitioner of this art in Louisiana; it is either Lee Yeun, Chen Kee, or Lee Yim (Adkins 1973). Even though the individual accountable for launching this enterprise is lost to history, early accounts are fairly clear 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 [known as] Cabinash. This camp was originally used in an effort to sun dry oysters, but when this proved . . . impractical the men began to dry shrimp." (Padgett 1960:142)

In the early 1880s, Louisiana Land Office records document Asian immigrants who purchased, for $1.25 per ha, several small islands in Barataria Bay to be utilized as platform sites (Adkins 1973). By 1885 the industry was well established when "Yee Foo was issued Patent Number 310-811 for a process to sun-dry shrimp. Actually, the Chinese have used this method for preserving shrimp and other animal foods for centuries, but the patent made the process an established method of food preservation." (Love 1967:58)

Platform Communities

One of the oldest marsh communities, St. Malo, was situated on Lake Borgne, east of New Orleans. A group of Tagalos, natives of the Philippine Islands, lived in piling-supported homes only inches above the surrounding terrain. These wooden dwellings were erected in Philippine style with large eaves and balconies. St Malo's vernacular architecture was intended to withstand the region's violent climate. Traditional palmetto and woven-cane structures were inadequate.

> . . . Of the 13 or 14 picturesque buildings nearly all have dried fish hanging from the roof, with chickens and pigs beneath the planking. They are lighted by lamps in which fish oil is used. The reason so little is known of the settlement is due to the peculiar reticence of the inhabitants, its isolated

locations, and the fact that they trade almost entirely with Chinese or Malays who live in out of the way places in New Orleans [Fortier 1909:307].

By the mid-1800s Louisiana's marshes sustained more than 150 wetland-oriented communities similar to St. Malo. Each village was supported by the estuary's renewable resource base and most were involved in the shrimping industry. The visual landscape was characterized by red-sailed luggers, isolated palmetto-covered houses, rustic cypress shrimp-drying camps, or isolated lake dwellings. From 2 to more than 300 cast-net and seine fishermen clustered in these secluded settlements (House Document No. 200 1917). It was a cultural landscape that revolved around the seasonality of wetland-dependent wildlife. At its zenith an estimated 75 shrimp-drying platforms were operational (Pillsbury 1964). A sizeable number were destroyed by hurricanes in 1893 and 1915, and an accurate tally was never compiled. The canning and packing factories were hard hit and the fishing fleet was decimated by these hurricanes. Of those that survived, Basa Basa, Manila Village, Chong Song, Rogers, Camp Dewey, Chenier Dufon, Cabinash (Cavenash), Fifi Islands, and Bayou Brouilleau were repaired or built to continue to preserve shrimp for transshipment to various world markets (House Document No. 200 1917). Pacific coast Asian communities were the primary markets, with each camp shipping an estimated $100,000 worth of dried product annually (Cole 1892). As production increased, distribution expanded to include most of the Far East. The greatest volume was exported to China, the Philippine Islands, and Hawaii. Smaller quantities were marketed in the West Indies and South America (U.S. Dept. of Interior, Fish and Wildlife Service 1950).

Shrimp used in the sun-drying process were commonly seined by French, Chinese, or Malays, but other ethnic groups were also involved. Consequently, platform crews were often composed of a multitude of water-oriented culture groups. Up to 15 seasonal seine crews, and a year-round occupancy of about 100, contributed to a maximum of 300 to 500 people living on any one platform. Many of these immigrants did not leave their secluded settlements, as they were often in this country illegally. It is rumored many were smuggled into Louisiana by commercial fishermen, who placed the aliens in barrels and brought them through the coastal waters unnoticed.

A Typical Shrimp-Drying Village: A Community on Stilts

Shrimp-drying communities were morphologically distinct. They contained a group of small, rude shacks made of rough, unpainted cypress boards that served as warehouse, storehouse, and living quarters (**Figure 3-48**). The platform was encircled by narrow foot bridges. Along these wooden paths were poorly constructed wooden shanties. More picturesque huts with thatched roofs and sides covered with palmetto were also present (Cole 1892). All of the buildings were of frame construction, rectangular, and ranged in size from the typical shotgun to a large general store. The wharf, used to unload the newly arrived unprocessed shrimp, and many of the buildings were built over the shallow water on hand-driven pilings. Pillars supported the community's dominant feature-the cypress platform utilized in the cooking, drying, and threshing process. The drying areas of these structures varied with each site; the average was about 9000 ft^2 with a capacity of 1000 baskets, or

approximately 110,000 pounds (49,940 kg). Hand-woven baskets were used for weighing purposes. Each held 100 pounds (45 kg), or half a barrel.

The cypress decking was constructed 8 to 10 ft (2.4 to 3 m) above the marsh to aid the curing process by facilitating the free passage of air under the floor. The platform's surface was not level, but undulated with an ocean-wave effect. The ridges, or humps were about 3 ft to 4 ft high (.92m to 1.2 m), 6 ft wide (1.8 m), with a distance of up to 30 ft (9 m) from crest to crest. A-shaped frames, placed along the ridge crest, supported tarpaulins that could be tied along the base of each stand (Louisiana Conservation Review 1937; Pillsbury 1964). When rain threatened, the drying shrimp were raked to the top of the wooden waves and covered, to prevent the absorption of moisture. At night they were covered for protection from dew. This covering remained open at each end to provide ventilation and prevent spoilage (Louisiana Conservation Review 1937).

Processors often used small sea bob (*Xiphopanaeus kroyeri*) boiled just long enough to insure the shell could be removed easily after drying-about 15 minutes. After boiling, the crustaceans were removed from the super-saline brine tanks, placed in wooden wheelbarrows, left to drain, then spread evenly on the drying platform. With wooden rakes the saturated shrimp were turned to insure uniform dehydration. When they were thoroughly dried, the heads and shells had to be removed. Prior to invention of the rotating-drum shell huller, patented by Fred Chauvin and Shelly Bergeron in 1922 (Love 1967), laborers wrapped their shoes in cloth or sacks and tramped or "danced the shrimp" (Dauenhauer 1938, **Figure 3-49**). In some cases, small batches would be flailed with a bundle of branches or a large homemade "flyswatter." Once the shrimp were "danced" or "flailed," loose hulls were removed by shaking the shrimp on a hardware-cloth frame or winnowing by throwing them in the air during a brisk wind (Love 1967). The non-edible outer layer was called "bran" or "shrimp dust". Found to be rich in protein, this by-product was sold as a fertilizer or supplementary feed for livestock and poultry. In the 1930s Germany was the principal foreign market for this by-product (Louisiana Conservation Review 1937). On many of the platforms small vegetable gardens were established. Vegetables were raised in wooden containers or wash tubs filled with marsh soil (rich in nutrients), night soil, and shrimp bran. These gardens supplemented and enriched the diet of the platform's population.

Never a primary industry, the sun-drying business played a key role, albeit a forgotten one, in nurturing Louisiana's estuarine fisheries. Platform settlements clearly show that since the late 1800s fishermen vigorously exploited the wetland's resources and harvested extensively the estuary-dependent shrimp. After a number of hurricanes damaged or ruined these shrimp drying factories, isolated platforms were replaced by mainland canneries and packing plants. As these facilities multiplied, the old drying platforms disappeared.

Modern Processing

Since the late nineteenth century, numerous packing houses have processed Louisiana's catch (**Figures 3-50 and 3-51**). This part of the industry's roots date from 1867 when G.W. Dunbar and Sons in New Orleans made the first attempt to can Louisiana shrimp (Clay 1938; Fiedler 1932). However, it was not until they devised the bag lining for cans in

1875 that Dunbar was successful. By 1880 the cannery was producing several hundred thousand cans of shrimp annually. A new industry was born and has been an important part of the wetland's economy ever since. By the late 1930s the Southern Shellfish Company was the largest shrimp cannery in the United States. More than 100 vessels provided this Harvey, Louisiana plant with as much as 1500 barrels of shrimp a day during the season (Louisiana Conservation Review 1938). During the 1930s, a typical shrimp picker could clean up to 180 pounds (82 kg) of shrimp a day. Each plant employed up to 200 pickers, generally women, who were paid a fixed rate per pail or cup of shrimp meat processed. Wage scales, however, varied considerably by region. Once picked, the shrimp were washed, boiled in brine, cooled, re-picked for refuse, graded as "small," "medium," "fancy," "extra fancy" or "jumbo" and packed in cans or glass containers, then re-cooked/heated to 250°F for up to 53 minutes, depending on the type of processing being used (Louisiana Conservation Review 1937). Mechanical shrimp processing machines sped up the operation and eventually replaced the handwork, but also removed a large number of people from the industry. Delcambre, known originally as the *Marais Carlin* or *Grand Marais*, became a shrimp-processing center when Bayou Carlin was a narrow canal with a few small boats, one oyster canning factory and a fuel dock.

In the canning factory, the shrimp were stored on ice to not only preserve the meat but to make peeling easier. The peeling was done by hand by folks who were paid one cent a pound and made about $2.50 a day. Once peeled, the shrimp were washed, boiled in salt water, cooled, graded and hand packed into cans. By 1930, Louisiana's shrimp canning factories led the nation in production. These plants produced nearly four times as much as any other state, canned more than half the total of all other states and twice as much as the entire east coast. The industry thrived in Louisiana (Rinderle 1930).

Yields

The earliest reliable records of the size of the annual shrimp harvest in Louisiana date from the late nineteenth century (**Table 3-6**). Except for the figure for 1880 (534,000

Table 3-6. Louisiana Shrimp Harvest, 1880 to 1929 (source: Fiedler 1932).

Year	Quantity (In thousands of pounds)
1880	534
1887	6,810
1888	6,943
1889	7,238
1890	6,662
1897	4,487
1902	7,635
1918	18,250
1923	27,753
1927	40,259
1928	53,779
1929	49,456

pounds), which seems low, the numbers for the last two decades of the century remained fairly steady between 4.5 million and 7.5 million pounds. There was a significant increase in 1918 to 18 million pounds, which is almost certainly related to the introduction of the otter trawl.

Industry growth and expansion resulted in shrimp becoming Louisiana's most valuable fishery. Today the catch is second only to menhaden in quantity, but first in dollar value (generally in excess of $200 million) (Keithly 1991) Louisiana's commercial shrimp landings vary from 51 to 101 million pounds (23 to 46 million kg) annually. Twenty to 25 percent of the shrimp processed in the United States are caught in Louisiana. Since 1880, Louisiana has led the Gulf states in shrimp catch 69 percent of the time (Barrett and Gillespie 1973). Consequently, the state is the largest producer of shrimp in the Gulf of Mexico (**Table 3-7, Figure 3-51**).

There are nearly 100,000 commercial and recreational shrimpers along the Gulf coast. In Louisiana more than 9000 boats were involved in the fishery in 1989, ranging from shallow-draft bateaus to ocean-going trawlers (Sass and Roberts 1979; Walter Keithly, personal communication 1992). Inasmuch as recreational fishermen are involved in the harvest, statistics are somewhat misleading, since the recreational catch is often unreported. In 1991 Louisiana's recorded shrimp catch was 90,593,961 pounds (41,085,697 kg) (44,121,701 pounds/20,009,842 kg of brown shrimp and 46,472,260 pounds/21,075,855 kg of white). In 1976 Louisiana's catch was 52,171,462 pounds (23,660,527 kg) valued at $79 million. The 1991 combined brown and white catch was valued at $139 million. In 1995 the combined catch was worth $144 million (Louisiana Seafood Promotion and Marketing Board 1995). Anywhere from 15,000 to 20,000 commercially licensed shrimpers are involved in the industry (**Table 3-8**). Of the harvest, about 50 percent is typically brown shrimp, 45 percent is white, and the remaining 5 percent is lesser known species (Keithly 1991).

Prior to the widespread availability of refrigeration, shrimp were practically unknown on the average household's table. It was strictly a part of the coastal fishermen's diet and associated regional markets. However, with development of refrigeration and fast-food restaurants, national demand for shrimp increased dramatically. People are willing to pay a premium price for shrimp, but the harvest depends on maintaining healthy estuarine habitats. If the habitat is degraded, then production will decrease. In Louisiana the barrier island system plays a pivotal role in maintaining the defined integrity of the estuary system.

Table 3-7. Value of Fish and Other Aquatic Products Taken with Various Apparatus in Louisiana, 1890 (source: Collins and Smith 1893).

Seines	$259,065
Lines	$78,139
Gill nets and trammel nets	.....
Cast nets and dip nets	$14,636
Miscellaneous apparatus	$308,294
Total harvest of 20,789,203 pounds valued at $660,134	
(Principal species were oysters, shrimp, catfish, and buffalo-fish)	

Table 3-8. **Shrimp Licenses Issued in Louisiana's Delta Plain (source: Louisiana Department of Wildlife and Fisheries 1991;Roberts and Pawlyk 1986).**

Parish	1976	1980	1985	1991
Iberia	368	562	462	600
Lafourche	1,045	1,612	1,702	2,025
St. Mary	459	622	517	115
Terrebonne	1,862	2,688	2,494	3,407

Oysters

> . . . when we pass by the outlets to the sea and continue along the coast, we meet with small oysters in great abundance, that are very well tasted [Le Page du Pratz 1774:289].

Oysters are plentiful in Louisiana. In fact, the state has a "larger territory available for oyster culture than all of the other coastal states combined" (McConnell 1930:13). Even with the impressive estuarine habitat, oystermen rely almost totally on one species, American oyster (*Crassostrea virginica*). In order to harvest their oysters, Louisiana's watermen must lease the right to harvest the state's water bottoms. Through the leasing system, private individuals obtain control of specific water bottoms used in the cultivation of oysters and the leasing period lasts for 15 years. Private bedding grounds encourage oystermen to work to improve the quality and quantity of the oyster harvest; it is in their best interest to increase productivity (Payne 1920). As a result of this competitive system, oystermen established isolated settlements to watch the leases, to insure poachers would not harvest the lessee's tonging-grounds. Consequently, by 1887 the oyster industry was well established in coastal Louisiana.

Oystermen discovered that water salinity was a major key to the identification of areas that were favorable to oyster production. This relationship was summarized by an early twentieth century review of the Louisiana oyster production:

> The out-pouring of fresh water into the Atchafalaya Bay and the Gulf of Mexico from the Atchafalaya and the Mississippi rivers carried along our coast line by the winds, tides and currents brings about conditions that are ideal for the propagation and cultivation of the oyster. The freshwater produces favorable conditions for the growth of the principal foods of the oyster, furnishes the young oyster . . . with proper mixture of fresh and salt water necessary for its development and limits the abundance of its greatest enemy, the conch or drill . . . which is always killed by the influx of fresh water [McConnell 1930:13].

Oystermen and Early Techniques

During the nineteenth and early twentieth century, oyster beds were harvested with a pair of tongs resembled two long-handled rakes tied so their teeth were facing each other (**Figures 3-52 and 3-53**). Leaning over the *chaloupe* or lugger's side, the 6 ft to 12 ft (1.8 m to 3.6 m) tongs were thrust into the shallow reef. They were then forced closed grabbing several clusters of oysters. The tongs were then lifted out of the water and the catch dumped onto the boat's deck, where the undersized catch was culled. Utilizing this technique a twosome harvested up to 20 barrels a day. One man used the tongs, while the other culled the cargo of oysters.

This process was repeated continuously, until the boat was full, the catch was too small, it got dark, or bad weather forced a return to camp. The oyster dredge eventually replaced tongs during the early twentieth century. After the dredge was introduced and accepted, the beds harvested were no longer limited to water depths that could be reached by the length of the tong handles. Prior to the 1890s, oysters in deep water were untouched. A dredge—a large basket-like framework with curved teeth that snagged the oysters as it was dragged through the beds—could retrieve oysters at much greater depths (Sheffield and Nicovich 1979). When full, the dredge was lifted off the bed by power-driven winches (Van Sickle et al. 1976). Luggers were quickly retrofitted with this new technology, but many individuals claimed the dredge would seriously deplete the oyster supply and damage the natural reefs. Others argued in favor of the dredge (Sheffield and Nicovich 1979). Regardless of the gear used, in the late 1930s the U.S. Public Health Service required oystermen to sack and tag all oysters at the bedding grounds as a means of identify the product's source (Clay 1938). This technique is still in use.

In most cases, the nineteenth century oystermen did not get home for weeks at a time. They were constantly subjected to the weather, as they were always over water traveling to their beds and to market. These trips often involved more than 100 miles (161 km) of sailing. Unfortunately, when there was no wind their perishable cargo was at risk. The only solution was to throw everything overboard, wait for two tides, re-tong the crop, and hope the wind was sufficient to reach the New Orleans market.

After the introduction of the dredge and motorized watercraft, the harvest increased. As a result, Louisiana became second only to Maryland in the production of oysters, with the harvest generally in the 9 million to 13 million pound range and valued at between $10 million and $30 million (Keithly 1991). However, because of increased saltwater intrusion, leases are moving up the estuaries into waters that are easily polluted. If the barrier islands and associated deteriorating wetlands are reestablished, it is quite likely that leases will again be located in the southern portion of the estuary and perhaps reduce the contamination problems that often shut down the industry.

In 1890 Louisiana ranked first among Gulf states in the number of individuals involved in the fishery. In all, an estimated 4000 people worked the reefs within and around the Chandeleur Islands, Bayou Cook, Grand Bayou, Bayou Lachuto, Timbalier Bay, Last Island, Barataria Bay, Wine Island Lake, Vermilion Bay, and Calcasieu Lake (Collins and

Smith 1893; Moore 1899; Stearns 1887; Zacharie 1898). Fishermen camps fringed all of these waterbodies (**Figure 3-54**). Knowing this, oyster wholesalers would purchase from these "rude camps ... built upon piles on the sea marsh" (Moore 1899:71) from 600 to 700 sacks (at 40 cents per sack). This approached the maximum load a large lugger, schooner, or steamboat could handle and operate with a safe freeboard. This was part of the transporting trade. These freight boats were used extensively to deliver the catch of the oyster fishery. In 1932 there were 83 vessels involving 472 people involved in the transport trade (Fiedler 1932). In this way, small leaseholders remained at work, rather than losing valuable harvesting time while traveling to the market. Prior to the Austrians/Yugoslavians arrival, Italians and Sicilians monopolized the industry (Stearns 1887).

Shipping and Processing

Outfitted with a false deck and temporary sides, the lugger's deck became an extension of the vessel's hold and could carry from 50 to 80 barrels (Prindiville 1955). Locally, these barrels were called "bank measure." It took two bank measure barrels to yield three barrels sold in the market (Zacharie 1898). In 1878 there were 120 luggers supplying oysters to the New Orleans market, with a carrying capacity each of 75 to 100 barrels. By 1887 the oyster trade was well established in coastal Louisiana with approximately 200 luggers of about "7 tons register" (Collins and Smith 1893:96). New Orleans' Lugger Bay was supplied with oysters by a work force of at least 600 (Stearns 1887). Grand Isle steamboats alone handled an estimated 14,000 sacks a week—representing 18,000 dozen. The typical lugger was a sharp, shallow, centerboard craft, carrying a single large lugsail. Vessels of this rig were celebrated for speed and general fitness for the work they had to perform.

The shallow-draft sailing fleet serving the New Orleans market delivered from 50,000 to 125,000 barrels annually. A barrel commonly sold for $2.00 to $3.50 indicating a wholesale value of between $137,000 to $343,000, based on $2.75 a barrel. Each boat was unloaded by Sicilian and Italian stevedores. No other group controlled the crews working the docks, other than these *Descareadores*. In fact, in 1890 "a larger number of foreigners is found in the fisheries of Louisiana than in any other of the Gulf States" (Collins and Smith 1893:155).

Approximately 200 luggers or oyster boats, employing more than 600 men, supplied New Orleans' "Lugger Bay" port facility with 50,000 barrels of oysters that commonly sold for $2 to $3.50 a barrel (Stearns 1887). Partial records of oyster landings have been kept in Louisiana since 1899 (Moore 1899; Van Sickle et al. 1976). The state's shucking houses annually process more than 1,102,500 pounds (500,000 kg) of meat, nearly 20 times the Mississippi catch (**Figures 3-55 and 3-56**). Catch statistics reveal a progressive increase after 1900. About 1910 the first major decline occurred. In the 1920s demand increased and was stable by the mid-1930s; in fact, the state's highest recorded production occurred in 1985. In that year, oystermen harvested more than 2.7 million pounds (1.3 million kg) (Keithly 1991) (**Table 3-9**). Various innovations have helped to improve production over the years. For example, in 1929, Louisiana's Department of Conservation required all oyster-packing houses to return 10 percent of the shells opened in a season. This practice guaranteed the state had the necessary clean shells for bedding purposes (McConnell 1934).

Table 3-9. Yield Comparisons for the Production of Oysters in Louisiana (source: Collins and Smith 1893; Keithly 1991).

	1880	1890	1991
Bushels	295,000	841,585	734,981
Value	$118,000	$299,896	$13,964,639
Price/bushel	.40	.35	$19.00

If the seed oysters came from reefs east of the Mississippi, the watermen had to pay lockage tolls on Doullut's canal at Empire and Quarantine Bay canal at Ostrica. Canal fees were also collected. These fees increased costs considerably. On the canals used in this voyage luggers were charged $1.00 per month for each boat using the canal for harborage. In addition, one cent/sack was collected on all oysters brought through these canals. This was an important route since more than 200 vessels used these canals, some making nearly 20 trips a year (McConnell 1932). Recognizing the costs associated with obtaining seed oysters, the state in 1932 purchased both canals for $55,000. These routes were immediately made toll free (McConnell 1936).

Toll Charges (from McConnell 1932)

For boats under 30 feet ... $3.25 at each lock
For boats even 30 feet ... $3.75 at each lock
For boats over 30 feet .$3.75 plus ¢.15/each additional foot.

There were other expenses, besides those directly related to the industry. For example, the state collected a $.03 privilege tax on every barrel of oysters taken from Louisiana's waters. In addition, a license tax of $.50 per ton or fraction of a ton was levied on each vessel or boat involved in the industry of one ton or more capacity. Twenty barrels of oysters was considered equal to a ton. Other taxes were collected on all vessels used in the purchase of oysters for resale and a tax on all factories canning oysters in Louisiana (Campbell 1914).

Louisiana currently leads the Gulf states in oyster production and supplies about 40 percent of the nation's oyster meat (Keithly 1991). Landings generally fall in the 9 to 12 million pound (3.6 to 5.4 million kg) range. Landings greater than 12 million pounds (5.6 million kg) are not uncommon (Keithly et al. 1992). For more than 20 years this figure has remained constant. Only severe environmental catastrophes influence the harvest. For example, when the Bonne Carre Spillway is opened and the Mississippi's sediment-laden waters are forced into Lake Pontchartrain, oyster production is affected (Dugas 1977; Engle 1948). After the initial shock to the estuarine system, the nutrient load directed into the estuary influences growth rates and ultimately increases production. Although environmental problems occasionally adversely affect production, Louisiana generally enjoys the highest annual oyster production in the nation. The 1991 dockside value of meat was $19 million (**Table 3-10**). By 1995 the dockside value had increased to $26 million (Louisiana Seafood Promotion and Marketing Board 1995).

Table 3-10. Economic Value of Shellfish and Selected Animal Hides in Louisiana, 1991 (source: Louisiana Summary, Agriculture and Natural Resources 1991).

Parish	Fishery	Number of Producers	Production (in pounds or sacks)	Value
Iberia				
	Oysters			
	Shrimp	600	5,360,576	$7,505,226
	Blue Crab	75	4,000,000	$2,000,000
	Muskrat/Nutria pelts		1,151	$ 3,309
	Alligator skins			1,379
	$550,221			
Lafourche				
	Oysters	59	107,853	$2,049,207
	Shrimp	1,716	7,100,970	$9,941,358
	Blue Crab	283	5,623,376	$2,811,688
	Muskrat/Nutria pelts		41,367	$112,032
	Alligator skins			2,710
	$1,081,290			
St. Mary				
	Oysters		5,800	$110,200
	Shrimp	110	929,149	$1,300,809
	Menhaden		52,000,000	$2,080,000
	Blue Crab	180	3,400,000	$1,700,000
	Muskrat/Nutria pelts			7,225
	$18,588		Alligator skins	
	1,646	$656,754		
Terrebonne				
	Oysters	451	60,000	$1,140,000
	Shrimp	3,407	31,242,419	$43,739,387
	Menhaden	13	253,000,000	$10,120,000
	Blue Crab	455	8,043,500	$4,021,750
	Muskrat/Nutria pelts			9,222
	$24,269		Alligator skins	
	4,753	$1,896,447		

Oysters harvested for raw-shop and over-the-counter trades are often not accurately reported. Raw-shop oysters are usually taken from natural reefs, cleaned, separated, and relocated on leased beds, where they mature to a harvestable size (McConnell 1934; Van Sickle et al. 1976). The raw-shop trade involves independent oystermen who bring their harvest to packing houses that remove the shells and pack the meat in half gallon and gallon cans that are numbered to identify the source (**Figure 3-57**). The containers were then shipped in refrigerated trucks to market. Raw shops also sell shucked oysters in bulk.

In the early 1930s, Houma was considered the "hub of this phase of the industry and [was] known from coast to coast as the Oyster City of the South" (McConnell 1934:34). A sample of the oyster houses in Houma in 1910 included: Houma Fish & Oyster Company, Pelican Lake Oyster & Packing Company, The American Oyster Depot, The St. Martin Oyster Company, Charles C. Miller and Company, The Daigle Oyster Company, Little Caillou Fish and Oyster Company, Wallace Picou and Company, John Labat and Brothers, C. Cenac and Company, Peoples Fish and Oyster Company, and Cenac and Blum (*The Southern Manufacturer* 1910).

The counter-stock trade demands oysters uniform in size, saltiness, and fat. Oysters meeting these standards are considered premium quality. They are shucked, placed on the half shell, and served at restaurant oyster bars (**Figure 3-58**). Oysters for this market are also cultivated on leased bedding grounds, but great care is taken in harvesting the reefs to produce the desired quality demanded by the restaurant business. In addition, a great deal of the harvest was steam canned. When the oysters arrived at the cannery they were dumped into latticed steel crates mounted on wheels. These "steam cars" were used to pass the oysters through a steam box, where they were heated under pressure for about five minutes. This caused the shells to open, making it easier to remove the meat from the shell. After shucking, the oyster meats are washed and placed in cans. The cans are then heated to 240°F for no more than 15 minutes.

After processing, the cans are immediately cooled and are ready to be labeled and sent to market (Fiedler 1932). In the early 1930s, Biloxi Mississippi, with 17 canning plants, was the center of this industry. However, most of these plants were handling oysters produced from Louisiana leases (McConnell 1934).

Other than adoption of the dredge and conversion from sail to motorized power, oyster harvesting methods are basically unchanged from the nineteenth century to the present. Major improvements include speed, refrigeration, and boat size—innovations that allow oystermen to travel more than 186 miles (300 km) to harvest prime reefs (Van Sickle et al. 1976).

Problems in the Oyster Industry

In the 1890s the oyster business was booming (**Table 3-11**). Factories and shucking houses were thriving from Biloxi, Mississippi (billed the "Seafood Capital of the World") to Morgan City, Louisiana, which was well known as an oyster, fish, and crab processing center (Fisher 1931; Gutierrez 1988; Sheffield and Nicovich 1979). Competition between the Louisiana and Mississippi lugger fleets, over the oyster reefs east of the Mississippi River, became so keen that both sides accused the other of being oyster pirates. The issue became a heated one. In 1905 armed boats patrolled the state boundary to insure only licensed fishermen were exploiting Louisiana's prolific oyster beds (Fountain 1985).

Timbalier Bay's oyster reefs were the focus of intense activity, particularly in the vicinity of Jacks Camp, Camp Malnomme, and Bayou Landry. Oysters were often harvested from other water bottoms, but stockpiled in these beds. In this way, oystermen

accumulated a catch that warranted a trip to the New Orleans' market. Reefs in Lake Felicity, Lake Barre (especially at Mud Bayou, Hatchet Bayou, and Muddy Bayou), and Bay Jocko were also dredged or tonged (Moore 1899, **Table 3-12**).

Table 3-11. Extent of the Wholesale Oyster Trade and the Canning of Oysters and Shrimp in Louisiana, 1890 (source: Collins and Smith 1893).

Number of firms	12
Number of employees	335
Value of property	$108,750
Wages paid	$ 67,900
Oysters handled in barrels	189,895
Value paid	$250,701
Value of oysters sold fresh	$342,164
Oysters, cans prepared	287,336
Value received	$ 34,699
Shrimp handled in pounds	1,153,469
Value paid	$ 34,604
Cans prepared	447,738
Value received	$ 77,538
Enhancement in value of products	$169,096

Table 3-12. Oyster Beds of Plaquemines, Lafourche, and Terrebonne Parishes in 1899 (source: Moore 1899).

Caminada Bay	Muddy Bayou
Timbalier Bay	Hatchet Bayou
Northern Timbalier	Little Lake Pass
Felicity	Jack's Camp
Lake Felicity	CampMalnomme
Lake Barre	Bayou Landry
Mud Bayou	Caminada Bay
Bay Jocko	Barataria Bay
Pelican Lake	Wilson Bay
Pass des Isles	Lake Chien
Sister Lake	Grand Bayou de Large
Bayou Grand Caillou	Oyster Bayou
Four League Bayou	King Lake
Bay Voisin	Lake Washa
Bayou de Large	Banana Bayou
Taylor Bayou	Champagne Bay
Bayou Jack Stout	Jack Stout Bayou
Big Bay Genope	Little Bay Genope
Bayou Provencal	Pelto Bay
Indiana Bay	Blue Hammock Bayou

* Terrebonne Parish contains the most important oyster-grounds of the State, and there are 600 boats of all kinds licensed to fish within the borders.

** There are about 200 boats licensed to harvest the natural reefs of Lafourche Parish.

*** West of Atchafalaya Bay the oyster-beds are few and considered "unimportant." The waters of Atchafalaya Bay, East Cote Blanche Bay, West Cote Blanche Bay, and some parts of Vermilion Bay are too fresh to support oysters.

As "farmers of the sea," oystermen must contend with many factors that can destroy their beds (Gunter 1955). In its infancy one of the most common problems was crevasses along the Mississippi River (Zacharie 1898). These breaks in the levee contributed freshwater to the system that temporarily influenced the oyster harvest. However, shortly after the break the reefs were "more prolific than ever" (Payne 1924:99).

Oysters are also the target of numerous predators. The oyster drill (*Thais haemostoma*) (locally known as a conch) and boring snail (*Thais floridana*) top the unwanted list, along with the black drum (*Pogonias cromis*) (Dugas 1977; McConnell 1934; McConnell and Kavanagh 1941; Van Sickle et al. 1976; Waldo 1957). Attached to the oyster, drills bore a smooth round hole through the shell and extract the meat (Chapman 1959, Van Sickle et al. 1976). The oyster has no natural defense against this enemy. The deadly predator survives only in high salinity areas. Consequently, if seed beds are located in low salinity water bodies, drills are not a serious problem (Burkenroad 1931; Galtsoff 1964). Black drum (*Pogonias cromis*) is a predator that crushes an oyster and devours its meat. When large schools congregate over a reef, the school's collective appetite can destroy a reef in less than 24 hours (Van Sickle et al. 1976). To keep these voracious eaters off the reef, fishermen encircle their beds with galvanized, wire-mesh fences.

Distribution of Oyster Leases

In 1985, nearly 22,008 square miles (57,000 km^2) of estuarine waters were identified as shellfish harvest areas (Broutman and Leonard 1988; Leonard et al. 1989; Leonard and Slaughter 1990) (**Figure 3-59**). Health hazards restrict the use of many of these beds. Harvesting restrictions are widespread throughout Louisiana. Degradation of these sites is a major political and economic concern. Even so, oystermen have learned to live with these adversities. Although oyster culture is plagued by predators, industrial wastes, and shell dredging operations, the oyster harvest continues to be an integral segment of the commercial fishing industry. It is an old established industry. In 1913, there were over 1700 persons involved in the fishery (Hart 1913) (**Table 3-13**). Today, oyster-dredging licenses consistently exceed 1000 per year, and for a small fee ($2.90/ha), these people can stake out an oyster lease. These private grounds generally represent 70 percent to 90 percent of the state's total annual harvest (Keithly et al. 1992). Leases were made for water bottoms by application submitted originally to the Conservation Commission. These were recorded and surveyed to establish lease boundaries. The first leases were made for 15 years, or until the rent was not paid in advance (Campbell 1914).

Changes in local salinity patterns have brought about changes in the location of leases. For example, in lower Terrebonne Parish during the early 1800s, there were no oysters north of Bayou Lagraisse, nor were there any within the small bayous that feed into Lake Barre. Because of drainage changes initiated by the excavation of logging canals, oysters had moved inland to these areas by 1900 (Moore 1899).

Table 3-13. Louisiana's Commercial Oyster Industry, 1913-1914 (source: Campbell 1914).

Description	1913	1914
Factories and shucking plants operating in Louisiana	4	6
Total Oysters Canned	195,672 barrels	241,538 barrels
Shucking plants or raw shops operating in Louisiana	48	51
Total Oysters Canned, Shucked and Shipped	175,928 barrels	195,634 barrels
Canning factories out of the state operating with oysters taken from Louisiana waters	5	7
Total Oysters Canned	197,535 barrels	207,852 barrels
Shucking plants or raw shops out of state operating with oysters taken from Louisiana waters	16	14
Floating Equipment engaged in the industry		
Power dredges	7	15
Sail dredges	41	83
Schooners	276	235
Gasoline boats	342	291
Luggers	415	367
Skiffs	61	25
Flats	35	10
Cat rigs	0	18
Sloops	0	34
Total	1177	1078
Total Oysters Canned, Shucked and Shipped	124,554 barrels	117,856 barrels

During the late 1800s, at least 20 camps were located in Terrebonne Parish on Bayou du Large between the Gulf of Mexico and Sister Lake. Oyster camps also fringed Pelican Lake. With a relatively small fleet of boats working the beds, from 4 to 8 barrels per day were taken from Sister Lake's reefs alone. Since the reefs were not initially worked, numerous boats began in 1898 to tong the water bottoms for Morgan City canneries (Moore 1899). It is a region that continues to serve the oyster industry well. In fact, seed oysters obtained from Sister Lake and Bay Junop were used in bedding grounds throughout the region (McConnell 1932; Payne 1920; **Figure 3-60**). In May, 1917 the state planted more than 16,000 barrels of shells in Sister Lake to increase the region's yields (Payne 1918).

In 1913, Louisiana oystermen leased almost 2,800 acres (1,134 ha) of bedding grounds (Hart 1913). In 1950 there were 5,200 acres (2,106 ha) under lease—a relatively small increase in nearly 40 years. By 1970 leased acreage was reported at 19,600 acres (7,938 ha) and almost doubled to 37,600 acres (15,228 ha) by 1980. In 1988 leased water bottoms had

expanded to more than 52,450 acres (21,242 ha) (Keithly et al. 1992). Areal expansion is directly linked to the industry-wide practice of not using the entire lease. This procedure allows leases to recover naturally from oyster dredging operations. In addition, oystermen report biannually harvesting a lease reduces the threat of predators.

Because of the salinity requirements for oyster growth, oyster leases are purchased in waters that are considered brackish. If there is too much salt water the oysters are exposed to predators; if there is too much fresh water the oysters die. For this reason, the distribution of oyster leases is a very good indicator of water salinity. One of the topics of interest in the present study is how the oyster lease areas have changed through time.

In 1914 there were no oyster leases in St. Mary and Iberia parishes and only 5 leases totaling 227 acres (92 ha) in Vermilion Parish. The only area of reported oysters was in Vermilion Parish near Marsh Island (i.e., at Southwest Pass). Oyster growth was hampered in Atchafalaya, East Cote Blanche, West Cote Blanche, and Vermilion Bays by fresh water from the Atchafalaya River. It was believed at that time that "this entire territory, however, could be made oyster producing by the removal of Point-au-Fer Shell Key, thus permitting the free flow of the Atchafalaya River to the Gulf" (Conservation Commission of Louisiana 1912-1914:124). Despite extensive dredging of the Point au Fer reef by shell dredging companies (US Army Corps of Engineers 1987:Appendix D) and the breach cut through the Point au Fer reef in 1916 for a ship channel (Payne 1920), the salinity of the western bays does not appear to have changed significantly between 1912 and 1924 (**Tables 3-14** and **3-15**; **Figure 3-61**). The increased salinity reported by Payne for the Vermilion Bay area in 1920 was a temporary change. The return to fresher conditions was perhaps due to the steady increase in Atchafalaya River flow occurring at the same time.

When the 1920 distribution of oyster producing areas is compared to the distribution of oyster leases for 1998, it is obvious that in recent years the oyster-producing zone has shifted inland in the Terrebonne Marsh region (**Figures 3-61** and **3-62**). For example, recent marsh deterioration west of Bayou Pointe au Chien (**Figure 3-63**) has accompanied the northern expansion of oyster growth at least ten miles (16 km) inland to the vicinity of Isle de Jean Charles (**Figure 3-64**) and oyster leases have been issued immediately west of this community. This shift reflects the response of oyster growth to land loss in this area. One other interesting observation is the lack of oyster production in East Cote Blanche, West Cote Blanche, and Vermilion bays between 1920 and 1998. The only significant change in oyster production for this huge bay area is the loss of oyster production from within Southwest Pass at the west end of Marsh Island. In the early twentieth century, sporadic oyster production probably occurred within the western bays during years when Atchafalaya River flow was lower than normal. However, since at least 1914, Vermilion Bay was not a productive oyster area compared to other coastal estuaries farther east. Within Vermilion Bay, the only productive oyster areas were along the western periphery of the bay, including Southwest Pass, Bayou Fearman, and Hell Hole Bay. In 1933, for example, the production of Iberia Parish was only 480 barrels and in Vermilion Parish it was only 390 barrels. These totals included production from the more lucrative oyster reefs south of Marsh Island in Iberia Parish and from Vermilion Parish leases along the coast west of Southwest Pass. By comparison, in that same year Terrebonne Parish produced almost 67,000 barrels and

Table 3-14. Oyster Producing Regions, 1914-1920 (source: Campbell 1914; Payne 1920).

Parish	Description of oyster producing region
Lafourche	The oyster region includes part of Caminada Bay, Lake Raccourci, Timbalier Bay and its tributaries. By 1920 Bay Leau Douce, China Bay, Bay Creux, Bay Canard Gris and adjacent waters had been added to the list of productive beds. The industry encompasses about 3000 acres. Number of acres under lease 1203.59 Number of active leases 95.00 Average size of a lease in acres 12.61 Fresh water associated with the crevasse at Hymelia in the spring of 1912 destroyed a great deal of the parish's oyster crop. In fact, "the fresh water crevasses occasionally, but only temporarily, effected productive capacity of Louisiana's oyster beds" (Zacharie 1898:297). It was suggested the levee board "construct locks at the head of Bayou Lafourche in order that fresh water can be secured from the Mississippi" to help sustain the oyster crop (Campbell 1914:123). Reefs in Timbalier Bay were destroyed because of the closure of Bayou Lafourche. The region no longer got the volume of fresh water necessary to keep the reefs healthy (Payne 1920)
Terrebonne	The oyster producing bottoms of Terrebonne extended from the west shore of Timbalier Bay on the east to Atchafalaya Bay, including Point-au-Fer. Approximately 122,000 acres were involved. By 1920 Bay Junop and Sister Lake had been set aside by legislation as seed ground and were not subject to lease (Payne 1920) Number of acres under lease 7808.24 Number of active leases 606.00 Average size of a lease in acres 12.87 It was suggested that Terrebonne offered "the greatest opportunity for oyster culture; its ... fine bottoms and depleted reefs present all of the advantages for the production of fine stock in large quantities" (Campbell 1914: 124). Oysters in Atchafalaya Bay never reach maturity. The annual input of fresh water from the Atchafalaya basin destroyed their growth and development. Each year a new crop grew on the dead shell and the following spring these were killed. The cycle was repetitive creating the Point-au-Fer shell reef between Point-au-Fer and Marsh Island serving as an effective barrier to the waters of the Gulf of Mexico (Payne 1920).
St. Mary, Iberia, Vermilion	In 1914 these parishes were classed as oyster producing, but in point of fact they were not actively involved in the industry. The problem was that the available oysters were destroyed annually by the fresh waters that drained into the Gulf from the Atchafalaya River. In 1914 there were in Vermilion parish five leases involving a total of 267.37 acres.

(continued)

Table 3-14. Concluded.

Parish	Description of oyster producing region	
Iberia	By 1920 the oyster-producing regions of Iberia Parish were closely identified with Marsh Island, along with the bayous leading into the island and Southwest Pass to Vermilion Parish contained 4000 acres of oyster bottoms. Few oysters were taken from this area until about 1916 when the "Ship Channel" was constructed through the Point-au-Fer reef. The channel reduced dramatically the quantity of fresh water impounded in the region. The change in hydrology allowed oysters to grow in the region; it was no longer too fresh. Oysters harvested in these water were taken to local markets in Lafayette, Abbeville, Lake Charles and the towns and residents along Bayou Teche. Some were marketed in Morgan City (Payne 1920).	
	Number of acres under lease	565.00
	Number of active leases	15.00
	Average size of a lease in acres	37.67
Vermilion	By 1920 the principal oyster ground in the parish were in Vermilion Bay, Hell Hole Bay, Bayou Fearman, Southwest Pass and the Gulf of Mexico opposite Southwest Pass. The industry, however, "labored under the same disadvantages as Iberia Parish due to the waters of the Atchafalaya River" (Payne 1920:139). With completion of the "Ship Channel" conditions in the region improved, since Atchafalaya River water could easily move out of the region.	
	Number of acres under lease	391.75
	Number of active leases	5.00
	Average size of a lease in acres	78.35

* In 1914, Louisiana had more oyster bottoms than all of the other oyster producing states combined. More importantly, Louisiana's oysters matured in 20 months, while in northern waters it took up to five years to obtain the same results. Two crops per year could be produced in Louisiana, compared to only one in northern environments (Campbell 1914).

Lafourche Parish produced over 29,000 (McConnell 1933:235). Since at least the early twentieth century, oyster production has been continuous along the south side of Marsh Island (**Figure 3-65**). The 1920/1998 comparison of oyster producing areas indicates that salinity within the three western bays has declined since 1920, but this decline has not been substantial. With perhaps the exception of the western periphery of Vermilion Bay, the 1998 conditions are probably similar to those observed between 1914 and 1920 (see Table 3-13), prior to the extensive dredging of the Point au Fer oyster reef. Salinities in the western portion of Vermilion Bay have probably been further reduced by Atchafalaya River flow that enters the bay from the GIWW via several natural channels and numerous newer openings, including the breach at Weeks Bay, Vermilion River Cutoff, and Freshwater Bayou Canal.

The modern oyster lease distribution is indicative of the inland settlement pattern with regard to the locations of oyster processing facilities, boat docking areas and residential areas of people engaged in the oyster business. Oystermen live near and operate out of ports that are in close proximity to the most productive areas. Oyster boats and seafood houses handling oysters are most common along Bayou du Large (**Figure 3-66**), which has served as a port for the oyster industry for many years (**Figure 3-67**). Oyster houses and oyster boats appear to be less common along bayous Terrebonne, Grand Caillou, Petite Caillou, and

Table 3-15. Leased Oyster Water Bottoms, 1914-1924 (source: Campbell 1914; Payne 1918, 1920, and 1924).

Parish	1914	1918	1920	1924
Lafourche				
No. of acres under lease	1203.59	840.48	1228.87	1210.10
No. of active leases	95	85	91	116
Average size of a lease in acres	12.61	9.9	13.50	10.43
Terrebonne				
No. of acres under lease	7808.24	7513.54	7650.71	9157.88
No. of active leases	606	616	646	855
Average size of a lease in acres	12.87	12.20	11.85	10.71
Iberia				
No. of acres under lease	267.37*	1189.74	565	760.00
No. of active leases	5	8	15	6
Average size of a lease in acres	53.47	148.72	37.67	126.66
Vermilion				
No. of acres under lease			391.75	413.00
No. of active leases			5	4
Average size of a lease in acres			78.35	103.22

* Data are an aggregate for St. Mary, Iberia, and Vermilion parishes.

Pointe au Chien. West of the Atchafalaya River, the Southwest Pass oyster leases are worked by only a few oyster boats operating out of Cypremort Point (**Figure 3-68**), the Port of West St. Mary (**Figure 3-69**), and a few other small fishing ports in the Vermilion Bay area. In 1992, there were no oyster harvesters registered in St. Mary Parish, only 2 in Iberia Parish and only six in Vermilion Parish. By comparison, there were 111 in Terrebonne Parish and 24 in Lafourche Parish (**Appendix B**).

The future of Louisiana's oyster industry will depend, in part, on the environmental changes taking place along the coast. Salinity-dependent healthy oyster beds are confined generally to polyhaline zones, with salinities that range from 18 to 30 ppt (Dugas 1977; Van Sickle et al. 1976). Sea level rise, subsidence, and other factors are contributing to salinity increases within many interdistributary basins (Barrett 1970; Morgan 1972). With the rise in salinity, and provided firm substrata is available, oyster populations could actually increase, assuming the beds are not affected by high coliform counts. Indeed, Louisiana's oyster harvest, while exhibiting wide fluctuations on a yearly basis, has clearly increased.

Pathogens–Bacteria and Viruses

Pathogens are disease-causing bacteria and viruses that can contaminate fish and shellfish and the number of cases of illness linked to eating contaminated fish and shellfish remains a nationwide concern. More than 4500 cases of shellfish-associated gastroenteritis, believed to be caused by viruses, were documented between 1980 and 1989. For more than 30 years, high coliform levels and salinity changes have plagued Louisiana's oyster beds. High coliform levels have resulted in numerous closures (Craig and Day 1977; Minerals Management Service 1995; U. S. Department of Agriculture 1986; Van Sickle et al. 1976). In the southern and western parts of Houma, seafood processing plants, some businesses and households pump raw sewerage and effluents into the region's bayous, contributing to high levels of fecal coliform and other toxins. This problem is being resolved by the Terrebonne Pollution Control unit and the Board of Health which are requiring homes and businesses outside of the sewerage controlled areas to install individual treatment plants to help alleviate the problem (Sevier 1990). Throughout the Gulf region, State and Federal agencies regulate the harvest in shellfish growing areas, largely because eating contaminated shellfish can result in typhoid fever, infectious hepatitis, gastroenteritis and cholera. These restrictions range from administrative rules to degraded water quality, which is the essential problem in south Louisiana because of the viruses and bacteria that can enter oysters and other mollusks through contaminated water (Gulf of Mexico Program 1996; Louisiana Department of Health and Hospitals 1997).

The Department of Commerce, Gulf of Mexico Program's Shellfish Challenge, designed to address shellfish-related problems, resulted in 32 strategies to improve the safe harvest of shellfish in the Gulf of Mexico. The top five strategies, as determined by the participants in the program were to: "connect poorly operating septic systems to wastewater treatment plants; reduce inputs of fecal coliform bacteria in runoff from densely populated areas; use existing reservoirs or diversions to impact high salinity growing waters (greater than 25 ppt); enhance cultch/substrate in areas of optimum salinities (10-25 ppt salinity); and develop a better risk-assessment system for classifying shellfish growing waters" (Gulf of Mexico Program 1996:1).

Human exposure can occur not only from eating contaminated shellfish, but also from swimming and other water contact sports in water bodies that in some way are contaminated. High levels of bacteria in waters at various times have led to beach closures, particularly along the North Atlantic coast and the Great Lakes. Those beach closures can be a community's worst nightmare because they often occur during the height of the tourist season.

Pathogens can come from agriculture and urban runoff, malfunctioning septic tanks or sewage plants, or combined storm/sewer overflows that bypass treatment during storms. Overboard discharges from small or recreational boat toilets also lead to introduction of pathogens into the waterways. To counteract part of this problem, sewage treatment plants were built and upgraded with grants under the Clean Water Act and have significantly improved the situation.

To guard against contaminated oysters, the State of Louisiana published a set of general harvest rules. These included:

- All shellstock harvested for either commercial or recreational purposes must come from waters classified or reclassified as approved or conditionally approved by the state health officer.
- Unless otherwise specified, oysters cannot be harvested within a 50-yard radius (150 ft or 46 m) of all manmade habitable structures. This closure is measured from the point of waste discharge. It is illegal to harvest shellfish within this designated area.
- The state health officer can order immediate closures to protect public health or upon request of the Department of Wildlife and Fisheries Secretary.
- When harvesting close to a classification/reclassification line, the harvester is responsible for knowing if he is in approved waters.
- Sometimes buoys or other field markers are used to show the boundaries of classified or reclassified areas. They follow the approximate positions show on the official classified/reclassified area maps.
- Boundaries, for enforcement purposes, are as identified by the buoys or field markers. Removing or relocating buoys or markers by unauthorized personnel will result in immediate closure of the area until such time as the proper boundary can be determined.
- It is the harvester's responsibility to know the classification of the growing area before conducting any harvest activity. If the area is conditionally managed, it is the harvester's duty to know if the area is approved for harvesting before performing any type of harvest activity.
- All oysters on a harvest vessel in Louisiana waters shall be considered to be oysters taken from state waters.
- Vessel captains are required to possess valid oyster harvesting licenses.
- Oysters harvested from state-owned shellfish growing areas for sale or consumption must be landed in Louisiana.
- Culling of legally harvested oysters is prohibited while in areas closed to harvest.
- It is illegal to harvest oysters _ hour after sunset to _ hour before sunrise.
- An official Louisiana Department of Wildlife and Fisheries harvester's tag must be applied to each container of oysters. It is imperative that the required information entered on tags be accurate and legible" (Louisiana Department of Health and Hospitals 1997:5-6).

Menhaden

Menhaden (*Brevoortia patronus*) or "pogie" support one of the oldest fisheries in the Gulf of Mexico. In 1880, less than 1,000 pounds (455 kg) 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 1950s. In 1971 more than 1.6 billion pounds (730 million kg) of menhaden passed through Gulf of Mexico ports. This amounted to nearly 75 percent of the United States' harvest. Since this record catch, landings

from the Gulf of Mexico have exceeded or approached 1 billion pounds (495 million kg). The Louisiana pogie fleet annually harvests between 600 million and 1 billion pounds (330 to 495 million kg) of this industrial fish. Most of these fish are harvested in the waters that fringe the Louisiana coast; a particularly productive area is located in and around the Mississippi delta. From these waters, menhaden fishermen harvest a catch worth, in most years, in excess of $10 million. In 1995 the menhaden catch was worth about $73 million (Louisiana Seafood Promotion and Marketing Board 1995). All of the fishing is done offshore with the exception of Breton and Chandeleur Sounds (**Figure 3-70**).

Among Louisiana's commercial fishery, the menhaden harvest has the greatest weight and has been the principal contributor to making Louisiana a national leader in fisheries production. However, in late 1995 the large menhaden processing facility south of Houma closed because of the "dead zone" in the Gulf of Mexico. Closure of this plant has certainly affected the local economy and the status of the region's fish processing. Despite the loss, the port of Dulac-Chauvin is still one of the nation's largest, ranking ninth in quantity harvested and sixth in dockside value in 1995 (Louisiana Seafood Promotion and Marketing Board 1995). In addition, it is necessary to maintain the estuarine environments utilized by the young fish in the early stages of their development. 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 fishery.

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 (**Figure 3-71**). Although commercial fishermen used baited lines to catch crabs during the early twentieth century (**Figure 3-72**), the modern industry is dominated by use of the baited crab trap (**Figures 3-73 and 3-74**). Commercial crabbing occurs all along the Louisiana coast and crabbers use small boats designed to carry several dozen wire traps at a time (**Figures 3-75, 3-76, and 3-77**). Crabs are caught live and are shipped in wooden boxes or crates (**Figures 3-78 and 3-79**). While crabbing is a year-round activity, periods of concentrated efforts correspond to the summer and spring shrimp season. In both periods, fishermen harvest hard- and soft-shelled blue crabs (*Callinectes sapidus*).

Jaworski (1972) reports that as a commercial enterprise one of the earliest blue crab fisheries in the United States developed near New Orleans. In fact, in 1908 crabmeat produced in Louisiana was valued at $21,000. By 1938 Louisiana ranked third in the nation in crab harvest. The one to five pound containers used in the industry were hand picked and graded into three classes, the "lump" meat from the back fins, the "white" or "flake" meat from the smaller muscles and the "claw" meat. In order to reduce the industry-generated waste, shells, together with other refuse, were dried and ground into animal feed and fertilizers that brought the processor about $25 to $30 a ton (Clay 1938). In a typical early twentieth century operation, the catch was boiled alive for about 20 minutes. Factory workers then "picked" out the meat and packed it in one-pound cans, which were sealed and

then placed in cold storage. The people employed in the industry added several hundred dollars a day to the local economy (Fisher 1931).

Southern Pacific rail connections to Morgan City were critical, since local fish dealers had a means to ship their perishable cargos quickly to market. There were three trains a day that served the city. Crabs, oysters, shrimp, catfish, gaspergoo (or freshwater drum) and buffalo were the principal fishery products shipped (Fisher 1931). In fact, the fish shipping business from Morgan City was one of the region's most important economic activities.

By 1930, at least 600 people were working in crab processing plants in Berwick and Morgan City. Consequently, along with the region's oyster shucking operations, fishermen were making a conscious effort to fish for crabs. Lines were used in this fishery and the crabs caught in this manner were brought into the boat and covered with "green" moss. Transfer boats were used to unload the catch and bring it to the Morgan City/Berwick docks.

Blue crabs occupy many different habitats, but the greatest numbers are caught in periods of low salinity and temperature. Optimal conditions include shallow water, mud and/or mud-shell bottoms, detrital matter, tidal fluctuation, warm temperatures, and mid-to-low salinities (Adkins 1972). If any of these variables are changed, as they will with the disappearance of the region's barrier islands, the industry will be affected. Currently, the crab industry has increased noticeably in recent years, primarily because of the large number of former oil industry personnel who now make their living in the fishing industry. Unfortunately, there are now so many people in the crab and shrimp fishery that the resource is becoming saturated. Competition is intense and catch per effort has been reduced. Even so, overall Louisiana produces between 50 percent and 70 percent of the Gulf region's annual harvest of blue crabs. Further, the state is responsible for 15 percent to 25 percent of the nation's annual harvest. As a result, the dockside value of this fishery is about $20 million annually (Keithly 1991). In 1992 there were about 750 commercially licensed crabbers within the five-parish study area (**Appendix B**).

Distribution of Marsh Structures within the Study Area During the 1930s

During the nineteenth and early twentieth centuries, two types of buildings were located within Louisiana coastal marshes: 1) dwellings (either seasonal or permanent) used by commercial fishermen, hunters, and trappers during the harvesting of coastal resources, and 2) seasonal camps constructed strictly for recreational purposes. The dwellings of marsh dwellers far outnumbered recreational camps, particularly in remote areas that required an extended boat trip to reach (**Figure 3-80**). Only the wealthy could afford to take the time necessary to reach these remote areas.

The locations and distribution of nineteenth century marsh dwellings were rarely recorded because these structures were often difficult to reach and maps were generally very unreliable. The USGS topographic quadrangle maps of the 1930s were the first to utilize aerial photography. Use of aerial photography permitted mapmakers to draft with greater detail than before and this allowed the depiction of physical and cultural features even in very remote areas. These maps are particularly useful because they illustrated buildings when

they were visible on aerial photographs. By using the 1930s USGS quadrangle maps of the study area, the distribution of marsh structures was plotted on a modern map base (**Figure 3-81, Table 3-16**). Although the identity or function of these structures is very difficult if not impossible to determine, it can be assumed that most of these buildings were the residences of fishermen, hunters, and trappers who made their living from resources found in the marsh and coastal water bodies.

Fishing Ports

All of the early towns within the study area developed along waterways and all contained some form of port facility. Major fishing ports included Houma, Morgan City, and Delcambre. Probably the two largest shrimp boat fleets operating in the area were docked at Morgan City and Delcambre (**Figures 3-82** and **3-83**). Today, seafood-processing plants can be found along every bayou that can float a shrimp trawler, crab skiff, or oyster lugger. Fishing fleets of varying sizes can be observed from one end of the study area to the other, from Freshwater Bayou Lock and Intracoastal City all the way over to Bayou Lafourche (**Figures 3-76** and **3-84**). Unlike oil and gas servicing industries, which tend to cluster in ports at strategic locations, fishing ports and fishing boat service facilities are widely dispersed along the banks of the numerous bayous of south Louisiana (**Figure 3-85**). While driving down the road along the navigable portions of Bayou du Large or Bayou Pointe au Chien or many of the other bayous, it is not unusual to find a fishing boat tied to a dock in front of every second or third house. As noted previously, oyster boats and processing facilities are more common in Terrebonne Parish than in the area west of the Atchafalaya River.

Wetlands Trapping and Hunting in French Louisiana

Louisiana's fur industry dates to the 1700s, but the state did not become a significant fur producer until the twentieth century. At its height, the trapping industry provided employment for 20,000 people. Now less than a third of that number are licensed trappers (**Figure 3-86**). In less than 50 years the marsh dweller transformed Louisiana's alluvial lowlands into the country's preeminent fur-producing region. Even so, few people recognize Louisiana is a major fur-producer. The region's subtropical marshes were ignored by trappers until the 1800s when alligator (*Alligator mississippiensis*), mink *(Mustela vison*), otter (*Lutra canadensis*) and raccoon (*Procyon lotor*) were recognized as valuable hide-and fur-bearing animals. The fallacy that quality furs came only from cold climates was unfounded; within 150 years Louisiana's marshes became North America's preeminent fur producing habitat.

Muskrat and Nutria

The fur trade's spectacular growth was a result of the willingness of the local inhabitants to exploit muskrat (*Ondatra zibethicus rivalicius*) and nutria (*Myocastor coypus*) also known as South American beaver, swamp beaver, and coypu. Although muskrat inhabited the wetlands, Arthur (1931) and O'Neil (1949) did not uncover any documents suggesting their pelts were included in the early French fur trade. Colonial fur buyers regarded the muskrat as worthless. It remained unwanted until 1914 when pelts began to

Table 3-16. Locations of Marsh Buildings Visible on USGS Topographical Quadrangle Maps From the 1930s (see Figure 3-81 for plot of map locations).

Note: In all cases, these are named sites or represent isolated structures that appeared to be "camps," "structures," or "homes;" these bayou settlements are only rarely mentioned and/or considered in available literature.

No.	Settlement Name	Description (Where Appropriate)	Location	Date
1	Bayou Chene	Several "camps"	15S-2E Sec. 1	1932
2	Coles Bayou	Several "camps"	15S-2E Sec. 12	1932
3	Fearman Lake & Vermilion Bay	Several "camps"	16S-3E Sec. 3	1932
4	Gordon Camp		16S-3E Sec. 6	1932
5	Belle Isle Bayou	Several "camps" along the bayou	16S-2E Sec. 1	1932
6	Chenier Au Tigre	Identifies St. Francis Church and a school, there are at least 25 structures shown	17S-2E	1932
7	Mayo Bayou	Several scattered "camps"	15S-3E Sec. 11	1932
8	Green Island Bayou	Several scattered "camps"	15S-4E. Sec. 6	1932
9	Caldwell Camp	An 11 camp cluster	14S-4E Sec. 34	1932
10	Boston Bayou	Eight "camps" scattered along the bayou	14S-4E Sec. 21	1932
11	Lighthouse		15S-4E Sec. 36	1932
12	Portage Lake	Two houses	16S-4E Sec. 36	1932
13	Lem Hawkins House		17S-7E Sec. 15	1932
14	Oak Canal	Five scattered "camps" shown on the canal	14S-5E Sec 17	1932
15	Avery Island		13S-6E Sec. 36	1932
16	Petite Anse canal	Two isolated "camps"	13S-6E Sec. 44	1932
17	Weeks Island		14S-6E Sec.37	1932
18	Cote Blanche Island		14S-6E Sec. 22	1932
19	Bayou Mascot	One structure	15S-8E Sec. 14	1932
20	Cow Island Bayou	One structure	15S-9E Sec. 21	1932
21	Cow Island Bayou	One structure	15S-9E Sec. 27	1932
22	Bayou Long	Two structures	16S-8E Sec. 12	1932
23	Bayou Carlin	Two structures	16S-8E Sec. 23	1932
24	Jackson Bayou	One structure	16S-8E Sec. 24	1932
25	Yellow Bayou	Five structures	West of Sound Bend	1932
26	Negro Hammock	Maybe a settlement	17S-10E	1932
27	Belle Isle	Two structures	17S-10E Sec. 36	1932
28	Live Oak Hammock	Maybe a settlement	18S-11E Sec. 2	1932
29	Wetfoot Hammock	Maybe a settlement	18S-11E Sec. 1	1932
30	Shrimp Platform on Point au Fer	Maybe a settlement		1930
31	Little Hammock on Point au Fer	Maybe a settlement		1930
32	Locust Bayou on Point au Fer	Two structures	21S-12E Sec. 2	1930
33	Deer Island	Two structures	18S-12E Sec. 17	1930
34	Pharr	59 structures	15S-12E Sec. 30	1930
35	Oakland	33 structures	16S-13E Sec. 41	1930
36	Glenoine	86 structures	16S-13E Sec. 43	1930

(continued)

Table 3-16. Continued.

No.	Settlement Name	Description (Where Appropriate)	Location	Date
37	Bayou Black Settlement	28 structures	17S-13E Sec. 1	1930
38	Bayou Chene	15 structures	17S-13E Sec. 3	1930
39	Bayou Shaffer	27 structures	17S-12E Sec. 11/12	1930
40	Avoca Island	54 structures on the Island	16S-12E Sec. 36	1930
41	Towhead Bayou	Three structures	17S-12E Sec. 26	1930
42	Cutoff Bayou	One structure	18S-12E	1930
43	Lower Pass	One structure	17S-12E Sec. 35	1930
44	Crooked Bayou	Two structures	18S-12E Sec. 34	1935
45	Plumb Bayou	Five structures	19S-12E Sec. 12	1935
46	Palmetto Bayou	Three structures	19S-12E	1935
47	Creole Bayou and tributaries	20 structures	19S-13E	1935
48	Big Carrion Crow Bayou	64 structures	20S-13E	1935
49	Alligator Bayou on Point au Fer	Three structures		1935
50	Mosquito Bayou on Point au Fer	10 structures associated with Steinberg's Camp	20S-12E Sec. 33	1935
51	Little Mosquito Pass	Four structures	21S-12E Sec. 3	1935
52	Wildcat Bayou	Four structures	20S-12E Sec. 21	1935
53	Mosquito Bayou	Six structures	20S-12E Sec. 26	1935
54	Lookout Tower	Two structures	20S-12E Sec. 13	1935
55	Carrion Crow Bayou	Seven structures	19S-14E Sec. 13	1935
56	Bayou Sanbout	10 structures	20S-14E Sec. 4	1935
57	Blue Hammock Bayou	Four structures	20S-14E Sec. 20	1935
58	Violin Bayou	Five structures	20S-14E Sec. 30	1935
59	Shrimp Platform	Four structures	21S-13E Sec. 17	1935
60	Vouvia Bayou	Three structures	21S-13E Sec. 16	1935
61	Oyster Bayou Lighthouse			1935
62	Shrimp Platform	Five structures	21S-13E Sec. 35	1935
63	Shrimp Platform	Five structures	21S-13E Sec. 20	1935
64	Bay Junop	Six structures	21S-14E Sec. 13	1935
65	Bayou de West	Two structures	21S-14E Sec. 31	1935
66	Bayou du Large	Nine structures located in a number of sections	21S-14E	1935
67	Mud Hole Bayou	Three structures	21S-14E Sec. 17	1935
68	Shrimp Platform near Proveausal Bayou	Six structures	21S-14E Sec. 33	1935
69	Bayou Penchant near Bayou Copasaw	Three "camps"	18S-15E Sec.30	1935
70	St. Paul Bayou	One structure	18S-15E	1935
71	Little Carencro Bayou	Three "camps"	19S-14E Sec. 24	1935
72	Mauvais Bois	Four "camps"	19S-15E	1935
73	Bayou DeCade	Five "camps"	19S-15E Sec. 33	1935
74	Bayou Chevreau near Lake Mechant	Five "camps"	20S-15E	1935
75	Petit Chevreau	Five "camps"	20S-15E Sec. 26	1935
76	Bayou Du Large	Five "camps"	21S-15E Sec. 1	1935
77	Hogs Point	One "camp"	20S-15E	1935
78	King Lake	Two "camps"	21S-14E Sec. 11	1935
79	Fish Bayou	12 "camps"	22S-15E Sec. 6	1935
80	Redfish Bayou	14 "camps"	22S-15E Sec. 4	1935
81	Bayou Grand Caillou	Three"camps"	22S-15E Sec. 4	1935

(continued)

Table 3-16. Continued.

No.	Settlement Name	Description (Where Appropriate)	Location	Date
82	Turtle Bayou	Two "camps"	22S-15E Sec. 16	1935
83	Isles Dernieres	Scattered camps		1935
84	Grand Pass Des Ilettes	One "camp"		1935
85	Marmande Ridge	Eight structures	19S-16E Sec. 3	1935
86	Small Bayou at the end of the road	Three structures	19S-16E Sec. 3	1935
87	Bayou Du Large	Many structures with six South of the bayou		1935
88	China/China Island	Seven "camps"	21S-16E Sec. 29	1935
89	Dog Lake Bayou	Two "camps"	22S-16E Sec. 6	1935
90	Dog Lake	One "camp"	22S-16E Sec. 6	1935
91	Pass Wilson	One structure		1935
92	Coteau Charles with access from Falgout Canal	Nine structures	19S-17E Sec. 69	1935
93	Bayou Chauvin	Two structures	19S-18E Sec. 69	1935
94	Lake Quitman/Boudreaux on Bayou Chauvin	Six structures	19S-18E Sec. 83	1935
95	New Canal	Three "camps"	19S-18E Sec. 74	1935
96	Lake Gero at Lake Boudreaux	One structure	19S-18E Sec. 74	1935
97	Mound Bayou	12 structures	20S-17E Sec. 8/17	1935
98	Bayou Grand Caillou	11 structures	20S-17E Sec. 17	1935
99	up the bayou to Bayou Dulac	40 additional structures	ca. 20S-17E Sec. 17	1935
100	Bayou Bluff	Two structures	20S-17E	1935
101	Four Point Bayou	Nine structures	20S-17E	1935
102	Bayou Platt	Two structures	20S-17E Sec. 21	1935
103	Alligator Bayou	Three structures	21S-17E Sec. 4	1935
104	Bayou Sale	13 structures	21S-17E Sec. 10	1935
105	Small "unnamed" Bayou	Three structures	21S-18E Sec. 96	1935
106	Sevin Canal	Two structures	21S-18E Sec. 33	1935
107	Cocodrie	13 structures	21S-18E Sec. 42	1935
108	Bayou Petit Caillou	One structure		1935
109	Bay Coon Road	Five structures	22S-18E Sec. 17	1935
110	Tambour Cut-Off	One structure	21S-18E	1935
111	Madison Canal	16 structures on Bayou Terrebonne south of the canal	19S-19E	1935
112	Grand Bayou	One structure	19S-19E Sec. 41	1935
113	Grand Bayou Boudreaux	One structure	19S-19E	1935
114	Petit Bayou Boudreaux	One structure	19S-19E	1935
115	Flat Bayou	One structure	19S-19E	1935
116	Pointe Barre	Nine structures	19S-19E Sec. 32	1935
117	Oyster Bayou	Two structures	19S-19E	1935
118	Bayou Tambour	Four structures	19S-19E	1935
119	Seebreeze Pass	Eight structures on the Pass	21S-18E Sec. 22	1935
120	Bayou Blue	12 structures with a road to LaRose	18S-20E Sec. 2	1939
121	Bayou connecting with Grand Bayou Canal	Two structures	19S-20E Sec. 11	1939

(continued)

Table 3-16. Concluded.

No.	Settlement Name	Description (Where Appropriate)	Location	Date
122	Bayou Pointe Au Chien		19S-19E	1939
123	Isle St. Jean Charles		19S-19E	1939
124	Faleau	Five structures	19S-20E Sec. 20	1939
125	Bayou Sevin	Three structures	20S-21E	1939
126	Bayou Jean Lacroix	8 structures on N end of the Bayou near Cut-Off Canal	19S-20E Sec. 29	1939
127	Bayou Jean Lacroix	Two structures on S end of Bayou	20S-20E Sec. 9	1939
128	Bayou Pointe Au Chien	Five structures on Bayou south of Cut-Off Canal	20S-20E Sec. 1	1939
129	Lake Chien	Two structures	20S-20E	1939
130	Brush Island		20S-20E	1939
131	Marsh Island	Several scattered single dwellings shown of the Is.		1932
132		Two "camps" on two small unnamed bayous into Lake Boudreaux	18E Sec. 84	1935

appear on the fur market (Chatterton 1944). In a relatively short period of time the muskrat was destined to become Louisiana's preeminent fur-bearer—a title it ultimately relinquished to the nutria. The Louisiana Department of Conservation in the late 1920s had set up experimental muskrat plots on their fur experimental farm on Avoca Island. Each plot was about one tenth of an acre and was the first attempt by the state to better understand muskrat behavior.

Muskrats build homes of woven-marsh grass, plastered with mud and rising about two to three feet (.7 to 2.7 m) above the marsh surface. These mounds are bases from which the animals can forage into the surrounding terrain. Since the mud heaps identify the muskrat's brackish-water habitats, trappers use mound density as an indicator of a region's productive value and set their traps accordingly. Muskrat are primarily vegetarians and prefer stems, roots and tubers. Their normal dietary intake often is as much as one-third of their body weight per day (Murchison 1978). To improve the commercial harvest, marsh dwellers burn the paludal surface, removing the less desirable vegetation (**Figure 3-87**). The conflagrations were a rarity before 1910, but by the 1920s, burning was well established and is now a local culture trait. The fires promoted growth of three-cornered grass (*Scirpus olneyi*)—the preferred vegetation of the muskrat.

Unlike the indigenous muskrat, nutria, or South American *coypu*, are alien animals. Although nutria were first released in Louisiana marshes in the early 1930's near New Orleans, they were reportedly all recovered by trappers shortly afterward (Evans 1970). The existing Gulf coast nutria population dates back to 1937 when six pairs and an extra female were shipped from Argentina to E.A. McIlhenny of Avery Island for experimental breeding stock purposes (Davis 1973). After escaping captivity in 1938, this Argentina rodent expanded its range to include most of Louisiana's swamps and marshes. Quickly, the prolific

rodent began to replace the muskrat. In 1942-43 the first colony was noticed 30 to 40 miles (48 to 64 km) west of Avery Island (Morgan and O'Neil 1976). This animal was new to the trappers who found it replacing the muskrat in their traps. Consequently, by the 1950s trappers were annually marketing nearly 80,000 pelts. Six years later more than 500,000 were processed—a remarkable increase in less than 20 years (Davis 1978). As early as 1948 some were predicting a rich future for Louisiana's nutria in the garment industry (Louisiana Conservationist 1948). Although not readily accepted in the United States, nutria is used as a food in South America, Europe and several Asiatic countries where it has been introduced.

If an area is not trapped for a series of years, the muskrat and nutria will exceed the land's carrying capacity. If overcrowding is not checked naturally, the vegetation cannot support the foraging population. The problem can become so severe that in less than two years muskrat-producing marshes can be eaten out. Before muskrat fur became fashionable (often dyed black and marketed as "Hudson seal"), eat-outs occasionally destroyed valuable chenier plain cattle range, and the rodent was hunted with pitchforks and dogs; ranchers in some areas gave a five-cent-per-tail bounty (O'Neil 1969; O'Neil and Linscombe 1975). As early as 1845, land survey crews described a deltaic plain eat out, thus we know that the animal has destroyed its habitat periodically for more than 150 years (Louisiana Conservationist 1956). At times, the problem has been extremely critical. In 1923, all of the chenier plain's marsh had been eaten out; ironically, nearly all of the muskrat were killed off by a 1915 hurricane, but eight years later, they overran the marsh (O'Neil 1949). Many times, eaten out areas never completely recover from overpopulation pressure, and years may be needed to produce even a small muskrat harvest (O'Neil and Linscombe 1975). Trappers remove some of these animals in order to protect the furbearer's habitat and insure the survival of this renewable resource.

Nutria were originally considered a nuisance, since they were heavy to carry out of the marsh, difficult to skin and confined to a single area (Dozier and Ashbrook 1950; Waldo 1958). They were considered a liability; but attitudes changed. Nutria pelts generate more than $7,000,000 annually and represent at least half of Louisiana's fur income—all from a dozen South American *coypu* that escaped from captivity and diffused throughout the state (Daspit 1948, 1950).

In less than 30 years nutria supplanted muskrat to become the principal animal trapped. In the 1961-1962 season, nutria surpassed the muskrat in number of pelts sold. It has maintained the lead, but in the marshes there is ample range to graze and both have done well. Nutria prefer fresh water marshes, but with increased densities will cycle into the muskrat's brackish water habitat. Although competition exists between both rodents, the end result has been an abundant fur harvest. Trappers' trails and trainasse that were established for muskrat trapping are now used for nutria (**Figures 3-35** and **3-88**). However, nutria are now so numerous the marshes are being destroyed by the animal. They feed on the roots of the marsh plants and destroy them. These are the plants that help hold the marshlands together and protect against erosion as well as provide valuable habitat for a wide-variety of aquatic and avian species. Without proper management, the nutria and muskrat would completely denude vegetation. Because they are so prolific, their populations expanded rapidly and continue to destroy their habitat. "Herbivore" is the term now used to describe

this form of marsh destruction. Evans (1970) suggests that muskrat can completely destroy the root system of the marsh and can take up to 10 years for the marsh to recover. A nutria eat-out, Evans notes, may be re-vegetated in one season. Regardless, the voracious appetite of these animals can destroy large tracts of valuable wetland habitat. When the population increases beyond the carrying capacity of the marsh, nutria will eat all of the existing vegetation, including the root mass. The end result is an eat-out that appears as a "rotten wasteland" (Murchison 1978:5). Both rodents can cause a great deal of damage and have contributed directly and indirectly to the state's deteriorating wetlands. Trapping seemed to have peaked in the 1976-1977 season when the industry was worth about $25 million. Prices for nutria that season averaged $7.80; dropped to $4.21 in 1978-1979; peaked at $8.19 in 1980-1981; and bottomed out at $2.80 in 1982-1984.

To try and expand the fur harvest, a consortium of companies is considering ways to reduce the number of nutria along the Louisiana coast. In theory, such a reduction would decrease damage to the state's coastline and take advantage of increasing fur demand in China and Russia. The Louisiana Bayou Fur Corporation was formed by a number of large landowners to create a financial incentive to increase the fur harvest. The Corporation wants to reduce the damage to their collective properties by nutria foraging on marsh plants and contributing to the breakup of the marsh. The "corporation has a goal to harvest 500,000 nutria a year, although . . . only 150,000 [were] taken by Bayou Fur trappers this year [1997]" (Schultz 1997:6A). In addition, the state has a new $2.1 million project to develop and publicize recipes for nutria meat. The project bottom line is "Eat nutria. Save the coast" (Anderson 1997b:2B). Both efforts are important, since a 1996 survey showed that 100,000 acres (40,500 ha) of Louisiana's marsh had been damaged by nutria (Anderson 1997a).

The American Alligator

First described in 1718, *Alligator mississippiensis* survived two centuries of hunting. Even after extensive exploitation to meet the Civil War demand for shoe leather, the marshes supported an immense population (Johnson 1969). In the late 1800s 4.5 to 6 m alligators were so commonplace they attracted little attention. The historian Le Page Du Pratz (1774) relates in his *History of Louisiana* of killing a 19 ft (5.8 m) alligator, whose head was 3.2 ft (1 m) long and at least 2.25 ft (76 cm) wide (Waldo 1957). The giant reptiles were so abundant they were a nuisance (True 1884).

Alligators have been hunted commercially since the mid-1800s (**Figure 3-89**). "As late as 1890 some 280,000 alligator skins were being processed annually in the United States" (Waldo 1957:12). Unfortunately, between 1880 and 1904 hide hunters reduced the species significantly. Nevertheless, despite a continuous decline in their numbers, no protective measures were initiated until 1960, when a 5 ft (1.5 m) size limit and 60 day season was established.

The season was closed in Louisiana by 1962. Federal Game Reserves followed the state's lead shortly thereafter. Closing the season, along with landowner cooperation, enforcement activity, and the courts, contributed to the alligators return to south Louisiana's marshes.

To assist in the management effort, in 1966 the alligator was placed on the Federal list of rare and endangered species. In 1970, laws were enacted, specifically the Lacy Act, to prohibit the interstate shipment of illegally taken alligators, thereby curtailing bootlegging. Under the Act, people could go to jail if they were dealing in alligator pelts. Consequently, throughout the southeastern United States, the protective legislation, along with habitat preservation, allowed the reptile to make a dramatic recovery (Nichols et al. 1976). Louisiana considers the animal a renewable resource. In 1972 one parish sanctioned hunting. The hunt area was gradually expanded until 1981, when the September season was opened statewide. Since 1981 hunters have harvested nearly 280,000 skins that averaged more than 2 m in length (**Figure 3-90**). The skins' cumulative value was $58.1 million (Louisiana Department of Wildlife and Fisheries 1991).

The once-endangered species provides Louisiana trappers with another revenue source. Further, alligator meat, always a popular item at south Louisiana fairs, is now a novelty item on many menus. If accepted as a serious food, the trapper will benefit from meat sales. Because the season is so short and demand for alligator products high, more than 100 commercial alligator farms are operating in Louisiana. The total value of farm-raised and wild alligators during the 1990-1991 season was $10,845,916 and $14,311,888, respectively (Louisiana Department of Wildlife and Fisheries 1991). Proliferation of these business ventures reduced alligator skin prices and affected the local trapping economy. It will take time to estimate the overall influence of these commercial enterprises on the indigenous trappers, but the industry is accustomed to fluctuations. Even with market problems and a decline in the price of skins, alligators generated $25,157,804 in revenue in the 1990–1991 season—a $7.3 million increase over the previous year (Louisiana Department of Wildlife and Fisheries 1991).

Alligator farms are a complex and costly business. Besides the costs associated with building alligator houses and setting up temperature units within the structures, farmers must maintain drainage systems in order to promote good alligator hygiene, buy, freeze and use tens of thousands of pounds of feed—primarily nutria meat. They must also pay the high utility expenses associated with keeping the enclosures at the correct temperature and pay to skin and ship the skins to oversea markets. On a typical alligator farm with a breeding program, alligators in the 8 to 10-year-old range are kept in a fenced-in pond. Since alligators do not normally successfully hatch eggs until they are 10 years old, farmers must buy eggs from approved suppliers/landowners until their breeding program produces an appropriate supply (**Figure 3-91**).

Trapping, a Seasonal Occupation

> . . . Thibodaux walked the marsh or jumped from the front of the boat to empty a trap. Once their 200-250 traps were checked, they called it a day at about 10 a.m. and prepared to travel the six nautical miles from Marsh Island across Vermilion Bay to Cypremort Point.

> This is almost a daily ritual for three months—December through February— for the team . . . During the season, more than 2 million pelts from nutria, muskrat, . . . and other fur animals will be harvested [Shelton 1987].

Before the 1914-1922 increase from eight cents to 50 cents a pelt, hunting was more profitable than trapping, with a brace of ducks selling for 25 cents (Branan 1938; Chatterton 1944). With the 500 percent increase in fur prices, local folks changed their winter subsistence livelihood from hunting to trapping. By 1916, muskrat was the mainstay of the trapping industry.

Ten years later approximately 20,000 people were trapping, but the industry was essentially uncontrolled. Trappers set their lines on any available land; no one was concerned about property ownership, only the land's productivity. To work the land, trappers went into the marsh with their entire family, as everyone was involved in the industry. Women and children worked with the men—walking the trap lines, cleaning, and stretching the skins. The children returned to school after the season to "catch back" their studies (Bergerie 1962; Frost 1939).

Historically, movement through coastal wetlands presented trappers with a special challenge and resulted in development of unique boat types and mechanical devices. The boat type found in French Louisiana is the pirogue (*pettyaugre*)—an aboriginal dugout copied by European settlers—derived from the Spanish or French "piraga" (Waldo 1965). For the first inhabitants, this shallow-draft vessel became an indispensable tool. It was the principal means of transportation and a direct descendant of those utilized by native Americans. *Pettyaugres* were the earliest craft to ply the waters of south Louisiana with any regularity. Made from a single tree, they were capable of carrying a large number of men and cargo. A *pirogue* draws so little water it is said to "float on a heavy dew."

The pirogue was ideally suited for the state's meandering wetland waterways. It also fit perfectly the trappers and hunters hand-chopped narrow paths, or *trainasse*, utilized to harvest marsh resources. Hollowed out cypress dugouts are no longer in evidence; plank-type counterparts are abundant. The small one to two man craft continues to serve sportsmen and trappers who "paddle" the wetlands checking up to 200 traps a day.

Marsh dwellers brought order to what could have been chaos by using cane poles to mark their trapping areas. Once staked out, individual plots were respected. Ditches or *trainasse*—large enough for a *pirogue* (Native American dugout)—were cut to gain marsh access (**Figure 3-92**). It was understood a *trainasse* crossing a claim could be used, but traps were never set on someone else's land (Davis 1976). It was folk law; a person's trapping ground was to be honored. When fur prices escalated, people from outside the area became involved in the industry (Davis 1973). These outsiders competed for the choice trapping areas. Their blatant disregard for individual rights culminated in the St. Bernard and Plaquemines parish trappers' war (Washburn 1951).

As a result of this helter-skelter approach to the industry, the state intervened. A season was established and pelts were, for the first time, graded to determine their value. In

addition, landowners allocated parcels of land to individual trappers. By designating property to licensed trappers, poaching choice trapping grounds was terminated (Washburn 1951). Arrangements with landowners varied. In general, a trapper worked on a 50-50 basis. When furs were scarce, a 65-35 share was negotiated, with the trapper receiving 65 percent (Frost 1939). Through time this has changed, a trapper may pay as much as 35 percent to 40 percent in cash or skins to owners (Shelton 1987).

To maximize income, trappers lived in camps on their leases (**Figure 3-93**). Initially, copies of Native American one-room, palmetto-thatched huts were used. Camps were crude by today's standards, but a camp was only actively inhabited in December, January, and February, so they were quite adequate. There was no need for a larger structure, because a trapping family spent most of their time out-of-doors. In some cases houseboat communities were established to trap a specific site and were, in effect, mobile settlements. Large boats provided camp access while motorized pirogues and mudboats allowed trappers to increase their trapping lines from 150 to 400 traps (O'Neil and Linscombe 1975).

At the camp the pelts were fleshed, washed, stretched, and dried. They were then sold to a local buyer who sold to one of the state's fur dealers. The method employed in trapping and handling the fur has changed little since invention of the steel trap by Sewell Newhouse in the mid-1800's (O'Neil 1969). It is a labor-intensive industry. Trappers must walk their land to make a living.

The Modern Trapping Industry

Like many businesses, good and bad years are part of the trapping industry. Throughout its history the industry has had economic problems. Low prices, competition from synthetic fibers, closing of trapping areas, animal rights advocates lobbying against fur, and other factors contribute to the industry's yearly success or failure. To many young people trapping is not an attractive employment alternative. To others, it is an important part of their winter employment cycle, as trapping is in their genes (Bertrand and Beale 1965; Shelton 1987).

Many young people are not willing to become trappers. They prefer to seek better paying jobs in the area's extensive oil business. Jobs as deck hands, roughnecks, roustabouts, and welders offer steady incomes. With the downturn in the oil industry during the 1980s, trapping has become an important avocation to those laid off from oil-related jobs. Although pelt prices have not been particularly high, the income has been a welcomed addition to many south Louisiana households. For many, the extra income from a trap line employing from 50 to 250 traps is an important buffer against economic hardships (**Figures 3-94** and **3-95**).

Many people go into the marsh because they enjoy the out-of-doors; for them, trapping is a form of recreation or therapy. At times the sport or job can be quite profitable, for in 1977 Chenier Plain trappers received $9.00 or better for nutria pelts (Cameron Pilot 1977)—a considerable increase over the 50 cents paid in the 1943-1944 season when 436 pelts were harvested. Trappers did not know how to handle nutria pelts to make them

marketable and profitable, so for many years the animal was considered only a nuisance. Further, in the early 1940s there was no market for nutria fur.

Habitat preservation is essential to maintaining quality pelt production. If prolonged high salinities destroy preferred habitats, an important renewable and sustainable resource will disappear. Pelt and hide prices need to be stabilized and advanced tanning and processing need to be established in the state, so local economies benefit from the value added to the product. Traditionally, pelts are shipped to Germany and Italy for treating and processing. However, without viable habitats these are short-lived solutions to maintaining the industry's economic well-being. As long as primary marsh habitats are not subjected to direct attack from the Gulf of Mexico, essential foraging environments will be preserved. Without protection, these habitats will be lost and the industry will die.

Louisiana has not changed its marketing strategy for nearly 100 years. Trappers sell their pelts to buyers, who then sell to dealers. The dealers sell the pelts to brokers, who deliver them to markets for processing and manufacturing generally overseas. The pelts are tanned, matched for color and texture, stretched and stored in refrigerated vaults before being stitched into garments. Even though Louisiana leads the nation in pelt production, it severely lacks the processing and manufacturing capabilities to handle, dress and improve the value of the raw fur. The majority of the dried skins are shipped to Europe, Asia and Japan for tanning and production into fur and leather goods. The end result is a foreign-controlled market that often results in low prices to the trappers, buyers and dealers, but high prices to American consumers. This has changed in recent years, but the state still does not benefit directly from the value added to this raw product. We need manufacturing companies to make coats, shoes, boots, belts, watchbands, wallets and purses. This would help stabilize our market and provide much-needed jobs in this industry (Shelton 1987).

In 1986, the state legislature approved Act 455, which established the Louisiana Fur and Alligator Public Education and Marketing Fund. The Act is designed to identify consumers of Louisiana furs and hides as well as develop fur and alligator makers; and to develop and implement an international advertising campaign about fur and alligator products. In short, the goal was to promote the fur industry and encourage the establishment of processing facilities in the state. Marketing is, in fact, the key to this industry.

Logging

As noted previously in the discussion of canals, industrial logging was important to south Louisiana during the late nineteenth and early twentieth centuries. The lumbermen were mainly interested in cypress, which was located in vast swamps that were concentrated in the northern third of the study area, with fingers of growth that followed many of the old distributary channels toward the Gulf. Louisiana was a leader in lumber production during the early twentieth century. By 1930 all of the virgin forests were gone (Mancil 1972). Vast amounts of cypress were cut within the Atchafalaya Basin and processed at sawmills scattered around the periphery of the Atchafalaya Basin. Very large mills were located at the pre-existing communities of Morgan City, Patterson, Jeanerette, Franklin, Houma, Baldwin, Gibson, and Bayou Sale (**Figure 3-96**). New logging communities were established

throughout the cypress region, but only the new logging communities of Garden City and Ramos were located within the study area (Mancil 1972:6) (**Figure 3-97**).

The construction of a large logging mill in an area, whether it was an established community or an area that was only sparsely settled, created a "boom town" atmosphere that lasted as long as the timber did. The economic benefits were short lived but the destruction of swamp habitat was severe and some areas never rebounded from the cutover of all merchantable timber. While scattered small mills are located within the study area today, cypress is not a major timber resource. Within the last 30 years, saltwater intrusion has brought about the destruction of large second growth cypress swamps in the lower half of the study area. Along the Houma Navigation Canal, swamp deterioration extends north almost to Houma (**Figure 3-98**).

Mineral Extraction (Oil, Gas and Sulphur)

Oil and gas activity has had a major impact on the economy and landscape of south Louisiana. Although production is declining, it is the most important sector of the economy within the study area. The greatest and most obvious impact on the landscape has been the construction of thousands of miles of canals for drilling access, transportation, and pipelines. Particular emphasis is placed on Terrebonne Parish because it contains some of the best examples of the physical impacts of oil and gas exploration (i.e., canals and erosion), and because oil and gas production was greater there than in the other parishes.

In 1896 Captain A. F. Lucas drilled a dry hole on Belle Isle, which represented the first attempt to find oil in Louisiana. In 1902 a dry hole was abandoned at or near Charenton. By 1919 the Border Research Corporation (later Louisiana Land and Exploration and now Burlington Industries) drilled two dry holes on Avoca Island. The search for marketable hydrocarbons in Louisiana's wetlands was established. As a result, in 1935 the Herton Oil Company drilled in the Jeanerette field the first producing oil well in St. Mary parish (Rule 1960). Early pioneers in the industry include: Humble, E. Cockrell, Texaco, Sinclair, Shell, Superior, Sun, and Phillips.

Oil and Gas Activities within the Study Area

Sailors exploring the coast of Louisiana and Texas in the 1600s recorded seeing a black gunk floating on the sea. This seepage provided a small clue to the vast storehouse of hydrocarbons trapped in a geosyncline stretching from Mississippi, through Louisiana and into the coastal provinces of Texas (Lindstedt et al. 1991; The Oil and Gas Journal 1935). The resource was not drilled until 1901 when a wildcatter completed the first producing well in south Louisiana (Postgate 1949). In 1947 the search for recoverable hydrocarbons moved offshore and a new chapter was added to the history of the petroleum industry (Londenberg 1972, **Figure 3-99**).

An integral part of oil and gas exploration is the geophysical survey (**Figure 3-100**). Using dynamite charges to create sound waves that are measured with instruments, the seismic crews recorded subsurface geological layers. These surveys were conducted both on

land and offshore and the geologists used the survey data to predict where oil and gas pockets were located **(Figure 3-101).** The land surveys were usually conducted with marsh buggies that left tracks in the marsh **(Figure 3-102).** Although these vehicles are still being used today (**Figure 3-103**), concern for marsh destruction has brought about an increase in use of airboats and marsh vehicles that are less destructive to marsh habitat (**Figure 3-104**).

Since the successful completion of an exploration well on the continental shelf, the oil industry has drilled more than 35,000 wells in the Gulf of Mexico (**Figure 3-105**). Currently, more than 3700 platforms are pinned to the Gulf's floor. With the ever-increasing demand for hydrocarbons, oilmen are drilling in areas previously considered economically unfavorable. Working in coastal marshes and farther and farther offshore on the continental shelf, drilling crews are now drilling on leases more than 150 miles (241 km) from logistic support bases in water greater than 1000 ft (305 m) deep. Onshore development has also expanded.

Within four of the five parishes included in the study area, almost 10,000 wells have been drilled (**Tables 3-17** through **3-21**). In 1993, these four parishes accounted for about 20 percent of the State's crude oil production (**Figure 3-106**) and about 20 percent of its gas (**Figure 3-107**). One of the most important gas-producing areas is centered around Henry in Vermilion Parish (**Figure 3-108**). This processing plant has been in place since at least the 1940s (**Figure 3-109**). This facility is known as the "Henry Hub" and the production at this site is the basis for determining gas prices for the entire United States.

Several facts support the claim that the nation depends upon the Louisiana coastal zone for energy, food and transportation: 1) coastal Louisiana petroleum and natural gas reserves contribute a significant share of the nation's energy; 2) the state's estuarine system adds nearly 30 percent of the country's fishery harvest; 3) much of the nation's sugar and rice is grown in the coastal zone; and, 4) along with a number of other waterways, the Mississippi River serves as a vital commercial artery into the country's interior. Moreover, these elements have contributed greatly to the area's industrial and economic development. In fact, the region's economy is based directly on these resources. Almost every basic economic activity can be traced to the petroleum, natural gas and other mineral reserves, the estuarine system, the fertile soils, or the navigable waterways.

Oil and Gas Activities: Terrebonne Parish

Beginning in the late 1930s, Terrebonne and St. Mary's wetlands areas experienced rapid economic growth and development. Much of this expansion was a result of the hydrocarbons developed onshore and, more recently, offshore (Lindstedt et al. 1991). Today oil and gas represent a multibillion dollar industry. Agriculture, seafood, trapping, and recreation are multimillion dollar businesses. The shift in economic emphasis from agriculture to water or marsh-oriented occupations is centered on Houma–the parish seat that is directly or indirectly tied to the economics of the marsh. Oil was first produced in Terrebonne Parish in 1929 (Terrebonne Parish Development Board 1953). Since that time, Terrebonne's land and offshore fields have produced more than 2 billion barrels of oil and at least 700 trillion ft (213 trillion m) of natural gas. The parish, consequently, is one of the state's top producers

Table 3-17. Louisiana Oil And Gas Fields by Parish, 1993 (source: International Oil Scouts Association 1994).

Parish	Iberia
Oldest Field Name	Fausse Point
Date of Oldest Field	1927
Total Number of Wells	1085
Cumulative Oil Production	531,394,658
Cumulative Condensate Production	103,509,728
Cumulative Dry Gas Production	/DO
Cumulative Casinghead Gas Production	590,694,862
Parish	St. Mary
Oldest Field Name	Jeanerette
Date of Oldest Field	1935
Total Number of Wells	3239
Cumulative Oil Production	682,571,479
Cumulative Condensate Production	141,763,308
Cumulative Dry Gas Production	/DO
Cumulative Casinghead Gas Production	1,276,818,386
Parish	Terrebonne
Oldest Field Name	Dog Lake, Lake Barre, and Lake Pelto
Date of Oldest Field	1929
Total Number of Wells	4248
Cumulative Oil Production	1,321,038,964
Cumulative Condensate Production	296,666,050
Cumulative Dry Gas Production	/DO
Cumulative Casinghead Gas Production	2,755,788,617
Parish	Vermilion
Oldest Field Name	Gueydan
Date of Oldest Field	1932
Total Number of Wells	1358
Cumulative Oil Production	266,441,225
Cumulative Condensate Production	196,178,887
Cumulative Dry Gas Production	/DO
Cumulative Casinghead Gas Production	260,912,471

Note: production is measured in barrels

of hydrocarbons. Further, the industry is responsible for significant parish-wide employment. In less than 40 years the exploration, development, and ancillary services associated with the region's hydrocarbons have remade the parish's economic landscape (Davis and Place 1983). All aspects of the petroleum industry have influenced the region's land use patterns (**Figure 3-106**).

Although Terrebonne Parish was created in March 1822 from a portion of the *Paroisse de la Fourche Interieure* with Houma serving as an administrative center as early as 1834, the parish was not incorporated until 1848 (Lytle et al. 1960). Consequently, for more than 150 years the city that bears the name of an Native American tribe has served local fishermen, trappers, farmers, and oil-field workers and entrepreneurs.

Table 3-18. Oil and/or Gas Fields and Wells Documented in the Study Area Through 1993 (source: International Oil Scouts Association 1994).

Parish	Field Names	Date of Discovery	Number of Wells
Iberia			
	Avery Island	1942	129
	Avery Island Southeast	1979	
	Bayou Long North	1967	7
	Bayou Pigeon	1940	84
	Bayou Pigeon East	1956	10
	Bayou Pigeon North	1971	5
	Bayou Postillion	1956	30
	Bayou Postillion East	1968	12
	Big Bayou Pigeon	1956	22
	Bird Island Bayou	1964	1
	Cote Blanche Bay E.	1971	3
	Fausse Point	1927	118
	Fish Island	1969	3
	Iberia	1917	184
	Jefferson Island	1938	42
	Lake Ferme	1964	3
	Lake Ferme West	1966	2
	Lake Sand	1949	58
	Lake Sand South	1960	54
	Lake Tom	1965	2
	Little Bayou Pigeon	1955	3
	Loisel	1955	9
	Loisel North	no date	no data
	Long Bay	no date	no data
	Rabbit Island Onshore	no date	no date
	Tigre Lagoon	1947	60
	Tigre Lagoon South	1949	10
	Vermillion Bay	1939	36
	Weeks Island	1945	238
		Total	**1085**
St. Mary			
	Atchafalaya Bay	1951	25
	Atchafalaya Bay E	1961	2
	Atchafalaya Bay S	1968	4
	Atchafalaya Bay W	1969	1
	Baldwin	1972	7
	Bateman Lake	1937	205
	Bayou Carlin	1945	43
	Bayou Carlin W	1966	1
	Bayou Sale	1949	308
	Belle Isle	1941	163
	Belle Isle SW	1962	6

(continued)

Table 3-18. Continued.

Parish	Field Names	Date of Discovery	Number of Wells
St. Mary (cont'd)			
	Charenton	1936	1152
	Cote Blanche Bay W	1940	538
	Cote Blanche Island	1948	138
	Franklin	1953	89
	Franklin East	1966	3
	Garden City	1957	47
	Horseshoe Bayou	1937	68
	Jeanerette	1935	186
	Jeanerette North	1943	7
	Jeanerette South	1945	27
	Lake Sand East	1958	15
	Little Bay	1969	9
	Myette Point	1972	6
	Myette Point South	1975	4
	Onion Bayou	1974	1
	Pass Fourchon	1962	5
	Patterson	1951	98
	Point Chevruill	1968	2
	Ramos	1957	10
	Shell Island	1968	1
	Six Mile Lake	1957	2
	Sweet Bay Lake	1953	50
	Turn Point	1982	5
	Wax Lake	no date	2
	Wyandotte	1968	9
		Total	**3239**
Terrebonne			
	Bay Baptiste	1938	19
	Bay Junop	1948	22
	Bay La Fleur	1961	2
	Bay Round	1958	1
	Bay St. Elaine	1957	428
	Bay Wallace	1974	1
	Bayou Chauvin	1959	9
	Bayou Copasaw	1971	4
	Bayou Copasaw S	1972	2
	Bayou du Large	1972	5
	Bayou Jean LaCroix	1951	32
	Bayou Penchant	1944	67
	Bayou Piquant	1952	7
	Bayou Pointe Au Chien	1969	1
	Bayou Rambio	1955	11
	Bayou Sauveur	1972	6
	Bourg	1952	48
	Bourg South	1957	5

(continued)

Table 3-18. Continued.

Parish	Field Names	Date of Discovery	Number of Wells
Terrebonne (cont'd)			
	Bourg Southwest	1961	5
	Caillou Island	1930	1248
	Chauvin	1957	12
	Chauvin South	1960	19
	Crescent Farms	1954	20
	Deep Saline	1983	4
	Deer Island	1942	54
	Deer Island West	1958	3
	Delarge	1938	11
	Dog Lake	1929	284
	Donner	1958	13
	Donner East	1971	1
	Dulac	1952	3
	Fiddlers Lake	1965	1
	Four Isle Dome	1935	76
	Four League Bay	1952	11
	Gibson	1937	116
	Gibson East	1943	6
	Gibson Northeast	1941	36
	Halter Island	1953	21
	Hollywood	1953	64
	Hollywood North	1964	1
	Houma	1945	66
	Houma North	1947	1
	Houma South	1938	11
	Houma Southeast	1954	5
	Humphreys	1956	17
	Humphreys South	1956	3
	Isles Dernieres	1957	1
	Kent Bayou	1950	28
	Kent Bayou North	1966	2
	Lake Barre	1929	512
	Lake Boudreaux	1971	6
	Lake De Cade	1942	16
	Lake De Cade East	1965	9
	Lake De Cade South	1967	1
	Lake Gero	1970	17
	Lake Hatch	1948	102
	Lake Lery	1966	2
	Lake Pagie	1958	48
	Lake Pelto	1929	323
	Lapeyrouse	1941	76
	Lirette	1937	73
	Montegut	1957	24
	Montegut North	1973	5
	Montegut Northeast	no date	3
	Mosquito Bay	1955	6
	Mosquito Bayou	1974	1
	Orange Grove	1953	32

(continued)

Table 3-18. Continued.

Parish	Field Names	Date of Discovery	Number of Wells
Terrebonne (cont'd)			
	Ouiski Bayou	1992	3
	Oyster Bayou	1967	4
	Palmetto Bayou	1955	6
	Pass des Ilettes	1955	4
	Pass Wilson	1958	7
	Pelican Lake	1957	3
	Point Au Fer	1941	50
	Presque Isle	1958	1
	Rice Bayou	1975	3
	Salt Bay	1958	2
	Seabreeze Pass	1968	1
	St. Paul Bayou	1962	9
	Sunrise	1957	23
	Sunrise South	1960	5
	Terrebonne Bayou	1987	3
	Trinity Bayou	1961	1
	Turtle Bayou	1949	37
	Turtle Bayou North	1957	10
	Wildcat Bayou	1957	2
	Willow Woods	1957	5
		Total	**4248**
Vermilion			
	Abbeville	1937	111
	Andrew	1962	6
	Bancher	1957	16
	Bayou Hebert	1964	9
	Boston Bayou	1956	18
	Buck Point	1958	22
	Buck Point East	1962	11
	Buck Point North	1970	6
	Cossinade	1960	3
	Erath	1940	183
	Erath South	no date	1
	Esther	1959	15
	Esther Southwest	1958	10
	Fire Island	1964	3
	Florence	1952	21
	Florence East	1952	21
	Florence South	1971	18
	Forked Island	no date	2
	Fresh Water Bayou	1942	18
	Fresh Water Bayou North	1958	27
	Grosse Isle	1958	16
	Gueydan	1932	95
	Gueydan Canal	1932	1
	Gueydan East	1973	2

(continued)

Table 3-18. Concluded.

Parish	Field Names	Date of Discovery	Number of Wells
Vermilion (cont'd)			
	Gueydan Southeast	1954	21
	Gueydan Southwest New	1971	8
	Gueydan Southwest Old	1960	1
	Gueydan West	1938	71
	Hell Hole Bayou	1965	6
	Hell Hole Bayou North	no date	1
	Intracoastal City	1955	46
	Kaplan	1947	14
	Kaplan Northwest	1964	1
	Kaplan South	1955	9
	Lac Blanc	1957	49
	Lake Arthur South	1955	33
	Leleux	1954	38
	Leroy	1955	6
	Leroy North	1957	13
	Live Oak	1954	36
	Maurice	1956	23
	Maurice West	1969	1
	Milton	1962	4
	Mulvey	1964	10
	Nunez	1967	1
	Outside Island	1949	7
	Parcperdue	1959	4
	Parcperdue Southwest	1974	1
	Parcperdue West	1970	4
	Pecan Island	1943	59
	Pecan Island North	1954	7
	Perry	1957	9
	Perry Point	1958	48
	Perry South	1960	1
	Redfish Point	1959	21
	Riceville	1958	13
	Riceville South	1972	2
	Theall	1956	16
	White Lake East	1940	71
	White Lake North	1960	4
	White Lake West	1943	111
	Wright	1976	6
		Total	**1358**

Table 3-19. Total Number of Oil and/or Gas Fields and Wells within the Study Area, 1917 through 1940 (source: International Oil Scouts Association 1994).

Parish	Earliest Discovery	Number of Fields	Number of Wells
Iberia	1917	5	464
St. Mary	1935	5	2149
Terrebonne	1929	10	2673
Vermilion	1932	6	532
	Total	**26**	**5818**

Table 3-20. Oil and/or Gas Fields in the Study Area with More than 100 Wells (source: International Oil Scouts Association 1994).

Parish	Field Name	Date	Number
Iberia	Avery Island	1942	129
	Fausse Point	1927	118
	Iberia	1917	184
	Weeks Island	1945	238
		Sub Total	**669**
St. Mary			
	Bateman Lake	1937	205
	Bayou Sale	1949	308
	Belle Isle	1941	163
	Charenton	1936	1152
	Cote Blanche Bay West	1940	538
	Cote Blanche Island	1948	138
	Jeanerette	1935	186
		Sub total	**2690**
Terrebonne			
	Bay St. Elaine	1957	428
	Caillou Island	1930	1248
	Dog Lake	1958	284
	Gibson	1937	116
	Lake Barre	1929	512
	Lake Hatch	1948	102
	Lake Pelto	1929	323
		Sub total	**3013**
Vermilion			
	Abbeville	1937	111
	Erath	1940	183
	White Lake West	1943	111
		Sub total	**405**
		Total	**6777**

Note: These 21 fields represents only 9.8 percent of the study area's 213 oil and gas fields, but account for 68.2 percent of the region's 9930 oil and gas wells.

Table 3-21. Total Oil and/or Gas Fields and Wells by Parish in the Study Area, 1993 (source: International Oil Scouts Association 1994).

Parish	Fields	Wells
Iberia	29	1085
St. Mary	36	3239
Terrebonne	87	4248
Vermilion	62	1358
Total	**213**	**9930**

When the first parish census was taken in 1830, the population consisted of 1088 individuals. By 1930, 29,816 people lived within the parish. With the pre-World War II oil boom and the post-war baby boom, Terrebonne's population has more than tripled since 1930. The 1940 and 1950 censuses reported 35,880 and 43,328 respectively. By 1977, the population increased to more than 85,000. The 1980 figure totaled more than 90,000. By 1990 more than 100,000 lived in the Houma standard metropolitan statistical area. If the parish continues to grow, it will have within its borders more than 150,000 individuals by the year 2000. Along with an increase in population, the economy has changed from one based on sugarcane, fishing, and trapping to one based primarily on oil-related industries and marine transportation (Fortier 1914). The complex cultural milieu, nevertheless, continues to absorb newcomers into the social fabric without too much disruption.

In the analysis of the region's financial base, the principal economic resources are related directly and indirectly to the petroleum industry (**Figure 3-110**). This sector of the economy is buttressed by a regional commitment to agriculture and harvesting the estuarine-dependent aquatic life. Although all of these industries are important, with few exceptions the most important is related to the production of raw materials. Employment, therefore, in the production of raw materials is quite high. Most of this production is exported. The region does not benefit directly from any value-added endeavors. Petrochemicals, processed fish, and processed farm products are exported from the area. However, the economic mainstay revolves around the petroleum industry. For example, in August 1994 there were 30,800 petroleum-related workers offshore (U. S. Department of the Interior 1994).

With discovery of easily marketable hydrocarbons within the alluvial wetlands and in the shallow water of the Gulf of Mexico, Houma developed rapidly into a regional logistic-support center. Petroleum-and marine-related industries have become the region's economic mainstays. In light of the demand that this growth and development has placed on the region's resources, the parish is faced with three key concerns; 1) the effects of continued population growth and industrial development patterns on land that is threatened by serious erosion and subsidence problems; 2) the growth-spurred demand for leisure time activities in an environment that is changing rapidly; and 3) the ability of the parish to provide the needed

service to an expanding population, when some of these communities are going to require extensive flood and drainage control measures that have directly and indirectly contributed to the region's environmental problems.

In the last half-century the economic and technological developments within the parish have led to a population shift from rural to urban areas. The rapid growth has been accompanied by the tendency of industry to locate on the most accessible and least expensive land. Industry, commerce, housing, and agriculture compete for the space available along the natural levees. As these levees narrow, space is at a premium. Current land loss threatens these sites.

In Terrebonne Parish the petroleum and natural gas are recovered from Miocene and Pliocene formations that range from less than 3000 ft (915 m) to more than 23,000 ft (7,015 m) in depth. The hydrocarbons reservoirs are often associated with large subsurface salt domes that have become a major source of petroleum and natural gas. This is especially true on the dome's flanks, where there are numerous traps, faults, pinch outs and unconformities that serve as the hydrocarbon's structural/stratigraphic traps (Davis and Place 1983; Lindstedt et al. 1991).

As early as 1914, Terrebonne Parish was in the hydrocarbon business. Less than 15 years after the business was started in the parish, exploration companies had begun to develop fields in the wetlands, particularly Bay Coon Road, Lake Pelto, Lake Barre and the Caillou dome (**Figure 3-111**). In fact, by 1933 production in south Louisiana exceeded that of north Louisiana (Louisiana Department of Conservation 1932, 1934).

For example, in 1933 the Lake Barre field produced an average of 250,000 barrels of oil per month, making this field one of south Louisiana's largest producing areas (Shaw 1933). Storage was a problem, so besides over-water storage tanks, the Texas Company's ship *Louisiana* was used to store oil from Texaco's Lake Barre wells (**Figure 3-112**). Moreover, by 1938 the oil from this field was shipped directly by barge from the field to three obsolete oil tankers grounded in Cat Island Pass (Louisiana Department of Conservation 1938; Moresi 1935).

The early south Louisiana production was almost exclusively crude oil. By 1933 all gas produced in the state was reported to originate from fields in north Louisiana (Nash 1933). This may have been the official position of the Louisiana Department of Conservation, but the Lirette oil field (also known as the Old Houma gas field) drilled by McCormick, Snyder and Hutchinson, supplied piped natural gas to Houma from 1918 until 1927, when the supply was exhausted (Louisiana Department of Conservation 1938). Even though gas was available in south Louisiana, the real interest was oil during the early years of exploration. In fact, in 1933 an estimated 2,000,000 acres (810,000 ha) of land was leased in south Louisiana signaling the true beginning of the region's oil boom (Dabney 1934). Throughout the coastal zone, this interest in the hydrocarbon potential of the region eventually increased the regional tax base (U. S. Department of Agriculture 1986).

Consequently, for more than 90 years the regional economy has been influenced by the exploration, development, and vendors associated with the oil and gas industry. In addition, five commercial sulphur deposits have been developed either within or immediately outside the study area: Lake Peigneur, Bay Ste. Elaine, Chacahoula, Lake Pelto, and Caillou Island. All but one (Lake Peigneur) are located within Terrebonne Parish. Bay Ste. Elaine is unique since its development involved the design and construction of the world's first floating sulphur plant. This amphibious mine was also used at the Lake Pelto site. One of the side effects of this production is the collapse of the top of the dome as the sulphur is liquified and pumped to the surface. This causes a regional depression. Production from these structural anomalies has made Terrebonne Parish a part of one of the most productive hydrocarbon and sulphur provinces in the world (Davis and Detro 1992).

Infrastructure and Community Impacts

Louisiana's pioneer role offshore resulted in many of the state's communities acquiring the necessary infrastructure to meet the needs of the offshore industry. Like Texas, Oklahoma and California, oil wells and the associated infrastructure are evidence of the industry's presence (McKenzie et al. 1993) (**Figure 3-113**). Companies involved in finding and marketing petroleum products and construction and maintenance of production platforms and subsequent extraction and handling of subsea hydrocarbons, require an extensive assemblage of onshore facilities (Davis and Place 1983; McKenzie et al. 1993). Prefabricated metal buildings, inexpensive housing that has almost become a trademark of the offshore industry, are part of the region's industrial complexes.

Refineries, terminals, boat docks, airports, helicopter bases, repair facilities, shipyards, pipe storage areas, and the like are essential to offshore operations (**Figures 3-114** and **3-115**). As a result, communities along the industry's corridor became base points of operation, attracting all types of businesses involved in meeting the needs of the onshore and offshore operators (Davis and Place 1983). Expansion of these support facilities stimulated the local economies and prompted an increase in residential, commercial, industrial and utility land uses (**Figures 3-116** and **3-117**).

In nearly all places on Louisiana's coast, the offshore petroleum industry's economic influences are readily apparent. And although there are more support services in some communities than others, nearly every community in south Louisiana is impacted. It is, in fact, difficult to find one community that has not profited by the exploration and development of the hydrocarbon reserves off Louisiana's coast. Exploration and development activities onshore and offshore modified directly the region's rural character and established the foundation for attracting additional industries (McKenzie and Davis 1994).

While metal buildings and a vast assortment of signage are onshore visual indicators of the industry's presence in Louisiana (**Figure 3-118**), many of the economic impacts associated with the petroleum business are not as conspicuous. The oil and gas industry also has a significant influence on secondary or tertiary industries that are also important elements in the region's total industrial activities. In many of Louisiana's smaller communities, particularly those south of Houma, along the Intracoastal Canal, and along Bayou Lafourche,

thousands of businesses, or vendors as they are often called, provide products and services to the on- and offshore industry and reap the financial benefits.

There are, therefore, primary and secondary industries associated with the production activities. For example, a list of these allied services associated with the petroleum industry includes, but is not limited to:

- office supplies
- computer supplies
- motels and hotels
- shore stores
- laundry services
- copy services
- computer firms
- hardware stores
- welding supplies
- lumber yards
- propeller shops
- parts houses
- filter suppliers
- rental services
- trucking firms
- surveyors
- book publishers
- clothiers
- waste disposal services
- food distribution
- printing companies
- health professionals
- paper product distributors
- diving specialists
- valve manufacturers
- gauge and boiler manufacturers
- desalination services
- wireline services
- advertising agencies
- caterers
- safety services
- wirerope manufacturers
- appliance stores
- newspapers
- air conditioning services
- refrigeration services
- grocery stores
- bicycle shops
- attorneys
- boat and barge leasing services
- towing companies
- engineering firms
- chemical distributors
- drilling mud and additive companies
- hardware outlets
- shipbuilders
- boat repair services
- towing contractors
- well-log libraries
- heliports and aircraft maintenance facilities
- boat charter and rental firms
- structural fabricators
- office supply companies
- diesel and gasoline distributors
- and many, many more.

Without this vast assortment of services meeting literally every need of the on- and offshore operators, the industry could not function profitably. Every item used in the wetlands or offshore has to be purchased from land-base nodal points, delivered to a distribution warehouse at a staging site and transported either by boat or helicopter to the exploration and/or production sites (**Figure 3-119**). In fact, this aspect of the industry can be likened to a large hourglass. Supplies, commodities, personnel, equipment and materials from a vast array of onshore locations are funneled into a collection facility located in one of the distribution points (**Figure 3-120**). From there the goods are transported to drilling and production facilities scattered throughout the coastal wetlands and offshore.

The oil industry meant jobs (McKenzie et al. 1993). The cultural heritage of the local population was one based on hard work and dedicated service to employers. In fact, Louisiana had no problem supplying the primarily unskilled labor force necessary to develop the oil and natural gas industry. Many coastal residents were eager to go to the high paying jobs being offered by the petroleum industry due to the continued downturn in their traditional fishing and trapping industries. Consequently, virtually every community with direct access to the Gulf of Mexico became a logistic support site (Davis 1991; McKenzie et al. 1993). Therefore, nearly every settlement cluster within the coastal zone acquired the necessary infrastructure to meet the needs of the on- and offshore industry. Moreover, in any large-scale extractive industry changes in the economy, employment, and land conditions are expected (McKenzie et al. 1993; Seydlitz and Laska 1994). In many instances, these changes toward a petroleum-oriented economy were welcome; they were not considered detrimental.

With time, this vast army of support personnel dominated the area's employment structure. The jobs became an integral part of the local economy. They are, in fact, so commonplace today they are taken for granted. Most people focus on the sheet metal, steel, boats, and helicopters that are an impressive part of the industry (Larson et al. 1980); many fail to see the vast assortment of people employed directly or indirectly in keeping the mineral fluids moving to market (McKenzie et al. 1993; McKenzie and Davis 1994). Thousands of vendors and tens of thousands of individuals work in meeting the nation's demand for fossil fuels. These are the faces that make the offshore industry work. In addition, they are a forgotten part of the industry's ability to successfully perform in what some would describe as a hostile environment (Ludlum 1963). Hence, throughout the coastal zone numerous businesses assist the offshore business. The importance of these community-based logistic support centers is illustrated by the fact that nearly all communities within the coastal zone have profited from hydrocarbon exploration and development (McKenzie et al. 1993; McKenzie and Davis 1994). For example, the community of Intracoastal City at the mouth of the Vermilion River was once known as Lower Egypt. It began to prosper in conjunction with the growth of the offshore oil and gas business, because of its quick access to the Gulf of Mexico.

Everything required to develop an oil and/or natural gas field, out of sight of land or in the wetlands, must come from a land base and, therefore, a supplier. Each item, regardless how small or large, must be purchased, manufactured, assembled, stored, or brokered through

local or regional vendors. These businesses in turn help sustain the local economy (McKenzie and Davis 1994). With time, facilities were established to serve the needs of the petroleum industry. Some of the more important nodal points for the services industry include: Johnson Bayou, Cameron-Creole, Grand Chenier, Delcambre, Intracoastal City, Lafayette, New Iberia, Patterson-Berwick-Morgan City, Houma, Harvey, on bayous du Large, Grand Caillou, Petit Caillou, Terrebonne, Lafourche, and at Fourchon, Grand Isle, Empire, and Venice (Larson et al. 1980; Davis and Place 1983; McKenzie et al. 1993; McKenzie and Davis 1994) (**Figures 3-121** and **3-122**). In most of these communities both sides of the highway are dotted with metal buildings. These prefabricated structures house the companies that cater to every aspect of the offshore industry (Blaine 1996).

The complex assemblage of businesses identified with the offshore industry represented an economic boom to an area that was depressed economically prior to the push for oil and natural gas. In that regard, the political and/or cultural heritage of the region's population did not preclude them from becoming active in the offshore industry. The local population had a good work ethic and was thankful for the jobs the petroleum industry provided. As a result, today it is not uncommon to find the third generation employed in the industry. These people have learned the business from their immediate and extended families. If it was good enough for dad, it is good enough for the children, both males and females. Skill levels have been passed from one generation to another. The end result is a type of family guild with everyone following the same type of economic pursuits (McKenzie and Davis 1994).

Even though their resources were often stretched to the limit, local governments enjoyed the unexpected benefits provided to them by the petroleum industry. Tax revenue increased dramatically. These monies paid for most of the services related to parish schools, roads and bridges, garbage pick-up, libraries, and other services the local population takes for granted. Everyone enjoyed the benefits that are provided both directly and indirectly by one industry. No one considered how the industry influenced local economies (Centaur Associates 1986). This influence is greater than the direct services underwritten through various tax issues. The influence extends down to the local business level because virtually everything that goes offshore has to come from some land-based vendor. Virtually thousands of companies are involved (McKenzie and Davis 1994). Obviously, the oil and gas industry will have a significant long-term effect on a variety of local businesses and their employees.

Direct Impacts from the Offshore Oil and Gas Industry – An Example of Economic Importance

- In 1992 there were 13,384 producing company jobs in the federally-controlled outer continental shelf (OCS) with 81 percent of these employees living in Louisiana. Consequently, 10,841 were Louisiana resident. MMS estimates there are 83,400 jobs directly and indirectly related to OCS activity.
- Payroll from producing companies to OCS-related employees living in Louisiana was $593,000,000 - an average of $52,580 per employee.
- More than $4.16 billion was paid by producing companies to vendors and contractors in support of OCS/GOM oil and gas activities in 1992.

- 6,617 vendors and contracts support the OCS activities.
- 3,819 of the 6,617 vendors are Louisiana-based .
- Louisiana vendors draw an estimated $2.4 billion in OCS-lease activity revenue from producing companies.
- OCS vendors are found in 165 different communities in 47 parishes.
- Louisiana vendors employ an estimated 55,376 people.
- 45 percent of Louisiana vendors derive more than half of their income from OCS/GOM activities (McKenzie and Davis 1994).

These facts point out how the industry has influenced Louisiana's economy. That is nearly the equivalent of $1000 for every person living in the state. Nearly 4000 vendors are involved (McKenzie and Davis 1994). And that is just to the vendors supporting the offshore industry. Within Louisiana, there has been rapid economic growth and development during the past 75 years (Centaur Associates 1986). Most of this growth has been associated with hydrocarbon development both onshore, and more recently, offshore (**Figure 3-123**). However, by 1995 the Gulf of Mexico was considered "a Dead Sea" as a result of declining production, low oil prices, and only limited new exploration.

Port Facilities

Oil men needed port facilities, as they were the mainstay of their marine operations. But adequate ports did not exist. It was not until the 1930s that the necessary infrastructure-support facilities were sufficiently developed to make extensive wetland exploration practical. Moreover, few coastal maps and charts were available. Most were inaccurate and inadequate because "of the constantly shifting land line and changing islands" (Williams 1929:41). Since there were few maps of the region, the Texas Company arranged with Edgar Tobin of San Antonio to fly, photograph, and map southern Louisiana. This aerial survey produced a photo mosaic that served as the foundation for land surveys of potential oil properties, canals, and other logistic matters (Williams 1929). Consequently, between 1924 and 1930—using new geophysical exploration techniques—more than $25 million was invested by the Gulf Production Company, the Texas Company and the Humble Oil and Refining Company to survey the Texas and Louisiana coast (Barton 1930; Deussen 1923; Seglund 1956; Shaw 1930). Smaller companies involved in early geophysical surveys included Republic Production Company, Sun Oil Company, and the Sinclair Oil and Gas Company (Deussen 1923). The investment paid off when it stimulated increased drilling and production throughout south Louisiana.

Port facilities of various sizes are located throughout the study area. Prior to the beginning of oil and gas exploration, most ports in the study area were designed primarily to service fishing boats. For example, large fishing fleets operated out of Morgan City and Delcambre (see discussion on fishing). Initially, boats associated with oil and gas exploration probably used the same facilities as the fishing boats. Over time, separate docking and servicing facilities appeared because, although the hulls and engines may have been similar, the cargoes of the two were very different and the annual operating schedules were also different. Today, the needs of various watercraft are so specialized that it is unusual to find fishing boats moored in the same vicinity as oil and gas service boats. Along some of the

bayous, oil and gas service industries developed along one side of the channel while industries servicing the fishing fleet have developed along the opposite bank (**Figure 3-124**). In the larger ports catering to the oil and gas industry, there is some spatial clustering of particular industries. For example, boat building or offshore platform construction areas tend to be located in one area while drill pipe yards or drilling mud industries tend to cluster in other areas.

Port facilities catering to the oil and gas industry range from small service docks to mega-ports containing a variety of offshore servicing companies and construction sites. The largest port complexes include Intracoastal City, the Port of Iberia, Houma, and Morgan City-Amelia (**Figures 3-125, 3-126, 3-127, 3-128a,** and **3-128b**). In some cases, growth of these ports has been phenomenal. For example, the Port of Iberia (also called the Port of New Iberia) included less than a dozen buildings in 1963. Today, dozens of buildings are spread out over 2,000 acres (810 ha) (**Figure 3-125**). In 1996, New Iberia's Port of Iberia had all 2,000 acres (810 ha) of its waterfront property under lease. In fact, the port director was negotiating with tenants to turn back property they were not using (Judice and Nolan 1996). Smaller ports may be found on just about every bayou that can be navigated.

Port Fourchon and the Louisiana Offshore Oil Port (LOOP)

Over the past decade, Port Fourchon has experienced unparalleled industrial growth (**Figure 3-129**). The Port has matured and grown in importance, particularly in meeting the needs of the offshore oil industry. It is Louisiana's only coastal port that can easily meet the needs of the firms involved in developing deepwater leases. This activity has strained the region's infrastructure. All infrastructure elements are under stress. Most noteworthy is the effect all of the recent activity has had on the region's only highway — Louisiana Highway 1, sometimes referred to as the "Longest Street in the World" (**Figure 3-130**). This two-lane road was not designed to carry the loads that are moving over it on a daily basis. It is crumbling under the pressure and since the Minerals Management Service collects more than $4 billion annually nationwide in mineral leases and royalties, the local population - buttressed by the Louisiana One Coalition - have requested the federal government intervene and improve/transform this road into a four-land highway that will better meet industries needs (La 1 Coalition 1997; *Sunday Advocate* March 15, 1998:1A).

The Port is the geographic and economic center of offshore drilling efforts along Louisiana's Gulf Coast and is served by a channel that is 300 feet (91.5 m) wide and up to 30 (9 m) feet deep. Its proximity to deepwater drilling areas makes it more economical for servicing the offshore areas. Texas has five deepwater ports that have depths from 30 to 60 feet (9 to 18 m), but they are not as close to the current deepwater leases as is Port Fourchon. The Port is also fortunate to have the available land, leadership and other resources necessary to meet the expansion needs associated with the growth of deepwater exploration and development. Recent Federal leasing activity has been highly successful in increasing the Port's service area. As a result, the Port handled in 1996 more than 30 million tons of cargo, a significant increase over the ten million tons handled in 1993. This represents a three-fold increase in three years. Because of the Port's strategic position, it will likely handle even greater quantities of cargo in the future.

A recent study by the United States Army Corps of Engineers projects that nearly 60 percent of all Louisiana offshore drilling over the next 30 years will be in the Port Fourchon service area. Over 6000 people currently depend on the Port as an avenue to and from offshore facilities and more than 13,000 individuals depend on the Port for jobs, supplies, facilities and as a hurricane evacuation hub to safer locations north of the coast. About 75 percent of the 80 deepwater oil and gas prospects in the Gulf are within Fourchon's service area. Most are within a 150 to 200-mile radius of Port Fourchon, which means they can save time and money by using this facility. This convenient location makes it the port of choice for the intermodal transfer of goods and services necessary to support these deepwater projects. More than 600 offshore oil platforms are located within a 40-mile radius of the Port, making it a focal point of the oil industry. About 1000 trucks are unloaded or loaded each day at the Port; that is the equivalent to about 1.3 every two minutes. About half of the 3000 vehicles in the Port's parking lots are from out of state. More than 100 businesses operate within the Port and most of the major and independent oil and gas companies operating in the Gulf have a presence at Port Fourchon. The Port Commission's planned development for the next five years is leased even before the facilities are completed.

Things are happening so fast at the port that the Greater Lafourche Port Commission cannot prepare the waterfront fast enough. One example is Edison Chouest Offshore's large-scale, one-stop supply depot called "C-Port" which, when finished, will allow vessels to unload and reload new supplies within 10 hours (**Figure 3-131**). Originally, the "C-Port" terminal was planned for Morgan City. Routes into this port were too shallow to accommodate the loaded, oversized vessels for the deepwater oil and gas industry. Port Fourchon was a better choice. The company is spending about $500 million to build 50 to 60 new 270-foot vessels to meet the needs of the deepwater drilling activity and the deepwater industry is still in its infancy. The Port's new multi-use dock offers industry a repair site only three miles (4.8 km) inland from the Gulf of Mexico. Within the immediate service area of the port there are pipe yards, shipyards, platform construction facilities, service bases and barge terminals working at or near capacity.

LOOP Facility

Completed in late 1980, Louisiana Offshore Oil Port (LOOP) was the nation's first facility built specifically for unloading ultra-large crude carriers. It is located 19 miles (30.5 km) southeast of Port Fourchon. LOOP was constructed by a group of major oil and pipeline companies (Marathon Pipe Line, Texaco, Shell Oil, Ashland Oil and Murphy Oil) and serves as the central unloading and distribution port for all incoming supertankers to the Gulf region. Large supertankers continuously offload crude oil into LOOP's 56-inch (142 cm) offshore pipeline connections at its Marine Terminal. This 56-inch pipe is the first of this size used in a U.S. project and largest ever barge-laid in the Gulf of Mexico. From the Marine Terminal, the oil is then piped to the Clovelly Dome Storage Terminal in Lafourche Parish, where it is stored and piped to markets all over the U.S. This facility also has the capacity to handle much of the oil and gas production in the Gulf, largely because the federal regulations governing LOOP were recently changed to allow the facility to receive and ship oil produced from the U.S. Outer Continental Shelf. For example, the recently completed deepwater Mars platform, and its pipeline connection to LOOP, is a direct result of this change in federal

regulations. LOOP will continue to handle a significant portion of the Gulf of Mexico's domestic deepwater production through its large-diameter pipeline system and onshore distribution network.

LOOP is the first U.S. port able to unload fully laden Very Large Crude Carriers and Ultra Large Crude Carriers (tankers from 175,000 to 700,000 tons). It is also the first facility anywhere to use American-made 48-inch (122-cm) pipe. Tankers offload at LOOP by pumping crude oil through hoses connected to a Single Point Mooring (SPM) base. Some of these vessels require water depths of 85 feet (26 m)—the water depth at each of LOOP's SPMs is 115 feet (35 m). The SPMs are designed to handle ships up to 700,000 deadweight tons. The LOOP port represents the first installation of a single anchor leg mooring system (SALM) in a continental U.S. offshore project. LOOP can supply 1.4 million barrels of oil per day of imported crude through interconnections with the 40-inch (102-cm) Capline system in St. James Parish. In fact, five connecting pipelines tie LOOP to more than 30 percent of the country's refining capacity.

In 15 years, LOOP has offloaded mover than 3.5 billion barrels of crude oil from over 3350 tankers. In 1995, LOOP handled over 250 million barrels, an estimated 685,000 barrels of oil per day. LOOP is presently handling approximately 11 percent of all crude oil imports coming into the United States. The Clovelly Dome Storage Terminal consists of eight caverns with a total capacity of 40 million barrels of oil. A 200-acre, 25-million barrel reservoir holds brine used to displace crude stored in the cavities (George 1980).

Deepwater: The Savior of Louisiana's Offshore Industry

> "Lord, please let me have another oil boom, and I promise not to blow it this time."(*Economist* 1997:31-34)

Although production numbers declined in the 1980s and early 1990s, the use of new technologies on- and offshore suggests Louisiana is poised for another boom—a forbidden word, loaded with lessons painfully learned in the 1980s when the local newspapers proclaimed "Houma-Thibodaux area hit hardest by slump" (Flournoy 1988; Judice and Nolan 1996; Lamb 1987; Schultz 1997). A new mantra takes the place of boom: "cautious optimism." Regardless, this hydrocarbon province is hardly dead; it is alive and well and the companies involved are operating with a new lean attitude. The 1980s downturn was a powerful learning experience (Lamb 1987). Real estate values declined, bankruptcies increased, and jobs dried up (Flournoy 1988). The region's dependence on the oil and gas business was evident. Consequently, the industry for nearly a decade has been in the doldrums; a renaissance has occurred with the remarkable resurgence of exploration and production activity in the Gulf of Mexico (Blaine 1996). The lure of large finds in "deepwater" [defined by the federal government as 656 feet (200 m) or deeper], coupled with new incentives and improved oil prices, helped generate a record number of bids at the April 1996 Federal auction of leases within the Central Gulf of Mexico. There were 1381 bids on 924 lease blocks. Five years earlier, producers were interested in only 151 blocks. Of these new leases, 442 (32 percent) were in water deeper than 1,300 feet (396.5 m). The sale resulted in $520.9 million in bids (Griggs 1996). It represented the first sale involving

deepwater tracts eligible for consideration under the Deepwater Royalty Relief Act. After completion of a two-phase evaluation process, $511 million was added to the Federal treasury. In March 1997 the oil and gas industry promised to pay $825 million to explore for oil and gas on 1032 tracts. That is the most money garnered from a lease sale since 1985. Money was invested on prospects in shallow water close to shore as well as the Gulf's deepwater. The U.S. Government has collected more than $100 billion in revenue from OCS oil and gas production since 1953. Eighty-four percent of the revenue was produced off the Louisiana's coast. The remaining 14 percent was collected from other OCS areas. Also, 92 percent of the total OCS oil production since 1954 has originated off Louisiana's coast (U.S. Department of the Interior 1994).

Industry leaders are expressing a new optimism that is manifested in the drilling activity in the northern Gulf of Mexico and the onshore impacts associated with this growth. Drilling is at a frantic pace, breaking decades-old records. A new euphoria is affecting the Gulf of Mexico. Led by a deepwater exploration and production program pioneered by Shell Offshore (who controls nearly one-third of the deepwater fields), subsalt programs headed by Amoco and Phillips, and a shallow water/transition zone program being championed by majors and independents, the Gulf of Mexico is defying all predictions of its demise (Le Blanc 1997). Blockbuster discoveries are attracting considerable attention. A new oil and gas province is being carved from the waters of the deepwater Gulf of Mexico. The region has suddenly emerged as the nation's most significant oil and gas province. Interest is so keen that Petroleum Geoservices, a Houston seismic company, has been hired to shoot new seismic surveys covering 16,000 square miles (41,440 km^2) of deepwater territory. In the push to greater depths, Conoco and Reading & Bates are building a drill ship capable of operating in 10,000 feet (3,050 m) of water, even though current production in the Gulf is in waters less than 3,000 feet (915 m).

Beginning with "Cognac" and "Bullwinkle," the industry has focused with considerable success on deepwater. To meet this deepwater technological challenge, Auger, Tahoe, Mars, Neptune Spar and Ursa platforms have been installed or planned (Judice and Nolan 1996). In 1994 Auger was established in more than 2800 feet (854 m) of water—an event that captured the public's attention. Several of the platform's nine wells produced oil in volumes greater than ever before in the Gulf of Mexico, and at its peak the platform produced 55,000 barrels per day. The Mars field commenced in July 1996. By August, production from this field (with reserves estimated at 500 million barrels) reached 100,000 barrels of oil a day, from a tension leg platform (TLP) twice as tall as the Empire State Building with a deck nearly as large as two football fields. Neptune, the world's first Spar Floating Production System, has begun production at a water depth of 1930 feet (589 m). This cylindrical steel structure floats upright by utilizing air-filled compartments near the top to provide buoyancy; seawater-filled tanks at the bottom provide weight and stability. Steel cables anchor the structure to the floor. The first well is producing 4800 barrels of oil a day. Oryx Energy expects to eventually achieve a daily yield of 30,000 barrels. Some wells in deepwater fields are flowing at rates ten times as high as those in shallower waters. Some suggest that within the next four to five years as much as 30 percent of the U.S.'s total domestic output will originate from the Gulf of Mexico. Even though deepwater gets the headlines, the oil patch is also booming in the wetlands. Drilling companies are turning down

work, because they do not have the equipment. As a result, many firms are building new drilling barges to meet the needs of the expansion in wetland exploration and production (Hall 1997).

Deepwater is America's new frontier with some suggesting the finds could hold more than 1.5 times the oil in Alaska's Prudhoe Bay field. In addition, the region has become a proving ground for new and improved offshore drilling technology (such as sub sea completions, multi-phase pipelines, and the possible use of floating production, storage and offloading facilities, and three-dimensional seismology). The area has also become a scientific testing center on the environmental effects of this drilling activity (Bornholdt and Lear 1995; Gallaway 1981; Judice and Nolan 1996; Schultz 1997). Further, new methods of project management have been initiated that include turnkey, shared risk and reward, alliance, quality control growth teams and fast track production. All of these management tools are in response to the high costs involved in developing a deepwater reservoir, which can easily involve over a billion dollars. As a consequence of this activity, the period of cost cutting and layoffs, downsizing and sell offs, has come to a close and been replaced by a job market considerably greater than the available supply.

In less than three years, effective operating depths have doubled (**Figure 3-132**). For example, the Ram-Powell find (3,218 ft or 981 m depth) is expected to yield up to 270 million barrels of oil, while the Mensa discovery (5,300 ft or 1616 m depth) is identified with about 720 billion cubic feet (219 cubic meters) of gas. When Ursa comes on-line, it will stand more than 4,200 feet (1,281 m) high—1,000 feet (305 m) short of a mile—and operate in 3,950 feet (1,250 m) of water. It will be the largest structure in the Gulf of Mexico, weighing 63,300 tons and the most expensive at a cost of 1.45 billion. Initial production is estimated at 30,000 barrels of oil a day, more than twice the highest flow rate ever achieved from a well in the Gulf of Mexico.

Very high rates of production by prolific deepwater wells have convinced operators that the Gulf of Mexico's deepwater is a sound economical investment. It has been estimated that one in every four wells drilled has found deposits containing 50 million barrels of oil or more. Between four and five billion barrels of oil have been discovered. Some estimate the full potential of the deep water may go as high as 25 billion barrels. Consequently, Baldpate, Troika, Genesis, Petronius, Allegheny, Fuji and Gemini are just a few of the structures that will be added to the inventory of deepwater production facilities by the year 2000. The push into deepwater has meant long-term contracts for the rigs capable of drilling in these areas. In effect, 100 percent of the usable rigs are working or, like Diamond Offshore's drilling rig the Ocean Star, have been transformed from a structure able to work in waters no deeper than 800 feet (244 m), to one that can handle depths of up to 4500 feet (1372.5 m). Amerada Hess, Amoco, British Petroleum, Chevron, Conoco, Elf Exploration, Enserch Exploration, Exxon Corp., Kerr-McGee, Marathon Oil Co, Oryx Energy Co., Shell, Tatham Offshore and Texaco are heading up major deepwater projects.

With discoveries of reservoirs containing at least 100 million barrels of oil or more and prices at $19 a barrel, the Gulf of Mexico is one of the hottest plays in the oil patch. In fact, demand for drilling rigs has outstripped available supply. New construction has begun, but

the fleet of new mobile drilling units will not be available for at least three years (Le Blanc 1997). Virtually every fabrication facility in Louisiana, and along the Gulf coast, is working at or near capacity (**Figures 3-133** and **3-134**). Regardless, all of this activity has improved the job market, because some fabricators have doubled their workforce in less than a year. For example, welders and shipfitters are being trained day and night to meet demand. The high demand has prompted many yards to initiate outreach programs to high schools and technical schools to help train students for the expanding job market. J. Ray McDermott visited trade schools in Pennsylvania and Ohio, but did not get any new hirings (Judice and Jackson 1997). Further, with unemployment at about 5 percent there are few workers willing to relocate, so foreign workers are filling the void (Furlow 1997; *The Times-Picayune*, April 13, 1997). In 1995 about 2200 oil and gas based jobs were added to Louisiana payrolls as a result of deepwater activity. As more welders and fitters are lured to the higher wages of the offshore industry, mainland shipyards are looking hard to fill their employment void.

The labor problem is so acute, based on heavy workloads and tight schedules, 200 men from India crossed two continents for temporary jobs as welders in Avondale Industries' shipyard. Several companies are now in the business of recruiting and hiring outside labor, typically providing foreign workers with housing, food and transportation. As a result, there are 125 Mexican nationals living in a hotel in Thibodaux working in the offshore industry. Demand for workers is high; Avondale, for example, had openings for 1000 workers in 1997 and is investing $250,000 into a free training school for welders and shipfitters. Bollinger Shipyards in Lockport has more than doubled their workforce and in 1997 needed at least 150 additional employees. Shipbuilding and fabrication facilities in St. Mary Parish have 1800 jobs available to build and repair the oil field boats and platforms need to keep the Gulf of Mexico oil rebound moving forward (Judice and Jackson 1997; *The Times-Picayune*, April 13, 1997, **Figure 3-135**). According to one source: "Labor is too precious to overhire and then lay off . . . Workers haven't forgotten the peak and valley of the last cycle when fabrication yards slashed their welding staffs from hundreds to a handful. This time around, companies have discovered that the skilled labor shortage will not be filled by a wave of workers returning to the area or by raiding yards in other regions of the country" (Judice and Jackson 1997:F-4).

The previous economic slump has made many cautious: "Jerry Blankenship, owner of Southern Gulf Operators Inc. of Lafayette, knows all about cycles. At the peak of the oil boom, his company had a fleet of 15 boats. It survived the 1980s, but with only two crewboats. Both boats are working with no idle time . . . and he knows he could do even more business with additional boats. But, he doesn't want to take the risk of suffering with debt through hard times. 'I've been through it once and once was enough'" (Schultz 1997:18C).

It is a worker's market and the region is losing business to competitors along the Gulf Coast. Work is plentiful. Numerous contracts for platforms and boats are being awarded. However, without the required labor force Louisiana's fabricators cannot bid on these jobs. The problem is costly since many yards cannot bid on projects that could generate several million man hours of work. Consequently, local employees are working under the premise that they must find local applicants, train them and create conditions that will keep them in

the industry. People who fled the industry are not returning, but the promise of years of steady work seems to be the best job recruiter (Judice 1996). The momentum will be sustained for many years, provided the work force can be obtained. A worker shortage is not the only problem facing the industry; housing is also in short supply. One fabricator built a 200-unit apartment complex to house workers employed in its yard. The Chitimacha Development Corporation is developing a 1500-unit community near its tribal lands in Charenton, 25 miles (40 km) west of Morgan City. The $300 million development will help ease some of the housing problem, but it is an important regional issue since many find suitable housing outside of the area (*The Times-Picayune,* March 16, 1997). As a result, the local tax base suffers. A recent estimate suggests Morgan City loses about $200 million because workers buy houses, cars and shop outside the parish (Sayre 1997).

A variety of skilled workers are needed to connect the metal parts of an oil rig or ship. Shipfitters assemble the pieces of each ship section, and pipefitters construct the intraship piping systems used for everything from plumbing to seawater discharge. Welders burn the metal together and make the systems whole. Regardless, all of this activity is simply one element in the job market. Equally important are the employment opportunities in related industries; they are also booming (Judice and Nolan 1998, *The Times-Picayune*, April 13,1997). The energy business is returning but in an economy significantly more diverse than the one that imploded when oil and gas prices collapsed in 1986, destroying thousands of jobs (Blaine 1996). Tourism and health care are bigger economic engines than they were 10 years ago. There are other alternatives; nevertheless, the oil and gas is welcomed back into the economic mix. Currently, shipyards and service companies are fiercely competing for every available welder and deck hand along the Louisiana coast; demand outstrips the supply of workers (Judice 1996). Fundamentally the region's economy is in great shape.

Current Recreational Pursuits

Louisiana's estuaries sustain an abundant marine biota of fresh- and saltwater aquatic species. The coastal plain is also a vast feeding ground for migrating birds and an essential link in the North American flyway. The assortment of avian and aquatic wildlife provide sportsmen unexcelled opportunities for recreation. With about two-thirds of Louisiana's population within two hours' driving time of the coastal zone, tens of thousands of man-days of sports activity annually take place in this environment.

Fishing

Fishing is the dominant recreational pursuit in the coastal zone. This activity has expanded rapidly over the last 30 years. A boat launch and/or landing is located at the southern terminus of virtually every road south of the GIWW (**Figure 3-136**). Recreational use of the coastal wetlands requires a substantial capital outlay, for maximum accessibility depends on a boat and motor. For the serious sportsman, purchase of this vessel is the greatest nonrecurring recreational expenditure. Often costing between $10,000 and $25,000, these outboard- or inboard-powered boats provide quick access to any potential hunting or fishing site.

Boat launching sites range from small shell ramps, able to accommodate 5 to 10 cars, to private marinas with space for 300 boats and as many as four launching areas. From these nodal points sportsmen travel into the marsh to fish, hunt, or trap. Launching sites also furnish weekend crabbers and cane-pole fishermen with parking space. Such persons do not use boats; they take advantage of the fishing available near the launching facilities. In the warm months, these fishermen line the roads, catching crabs and many species of fresh- and saltwater fish.

Rather than commute to the marsh, many sportsmen build or purchase camps to meet their recreational needs. More than 10,000 seasonally occupied recreational dwellings are part of the wetland's landscape (**Figure 3-137**). These 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 marsh camp, one must obtain a lease and adhere to guidelines established by property owners and governmental permitting authorities. Nearly one-third of the coastal zone's camps are accessible only by water (Gary and Davis 1978, 1979). They are in a sense isolated.

From these camps and boat-launching facilities many individuals enjoy fishing. Due to species diversity, fishing generates the highest participation rates of all recreational endeavors. Fishing is a year-round leisure-time pursuit. Success depends on various species breeding cycles, water levels, fishing pressure, and habitat productivity. Summer months are periods of intense fishing activity. At times there are so many people seeking marsh access that launching sites may contain 100 or more automobiles and boat trailers (Gary and Davis 1979, **Figure 3-138**). Camps are in constant use. To the uninitiated, the isolated and uninhabited marshland appears heavily trafficked. In many places, it is difficult to find a pond or well-location canal not being utilized. With over 6800 miles (10,941 km) of wetlands shoreline, anglers are not without a spot to enjoy fishing.

Sixty fish species are identified with the estuarine or marine environment (McIntire et al. 1975). Freshwater fishermen seek largemouth bass, catfish, "sac-a-lait" or crappie, and bluegill or bream. The black bass (largemouth bass) is considered Louisiana's most sought after freshwater game fish. Saltwater anglers catch primarily spotted seatrout; Atlantic croaker, one of the most abundant commercial fish along the Gulf coast; redfish, sometimes referred to as "bull" or "rat" reds; and black drum. The spotted seatrout is the main species caught, representing nearly 30 percent of the saltwater catch. More than 200,000 saltwater licenses are annually sold in Louisiana. In 1991 commercial fishermen generated $1.2 million from the sale of speckled trout. In addition, many other species use the estuaries as primary nursery areas (Williams et al. 1990).

Along Gulf coast beaches, gigging southern flounder is a popular evening pastime. Floundering is a favorite sport for those who have camps at Grand Isle, as well as those who visit the barrier islands. A successful outing is attained when 10 or more flounder are gigged, but some people are happy to get one! Fishing is such an important sport, people are often organized into clubs. In addition, the fresh- and saltwater anglers have added new meaning to the word "rodeo." In south Louisiana, it means a fishing contest that can attract several thousand participants who compete for prestige and prizes. One of the earliest game fish to

be prized in Louisiana was the silver king, or tarpon, which often measured more than seven feet (15 m) in length and could be caught within the city limits of New Orleans and while surf fishing at Wine Island (Durand 1933; Marston 1932).

In 1928, a group of New Orleans' sportsmen organized the Grand Isle Tarpon Rodeo-one of the earliest sporting events in coastal Louisiana. In that year, eight tarpon were "brought to gaff" (Durand 1933:13). In 1929 five were landed within five hours, all over six feet (1.8 m) long. These fish, however, were not caught during the rodeo. Tarpon were plentiful. Today, it takes considerable effort to bring one tarpon to the rodeo's weigh master.

During 1990, Louisiana issued 121,663 resident fishing licenses in the parishes bordering the barrier islands–Iberia, Jefferson, Lafourche, Plaquemines, St. Bernard, St. Mary and Terrebonne (**Table 3-22**). During the 1996-97 season, the five-parish study area accounted for over 82,000 resident fishing licenses and over 75,000 saltwater licenses (Louisiana Department of Wildlife and Fisheries 1997). Since 1950 the number of resident licenses increased in the coastal parishes by 118,000. Sport fishing continues to grow in popularity. In the same period, non-resident trip and season license sales increased as well. Because many people fish without a license, these numbers may under-represent the true figures.

Due to the large variety of fresh- and saltwater species, fishing is south Louisiana's largest recreational sport. Spotted trout (called speckled seatrout [*Cynoscion nebulosus*] or "specs") are the most sought-after saltwater species. Found in shallow waters, "specs" average from one to five pounds (.45 to 2.3 kg) or better. In freshwater marshes, the quarry is a five pound (2.3 kg) or better largemouth bass (*Micropterus salmoides*). Although bass coexist with saltwater species, they prefer freshwater. Bass are difficult to catch and it takes "bass savvy" to land them consistently.

While not caught in the marsh, pompano is a prized game fish–a gourmet item considered by many as the best eating of all fish taken off Louisiana's coast. Until hydrocarbon exploration offshore, pompano (*Trachinotus carolinus*), king mackerel

Table 3-22. Fishing Licenses Issued in Louisiana's Delta Plain (source: Louisiana Wildlife and Fisheries Commission, various years).

Parish	1950	1960	1970	1980*	1990
Iberia	538	2,458	5,985	6,660	8,977
Jefferson	764	7,238	17,502	19,061	45,801
Lafourche	490	1,753	3,995	11,823	21,066
Plaquemines	61	811	2,307	3,124	6,978
St. Bernard	175	1,331	5,475	6,391	7,829
St. Mary	286	1,659	3,870	3,411	11,256
Terrebonne	739	3,714	6,128	10,093	19,756

* Data difficult to read from original field information, may be errors in interpretation

(*Scomberomorus cavalla*), Atlantic croaker (*Micropogonias undulatus*), jack crevalle (*Caranx hippos*) and red snapper (*Lutjanus blackfordi*) were rarely caught. Offshore production platforms became, in effect, artificial reefs. As new platforms were added, they enhanced the saltwater species feeding grounds. With time, these "reefs" turned the Louisiana coast into one of the world's finest offshore fishing provinces (Ditton and Auyon 1984; Reggio 1987; Wilson et al. n.d.).

The estuarine-marsh-swamp system is also a nursery ground that guarantees an abundant seafood supply. More than 90 percent of the Gulf's finfish spend part of their life-cycle within the coastal zone. Nationally, Louisiana's fisheries rank first in tonnage and second in value. Although coastal waterbodies are commercially exploited, production is sufficient to support an active recreational fishing population. Recreational enthusiasts contribute more than $400 million to the local economy, with more than one half million people involved in this leisure-time activity.

Sport fishing is a year-round enterprise (**Figure 3-139**). It changes with the various species' breeding cycles and summer months are preferred. At times, so many people seek marsh access that 100 or more automobiles may be seen at launch sites. To meet public demand for launching facilities, boat ramps dot the landscape; there are 150 to 200 launching ramps available for public use. Some can accommodate up to 100 cars and trailers. As might be expected, they range from small, roadside ramps, able to accommodate five to ten automobiles, up to private marinas with as many as four launching ramps or hoists. At many of these larger facilities, charter boats take small groups of fishermen offshore to troll or bottom fish for larger species. Boat ramps are difficult to count because of the vast number of private launches available along coastal bayous. Private ramps or launches probably outnumber public launches by a ratio of more than 50 to 1. Along lower Bayou Pointe au Chien for example, docking facilities were observed adjacent to every camp or home that fronted the bayou along the last mile of the road. A ramp or launch area was available for about 1/4 of the camps and houses in the same area. The ratio of launch sites relative to camps varies from bayou to bayou, depending to some degree on proximity to the nearest public launch and condition of the channel. For some of the observed small private ramps associated with a single camp, gates or chains restrict access. Many private ramps are not gated, either because unwanted boat launchers are not a problem or perhaps to make them more accessible to friends or relatives of the ramp owner.

Along the north-south oriented bayous that extend toward the coast, some of the most popular boat ramps are located at or near the southern end of the road. Relatively large and well-utilized launches were noted at East Pecan Island, Cypremort Point, Port of West St. Mary, Cocodrie, lower Pointe au Chien, Four Point Bayou, and Bayou du Large. For the 1996-1997 fiscal year, the Louisiana Department of Wildlife and Fisheries issued over 82,000 regular recreational fishing licenses and over 75,000 saltwater licenses within the five parishes included in the study area (Louisiana Department of Wildlife and Fisheries 1997). In 1992, approximately 1,800 commercial and over 3,600 recreational watercraft were registered in the five-parish study area (Castille 1993:Appendix L). These numbers do not account for all of the watercraft utilizing the study area. Hundreds of fishermen live outside the study area and simply tow their boats to coastal waters on weekends.

Once their boats are in the water, the outdoorsmen can go after either fresh or saltwater species. Travel is easy, as the region is laced by an intricate system of natural and artificial waterways. These routes supply the connectivity necessary to exploit marshland resources.

In addition to fishing, two additional recreational activities have developed from a commercial base: crabbing and shrimping.

Crabbing

Crabbing is a family-oriented pastime concentrated in the summer. Blue crabs (*Callinectes sapidus*) are migrants. They stay in shallow waters in warm months and move to deeper waters in winter. They can occupy almost all available habitats, with a large number caught in periods of low salinity and temperature. In warm weather, with abundant available food, a crab can mature in about 12 months. In attaining adult status each crab sheds its shell approximately 15 times. For two hours it becomes a soft-shell crab, considered a delicacy (Adkins 1972). After two hours the crab is considered a "paper shell."

Recreational fishermen crab along roads bordering coastal bayous and drainage canals and in estuarine waterbodies. Trotlines and drop nets are traditional methods employed to capture this crustacean. The recreational catch provides many families with seafood at a nominal expense.

Shrimping

A special license is now required to sport shrimp. These individuals can catch up to 100 pounds (45 kg) a day; a shrimping license is mandatory and the catch cannot be sold. Like their commercial counterparts, recreational shrimpers must trawl within the regulated season. To improve their harvest, some build large, winged "butterfly" nets. These wharf-mounted *poupiers*, when lowered into a bayou, are an efficient way to "trap" migrating shrimp (**Figure 3-140**).

Hunting

Within the study area, winter recreation endeavors focus on hunting (St. Amant 1959). At least 100,000 individuals hunt within the marsh (**Figure 3-141**). These sport enthusiasts hunt waterfowl, puddle ducks, deer (*Odocoileus virginianus*) and rabbits (*Sylvilagus aquaticus*). Demand for hunting space is so acute that two recurring costs are inescapable: a land lease or a membership in a private hunting club. Louisiana has long been considered an ideal area for hunting. The following account provides one perspective from an early 20th century duck hunter:

> A man using a gun there [south of Bayou Teche] does not have to bother about blinds, for nature has provided them. He does not have to worry about heavy underclothing and waterproof trousers, and a coat that will 'break

> the wind,' for nature has obviated all of that too. In the severest weather he will need clothing of no greater weight than is worn North in the fall. He will not have to worry about decoys, for he can always kill a duck or two, and, setting them out on the water, with sharp sticks under their chins to keep their heads up, he can kill more [Canfield 1903].

There are approximately 50 major wetland landowners. In order to hunt the marsh successfully, a lease must be obtained from one of these individuals or corporations. Cost varies, depending on location, size, number of ponds, and the tract's hunting potential. As a standard rule, the better the hunting, the greater the fee.

Louisiana's marshes, swamps and waterbodies constitute one of the nation's most important waterfowl wintering habitats. Millions of birds rest and feed in the coastal zone before flying to their wintering grounds in Central and South America. Indeed, the coastal marshes make up less than 15 percent of the total area of the state, but more than 50 percent of the ducks and geese harvested in Louisiana are harvested in the coastal wetlands (Chabreck 1988). During their winter stay, the migratory populations seem to prefer fresh to intermediate marshes, although some species can tolerate brackish conditions. They make hunting an extremely important and popular pastime (**Figure 3-142**). Managing this resource is accomplished by regulating hunting pressure within breeding, migration and wintering areas (Herring 1976). Within the five-parish study area, over 454,000 waterfowl were harvested during the 1996-1997 season (Louisiana Department of Wildlife and Fisheries 1997). Ninety percent of all bird species of eastern North America have been observed in the Gulf Coast marshes (Lowery and Newman 1954)

Hunting Clubs

At the turn of the century, hunting clubs were organized on large landholdings to take advantage of leased land. In some cases, these clubs controlled extensive hunting tracts, such as those of the Gulf Coast Club–later called the Vermilion Corporation–that controlled 125,000 acres (50,625 ha), more than 70 percent classified as wetlands (Knapp 1991). The Vermilion Corporation in fact continues to manage this property, which was deeded to its corporate predecessor by the Department of State from public landholdings within Vermilion Parish in 1849. Hunting was the primary objective of the well-to-do persons interested in this club and others scattered across Louisiana's wetlands. Currently, colorful placards identify camps as "Tropical Gardens Gun Club," "The Scrip 'N Scrounge Duck Club," "Carlton's Folly," or "Florence Hunting Club." Louisiana's French heritage is reflected in camps called "*C'est notre Plasir,*" "*Chateau de Bateau,*" "*Lagniappe,*" and "*C'est La Vie.*" Whatever whimsical name is employed, these dwellings are staging points for recreational activities (Davis and Detro 1975).

In addition to the Vermilion Corporation holdings, other clubs also own hunting rights to large tracts–some greater than 40,000 acres (16,200 ha). Other clubs control smaller plots. Regardless of size, hunting space is guaranteed. On club property facilities range from spartan to spacious. Some club members pay an initial fee from $1000 to $5000 and yearly dues of as much as several thousands of dollars. In such surroundings the only thing a

member does is pull the trigger. All arrangements are made to insure a successful hunt. Often club employees kill the game so members do not need to leave the clubhouse.

For those who cannot afford a lease or club membership, state operated wildlife management areas are free. Within these preserves, hunting is controlled in an attempt to assure a never-ending supply of game resources. These management areas protect numerous avian and aquatic species. On wildlife refuges hunting is not permitted, as continued enjoyment of the outdoors depends on maintaining a healthy resource (Duffy and Hoffpauer 1966). Refuges are particularly important as nesting sites for recreationally significant species. As one link in the North American Flyways, they help alleviate "heavy shooting pressure" on the waterfowl population. During peak years it is estimated between 6 to 8 million birds will rest in Louisiana's marshlands (Burts and Carpenter 1975; Chabreck 1988).

It should be emphasized that marsh recreational days may be dual in nature; hunting and fishing are often carried on during the same day. Consequently recreational endeavors totaling millions of man-days (1 man-day = 24 hours) annually take place in the waterlogged lowlands. Before the beginning of the hunting season in each year, every chartered or unchartered hunting club or association in the State must apply to the Department of Wildlife and Fisheries for a special hunting club permit and license through its officers (**Table 3-23, Figure 3-143**). Permits are required for any club that 1) has more than three regular members and 2) occupies or owns a clubhouse, club-boat or other fixed or regular place of abode during the open season. This permit is issued by the Department upon receipt of five ($5.00) dollars.

In the sportsmen's annual use cycle, winter is devoted primarily to hunting (**Figure 3-144**). Taking advantage of the waterfowl's migratory cycle, hunters annually kill more than 2 million winter waterfowl (**Table 3-24**). Although a substantial number of birds are killed, considerable effort goes into maintaining habitat diversity. As a renewable resource, the migratory populations are sustained by properly managing the wetlands. This is accomplished by closely regulating hunting activity within breeding, migrating, and wintering areas. 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.

In 1990 38,279 people purchased hunting licenses in the coastal—Iberia, Jefferson, Lafourche, Plaquemines, St. Bernard, St. Mary and Terrebonne (**Table 3-25**). Wetland hunting is so attractive, sportsmen from throughout the state hunt the marshes and swamps along the coast. These hunters can be divided into two categories—those who hunt waterfowl, primarily puddle ducks, such as mallards, pintails, and teal; and those who hunt quadrupeds, principally deer and rabbits. Because demand for hunting space and expenditures associated with this sport are greater than with fishing, most hunters must obtain a land lease or membership in a private hunting club in order to enjoy the sport. Property has become so precious a lease or membership in a club can cost several thousands of dollars. For many individuals, hunting is beyond their means, or confined to only those with leases that have been in the family for several generations. These grandfathered leases allow a larger percentage of the hunting population to enjoy the sport. For those individuals

Table 3-23. Report of Licensed Louisiana Hunting Clubs, 1929-1930 (source: Department of Conservation 1931).

Club Name	Licensed Hunters
Coastal Club	561
Delta Duck Club	674
Lake Arthur Club	93
Crowley, Louisiana Club	N/R
Daigle Hunting Club	196
Star Hunting Club	230
E.L. Pratt Club	228
Little Lake Club	28
Pass-a-la Loutre Club	253
Savanne Neuvelle Club	37
Stella Duck Club	22
Netherlands Gun Club	12
Dixie Delta Club	132
Lake Charles Club	66
Florence Club	64
C.A. Savoy Club	84
Crescent Gun and Rod Club	8
Lafitte Gun and Rod Club	10
Orange Cameron Lake Co	35
Mount Forest Club	8
The Rigolets Club	3
Manchac Hunting Club	17
Ruddock Gun and Rod Club	9
Buck Horn Club	3
E.M. Percy Club	8
Grand Chenier Club	NR
Seven Ponds Club	7
Sweeney Hunting Club	N/R
Barmore Hunting Club	5

N/R = No Record

Table 3-24. Waterfowl Hunting in Louisiana's East Coastal Zone, 1977-1978 Season* (source: Gauthier 1978).

Area	Number of hunters	Days hunted	Birds bagged
East-Coastal Inland (corresponds to the Louisiana Delta Plain)	28,466	160,167	591,321
State Total	167,686	1,297,115	2,831,949
Percent	17	12.4	20.9

* Figures are averaged and represent best estimates

who do not have a lease or club membership, public-managed refuges are available for their enjoyment.

In the 1990-1991 season, 66,000 individuals bagged 635,000 birds in Louisiana and most of these birds were killed in the south Louisiana marshes (**Table 3-26**). The East-Coastal zone corresponds roughly to the region outlined by the State's barrier islands. In this area sportsmen hunted a total of about 160,000 days or 12 percent of the total days hunted in the State during the 1977-78 season. For their efforts, they harvested 21 percent of the waterfowl killed in Louisiana during the 1977-78 season. In that same season, Louisiana's waterfowl hunters in the coastal zone contributed 40 percent of the total State waterfowl harvest. The East-Coastal Zone, has approximately one-half of the hunters and harvests 15 percent less waterfowl than the West-Coastal Zone. In 1995, the five parishes within the study area accounted for 23 percent of the total birds bagged in Louisiana (Louisiana Department of Wildlife and Fisheries 1995). In 1997, over 26,000 resident hunting licenses were issued in the five parishes located within the study area (Louisiana Department of Wildlife and Fisheries 1997).

South Louisiana's climate provides the recreational enthusiast with nearly ideal weather conditions. Warm summers and mild winters are the generalized weather conditions. Since precipitation falls all year, there is rarely a dry period. In spite of nearly ideal weather and lengthy coastline, beach-oriented recreation is limited (Gary and Davis 1978; Davis and Detro 1975). There are few accessible beaches within the coastal lowlands. For the most part, Louisiana's outdoorsmen prefer to build "camps" that are used as away-from-home bases for hunting, boating and fishing. In addition, day trips are a common recreational endeavor.

Modern Camps and Camp Communities

During the nineteenth and early twentieth century, only the wealthy could afford the time and expense needed to reach recreational camps in remote areas. By the middle of the twentieth century, recreational camps became very popular for the middle class of society. A host of technological inventions - including the automobile, improved roads, the outboard motor, ice machines, and rural electrical networks - made fishing and hunting trips much more practical for the average sportsman. As a result, the population of camps has mushroomed along the Louisiana coast. Today there are more than 10,000 wetlands camps in coastal Louisiana (Gary and Davis 1978). While nineteenth century camps were most commonly occupied by marsh dwellers trying to make a living off of the local resources, most modern camps are primarily for recreational use. These recreational dwellings come in all shapes, sizes, style and designs (**Figures 3-137, 3-145,** and **3-146**). Whether built on pilings above marsh mucks, or on a slab anchored to a natural levees, *chenier* or beach, the dwellings include roughhewn, tar-paper hovels, piling-supported mobile homes suspended as much as 15 feet (4.6 m) above the ground, simple bungalows, elaborate second homes, and a multitude of other architectural gems. On account of their dilapidated status, many are described as "Tilten Hiltons." Swimming pools, glass-enclosed verandas, and enough rooms and beds to accommodate 50 guests comfortably are normal for luxurious camps. Some two-storied units

Table 3-25. Hunting Licenses Issued in Louisiana's Delta Plain (source: Louisiana Wildlife and Fisheries Commission, various years).

Parish	1950	1960	1970	1980*	1990
Iberia	3,869	4,449	5,015	4,698	4,003
Jefferson	5,558	9,340	15,198	15,868	12,934
Lafourche	4,265	5,162	8,182	9,062	6,819
Plaquemines	1,271	1,580	2,175	3,543	1,053
St. Bernard	1,000	1,328	3,102	3,040	2,683
St. Mary	2,848	4,409	6,158	6,401	4,640
Terrebonne	4,553	5,109	7,956	9,824	6,147

* Data difficult to read from original field information, may be errors in interpretation.

Table 3-26. Waterfowl Hunting Data for Louisiana, 1990-91 (source: Louisiana Department of Wildlife and Fisheries 1991).

	Number of hunters	Birds bagged
Statewide	66,000	635,000
Species composition		
green-winged teal		18 percent
mallard		20 percent
blue-winged teal		8 percent
wood duck		16 percent
gadwall		13 percent
pintail, shoveler, widgeon and ring-necked comprising most of the remainder		

are equipped with outside elevators. Others are one-room "houses" built for only the most rugged, and determined individual.

Whatever design and costs are involved, camps are constructed to meet their owner's leisure-time needs: all can be considered multifunctional and seasonal. Based on utilitarian function, two types emerge: hunting and fishing. Hunting camps are utilized mainly during the fall and winter hunting season. They tend to be ramshackle buildings located in fresh and brackish marshes, which are the sites preferred by wintering waterfowl. In contrast, fishing camps are used year-round. They are more elaborate and are located throughout marshes of any salinity, as game fish and certain shellfish are found in almost all wetlands habitats. In addition, several hundred barge-mounted camps can be towed to saltwater angling sites during summer and moved inland for hunting purposes.

Very large camp communities, some with associated marinas, have sprung up throughout the study area (**Figures 3-147, 3-148,** and **3-149**). In most instances, the communities developed at the downstream extremity of a road that parallels a channel, usually a bayou. Camps are constructed along virtually any type of water body, including areas that lack a firm subsurface foundation. However, the densest camp development is confined to natural levees of bayous, and in particular to those areas accessible by automobile. Examples of camp communities include East Pecan Island, Cypremort Point, Bayou Grand Caillou (Dulac), Bayou Petit Caillou (Cocodrie), Bayou du Large, and Bayou Pointe au Chien (**Figure 3-150**). For elongated bayous such as Bayou Petit Caillou or Bayou Pointe au Chien, the upper (northern) end is dominated by permanent residences and the lower (southern) end is dominated by recreational camps. The two types of structures overlap along the middle section of the bayou.

Some camp communities have developed in areas accessible only by boat, such as the area along Bayou de Cade in Terrebonne Parish (**Figure 3-151**). Numerous distributary channels of the Terrebonne marsh are now lined with camps in areas that supported only small, scattered farms during the early twentieth century. In some cases, major camp communities develop at the intersection of a bayou and a modern navigation canal. Examples of this latter type include the Falgout Canal development along Bayou du Large and to some extent, the camp community at the intersection of Four Point Bayou and the Houma Navigation Canal (**Figures 3-152** and **3-153**). Camps accessible by boats are often equipped with generators, butane and ingenious cisterns to make them a bit more comfortable. Those with highway access are better built. Public utilities are often available.

Cypremort Point is a good example of a camp community that has developed within the last 50 years. In 1932, the road to Cypremort Point was a single lane gravel trail and only two camps existed at the end of the road (**Figure 3-154**). A camp construction boom began during the 1940s (**Figure 3-155**) and has continued up to the present. Today, Cypremort Point includes several hundred camps for weekend visitors, a marina, and about 100 permanent residents. New construction is still occurring and a large marina-type development is occurring adjacent to the present marina (**Figures 3-156** and **3-157**).

Of all the distributary channels that extend toward the Gulf, Bayou Sale in St. Mary Parish is the only one within the study area that does not support a large population of camps. Camp development along Bayou Sale did not occur probably for two reasons: 1) because of the extensive oil and gas development along this channel and 2) because Bayou Sale was not considered a navigable stream; it was blocked by numerous culvert dams, bridges, and trees. A blocked channel did not provide access to coastal marshes and bays sought by recreational fishermen and hunters.

Bayou Sale differs from other distributary channels in another way. Since the 1930s, the banks of Bayou Sale have been the site of oil and gas facilities associated with the development of the Bayou Sale Oil Field that underlies the entire lower portion of Bayou Sale. During the height of oil exploration in the 1940s, small worker communities were created adjacent to both the Humble Oil and Texaco fields (**Figure 3-158**). Because of the significance of this oil field, a flood protection levee was built along Bayou Sale during the

1940s (**Figure 3-159**). This levee was constructed years before similar levees were installed along Bayou du Large, Bayou Pointe au Chien, Bayou Terrebonne, and other distributary channels where only farms or camps occurred.

Refuges

Edward A. McIlhenny, along with Willis Ward, purchased from the Orange Land Company 54,000 acres (21,870 ha) on the south side of Vermilion Bay. On November 4, 1911 these philanthropists donated 13,000 acres (5,265 ha) to Louisiana that became the Louisiana State Wild Life Sanctuary. The donation was the first wildlife refuge in the world, privately funded for the public good (McIlhenny 1930). While this tract was going through the acceptance process, McIlhenny quietly got together options on Marsh Island. This was not an easy task, since all of the people who owned property on the island had to be willing to sell their property and all titles had to be researched and a survey of the property completed. In order to complete the acquisition, Mr. McIlhenny needed to finance the sale. Working with a number of intermediaries, the proposed refuge came to the attention of Mrs. Russell Sage who paid $168,980 for the property, leaving the title in Mr. McIlhenny's name. The property in 1913 was placed under the control of the State of Louisiana (McIlhenny 1930).

To the east of the Russell Sage property the state has established the Atchafalaya Delta Wildlife Management Area. In the State's annual aerial survey of wildlife within the region, those taking the survey "look down and actually see water churning brown from rafts of pintails rooting in the duck potato"– prime duck fodder (Fontova 1997:14). The Delta covers 137,000 acres (55,485 ha); most of this is water. Only about 30,000 acres (2,150 ha) are vegetated. Even so, from 200,000 to 300,000 ducks use the site; consequently, each hunter using the Management Area bags an average of two to three ducks per trip (Fontova 1997).

The Louisiana State Wild Life Sanctuary and Russell Sage refuges represent some of the earliest nationwide efforts to provide wildlife habitat designed to restrict hunting. At the time these properties were being developed, sportsmen and conservationists were encouraged by the passage of the Migratory Bird Law of 1913 and the Migratory Bird Treaty Act of 1918. Under the provisions of this legislation, spring shooting and market hunting were abolished–considered a major step in the conservation of migratory waterfowl (Redington 1933).

Eco-tourism

Although it is not yet a major economic endeavor, eco-tourism is certainly a growth industry. Guided swamp and marsh tours have been established within the last 10 to 15 years (**Figure 3-160**). A check of two visitor centers within the study area revealed advertisements for about a dozen different tours in south Louisiana, and several are located within the study area. These tours are indicative of the interest and concern for preserving natural habitat along the Louisiana coast.

Urban Growth

Because of vast wetland expanses along the coast, inhabitable areas are limited and confined to higher elevations. As a result, the highest elevated lands are becoming crowded as the population increases. As a general rule, the larger the natural levee, the larger the community that can be developed. This rule was certainly true before pump drainage was installed. Today, urban expansion has outgrown the elevated land in several areas. Although Houma, Morgan City and New Iberia are ports, in the early nineteenth century, Franklin was the region's principal port. It served the area's plantation economy by providing easy access to Bayou Teche and the system of waterways that make up the Atchafalaya basin. The Attakapas Canal and Grand Cote Canal were also important links in the development of markets connected to Franklin and later New Iberia. These channels connected Bayou Teche with Bayou Lafourche and the Mississippi River (Bergerie 1956). In addition, schooners from eastern ports brought products to Franklin and returned with cypress lumber milled within the Teche country. This schooner trade lasted until the early 1900s (*Daily Review*, March 5, 1991). Morgan City is highlighted here as an example of a typical small city with an economic foundation that includes agriculture, fishing, and oil and gas. It was also selected because many of the environmental problems (flood control, threat of hurricanes, loss of natural habitat, lack of undeveloped elevated land, etc.) are common to other developing urban areas within the study area.

Morgan City

In many respects, Morgan City is a good example of a coastal community that has undergone the transformation from an agricultural center to a hub for inshore-offshore oil and gas activity (**Figure 3-161**). Similar transformations have occurred in New Iberia, Patterson, Houma and numerous small communities. Morgan City is one of the principal towns in St. Mary Parish and was established on Tiger Island, once inhabited by coastal Native Americans who survived by fishing, trapping and hunting. The region was originally part of the Attakapas District of French and Spanish Colonial Louisiana, later described by Longfellow as the "Eden" of North America. In 1857 with real estate speculation booming, Brashear City was laid out beside the New Orleans, Opelousas and Great Western Railroad, an 80 mile (49.7 km) route from Algiers on the west bank of New Orleans to Berwick Bay. In effect, the railroad shortened the distance from New Orleans to Galveston, Texas by 160 miles (257 km) and 24 hours over the water-only route. Once the line was completed, ships could avoid the "unpredictable" Mississippi River and shippers could avoid the high property taxes and port fees charged by New Orleans.

The community/town was incorporated in 1860 as Brashear City (named after Dr. Walter Brashear who owned the Tiger Island Sugar Plantation and was an early settler on Belle Isle). The community served as the western terminus of the railroad (Broussard 1977, Gibson et al. 1978, Leeper 1976). The railroad actually gave birth to the town and was completed as far west as Bayou Boeuf. To meet passengers' needs to travel further west, the railroad entered into an agreement with Cornelius Vanderbilt for steamer service between the railroad terminus and Galveston, Texas. The sidewheeler *Galveston* was placed in service in April, 1857 and the second vessel, *Opelousas*, was added in May, a month after the railroad

was completed (Broussard 1977). Early twentieth century shipping was centered on the Southern Pacific Railroad and Atchafalaya & Bayou des Glaize packet steamship companies. Southern Pacific's railroad served the community's transportation needs as well (Fortier 1914). Both water and rail transport was important for exporting sugar, one of the most important crops of the study area. By the 1840s, planters within the region were using horse or steam-powered sawmills to manufacture cypress boxes to ship their sugar products to markets in New Orleans and beyond.

A town began to emerge. "In 1857 cattle pens, to take care of livestock shipments from Texas, dormitories for the train crews, a house for a station agent, sidetracks, turntable, and other facilities were built. Homes and business places sprang up on either side of the railroad track . . ." (Broussard 1977:38). By 1859 there were 40 homes on the town site. During the Civil War, the region went through a number of battles, skirmishes and, along with the entire state, the longest military occupation in the south—ten years. The region was considered important as an infantry and marine base to support Union forces involved in the Texas campaign and to thwart Confederate efforts within the Teche and Atchafalaya regions (Gibson et al. 1978).

During the Civil War period, a way of life ended and a new era emerged. The growth of Brashear was temporarily retarded at the end of the war as a result of inundations in 1865 and 1867 that were caused by breaks in the Mississippi River levees. In addition, with these floods came yellow fever (Broussard 1977).

Charles Morgan established his steamship line in Brashear and in 1875 the city of Morgan City was incorporated and renamed in his honor. In conjunction with his steamship operation, Morgan dredged, at his own expense, the 100-foot wide, 12-foot deep Atchafalaya Bay Channel in 1872, along with the Houston Ship Channel in 1874. The Atchafalaya Channel contributed to an era of major economic development. A lighthouse and other navigation improvements helped guide ocean-going vessels into port at Morgan City (**Figure 3-162**). It was a key element in Morgan's decision to make the region the hub of his steamboat operation in conjunction with his Louisiana and Texas Railroad (formerly the New Orleans, Opelousas and Great Western Railroad). At the height of his local operations in the early 1870s, Morgan had 15 steamships sailing out of Brashear to New York, Cuba and numerous Texas ports. Railroad construction opened up a new industry. Sawmills were established along the rail route to provide railroad ties, along with lumber for the construction of box cars, rail terminal facilities, wharves and docks, homes for settlers, and for commercial buildings (*Daily Review*, March 5, 1991).

In 1875, Morgan City contained the following: 800 houses, five churches, five schools, one Masonic lodge, two fire companies, two newspapers, one social club, one moss factory, one sash, door and blind factory, four steam sawmills, one ice house, one custom house, three drug stores, 50 wholesale or retail stores, 15 coffee shops, five billiard rooms, three bakeries, and 17 vessels in active operation between Morgan City and Texas, New York, Havana, Cuba and ports in Mexico and Central America (Broussard 1977). Among the community's original industries were sugar mills and refineries, oyster and shrimp canning establishments. In addition, large quantities of fish and terrapin turtles were shipped to New

Orleans and northern markets. In the early 1900s, because of its importance as an inland port and commercial fishing center, Morgan City attracted a widely diversified population. Norwegians, Swedes, Poles, Greeks, Italians, Portuguese and some Filipinos were part of the city's fishing culture. In addition, Morgan City and its sister communities of Berwick, Patterson, and West St. Mary were important cypress timber processing centers. Mills were an essential part of the region's industrial landscape. The local economy was also supported by boat- and ship-building, seafood, fur-trapping, moss picking and processing, and shell-crushing plants (Gibson et al. 1978).

Sawmills

Rotary, circular and band-saws, new and improved methods of tree harvest and removal, coupled with an expanding market, attracted lumbermen and their sawmills to Baldwin, Berwick, Franklin, Centerville, Patterson, and Morgan City. Mills in these communities located on the region's waterways and railroads and could, therefore, easily furnish the fuel required by the wood-burning engines used during this period.

The largest mill was the F. B. Williams Cypress Lumber Company (in the 1870s it was the Pharr-Williams Company), which owned more than 60,000 acres (24,300 ha) of timber lands that contained about 1.5 billion feet of cypress lumber. Other lumber companies in the area were: Berwick, Gates, Hanson, May Brothers, Kyle-Taylor, Baldwin, Jeanerette, Norgress-Menefee, Brownell-Drews, Cotten Brothers, Ramos and Waddell-Williams, which in 1922 became Norman-Breaux (**Figure 3-163**).

During World Wars I and II the mills supplied shipyards at Morgan City with material to build U.S. Naval vessels and dry-docks for repairing naval vessels. With establishment of the "jumbo" shrimp industry in 1937, local mills supplied wood products for building shrimp trawlers. In addition, the mills provided wooden crates to ship seafood products by rail and truck directly to New York markets. The Texas Company (now Texaco) had a snook mill in Morgan City specifically to build wooden boxes used in the shipment of five-gallon cans of motor oil or kerosene from its Beaumont refinery.

The Norman-Breaux mill was the last mill in Morgan City and by 1925 was the largest producer of cypress products in the United States. It closed in the 1950s, thirty years after most of the mills ceased their operations. While in operation, it shipped boxcar orders of cypress to clients in 36 states (*Daily Review*, March 5, 1991).

Red cypress, oak, tupelo-gum and other trees, were used by early settlers for building purposes. Cypress was particularly important as it was used to build small cottages, boats, fences, furniture, cisterns, plantation manor houses and out- buildings, sugar mills and associated structures. This was an ideal building material, since cypress is nearly indestructible under water, hence it was often referred to as "The Wood Eternal." Because of this quality, cypress quickly became a sought after building commodity and was milled into different sized beams, planks, boards, shingles, lath, moulding, boxes and other wood products used by manufacturers. The industry's mainstay was originally shingles, with some mills having the capacity to produce more than 150,000 shingles a day.

Between 1865 and 1920, Morgan City's population had grown from approximately 500 to more than 5400. After 1920 the city faced the Depression and the demise of the timber industry and changes in the region's oyster business. These were difficult times. However, by 1940 the city was showing signs of recovery with development of the deep-water shrimping industry—shrimp production continues to be a multimillion dollar industry for the city (Gibson et al. 1978). Also, Morgan City was the site of a defense plant charged with building "huge floating drydocks for the U.S. Navy" (Broussard 1977:97). Although a welcome addition to the local economy, the influx of people employed in this enterprise taxed the local housing market and public facilities. Morgan City responded by improving its municipal power plant, water and transmission lines, garbage and trash disposal, gas utility system and recreation program.

Oil and Gas Exploration

In order to continue to expand its industrial base, the city needed to improve the navigation channel that served the region. This was accomplished about the time the city began to recognize the importance of the area's oil and gas business. In 1933 the first attempt was made to drill a well in the Gulf of Mexico (**Figure 3-164**). This endeavor from a platform on timber pilings was in 12 feet (3.6 m) of water about 3000 feet (915 m) off Creole in Cameron Parish. It was a dry hole, but nevertheless began interest in offshore drilling. Four years later Pure Oil and Superior Oil companies completed a well 6000 feet (1830 m) offshore from Creole in 14 feet (4.3 m) of water. Supported by a wooden platform island, the offshore industry was born (Lindstedt et al. 1991; Londenberg 1972; *The Oil and Gas Journal* 1935). The following nine years brought a series of steps into deeper water, further from the shoreline. It was not until November 17, 1947, that a consortium led by Kerr-McGee (along with Phillips Petroleum Company and the Stanolind Oil and Gas Company), successfully completed a well out-of-sight of land—10.5 miles (17 km) from shore in Ship Shoal Block 32 (Barnes and McCaslin 1948; Londenberg 1972; Mathews 1977). Civil engineers realized that wood pilings were unacceptable, so this well was completed using a converted naval vessel, the *Yard Freighter (YF) 893*, renamed the *Frank Phillips*. In the process, the exploration well opened a new chapter in the petroleum industry and completed the land, marsh/swamp, and offshore exploration history of Louisiana's petroleum industry (Postgate 1949; Vice 1987). Prior to 1940 the petroleum industry in Morgan City was almost unnoticed (**Figure 3-165**). By virtue of its location in relation to the Gulf of Mexico's new exploration and development programs, Morgan City during the 1940s began to become: "The Gateway to the Tidelands and Hub of the Inland Waterways." In the process, international attention was focused on the region, since it served as homeport and supply base for the "gamble" and "unknowns" associated with exploration and production in open water.

Within seven years after Kerr-McGee's initial discovery, oil companies extended the offshore frontier to 50 miles (80 km) and were hitting hydrocarbons on 25 percent of the exploration wells drilled. In 1954 another new chapter in offshore drilling began when Alden J. "Doc" Laborde, launched the world's first mobile offshore drilling rig. The *Mr. Charlie* (named after Charles Murphy, Sr. the founder of Murphy Oil Corp) made maritime history.

The rig was completed by Alexander Shipyard, now Trinity Gulf Repair, in New Orleans, and it marked a major milestone in Louisiana's pioneering role in the world's offshore-oil industry (Hall 1996). Consequently, by 1955 more than 40 offshore rigs were in operation (Davis and Place 1983; Larson et al. 1980; Le Blanc 1997). Morgan City began serving as an important oil logistic support site (**Figures 3-166, 3-167,** and **3-168**). The region, for example, became the hub for deep-sea diving operations. With Kerr-McGee's success, an unpredictable stampede took place as major oil companies accelerated their interest in operating offshore. They risked millions on their offshore endeavors and accepted the associated risks. The resulting "boom" greatly benefited the Morgan City-Berwick-Patterson region (**Figures 3-128a and 3-128b**). In addition, much of the technology used in open water elsewhere in the world was developed in the greater Morgan City area, because of Kerr-McGee's gamble in the Gulf of Mexico (Mathews 1977).

Onshore the industry was also doing quite well (Cahoon 1989, **Table 3-16**). During the 1940s there were 251 fields added to the state's list of producing properties. By the mid-1950s there were more than 440 fields in the state, three times the number prior to 1940 (François 1993). The region was described as "one of the country's most promising frontiers for exploration" (Williams 1957:142). Regardless of the enthusiasm and success rates offshore, supplies, supplies and more supplies were critical to the exploration/development process. New businesses were established. Old businesses found new markets. The region prospered and vendors found their niche—a second industry was born out of the offshore boom and Morgan City has benefited greatly. For example, in 1953 J. Ray McDermott constructed the first fabrication yard to be built solely for offshore fixed steel structures; fabricators built nearly 5500 of them (Le Blanc 1997, **Figure 3-128b**). In 1955 McDermott built the first 250-ton revolving derrick barge for offshore use. With Kerr-McGee's success, the Navy's fleet of surplus yard-freighter and landing ship-tanks (LSTs) were quickly sold to the industry.

By 1953, operators were building their own support vessels. Two years later, Tidewater Marine Service Company built and put into use the first custom-built cargo boat, the *Ebb Tide* (Londenberg 1972). The oil logistic support industry began immediately meeting the needs of the rapidly expanding industry. Contractors became critical to the exploration and development process and by 1965 were a fixture in the business (Le Blanc 1997).

Since completion of the first well, more than 3700 drilling and production platforms are now anchored in federal waters of the Outer Continental Shelf, and all but 23 are located in the Gulf (U.S. Department of the Interior 1994). The only logical and consistent way to meet domestic and industrial demands for the hydrocarbons produced from these structures was to build an efficient pipeline network. Barges were originally used to transport oil ashore, but were expensive. An alternate method was required. The offshore pipeline industry was born and served as the basis for an intricate pipeline web that currently connects the supply source to the market (**Figure 3-169**). These pipelines guaranteed that many industries could maintain their production levels, which in turn helped to insure delivery of their products to their markets. The oil, gas and pipeline industries had been good to Louisiana, but by 1995 the industry had lost its momentum and appeared to be dying.

Statewide, the economy suffered, but in less than two years major oil companies that had all but abandoned the United States in the early 1990s were back, exploring in depths unimaginable less than ten years before. Today service industries concentrated in Morgan City, Houma, New Iberia and other coastal centers are benefiting from this renewed interest offshore. "Only over the past three years has Morgan City fully recovered from the 1986 crash of oil prices. Skilled tradesmen left the region in droves. With a new boom triggered by deepwater drilling in the Gulf, various companies have signs posted seeking welders, fitters and other positions" (Sayre 1997:16A).

As noted previously, urban development within the study area was confined to major natural levee ridges prior to the influence of the oil and gas industry. By the middle of the twentieth century, the natural levees along the Atchafalaya River were no longer wide enough to accommodate the expanding suburbs and industrial developments brought on by a healthy economy. As in New Orleans, Morgan City has expanded into surrounding wetlands areas through the construction of levees and forced or pump drainage (**Figure 3-170**). Because of its precarious position along the banks of the Atchafalaya River, flooding and pump drainage are major concerns. Prior to the 1960s, new construction was directly related to land elevation; by necessity, all construction occurred either upon natural levee ridges or on artificial spoil. With the introduction of pump drainage, development now occurs in lowlands and the levees serve as sharp boundaries separating the developable from the undevelopable land surface.

CHAPTER 4

CONSTRUCTION PROJECTS, POPULATION GROWTH, AND IMPACTS

As noted in Chapter 3, human settlement has imposed an indelible mark on the landscape of the central Louisiana coast. It is apparent that many human activities will have an impact on the natural surroundings and that some of these impacts last longer than others. For the present study, it would not be practical to examine every construction or public works project and the impacts that these projects have had on the local landscape. However, several terrain modification measures have been singled out in order to focus on the physical and cultural impacts that these activities have caused. A number of factors influence Louisiana's land loss rates. Natural and human-related elements have contributed to this loss, but, in general, change in the Mississippi's flow regime, local hydrology, sea-level rise, subsidence, fluid withdrawal, and hydrocarbon exploitation are the principal catalysts involved in this change. Within the coastal lowlands, wetland losses exceed 100 km^2/year (Gagliano et al. 1981; Gosselink et al. 1978; Penland et al. 1990; Turner and Cahoon 1987)—a fluctuating rate that appears to be decreasing (Britsch and Kemp 1990). When equated with the remainder of the United States, these land-loss assessments are exceptionally high (Gagliano et al. 1981; Gosselink and Baumann 1980). If allowed to proceed unabated, in ten years a province larger than the District of Columbia will vanish (Byrne and Anderson 1977; Kerns et al. 1980). In 21 years, Louisiana's land loss would be equivalent to the area of Rhode Island. In half a century, the sea would repossess coastal property equal to all of the tracts reclaimed in the Netherlands during the last 800 years (Turner 1987).

In Chapter 2, the removal of the Atchafalaya River raft was cited as an example of human interference with the physical landscape. If left to its own, the Mississippi River would likely have abandoned its present course above Baton Rouge and completely shifted to the west and into the Atchafalaya River. If engineers were to allow such a change, it would have a devastating effect on the part of the state that relies on the lower Mississippi River for its livelihood. In an attempt to control or at least influence the flow of the Mississippi River, a system of levees and control structures has been constructed. As a result of these measures, the major erosion, subsidence, and land formation processes within the study area are influenced by water control measures that are sometimes far removed from the area of impact.

Mississippi River Levees

> Be it enacted by the Senate and House of Representatives of the State of Louisiana, in General Assembly convened, That the Louisiana Levee Company, a corporation organized under the general laws of the State, by notarial act passed on the eleventh day of February, in that year one thousand eight hundred and seventy-one, . . . is hereby recognized and approved as a body politic and corporate, . . . The object and purpose of the company are declared to be the reclamation and protection from overflow of the alluvial lands in the State of Louisiana, and to enable the said company to accomplish said purposes and object, it shall have power– To contract with the State of Louisiana, and under such contract to locate, construct, build and own, maintain, control and use levees on both banks of the River Mississippi and of such tributaries and outlets of the same as may be deemed necessary by a commission of competent engineers, appointed as may be so agreed upon in said contract [From: Act 4 - relative to the Louisiana Levee Company, a corporation organized under the general laws of this State . . . [*In* Acts passed . . . 1871].

The history of levee construction in Louisiana began with the establishment of New Orleans in 1718. From its inception, New Orleans was an "island city" surrounded by water. When it was surveyed in 1720, each block was circled with drainage ditches. These small channels established New Orleans' dependence on a levee/drainage network. Levee construction began as early as 1718. By 1727, a hand-made mud wall protected the earliest city—the "Vieux Carre." With time the initial levee extended along the Mississippi River for a total of 42 miles (67.6 km). The first artificial levee built to protect New Orleans was in place. It was, nevertheless, neither high enough nor wide enough. By the 1850s, intermittent embankments flanked most of the lower Mississippi River. The purpose of these levees was to protect "the most fertile agricultural lands of the State [Louisiana], equaled by few and surpassed by none in the world in productive capacity" (Morehouse 1910:415).

Since the devastating flood of 1927, the Mississippi River has been locked into a conduit framed by artificial levees. The river can no longer inundate its historic floodplain. Sediments are now channeled away from the wetlands. Loss of these sediments deprives the coast of the material necessary to build new land at a rate slightly greater than subsidence. There is nothing available that can offset the rapid rate of wetland loss. Consequently, to exist in this dynamic and sometimes inhospitable physiographic province, the population had to develop and utilize innovative engineering techniques, unconventional wisdom, and unique cultural occupancy patterns.

> The ground on which New Orleans is situated, being an earth accumulated by the ooze . . . is a good quality for agriculture . . . This land being flat, and drowned by the inundations [sic] for several ages, cannot fail too be kept in moisture, there being, moreover, only a mole or bank to prevent the river from overflowing it; and would be even too moist, and incapable of cultivation, had not this mole been made, and ditches, close to each other, to facilitate the

draining off the waters: by this means it has been put in a condition to be cultivated with success [Le Page du Pratz 1758:158].

Transgression, sea-level rise, subsidence, vibracores, seismic profiles, and sediment loading are part of the lexicon of coastal geology. These terms and others are used to describe the fluvial and regional history of Louisiana's delta plain. The descriptive techniques employed are used to unravel the sequential history of the Mississippi's sedimentary patterns. More than 10,000 years of geomorphic history has been analyzed in producing the contemporary map of deltaic history. Superimposed on this natural sequence of deltaic events are the engineering structures that have harnessed and trained the Mississippi River's 54 tributaries to follow a designated route. The river can no longer overflow at random; it must follow a course framed by levees constructed to control spring floods. After the record deluge of 1927, under the direction of Congress, the United States Army Corps of Engineers went into the levee business. Levees, therefore, have been a part of the Mississippi River's history since New Orleans was settled in 1718.

Flooding was a reoccurring problem along the Mississippi. Within the river's floodplain, vast inundated tracts were common during periods of high water. Although a complete inventory of all floods has never been compiled, a list of the great floods has been documented in the literature (**Table 4-1**).

Table 4-1. Floods of Notable Importance on the Mississippi River (from Elliott 1932; Vogel 1931; Waddill 1945; and Warfield 1876).

* Between 1543 and 1799 there were 15 recorded floods (1543, 1664, 1684, 1717, 1718, 1724, 1735, 1770, 1775, 1782, 1785, 1791, 1796, 1797, and 1799), an average of one every 18 years. Discounting 1543, 1664, and 1684, the average for the eighteenth century is one every 5.8 years.

* From 1801 to 1927 there were 47 flooding events (1801, 1809, 1811, 1813, 1815, 1816, 1817, 1823, 1824, 1826, 1828, 1832, 1836, 1840, 1843, 1844, 1847, 1849, 1850, 1851, 1854, 1858, 1859, 1862, 1865, 1867, 1868, 1871, 1874, 1875, 1876, 1881, 1882, 1883, 1884, 1886, 1890, 1892, 1893, 1897, 1903, 1907, 1912, 1913, 1916, 1922, and 1927)*, an average of nearly one every 2.6 years.

- For the most complete listing of flooding events see Elliott 1932: 104
-

The Earliest Artificial Levees along the Mississippi River

The Mississippi embraces within its confines portions of . . . Missouri, Illinois, Arkansas, Tennessee, Mississippi, and Louisiana, and contains about . . . 24,868,000 acres. Of this amount there are about . . . 2,560,000 acres of sea-marsh, and irreclaimable, leaving 22,308,000 acres of land of inexhaustible fertility, lying in the very heart of the richest valley in the world, wholly idle, useless, and being rapidly deserted because it is annually

inundated by the waters of the Mississippi. Divided into farms of 100 acres (40.5 ha) each, it would give us 223,080 farms [Warfield 1876:1].

Flanking the Mississippi River are natural levee ridges that along its lower channel rarely exceed 30 ft (9 m) above sea level. The crest of this natural levee is near the stream bank and the backslope is so slight it is not recognized easily. Drainage is away from the river. Moreover, during a flood the velocity decreases away from the main channel. At this point the heaviest and coarsest sediments are deposited near the river. Through repeated floods the riverbanks are built higher and higher producing an easily defined system of natural levees (Ellet 1852; Morehouse 1910). In addition, repeated flooding diverted sediments into the surrounding lowlands building up the lands at a rate that counteracted subsidence and sea level rise.

The height and width of these topographic elements are directly proportional to the size of the river, stream, or bayou that created them. Stream patterns are complex and so are the associated guide levees. Within the distributary networks that shaped the delta plain, are natural levee configurations that can be utilized to distinguish and classify, by time periods, a stream's history. Some of these levees are not continuous; local subsidence has disrupted their continuity to create isolated levee segments. Others disappear beneath the wetland surface. Regardless, these features furnished the essential "high ground" for colonization. In the delta plain, elevations above sea level are not great. Differences are slight, but vital from the standpoint of human occupancy. Floods were a perpetual dilemma that had to be endured.

Annual floods renourished the land; but they were an aggravating part of living within the river's floodplain. To neutralize these seasonal disasters, natural levees were augmented by engineered structures high enough to counteract floodwater or at least minimize its effects. Actually, artificial levees are the only practical technique that can be implemented to resolve flood-control problems.

From the first explorers to the present, there has been widespread interest in the Mississippi River. It was explored, claimed, and exploited by the English, French, and Spanish. In 1543, De Soto's expedition observed the Mississippi overflowing its banks for about 80 days (Elliott 1932). Garcilaso de la Vega wrote "the inundated areas extended for 20 leagues on either side of the river" (Elliott 1932:105). LaSalle in 1684 also found the Lower Mississippi out of its defined channel.

To these explorers, control of the Mississippi was paramount, but not in the sense of building a massive levee system to channelize its flow. To the European explorers, political jurisdiction was deemed imperative. From the 1540s until around 1700, the main political concern was free navigation. The concern for navigation was so strong that Thomas Jefferson attempted to gain authority over at least the river's east bank. Through the Louisiana Purchase in 1803, the United States acquired over 2,590,000 km^2, including most of the Mississippi's drainage basin. After 1803, the river was under the jurisdiction of one government that began to exhibit an interest in the connectivity between flood management and navigation.

Flood control was not a new issue; there is ample evidence to suggest flooding problems extended back to the earliest settlements. From the beginning, New Orleans learned to endure the hardships that accompanied the river's annual floods. When French explorer Jean Baptiste Le Moyne, Sieur de Bienville selected the site for New Orleans, it was over the objection of Dumont de la Tour, his chief engineer, who felt the area would be flooded periodically. The new colony was above the surrounding terrain. Ironically, it could not be built until the water receded from the 1717 flood (Martin 1882, Elliott 1932). This was an omen of things to come. As Samuel Clemens once said: " One might as well bully the comets in their courses . . . as try to bully the Mississippi into right and reasonable conduct" (Twain 1901:207).

Flooding occurred in the vicinity of New Orleans in 1735, 1775, 1785, 1791, 1799, 1816, 1823, 1844 (at Algiers, opposite New Orleans), 1849, and 1927 (Elliott 1932). New Orleans flooded often, so much so it became a walled city. Levees formed the protective barriers; without them the river would easily engulf North America's premier below-sea-level city. Water was pushed often over the levee crests into the city's reclaimed land. When this happened, a second reclamation effort was initiated to pump the floodwater out of the holding basin. Even though the area is drained, the natural system is superseded by an artificial one, that, at times, cannot accommodate the torrential rainstorms or hurricanes of the summer months.

While the situation in New Orleans was bad, other settlements fared even worse. "They were almost destroyed by the mighty floods that came sweeping down upon them in early spring" (Frank 1930:14). Even so, the earliest emigrants recognized the narrow, elevated, fertile natural levees were capable of being quite productive. Shutting out the floods was a massive undertaking. When the river was in flood a thin sheet of water flowed over the banks into the backswamps destroying the plantation's crops. At times, this thin column of water passed over both banks of the Mississippi for more than 1,000 miles (1,609 km) (Ellet 1852; Richardson 1901).

To protect their investment, planters began to build crude, flimsy mud embankments without any regard for the natural landscape. These earthen levees were the cheapest and most practical structure to keep floodwaters off their land. Planters, however, were not hydrologic engineers, so they paid little attention to the bayous, or natural outlets that helped divert floodwaters away from the main channel. These smaller channels were stopped up by the extension of the levee network and as a result floodwaters could no longer flow into the backswamp reservoirs (Ellet 1852).

Expanding the Mississippi River Levee System

The history of the levee system of the Mississippi River is replete with the records of failures, breaks in the embankments and crevasses (McDaniel 1930:4). Europeans and others constructed levees to protect their communities from floodwater along the Nile, Po, Danube, Rhine, Rhone, and Volga rivers. Prior to the establishment of New Orleans, this technology was widely used, accepted, and understood in Europe. The new immigrants knew the

solution to the flooding problem and needed to only implement it. Consequently, immediately after New Orleans was founded, de la Tour began to construct a river front levee "to preserve the city from overflow" (Morey 1874:5). Initially, a 5 ft (1.5 m) wide earthen mound was created to defend the city from floods. Completed in 1727, the mud embankment was 5400 ft (1,647 m) long, 3 ft (.92 m) high, with a crown width of 18 ft (5.5 m). With time it expanded as settlements migrated along the river's lower reach (Elliott 1932). In fact, in 1728 de la Tour reported there were five colonies "extending for thirty miles above New Orleans who were obliged to construct levees of earth for their protection" (Morey 1874:5). Planters were responsible for erecting these embankments on their own land with each building a levee the length of the plantation's riverfront.

By 1735 the levee extended from English Turn (12 mi/19 km south of New Orleans) to approximately 30 miles (48 km) north of the city. A flood in that year proved the inefficiency of the levee, as it broke in many places (Le Page du Pratz 1774). Two hundred years after de la Tour completed the first mud embankment, a flood of major proportions would result in a levee construction strategy that would permanently alter the Mississippi River's natural flow regime. De la Tour effectively gave birth to the Mississippi River's levee system. Although it was small by contemporary standards, De la Tour's levee was the beginning of an engineered rampart designed for flood control.

When Louisiana became a state in 1812–nearly 100 years after construction of New Orleans' first levees–the de la Tour embankment extended 150 miles (241 km) on the east bank and 185 miles (298 km) on the west bank (Frank 1930). During the colonial period, Louisiana citizens were mandated by law to work and maintain the levees, if they lived within 7 miles (11 km) of the river. Spanish Governor Alexandro O'Reilly passed an ordinance in 1743 that required property owners to complete their levees by January 1, 1744, or forfeit their land as a penalty for their negligence (Frank 1930). He further required every family settling in the province to construct, within three years, a levee and finish a highway with parallel ditches toward the levee (Martin 1882). O'Reilly wanted Louisiana to become a self-sufficient, agriculturally based, exporting colony and recognized the need for adequate drainage and flood control.

While flooding was of local and regional concern, the national interest in the first half of the nineteenth century was focused on enhancing river navigation. Protection against flooding attracted little legislative attention. However, in 1822 a survey by Bernard and Totten concluded the only way to reduce the number of snags in the Mississippi's main channel was to construct levees. It was believed these features would prevent the lateral currents responsible for the snags and enhance navigation (Frank 1930). The connection was thus made that levee construction improved navigation.

Nationally, improvement of navigation was the center of appropriation debates. As late as 1855 there was no mention of levees to defend against floods—only to augment navigation. Merchants and the business community successfully lobbied for navigational improvements. The agricultural and urban communities said practically nothing. In 1835 Henry Clay suggested to the Secretary of the Treasury the government should study carefully the cost of raising a levee on the Mississippi's west bank. "The resolution also called for an

estimate of the probable effects upon the health and prosperity of the country in which any such works may be constructed" (Frank 1930:20). The suggestion fell on deaf ears.

Flood control may not have been a concern at the national level, but through the efforts of local governments and individual riparian property owners, the interconnecting levee network increased in length and strength. Planters using slave labor extended their levees during the seasons when these farm hands were not in the fields. Unfortunately, these levees were so small and low as to be frequently overtopped and broken by floods (Frank 1930). After the 1828 flood, the highest water recorded up to that time, the population requested a 2 ft (.61 m) high protective levee (Harper et al. 1836). In fact, as late as 1851 most of the levee system between New Orleans and the Red River was only 6 ft (1.8 m) high. The largest was only 8 ft (2.4 m) high with a base of 32 ft (Richardson 1901).

By current standards, these levees were small; their average height was about 3 ft (.92 m) (Elliott 1932; Waddill 1945). All levees built during this period were insufficient in height and cross-sectional profile. An indication of the levee's deficiency is the number of crevasses identified with each flood. Numerous gaps were present—although in 1851 the Baton Rouge-to-Pointe-a-la-Hache levee segment was continuous with a mean height of 4.5 (1.4 m) (Elliott 1932). Many of these levees were, nevertheless, too close to the river. They were inefficient and failed because of overtopping, crevassing, seepage, and bank collapse or caving. It was a weak system, easily breached by crevasses. Although recognized as significant outlets for the discharge of high waters, crevasses served to alleviate flooding along the river. They acted as natural safety-valves that redirected flood waters away from the main channel which in many cases reduced the flooding problem downstream.

Government and Flood Control Prior to the 1927 Flood

From 1840 to 1860 a series of harsh and injurious floods made it apparent the flooding problem was too large to be handled at the local level. It was a national issue. Much of the unprotected/ unoccupied land was in the public domain. If reclaimed and protected against overflow, it would become an economic asset (Waddill 1945). Two severe floods in 1849 and 1850 convinced the Federal government to provide financial assistance to construct a continuous levee system; one without gaps fronting unoccupied lowlands.

In Louisiana there were 1400 miles (2,253 km) of privately built levees, providing flood protection for more than 3 million acres (1,215,000 ha). An 1850 survey reported these levees were about 5 ft (7.6 m) high, 7 ft (2 m) wide at the top and 30 ft (9 m) wide at the base. Further, it was noted that the "building and keeping of them in repair was quite expensive" (Wilson 1850:3). Wilson (1850) also reported the necessity for building "safe, strong, and sufficient levees." He correctly pointed out the danger of failing to construct levees along sections of the river that were either not owned or not developed. Allowing these gaps to remain would result in "ruin and desolation on all the adjacent country; and, therefore, all of such lands remaining the property of the government must . . . be leveed at the expense and cost of the citizens of Louisiana" (Wilson 1850:3).

To expand this network was beyond Louisiana's capabilities; consequently, major financing was needed. The New Orleans Chamber of Commerce reported Louisiana spent more than $25,000,000 for construction and maintenance of the 750 miles (1,207 km) of Mississippi levees within the state's boundaries. In 1873 more than $400,000 was needed for repairs, while an additional $800,000 was required for construction of levees destroyed by crevasses (Oglesby 1873).

The Federal government recognized the problem and enacted the Swamp Land Act of 1849 (Tomlinson 1926). It applied only to Louisiana, while the Swamp Land Act of 1850 extended to other states ownership of wetlands within their borders (Schneider 1952). As a result of these two acts Louisiana and Florida received the largest share of Federal swamplands donated to the states.

Through these Acts Congress granted/gave states the swamp and overflowed lands within their boundaries. The understanding was this land was to be sold with the proceeds used for: 1) levee construction, and 2) reclamation projects required to make the land fit for cultivation and settlement. South Louisiana's swamps and marshes were ideally suited for this type of reclamation endeavor, as they were considered "nearly valueless until reclaimed by drainage" (Morse 1854:1).

In the early 1800s, it was believed that by properly managing rainwater runoff, and high water "the whole of this country [south Louisiana] may be reclaimed and made in the highest degree productive" (Graham 1829:614). The levee issue was so acute the State Engineer in 1854 reported that along Bayou Lafourche the "amount of swamp and overflowed land . . . , which is . . . perfectly worthless, would, after being saved from inundation by . . . [levees], . . . sell for more than enough to pay for [them]" (Morse 1854:1). Further, by reclaiming the overflowed lands, the habitats preferred by mosquitoes carrying yellow fever would be eliminated. This was another argument in promoting reclamation (US Government Printing Office 1887). As a result, between 1880 and 1930 reclamation activity was intensified within Louisiana's alluvial wetlands-10,196,605 acres (4,129,625 ha) were involved (Elliott 1908).

While the Federal government was deciding the merits of flood control, the states created levee districts and levee boards. These quasi-public corporations were empowered to construct the drains necessary to reclaim the swamps and overflowed lands. They were empowered to fight the battle against floods. With these boards and the Federal government working together, by 1858 there were more than 2000 miles (322 km) of 8 to 10 ft (2.4 to 3 m) high [with a base of 50 to 70 ft (15 to 21 m)] levees outlining the Mississippi. In Louisiana there were 745 miles (1200 km) that cost the state $18,000,000 (Forshey 1873 Morey 1874). By 1927 from Cape Girardeau to New Orleans there were 28 of these boards who were working on a two-to-one match. For every two dollars spent by the Federal government the local district would have to spend one dollar (Simpich 1927). In Louisiana, 13 levee districts were incorporated and each had the power to levy taxes, issue bonds, and generally do whatever was necessary to construct and maintain levees within each district. In addition to the money generated internally from each district the proceeds of a 1-mill tax throughout Louisiana was available for levee work (Richardson 1901).

Floods in 1862, 1865, 1867, 1874, 1882, 1883, and 1884 penetrated the artificial levees, thus demonstrating the necessity for raising and strengthening their height and base. Floodwater went through and over them without restraint. Both armies of the Civil War had done their jobs well; the levee system was destroyed, neglected, or in disrepair (Waddill 1945). Crevasse after crevasse further helped demolish the post-War levees. By 1878 "hundreds of miles of the main line had disappeared or had been destroyed" (Frank 1930:30). The problem was so severe that some seriously considered abandoning the levees and allowing the river to overflow its banks and flood the formerly protected fields. The people were losing to the river, but the Federal government was taking an interest. The detailed and scholarly Delta Survey conducted by Humphreys and Abbot was published in 1861. In 1865 the Secretary of War, Edwin M. Stanton, commissioned General A. A. Humphreys to investigate the status of the Mississippi River's levees. In 1866 Congress wanted to know what it would cost to repair the levees after Humphreys determined their status. President Johnson urged Congress to pass the necessary legislation to rebuild the levees of the Mississippi River.

Lack of enthusiasm during Reconstruction killed the momentum. Reconstruction was a period of inactivity. Planters were financially unable to push into the backlands. Levees needed to be repaired, but funds were unavailable. For a time, the river regained control. Natural processes dominated. Suitable habitation and agricultural land was confined to the natural levee. Interest in reclamation and flood protection waned, but was not terminated.

Floods in 1868 and 1874 rekindled the issue. Congress began to move off center to support flood-control legislation, particularly after the 1874 flood when it was reported "gaps in the levees equaled from one-third to one-half of the entire length of the levees" (Frank 1930:39). After this flood a board of engineers, called the "Levee Commission," was convened (Waddill 1945:3). Five years later the Mississippi River Commission was created by an Act of Congress (approved June 28, 1879) and immediately put the United States into the flood-control business. In 1882 the Commission adopted a levee policy based on "the theory that confinement of floodwater would periodically flush out the channel, thus removing obstructing bars and preventing the formation of new obstructions" (Waddill 1945:5).

Creation of the Commission marked the end of the nonsystematic approach to levee construction, which had relied upon the gradual extension of the system through the cooperative efforts of interested landowners. The levees were inadequate because they were built without effective supervision from a central authority (Ellet 1852). This era of uncontrolled, unstructured, and unsupervised construction was over. It was no longer acceptable to build levees around the premise "the whole is no stronger than its weakest link." Under that principle the levees were defective. There was little incentive for a landowner to build a strong levee if his neighbor did not do the same.

With establishment of the Mississippi River Commission levee construction was altered. Early levee specifications called for the right-of-way to be carefully cleared. A muck-ditch was used to close all root holes. These levees were constructed by excavating parallel drain ditches whose spoil was utilized to build the embankment. "Station men" using wheelbarrows contracted to work 100 ft (30 m) of levee (**Figures 4-1** and **4-2**). As the levee

increased in height and volume, mules and scrapers were added to the construction effort (Cowdrey 1977). With time, mules were replaced by dredging equipment that required coal, gasoline, diesel, fuel oil or electricity (Waddill 1945). Once completed, these machine-made levees often were set back and raised in order to maximize high-water protection. By 1901, most of the Mississippi River levees north of New Orleans averaged 12 ft in height. In some stretches their height was over 20 ft (6 m). South of New Orleans the levee system was between 5 and 6 ft (1.5 to 1.8 m) high (Richardson 1901).

The 1927 Flood

> At noon the streets . . . were dry and dusty. By 2 o'clock mules were drowning in the main streets . . . faster than they could be unhitched from wagons. Before dark the homes and stores stood six feet deep in water. [Simpich 1927:256].

The flood of 1927 was considered the "greatest peace-time disaster in our history" (Simpich 1927:245). It was the product of abnormally high rainfall falling over the 31 states and two Canadian provinces that comprise the Mississippi's drainage basin. Deluge after deluge increased the Mississippi's discharge rates. Thirteen crevasses breached the levees of the Lower Mississippi, siphoning off enough flow to reduce the flood stage down reach (**Figure 4-3**). Nevertheless, parts of seven states were submerged. More than 5 miles (8 km) of levee was breached. The current was so strong small homes were often tied to trees with wire or ropes to hold them fast. Many floated off of their foundations, often lodging kilometers away from their original sites. It was apparent the levees needed to be strengthened (**Figure 4-4**).

Approximately 800,000 individuals were driven from their homes and housed in tents, warehouses, schools, churches, and other shelters—a number nearly equal to the 1927 population of Washington, D.C. (Simpich 1927). Over 500,000 people were vaccinated for infectious diseases, since the flood was considered "the most extensive health hazard ever experienced in America" (Simpich 1927:265). To guard against disease, more than half a million people were "vaccinated, inoculated, or given malarial prophylaxis" (Simpich 1927:264). About 59,570 km^2 were inundated.

Within the walled confines of New Orleans the population began to demand action to reduce the flooding. They wanted the levee cut and on April 26, Louisiana's governor, O. H. Simpson, signed a proclamation giving permission to dynamite the levee (Dabney 1944). To reduce the floodwater height, 1500 pounds (681 kg) of dynamite was used to blow up the levee at Caernarvon (also called Poydras) creating a 3200 ft (976 m) wide artificial crevasse. This breach removed 12,039 cu yd/sec (9,204 cu m/sec) from the main channel and thus relieved the pressure on the levee at New Orleans (Simpich 1927). The 1882 and 1927 floods submerged 57,000 square miles (149,184 km^2)—an area larger than Delaware, Connecticut, Hawaii, Massachusetts, Maryland, New Hampshire, New Jersey, Rhode Island, and Vermont combined (Elliott 1932).

The severity of the 1927 flood resulted in passage of the 1928 Flood Control Act. This comprehensive legislation began the process of locking the Mississippi into a conduit with spillways constructed along its course to protect against severe flooding. These spillways proved their worth during the 1937 flood. Even so,

> The area overflowed in 1882 by Mississippi River waters is estimated at approximately 34,600 square miles, while during the flood of 1927 (the greatest gaged flood of record), the total overflowed area approximated only 23,000 square miles [Elliott 1932:29].

After the devastating 1927 flood, the Army Corps of Engineers began to construct the Mississippi's "guide levees." Today this levee network protects cities, towns, villages, farmland, and industrial complexes. In retrospect, they had a dramatic impact on the general ecology of the wetlands, and modified the orderly distribution of freshwater out of the river into the marsh-estuary complexes. Natural wetlands processes, interlevee-basin drainage regimes, and vegetation patterns were permanently altered. Engineers brought about these changes through their use of levees, internal drains, and pumps. Through time, the Mississippi River levees were strengthened, eliminating overbank flooding and the systematic sediment recharge to Louisiana's subsiding coastal lowlands. Sediment flow was effectively shut off. Natural accretion, derived from overbank flooding, was terminated. An artificial levee system was largely responsible for these changes. Engineered to protect the population living within the river's alluvial valley, this levee also altered the region's natural topography.

The strength of the present levee system has been questioned by at least one researcher:

> The levees were supposed to be built to handle an even greater flood than the one that occurred in 1927, but their completion date is more than 30 years behind schedule, . . . In several spots, including Baton Rouge and Darrow, recent high waters forced emergency action to raise or otherwise fortify levees that are too low . . .
>
> If a bad break . . . occurred on the western side of the Mississippi River below the Red River, . . . the river could cause flooding all the way to Thibodaux and Houma . . . a major topping of the levee at its low spot in Baton Rouge would flood the immediate downtown area . . . [Anderson 1997a:1B-2B].

Another researcher reached a similar conclusion:

> If we were to have the flood of 1927, we don't feel we could hold the flood, even with the use of other flood-fighting measures [Mike Robinson, Mississippi River Commission]

Levees along Bayou Lafourche

Ellet (1852) described Bayou Lafourche as the least important of the active outlets of the Mississippi. He estimated the flood discharge at 10,200 ft^3/sec and stated that its slope near its head was only 3.5 in/mi (8.9 cm/km). On the other hand, Humphreys and Abbot (1861) described Bayou Lafourche as resembling an artificial canal of recent construction. According to Elliott (1932) the greatest measured discharge was approximately 32,000 ft^3/sec in 1890. Existing historical evidence indicates that there was little change in the bayou between the time of its first exploration by the French and its closure in 1904. This closure was effected by the construction of an earthen dam across the head of the bayou (Elliott 1932). Throughout the nineteenth century, the channel suffered from neglect: "There has been no survey or examination other than a simple inspection of the lower part of this bayou since 1874. At that time the lower part of the bayou was very much obstructed by tow-head islands, which . . . prevent a free discharge of the water" (Stickney 1882:2).

Along Bayou Lafourche plantation owners erected levees. Ellet (1852:86) noted the "levees are generally from ten to twenty inches wide on top; from three to five feet high, and of very irregular slope, with each planter determining the slope." In general, the earthen embankments were poorly designed, carelessly built, and woefully inadequate to protect against a flood. In fact, these slave levees were 3.5 ft (1 m) high at Donaldsonville and increased to 8 ft (2.4 m) at Lockport. By 1859 they extended south from Donaldsonville 83 miles (133.5 km). Levees along the bayou's lower reach were raised because the high water level was increasing constantly (Humphreys and Abbot 1861). Between 1874 and 1882 debris accumulated at the mouth began to restrict flow down the bayou. A survey revealed the obstructions within the bayou needed to be removed. This was accomplished from Donaldsonville to a point 24 miles (38.6 km) south of Lockport, but not beyond (Stickney 1882). These early earthen embankments were narrow, scarcely wide enough for a foot or bridle path. When water came to within a few inches of the top, they caved in creating a crevasse that could lower the surface from 2 to 3 ft (.61 m to .92 m) (Humphreys and Abbot 1861). Many levee breaks were frequently less than 500 ft (152.5 m) wide, but scoured a channel 9 ft to 10 ft (2.7 m to 3 m) below the top of the levee. South of the termination point of these levees, Bayou Lafourche discharged freely into the surrounding swamps and marshes. Humphreys and Abbot (1861) calculated that this lateral discharge extended for 20 to 30 miles (32 to 48 km), adding valuable sediments to the alluvial wetlands and contributing substantially to the accretion process.

West of Bayou Lafourche is a series of bayous whose natural levees were left undisturbed. Along these watercourses planters did not build an extensive levee system. When local government authorities petitioned Federal agencies for assistance, they were interested in improving the local waterway's navigability—not in building an extensive levee network. Sugar cane, oysters, cypress timber, and a variety of general cargo moved through these bayous. Since farmers operated boats in much the same manner as wagons and draft animals were used in other farming districts, the bayous served as primary transportation routes. Keeping them free of obstructions and at a depth that would allow commerce to move easily was paramount in the minds of the locals. While they realized an enlarged

channel would assist in the drainage of adjacent low lands, their main concern was navigability (Dent 1922).

From the late eighteenth century until its closure during the first decade of the twentieth century, Bayou Lafourche was the subject of intense debate. Local interests needed the channel to carry their goods to market, yet frequent overflows made cultivation of cash crops a risky business. The banks of Bayou Lafourche became one of the most populous areas of the state. "From Donaldsonville to Lockport bayou Lafourche is almost as populously settled as St. Charles avenue. Not an acre goes to waste, nor an arpent lies idle. Great fields of corn and cane roll away three and four miles deep, and between these are the forest groves, in which the plantation homes are placed . . ." (Cole 1892: 12).

Although hand-made levees were a vital part of the landscape along Bayou Lafourche, they were never a significant element along the bayous between Bayou Lafourche and the Atchafalaya. Bayou Terrebonne, for example, at one time connected with Bayou Lafourche. It functioned as an additional distributary. The junction was closed; thus, the bayou's waters are derived internally, largely from runoff associated with Bayou Cane and the adjacent swamp. North of this point Bayou Terrebonne is essentially dry. By 1890 the upper reach of this watercourse was only 2.3 ft (.70 m) deep (Crosby 1890). No significant levees were built along bayous west of Bayou Lafourche until the construction of the Atchafalaya Floodway.

Between 1866 and 1904 Bayou Lafourche served as an active distributary of the Mississippi River. In 1904, the upper end at Donaldsonville was dammed off, closing the access to the Mississippi River permanently. With this closure, there was no longer a major source of freshwater entering the Gulf along a wide section of the Louisiana shore between the mouths of the Mississippi River and the Atchafalaya River. This severance of a source of freshwater and sediments certainly has had an impact on the marshes of Terrebonne Parish immediately west of Bayou Lafourche. After construction of the dam at Donaldsonville, Bayou Lafourche commerce had to use either the railroad or the region's system of interconnecting canals to move goods to market. There was no longer any flow into the bayou; it was not until 1955 that pumps began to add water back into the Lafourche (Pearson et. al. 1989).

With the closure, the upper reach was allowed to deteriorate. By 1907, private parties had placed obstructions in the channel, further limiting its use (US Army Corps of Engineers 1908). As a result of problems related to water stagnation and poor water supply for local industry, minimal flow from the Mississippi River was reinstated with the construction of a pumping station at Donaldsonville in 1955. This station maintains a flow of about 400 cfs in the channel (Doyle 1972).

More recently, Bayou Lafourche has been suggested as a potential channel for fresh water diversion that would result in an increase in minimum flow to about 20,000 cfs (van Heerden 1993, 1994). This suggested diversion has generated considerable division among those living along the bayou and prompted a number of studies documenting the drainage ditches and pipes that empty into it (Ferstel 1997). The feasibility of the diversion project is

now under investigation but it appears unlikely that the flow will increase substantially above its current rate.

Atchafalaya Basin

Of the many physical forces that have impacted the landscape within the study area, it is the Atchafalaya River that has been most influential. While the impact of Atchafalaya River flow has been phenomenal, this influence has been matched by the cumulative effects of over 200 years of human attempts to control not only the Atchafalaya River but virtually every other major waterway and landform as well. Until recently, the overriding concern for the modification of most waterways in south Louisiana has been flood control and transportation. Within the past 20 or so years, concerns have been raised over the long-term environmental changes in the region. These concerns have grown primarily as a result of the numerous studies that have documented land loss and have also shown that land loss will continue to occur along the Louisiana coast (e.g., Gagliano and van Beek 1970; Gosselink 1984; Turner and Cahoon 1987; Williams et al. 1992).

The Atchafalaya River Raft

Human attempts to influence the flow of the Atchafalaya River began with the removal of the Atchafalaya River raft. During the early nineteenth century, a 20-mile (32-km) long segment of the Atchafalaya River was obstructed by a series of naturally formed logjams or rafts. Collectively, these obstructions were referred to as the Atchafalaya River raft. Farming along the banks of the upper Atchafalaya River began in the ante-bellum era prior to the removal of the raft. The new planters eagerly sought removal of the raft on the grounds that a navigable Atchafalaya River would permit them to bring their products to market. They also believed that raft removal would decrease the danger of flooding along the Atchafalaya River. Raft removal began in the 1830s. The following account provides an optimistic view of the anticipated impact that raft removal would have on development of the lower Atchafalaya River:

> The Atchafalaya, or long river, as the Indians term it, rises in the Arkansas country. For a number of years the lower part has had a large raft in it which has forced a part of its waters into the Mississippi. This has given the Red River country a free navigation to this city; but during the present low stage of water a bar has formed at its mouth on the Mississippi, which has thrown its waters back into their natural channel, and which has been able to receive them, as two thirds of the raft has been cleared away the past summer, which heretofore stopped them from flowing undisturbed; and now; as the snag boat has resumed her labors on the raft, the settlers daily expect to have a free and undisturbed navigation from the Gulf of Mexico, to its upper end, which is a considerable distance. Since the removal of the raft there is to be seen six to eight feet water in places heretofore nearly dry. Land that once could be bought for $2 to $3 per acre, cannot be got now for less than $20, large purchases are daily being made by capitalists. Most of the inhabitants are very enterprising men, and will spare no expense to make this river, as it were

> a rival of the Mississippi, which will no doubt be so at some future period, as it possesses more natural advantages than the former [*The Daily Picayune* 1838:2].

By 1855, the raft reportedly had been removed and almost immediately, new rafts began forming. Shortly after the Civil War raft removal work was again conducted, but this time with better success. In 1874 the last major raft was removed, and this was followed by a great flood during the next high water period. Along the upper portion of the Atchafalaya River, "large plantations were in cultivation here up to 1874, levees having been built previous to that time. After the overflow of that year they were practically abandoned" (U. S. Army Corps of Engineers 1882: Part 2, 1398-1403). This seemingly insignificant modification to the Atchafalaya River initiated a change in the relationship between the Atchafalaya River and the Mississippi River. The long-term impact was the partial capture of Mississippi River flow by the Atchafalaya River, and this shift in flow stimulated the Corps of Engineers to stave off the complete channel capture by constructing the Atchafalaya Floodway and its associated control structures.

Construction of the Atchafalaya Floodway

The Atchafalaya Floodway is more than a simple high water chute confined between two artificial levees. The floodway system includes a complex set of levees and control structures designed to handle a variety of high water conditions (**Figures 2-2** and **4-5**). The Atchafalaya Floodway was authorized in 1928 in response to the flood of 1927. The following discussion includes descriptions of the major components of the floodway.

The first construction phase of the Atchafalaya Floodway included the construction of the east and west Atchafalaya Basin Protection Levees, referred to as the EABPL and the WABPL. These levees separated the floodway from outside areas that were to be protected during high water periods. The levees were first constructed during the 1930s and were improved during the 1970s after the high water of 1973. During extreme high water periods, virtually all of the land between the east and west guide levees may be flooded.

The Morganza Control Structure, the Overbank Control Structure, and the Old River Low-Sill Control Structure represent the primary structures that divert water from the Mississippi River into the Atchafalaya River, and during high water periods, into the floodway as well (**Figures 2-2** and **4-5**). These structures were completed by 1962. During the flood of 1973, the Low-Sill Structure was damaged (U.S. Army Corps of Engineers-NOD 1993). Supplemental control was added through construction of the Auxiliary Control Structure in 1986 and the S. A. Murray, Jr., Hydroelectric Power Plant (U. S. Army Corps of Engineers-NOD 1995:30-32). The Auxiliary Control Structure, the S. A. Murray plant, and the Low-Sill Control Structure operate during low water periods. The Overbank Control Structure and the Morganza Control Structure are opened to varying degrees during high water periods to alleviate pressure along the levees downstream in the Baton Rouge and New Orleans areas.

At the lower end of the basin are located the outlets to the Gulf of Mexico. These include the Atchafalaya Basin Main Channel, which flows between Morgan City and Berwick, and the Wax Lake Outlet, which extends from Sixmile Lake to the Atchafalaya Bay (**Figure 2-2**). The Wax Lake Outlet was constructed in 1942 to supplement the main channel of the Atchafalaya River during high water. The channel crossed Bayou Teche and flow between the two has been controlled by the Calumet floodgates (**Figure 4-6**). In 1986 a rock weir, called the Wax Lake Outlet Control Structure, was completed across the channel (**Figure 4-7**). This weir was designed to "stabilize the distribution of low to normal floodway outlet flows to approximately 70 percent/30 percent between the Lower Atchafalaya River and the Wax Lake Outlet and to increase the channel development of the Lower Atchafalaya River" (U.S. Army Corps of Engineers-NOD 1995:37). The structure was removed in 1995 in response to complaints from residents and businesses in Morgan City, who claimed that the structure increased flooding in the Morgan City area (**Figure 4-8**). Removal of the weir has resulted in increased flow through the Wax Lake Outlet and this has generated complaints of increased freshwater flow from fishermen in the Vermilion Bay area (**Appendix A-1** and **A-10**).

In addition to the main channel and Wax Lake Outlet, some Atchafalaya River water is entering the Gulf to the east and west of the main channel via the GIWW, which crosses several waterways that open directly into the coastal bays. Most of this flow is to the west. Eastward flow is constricted by the Bayou Boeuf lock at Morgan City (**Figure 4-9**) and by the lack of major cross channels leading toward the Gulf between Amelia and Houma. To the west, major flow routes from the GIWW include Charenton Canal at The Jaws (**Figure 4-10**) and the breach between the GIWW and Weeks Bay (**Figure 4-11**).

Of the variety of impacts the Atchafalaya River flow has had on the study area, one of the more recent is decreased salinity within Vermilion Bay. Prior to removal of the Atchafalaya River raft, the Atchafalaya was so constricted the flow into the Atchafalaya Bay must have been considerably less than today. That all changed after about 1870, when the flow began increasing steadily until it reached its maximum in 1952, when 30 percent of the Mississippi River flow was being diverted into the Atchafalaya. Modern controls maintain a 30 percent flow today. Diversion of freshwater westward has probably increased since 1995 with removal of the Wax Lake Outlet Weir. Because Wax Lake Outlet was constructed in 1942 and the peak for freshwater entering the coastal bay system was not reached until 1952, the present low salinity levels in Vermilion Bay were probably not reached until the 1950s. This predominantly fresh condition has probably remained fairly consistent since then, with perhaps a slight increase after 1995. Some accounts of local fishermen familiar with Vermilion Bay note that the Vermilion Bay waters were saltier prior to the 1940s. Prior to 1940 oysters were found in the Cypremort Point area and none are present today (**Appendix A-10**). While some have suggested this change was rapid, the oyster lease data and vegetation studies indicate the change was probably gradual. Even in 1968, Vermilion Bay, West Cote Blanche Bay, and East Cote Blanche Bay were still brackish, as is demonstrated by the fact they were almost completely bordered by brackish marshes. Within the study area, in 1968 the only substantial fresh or intermediate marsh areas along the coast were in the Lower Atchafalaya region and the extreme western portion of Terrebonne Basin at the north end of Four League Bay (Chabreck et al. 1968). By 1978, fresh marsh and

intermediate marsh had expanded westward from the mouth of the Atchafalaya River to Cypremort Point, with a small pocket expanding in Weeks Bay where the GIWW is now connected to the bay. West of Weeks Bay, the entire Vermilion Bay shore was lined with brackish marsh (Chabreck and Linscombe 1978).

While flow from the Atchafalaya River has certainly reduced salinity and that in turn may have pushed some saltwater fish and oysters out of Vermilion Bay, the reduced salinity has also improved fishing in the marsh areas fringing the bays. For example, good bass fishing is reported in the swamp and marsh areas immediately east of Bayou Sale in St. Mary Parish (Shoopman 1998b:30). This observation is in line with recent accounts of an increase in production of bass and other recreational fish in the upper Breton Sound area. Since 1991, bass catches have increased in the Breton Sound area as a result of the opening of the Caernarvon Freshwater Diversion Structure in Plaquemines Parish (*The Advocate*, November 4, 1997:1A; March 9, 1998:1B; *The Times-Picayune*, November 20, 1997:1A; *The Watchman*, November 25, 1997:12). Any reduction of freshwater flow into Vermilion Bay would reveal the reverse side of the coin, as in Terrebonne Basin where the lack of a consistent source of freshwater is in part to blame for the tremendous land loss and salt water intrusion. Land loss and saltwater intrusion are lower in the eastern portion of the Teche/Vermilion Basin as a result of Atchafalaya River influence. Deflection of more of the flow out to sea would probably increase salinity and land loss in the Teche/Vermilion Basin and it would likely affect oyster production and fishing south of Marsh Island as well.

In addition to insuring a state of decreased salinity, the continued flow of the Atchafalaya River into the western bays has also meant an increase in sediment deposition in that area. Local fishermen claim that the depths of Vermilion, East Cote Blanche, and West Cote Blanche bays have declined over the last 50 years as a result of sedimentation from the Atchafalaya River (**Appendix A-1** and **A-10**). Increased sedimentation has also been observed in canals and bayous located between Atchafalaya River and Wax Lake Outlet. In some cases, channels that were several feet deep less than 50 years ago have filled in to such an extent that willow trees are now growing across the entire channel bed (Joe Owens, personal communication May 1998).

Other "Public Works" Projects

Within the study area, there have been numerous public works projects involving the construction or maintenance of waterways. Virtually every bayou and stream that has a potential for navigation by fishermen or oil and gas interests has been dredged or modified in some way (**Figures 3-31** and **4-12**). The following discussion highlights some of the more important waterway projects that are located within the study area.

Construction of the Gulf Intracoastal Waterway (GIWW) had a major impact on east-west water transportation in south Louisiana (**Figures 4-13** and **4-14**). Prior to the GIWW, most inland traffic utilized the Barataria and Lafourche Canal and a maze of smaller canals that provided an extended water route between the Teche country and New Orleans. The project was originally authorized in 1925 and excavated in sections during the 1930s and 1940s. Travel along the GIWW is dominated by towboats pushing barges, and a large

portion of that traffic is related to the oil and gas industry (Davis 1973). Within the study area, the GIWW has developed an alternate function with respect to the diversion of fresh water from the Atchafalaya River, particularly during high water periods. Atchafalaya River water can flow unobstructed to the west down the GIWW all the way to the lock at Intracoastal City. Atchafalaya River flow into the GIWW is obstructed toward the east by the Bayou Boeuf locks near Morgan City.

Freshwater Bayou Canal and lock were completed in 1968 to provide access between the Gulf of Mexico and the GIWW (U.S. Army Corps of Engineers-NOD 1984). This canal is now utilized heavily by offshore oil and gas supply vessels and by shrimp and oyster fishermen in the Intracoastal City area (**Figures 4-15** and **4-16**). The canal is composed of three segments: Belle Isle Canal, Six Mile Canal, and Schooner Bayou Cut-Off. As with the GIWW, the Freshwater Bayou Canal has taken on a secondary function as a freshwater diversion route. Water from the Atchafalaya River can travel west down the GIWW, then south along Freshwater Diversion Canal all the way to the Freshwater Bayou Lock. As noted elsewhere, decreased salinities in Vermilion Bay are in part due to this diversion function.

The Houma Navigation Canal was completed in 1962 by local interests. It was deepened and widened in 1974 (U. S. Army Corps of Engineers-NOD 1984; U. S. Army Corps of Engineers-NOD 1995:101). Although this canal has certainly provided a convenient Gulf navigation connection between the oil and gas construction and supply center in Houma, the canal has caused environmental damage through saltwater intrusion. This impact is particularly evident from the dying cypress swamps located to the south of Houma (**Figure 4-17**).

Hurricane Protection Levees

After the 1920s, land reclamation projects were no longer popular, and with the exception of land reclamation in urban areas such as New Orleans, most of these ventures died. After Hurricane Betsy hit in 1965, the public took a renewed interest in levees and protection against storms. The U. S. Army Corps of Engineers sponsored massive hurricane protection levee projects around New Orleans, around Morgan City, along lower Bayou Lafourche, and along the Mississippi River (Kemp and Mashriqui 1996:9-10). More recently, hurricane protection levees have been extended southward from Houma to incorporate portions of several bayous. Hurricane protection levees and floodgates now encircle portions of Bayou du Large and Bayou Terrebonne (**Figures 4-18** and **4-19**).

Localized Canal Construction

Louisiana's coastal margins and wetlands are vanishing and canal construction is one element in the land loss equation. Canal excavation altered land/water ratios. In previous discussions, a variety of canal types were noted within the study area. Of all of the artificial excavations that have affected land loss, canal construction related to the exploitation of wetland hydrocarbon reserves is most conspicuous (**Figure 4-20**). For example, in one oil and gas field, there are 42 miles (67.5 km) of petroleum-related canals, representing removal of at least 116.5 million cubic feet (3.3 million m^3) of spoil. These waterways are part of an

extractive site encompassing 69 mi^2 (178 km^2) and are a visible indicator of land loss (Davis 1983). In addition to concerns over direct land loss from canal excavation, spoil disposal has become a secondary issue, with some suggesting that spray disposal has potential for minimizing impacts (Cahoon and Cowan 1986).

As canal networks expanded, so did land loss (**Figure 4-21**). Louisiana was in a no-win situation. If canals were not constructed, valuable mineral fluids, and other resources, could not be exploited easily. If canals were excavated, valuable estuarine habitats were lost. Since many considered the marsh worthless, land was sacrificed to capitalize on the subsurface mineral fluids. In retrospect, the state paid dearly for the short-term gains associated with mineral exploitation. However, it should be noted environmental concerns only became a part of the local vernacular during the early 1970s. Before this heightened environmental consciousness, wetland modification was not recognized as a major issue. Louisiana was simply following the national trend.

Forced Drainage

> When or where the idea of diking marshes to prevent the overflow of tides had its inception, is not known. The nations of the Old World banked out the waters of their seas and rivers to make room for increasing population many centuries before Columbus crossed the Atlantic, and the early colonists from Holland, Sweden, England, and Scotland, with an unexplored continent before them, began the work of excluding the tides from the rich meadows bordering their rivers. The subject is not new . . . [Nesbit 1885].

Throughout the study area, forced drainage is perceived as the most acceptable solution to flooding (**Figure 4-22**). For example, in Terrebonne Parish a parish-wide plan was created in 1971 in response to continued flooding because of 1) the absence of pumping facilities to remove excess runoff, 2) moderate tidal flooding and 3) backwater flooding from high water stages associated with the Atchafalaya River (U. S. Army Corps of Engineers-NOD 1983). There was a need to improve the parish's ability to remove excess water. Along Bayou du Large, for example, people have occupied the ridge since the 1800s. As water moved in on them, levees were constructed. In addition, new residents within the parish moved onto areas less than 5 feet (1.5 m) above mean sea level; these are flood-prone. Part of the problem was that the natural gravity flow system could no longer handle the increased runoff. In addition, subsidence and rising sea level contributed to the flood problem on some lands that were previously dry (Altschul 1978; Kemp and Mashriqui 1994; U. S. Army Corps of Engineers-NOD 1983).

In designing the region's forced drainage projects, the boundaries generally follow old agricultural levees, existing canals, or newly constructed levees. In order to develop the envisioned drainage scheme, the parish applied for a Section 404 permit, as provided by the Clean Water Act, for placement of fill material into wetland habitats. Further, before construction could begin on any project, an individual assessment and permit application was required. Maximum levee heights were 10 feet (3 m), but this elevation depended on existing project-site elevations. Material dredged from "borrow canals" is used to build the

required levees. Each of these individual drainage districts required at least one pump; however, the number and size depended on the drainage area.

In Terrebonne Parish, forced drainage districts range from 10 acres (4 ha) to slightly more than 10,000 acres (4,050 ha). The levees for these projects generally are located within the wetland-non-wetland interface because of minimal impact on wetlands and to maximize the availability of uplands. The desirable objective of these projects was to protect existing property and "all undeveloped agricultural and other non-wetlands that are probable for development in the future" (U. S. Army Corps of Engineers-NOD 1982:II-4). In many ways this is not a new concept since plantation often relied on large drainage machines to move water off of their cane fields (Begnaud 1980).

With the exception of levees along selected portions of bayous du Large and Terrebonne (**Figure 4-23**), the levee network south of Houma provides protection from minor tidal flooding only; it is not designed as a hurricane-protection levee (**Figures 4-24** and **4-25**). North of Houma, the levees protect against minor backwater flooding associated with high-flood stages in the Atchafalaya River. These levees are not designed to impede a major flood. Nevertheless, marginal lands are projected to become more attractive as development sites, particularly as they are incorporated into forced-drainage districts (**Figures 4-26** and **4-27**). Consequently, property values in existing and proposed drainage projects will increase (U. S. Army Corps of Engineers-NOD 1983). Prior to the 1960s, very few forced drainage projects were established within the study area west of the Atchafalaya River.

As part of Terrebonne Parish's long-term plan, development in coastal floodplains is discouraged. In order to build in flood prone areas, a Flood Control Utility Permit is required (Terrebonne Parish Police Jury 1983). The permit program established minimum first floor elevations in flood prone zones and specific construction practices in special flood-hazard regions that must be implemented before connection to public utility services. As a result, newer houses in flood-prone areas are elevated much higher than older ones, even when they are constructed within pump drainage districts that are not supposed to flood (**Figure 4-28**). Houses constructed further inland to the north of the GIWW are not required to be raised on pilings (**Figure 4-29**).

Flooding is a problem throughout the study area, as it is in most other parts of Louisiana. To the citizens of the area, the drainage district concept offers an admitted short-term solution–one designed for only minor flooding events. Parts of the drainage system will be obsolete in 50 years, but in the interim, the implementation of a drainage program has contributed to changing the region's natural hydrology.

Projects with a 40 to 50 year life expectancy may seem ill-advised. In point of fact, the long-term flooding problem may require more drastic means than the $100 million dollars or so required to complete the Terrebonne Parish drainage program. In the short-term, the current projects will provide communities with some level of protection. In the long term, more detailed and massive bulwarks are planned, such as rebuilding the barrier islands and reconnecting the region's natural plumbing. The feasibility of these projects will

be evaluated and sources of funding located that will allow these larger projects, and others, to be constructed. For a summary of various options for addressing coastal erosion, see the Committee on Coastal Erosion Zone Management (1990).

Within the study area, drainage districts protect some lands known to be only marginally suited for development (Kemp and Mashriqui 1994). While the problem appears to be most acute in Terrebonne Parish, it occurs everywhere. In many cases, the drainage districts are designed so part of the protected acreage is left in its natural wetland state. In fact, the discharge from some of the pumps has assisted the parish engineer in developing new wetlands because of the high nutrient loads associated with the pump outfall. Further, these enclosed wetlands serve as natural absorption zones as long as they remain in their natural state. Unfortunately, vacant lands within expensive drainage districts are eventually converted to home sites and other forms of development. Within many of these drainage districts, development has expanded beyond the edges of natural levees that originally served as the defining boundary for development. Wetland areas are destroyed when pump draw down lowers the water level below the natural water table and development soon expands into the former wetlands. Of the larger communities in south Louisiana, Morgan City is located in one of the most precarious situations:

> There is a specter that Morgan City hopes it doesn't have to face: the opening of the Morganza Floodway just north of Baton Rouge. It has been used only once –in 1973– . . . After the Atchafalaya's wave hit the top of the 10-foot [sea]wall in 1973, it was raised to 21 feet. Still, opening the Morganza Floodway would bring floods via the bayous and lakes that are not protected by the seawall. Due to levees and the seawall, Morgan City proper has not had a major inundation since the Great Flood of 1927, which led to the birth of southern Louisiana's levee system" [Sayre 1997a:16A].

Hurricane-induced storm surge or high water in the Atchafalaya River add to the flooding risk. Project levees protect only from minor floods. Throughout the study area, the flood insurance program requires structures be built above the flood level. As people and businesses move into some of these areas, they can expect to be flooded from one to five times in the next 50 years, particularly as sea level rises and subsidence becomes more significant.

Little if anything can be done to prevent sea level rise and subsidence. However, sound, rational, long-term planning can mitigate their affects on existing and proposed intensive land uses. Options available to planners include concentrating development on higher ground, preventing encroachment into unsuitable zones, and designing projects that can withstand the predictable problems. Buildings must be flood-proofed to reduce damages and the district's lower regions should remain as open-space wetlands or ponding areas and part of the overall, drainage network.

Finally, several of these drainage district levees in Terrebonne Parish will soon be exposed to the direct impact of Gulf processes. The wetlands are deteriorating and the barrier islands are eroding. The protecting forelands are disappearing along the coasts of all

the parishes within the study area, despite the introduction of wetlands restoration projects (**Figure 4-30**). Barrier islands and wetlands serve to protect the interior from waves and reduce the height and impact of storm surge. Once these two environments are gone, changed to open water, drainage district levees will bear the full force of waves and storms. To counteract the problem, Terrebonne Parish has actively been involved in rebuilding and stabilizing its barrier islands. Of course, maintenance cost will be a necessity as the levees are undermined or washed away and the probability of breaching is increased. History demonstrates this to be a predictable problem. Numerous agricultural reclamation projects were tried in the late nineteenth century and early twentieth century (Davis 1993; Okey 1918). Most failed, as the levees were not maintained properly and storms and waves eventually flooded the projects. Hopefully, the hurricane protection levee system will not be plagued by this problem. The record hurricane or rain event can obviate the best plans, but in the eyes of the people some protection is better than none at all.

Even so, one must always be cautious when it comes to hurricanes. Hurricane Andrew in two weeks created damages of $27.2 billion in Florida and Louisiana in 1991. Iberia, St. Martin, and St. Mary parishes were severely damaged with more the 40 percent of the area's bottomland hardwoods affected by the storm. It was a storm that changed a number of habitats on the state's barrier islands and introduced large amounts of sediment into a number of coastal marsh systems, particularly those closest to the storm's path. East of Atchafalaya Bay, storm-generated sediments were from 4-6 inches deep. Andrew also affected salinities. Five days after the hurricane, the salinity of some interior marsh sites was still eight times higher than it was prior to the storm. At one site in Terrebonne Parish, 55 days after the storm saltwater was still evident below the marsh surface. Habitats throughout the storm area were affected (Guntenspergen and Virin 1996). These storms are inevitable; and levees are one tool to try and mitigate their effects. But the levees can give a false since of safety, since a category five storm will overwhelm any system at its weakest point.

Levees certainly help, but they are not designed to retard all hurricane-induced storm surges. They have their limits. Therefore, with many parts of the region less than three feet (.92 m) above mean sea level, flooding is a constant problem. Even though the area is drained, the natural system is superseded by an artificial one that is outlined by levees, floodgates and residential/commercial/ industrial activity. All are new additions to the landscape, since there is no record of leveeing the marsh in the 1800s (Nesbit 1885). Even so, as early as 1814, Louisiana's natural hydrology was being altered when General Andrew Jackson issued an order to close and completely obstruct Bayou Lafourche to prevent the ascent of the British by this route (Randall et al. 1846). The process of altering the natural system continues.

Soil compaction further complicates the regional environmental concerns. In addition, when subsidence is considered with sea level rise, it has been determined that relative sea level rate increases could range from .6 ft to 9 ft (.18 m to 2.7 m) over the next century (Gagliano and Van Beek 1970; Penland et al. 1988). In analyzing the marsh, the flooding or subsidence problems are heightened by a landscape that is now more water than land. Even so, despite the loss of more than 126,000 acres (51,030 ha) of fresh marsh between 1955 and 1979, Terrebonne Parish contains one of the largest continuous expanses

of coastal freshwater marsh in the state and nation (Wicker et al. 1980). Subsidence is exceeding deposition in most of these regions and is increasing the open-water surface area. Other reasons for habitat change include 1) shoreline erosion, 2) breakup of *flotant* and fresh marshes by floods and storms, 3) replacement of land areas by canals and borrow pits and 4) impoundment and flooding resulting from cross-drainage spoil deposition (U. S. Department of Agriculture 1986; Wicker et al. 1980). As a result, most of the *Paroisse de la Fourche Interieure* is losing both land and vital parts of its productive estuarine environments. Although these are natural processes, humans have had a direct impact on a number of the natural variables that maintained the estuarine landscape: land use conversion, levees and forced drainage districts, industrial activity, water quality, and dredging activity.

Land Reclamation in Coastal Louisiana

> Be it hereby enacted by the Senate and House of Representatives of the State of Louisiana in General Assembly, . . . hereby created a corporate body, under the name and title of the "Louisiana Land Reclamation Company," for the purpose of reclaiming and protecting swamps and overflowed lands in the State of Louisiana, by constructing canals, levees dykes, and other necessary appurtenances and appendages to prepare said lands for rice culture, pasturage, and other pursuits, and for habitations, settlements, navigation and irrigation. [From: Act 52 - incorporating the Louisiana Land Reclamation Company; to authorize, encourage and assist in the reclamation and protection from tidal overflow certain lands in and belonging to the State . . . *In* Acts passed . . . 1878].

The cumulative deltaic processes within coastal Louisiana have resulted in a landscape distinguished by broad, gently sloping, natural levees that served as principal high ground. These depositional landforms provided the impetus for settlement. Backswamps and marshes were generally considered inhospitable environments for settlements. Reclamation efforts were needed to make these physiographic regions suitable for colonization.

Settlers had to learn how to endure the annual floods that were an aggravating part of living within the Mississippi River's floodplain. To neutralize these seasonal disasters, natural levees were augmented by engineered structures high enough to counteract floodwater, or at least minimize its effects. Actually, artificial levees were the only practical technique that could be implemented to resolve flood-control problems and reclaim the wetlands for human use. If the land was not high enough for settlement, it was ringed by levees, put under a system of forced drainage, and reclaimed.

New Orleans—A Reclaimed City

Because New Orleans was built at such a low elevation and was surrounded by water, drainage was critical to its survival. Its initial plan included ditches surrounding each block. When it rained, these trenches filled with water creating little islands—locally known as "islets." Canal by canal the islets radiated out from the *Vieux Carre*. These channels

established the city's dependence on a drainage network built and maintained by the populace. In a practical sense these early ditches were part of a great land reclamation project designed to aid planters and urbanites drain potential agricultural, pasture, residential, and industrial real estate.

In New Orleans levee construction began as early as 1718. Ten years later an earthen embankment 1 mile (1.6 km) long protected the new colony. By 1735 the rampart extended 41 miles (67 km), but was neither high, nor wide enough to succeed (deVilliers 1920; Schneider 1952). To insure settlers confronted the drainage issue, Spanish Governor Alexandro O'Reilly in 1770, issued regulations requiring that every family moving to the province be given a tract of land, with the proviso that within three years they build a levee to protect their property (Martin 1882). These regulations guaranteed many of Louisiana's lowlands would be drained adequately. By 1860 there were 1400 miles (2253 km) of privately built levees, providing flood protection for more than 2.9 million acres (1.2 million ha) (Tomlinson 1926). Most of this was agricultural land. As need arose, the urban and rural drainage system expanded.

In "The Crescent City," the challenge was to insure flood control through adequate drainage measures. To meet this challenge, improved machinery and engineering techniques were imported from Europe. As New Orleans expanded beyond its natural levees, drain and reclaim measures have resulted in parts of the levee-protected city being nearly 4 m below sea level. At least 45 percent of the metropolitan core is at or below sea level, with levees and drains protecting the community. A single pump failure, levee crevasse, hurricane, or 8 in to 10 in thunderstorm can be disastrous. Levees are essential to keep floodwater out; they also keep rain water in. Pumps must function continually to remove surface runoff and groundwater seepage. As much of this complicated drainage network is old and in need of complete overhaul, a major breakdown will necessitate immediate repairs. If pumps fail during a major storm, the city's topographic depressions will flood—compounding the calamity.

Reclamation Beyond New Orleans

While the situation in New Orleans was bad, other settlements fared even worse because guarding against overbank flow was a massive undertaking. Throughout the eighteenth and nineteenth centuries, artificial levees were extended along the Mississippi River both upstream and downstream from New Orleans. By the late nineteenth century they were constructed along Bayou Lafourche. Once these structures were completed, floodwaters could no longer pour into the backswamp reservoirs (Ellet 1852), but were made to flow down the main course. There were no natural relief valves. The Mississippi River was gradually being locked into a conduit, allowing the surrounding wetlands to be reclaimed.

The Swamp Land Acts of 1849 and 1850

> The object of this pamphlet is not in any manner to detract from the splendid highlands of Louisiana, but to place before the public facts concerning the

> agricultural possibilities of what is designated as swamp, or overflow lands of the State, concerning which the Department of commerce and Labor of the Federal Government recently published . . . that Louisiana has 9,500,000 acres of such lands [Merry 1910:3].

As a result of this reclamation euphoria, between 1880 and 1930, reclamation activity was intensified within Louisiana's alluvial wetlands (Merry 1910; Okey 1914). Since arable land was in short supply, the only practical way to solve the land shortage problem was to reclaim swamps and marshes. Large-scale drainage districts were established and land was reclaimed at a record rate. Consequently, reclamation techniques in the early part of the twentieth century converted unused wetlands to prime pasturage. Available high ground is traditionally used for the production of agricultural crops, with cattle grazing only a few isolated tracts. On many of these reclaimed tracts commercial cattle operations were not started until the great land reclamation efforts of the early 1900s (Merry 1910; Okey 1918a, 1918b).

These projects were considered the salvation of the wetlands; according to their promoters, they would open the marshes for settlement (Merry 1910). Unlike wetland reclamation in the Netherlands, continuous grazing and farming were practiced in Louisiana. Within a short period of time the fertility of the reclaimed wetlands was exhausted. As a result, the "ballyhooed" projects were abandoned or used only as pasture (Harrison 1961; Harrison and Kollmorgan 1947). 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. This they did by expanding the area of arable land beyond the confines of the natural levees ridges. This expansion was achieved in adjacent swamps and marshes by reclaiming efforts involving pumps, canals, and large engineered levees (Merry 1910).

Flood and water control methods extended cultivated land beyond the natural levees into the backswamps, expanding the riparian landowner's property holdings. During this period over 50 land reclamation efforts were started in coastal Louisiana. Local swamp and marshland owners considered these schemes folly and were glad to sell their "wasteland"—a move many would regret when hydrocarbons were discovered in stratigraphic traps under these lands.

Reclamation companies and a number of railroads advertised the agricultural merit of these reclaimed parcels. Pamphlets promoting the new land were distributed widely (Merry 1910). Immigrants from the Corn Belt and the Lake states began to arrive in America's new agricultural paradise. These settlers believed that all projects were destined to succeed, since only the wetlands' positive aspects were promoted. The promoters' exaggerated claims made it difficult for Northern farmers to turn down the opportunity to reestablish their families in what was proclaimed as a second corn belt, a major truck-gardening region, a new citrus district, or another rice bowl.

Reclamation entrepreneurs reclaimed tracts that varied from 640 acres (259 ha) to more than 25,000 acres (10,125 ha). Their efforts resulted in more than 138,000 acres (55,890 ha) being reclaimed (Davis and Detro 1980). By the early 1900s, reclamation of tidelands was occurring on a national scale and Louisiana was simply emulating the emphases on reclaiming marshlands (Wright 1907). Within the study area, one of the largest land reclamation projects was Avoca Island located just south of Morgan City (**Figure 4-31**). Reclamation work began during the 1890s. The project was inundated during the 1927 flood and no attempt was made to reestablish the pump drainage system (Weinstein and Kelley 1992:63-64).

In most land reclamation attempts, the large-order system of polders proved unsuccessful (**Figure 4-32**). Under cultivation, the organic soils within the ring levees shrank and settled. After ten years of cultivation, many sites subsided nearly 6 ft (1.8 m), which meant that the subsided ground surface was below sea level. Without proper levee maintenance, these negative surface elevations were easily flooded. As the land depressed, protecting the property from stream overflow and tidal flooding, and pumping off the surplus water that accompanies a 10-inch thunderstorm, were expensive. The costs became prohibitive and projects failed. In fact, the numerous rectangular lakes that now dot the marshes serve as monuments to poorly conceived reclamation schemes. Visions of a new American agricultural wonderland slowly dwindled as the marsh took back the reclaimed land as its own (**Figure 4-32**). Only those reclaimed tracts in urban areas survived. The main reason that urban reclamation efforts have survived is that the cost of pump drainage is surpassed by escalating land values brought on by a shortage of inhabitable land. For this reason, urban land reclamation efforts are likely to continue.

Destruction of Coastal Oyster Reefs

With reference to coastal land loss, one of the damaging policies in place during the first three-quarters of the twentieth century was the permitted removal of coastal shell reefs. This practice began in the Atchafalaya Bay area in 1914. At that time, laws and regulations allowed for the removal of "dead" reefs. At the beginning of the twentieth century, the Point au Fer reef stretched for more than 25 miles (40 km) from Point au Fer to Marsh Island and was probably the largest oyster reef complex along the Louisiana coast. The first major breach of this almost continuous reef occurred in 1916 when the Atchafalaya River "Ship Channel" was dredged. Apparently, this breach reduced the amount of fresh water impounded by the reef and temporarily encouraged oyster production in the coastal bays to the west by increasing salinity (Payne 1920). Extensive portions of the Point au Fer reef were removed by dredging between 1937 and 1955. Dredging was in fact encouraged by the Louisiana Department of Wildlife and Fisheries because the multiple-year lease agreements required dredging companies to pay annual royalties to the State, whether shells were dredged or not during each year the lease was active.

Prior to the 1970s, the environmental impact of these pro-dredging policies was relatively unknown and of little concern. Complete removal of the entire reef system would probably have occurred if not for a more immediate economic concern. Dredging was halted by the Louisiana Attorney General in 1968 due to fears that complete removal of the reef

would eliminate this island chain from consideration as a part of the Louisiana shoreline and thus alter the determination of the State/Federal boundary then being negotiated (i.e., the Three Mile Limit). In 1973, limited dredging resumed on the landward side of the reef. No dredging of the Point au Fer reef has been permitted since expiration of the last dredging lease in 1982 (U.S. Army Corps of Engineers-NOD 1987).

Although research indicates the significance of barrier systems as buffers to storm surge, wetland loss, and preservation of coastal bays (Williams et al. 1992), very little research has been conducted on the significance of shell reefs as a component of Louisiana's coastal barrier system. Generally oriented parallel to the coast, these reefs appear to serve a coastal preservation function similar to barrier islands. Shell reefs differ from barrier islands in two distinctive ways: 1) they do not migrate and 2) the highest elevations rarely project above water more than the high tide level. Reefs are resistant to erosion and some are "strong enough to withstand hurricane-force wave energy" (U.S. Army Corps of Engineers-NOD 1987:Appendix D). Despite their obvious benefit to the maintenance of stable coastal estuaries, some authorities claim that these features "are not considered important" and that "the value of submerged oyster reefs from a hydrological viewpoint are minimal" (U.S. Army Corps of Engineers-NOD 1987:Appendix D). This claim is based on the assumption that coastal ridges, whether they are sandy barrier islands or oyster reefs, are not effective as barriers from storm surge, wave reduction, fisheries preservation, or salt water intrusion if they do not project above the surface of the water. Another point worth noting is that removal of many of the reefs was justified because shell dredgers claimed that they were "dead." As one witness has observed, it was an exaggeration to claim that all of the Point au Fer oyster reefs were dead. Dredging of one living reef in this chain was halted only after repeated complaints were filed. The final result was preservation of "Outside Reef" or "Nickel Reef" (**Appendix A-7**). It is somewhat telling that in at least this one instance, an oyster reef could be classified as "dead and buried under sediment," yet on aerial photography, obvious shell exposures were visible at low tide (**Figure 4-33**). With reference to proposed shell dredging in the Point au Fer reef area, it is interesting that as recently as 1993, some still claimed that removal of shell reefs to be a "beneficial" policy, as long as the reefs are not exposed above water:

> Oyster reef structures buried beneath the mud bottoms of the waters in the project area do not provide barriers to coastal erosion forces inshore of the project area. Only those reefs which are above the mud line can provide protection for inland shoreline areas. The removal of buried reefs will, therefore, have no significant impact on land loss. The use of the harvested shell in activities which could accelerate degradation of the wetlands appears to have no greater impact than the use of any other material. To the extent that use of the relatively light weight shell limited degradation of the wetlands (and land loss) its use has been considered beneficial [U.S. Army Corps of Engineers-NOD 1993:35].

Beneficial Use of Dredge Spoil

In the 1970s Louisiana's wetland loss problem began to receive special attention from the research and public communities. As a result, for nearly three decades wetland interest and research increased dramatically. State officials began to take action in the design of a plan to reduce land loss and its immediate impacts. These actions included: construction of controlled freshwater diversions, regulating dredge and fill activities, promoting the beneficial use of dredge material, and promoting land building in the Atchafalaya delta (Cowan et al. 1989). In fact, a comparable plan is currently being proposed for renourishing Louisiana's disappearing wetlands. One technique that has proved noteworthy is the beneficial use of dredged material.

Within the Water Resources Development Act of 1992, the U.S. Corps of Engineers is authorized to use material dredged from construction, operation, or maintenance of navigational projects in the protection, restoration or creation of aquatic and ecologically related habitats. In this regard, the New Orleans District removes more than 30 million cubic yards (23 million cubic meters) of dredged material annually that can be used to help restore Louisiana's wetlands. One of the first marsh habitats to be created using this technique was along Southwest Pass at the mouth of the Mississippi River, and from this project the Corps learned how to effectively manage the distribution of spoil (Hawes 1986). Currently, throughout the study area there are examples of spoil obtained in channel maintenance being used in the creation of new wetlands.

Perhaps the best example can be seen in Atchafalaya Bay, where the Corps has had a policy of using dredged material to build new land in the bay (**Figure 4-34**). Within the developing delta, channel maintenance dredging is necessary to insure a navigable route from the Atchafalaya River out to the Gulf. Channels become clogged with sediments, particularly where distributaries widen near the delta front. Under natural conditions, small horseshoe-shaped islands form at the point where delta channels split. The Atchafalaya delta formation is being structured by using dredge spoil to create artificial horseshoe-shaped islands at points where channels are bifurcating. These islands are formed to match the shape of those that occur naturally during delta formation (*The Advocate*, May 25, 1998:2A). By carefully choosing disposal sites and moving the dredge pipe as often as practical, significant new land has been created in other areas as well.

Recent Changes

Urban Growth

As a general rule, the larger the natural levee, the larger the community that can be developed. This rule was certainly true before pump drainage was installed. Today, urban expansion has outgrown the elevated land in several areas. Morgan City was cited as an example of a typical small city with an economic foundation that includes agriculture, fishing, and oil and gas. It was also selected because many of the environmental problems (flood control, threat of hurricanes, loss of natural habitat, lack of developable land, etc.) are common to other developing urban areas within the study area. The problems facing Morgan City are indicative of the problems facing population growth in any area that is becoming more susceptible to impacts from hurricanes, land loss, and flooding.

Recent Trends In Population Distribution

The study area is a landscape dominated by broad, gently sloping natural levees, marshes, swamps, beach ridges, exposed salt domes, and "prairie." To some degree, all of these environments were settled. Even so, since early cultures had to adapt to a changing environment, settlements were rarely continuously occupied. Shifts in Mississippi River channel, floods, or hurricanes determined the longevity of many early communities. Abandonment was common. Whether associated with logging, shrimping, or working oyster leases, most early settlements that were not located on high natural levee ridges were eventually abandoned. As water encroached on these sites, or the community simply wanted the amenities associated with the region's high ground, people moved. Modern settlements have not accepted this practice. Rather than move as the environment changed, the region's natural waterways/hydrology were managed to prevent change and guarantee the viability of the settlements. As a result, many cultural components, including dispersed and agglomerated settlements, linear hamlets, T-towns, grid cities, plantations, levee-protected suburbs, isolated communities, and nucleated settlement clusters, are all part of the landscape.

Prior to 1900, settlers who attempted to take up permanent residence in the marshes usually moved from the wetlands to the high ground. This movement was most evident after devastating hurricanes or tropical storms came ashore. Dwellings located within flood prone areas were usually viewed as temporary residences (e.g. oyster camps). In some cases, the local marsh resources may have been so plentiful that it was considered worth the risk to live in the marsh all year long. The 1930s distribution of camp or camp-like structures throughout the study area is a good indication of the relatively small number and the relatively dispersed nature of structures within the coastal marshes (**Figure 3-81**). Most of these structures were probably occupied on only a seasonal basis.

The first serious attempts at permanent occupation of the flood-prone wetland areas came between 1905 and 1925 when numerous wetland reclamation projects were initiated. Those projects located within the study area were all associated with agricultural development. All of them failed. Forced drainage projects were again introduced after Hurricane Betsy (1965) when many local governments and the Corps of Engineers began promoting the construction of hurricane protection levees (Kemp and Mashriqui 1996). Since 1965, levee impoundments of varying sizes and shapes have been constructed along most of the populated distributary channels within the study area. In some instances, these embankments are less than five feet high (1.5 m) and would hardly qualify as hurricane protection levees.

One of the historical repercussions of the unresolved boundary dispute between Terrebonne and Lafourche parishes was that the boundary used for enumeration of the region by the United States Census. Until the 1920s, the Census used Bayou Lafourche as the boundary line between the parishes, only using the present Bayou Blue-Bayou Point au Chien line beginning with the 1930 census (Thorndale and Dollarhide 1987). Approximately 200 square miles (518 km^2) of Lafourche Parish were considered part of Terrebonne Parish until the 1930 census.

Another boundary consideration is the land/water boundary of the parishes. While these boundaries are not necessarily in dispute, they have been constantly changing, both on the Gulf Coast and in the interior wetland areas. Land loss began occurring in the nineteenth century and peaked at almost 30 square miles (77.7 km^2) per year within the Deltaic Plain in the late 1960s (Gagliano et al. 1981). Though the land loss rate had dropped to about 20 square miles (51.8 km^2) per year in the Deltaic Plain by the late 1980s (Britsch and Kemp 1990), land loss had dramatically affected the land area of some parishes in the study area, and continues to do so today. The highest concentration of loss in the central coast area is contained in the Terrebonne Basin, most directly affecting Terrebonne and Lafourche parishes (Gagliano et al. 1981).

Land loss affects human settlement in numerous ways, one of which is population density. Geographical population comparisons are often made using the population density of a given area, as the number of inhabitants per square mile within a political area, such as a parish. When comparing political areas, both the size of the population and the size of the area affect the density. If the number of people occupying an area grows, then the area is said to have a greater population density. However, if the political area that people occupy gets smaller, it will also have a greater population density. This is precisely the case in Terrebonne Parish. Over the years, both population growth and land loss have increased the population density of the parish. Both the census boundary discrepancy and land loss have been taken into consideration in this analysis.

The historical settlement of the central coast of Louisiana, as with any region, is a story of opportunities and constraints and the processes that drive them. Whether land is scarce, conditions poor, or better jobs await elsewhere, people leave their traditional homes out of a certain degree of necessity and settle in places that can sustain them, and possibly lead to their prosperity. In industrial societies, the economy is the primary driving force behind the opportunity structure. The constraints are many and varied, but the key constraints are political stability and the social and physical environment. Crime in an area, for example, is a social environmental constraint to living in a given area, just as periodic flooding would be a physical environmental constraint to living unprotected next to a river.

The major processes at work during the past 150 years have caused dramatic changes in the shape of Louisiana. The population has grown, people have moved off the farms and into the cities, and industries have come, gone, and occasionally returned. Over the past century, the country as a whole has been becoming more urban. People left rural areas for cities, immigrants settled predominately in cities, and more children of each new generation are born in cities. The rural-to-urban shift began around the turn of the century. It rapidly accelerated following World War II. In Louisiana, the shift was accompanied by a trend of intrastate migration from the rural northern areas of the state to the southern cities. Within the study area, this urban migration is reflected on twentieth century maps and the movement is particularly evident within sugar cane growing regions (**Figure 4-35**). Along Bayou Sale for example, one account noted that about 1000 people lived along the channel in 1849 (*Planters' Banner* 1849:1). Today, less than a dozen houses are located along the southernmost five miles (8 km) of the channel; it is unlikely that more than 100 people live

along the entire length. The recent oil boom has further pulled people away from farms and into oil and gas related jobs (*Sunday Advocate,* May 3, 1998:1I). There has also been some abandonment of isolated farming/fishing communities in areas that are only accessible by boat. The abandonment of permanent residences on Cheniere au Tigre and lower Bayou Pointe au Chien are two examples (**Figure 4-36**).

Since the end of the Civil War the population of Louisiana's central coast has grown by 558 percent, compared to a state growth rate of 480 percent for the same period. The average growth rate for the study area, for the decades between the United States Censuses, was 17.9 percent, while the average decennial growth rate for the state was 16.1 percent (post Civil War - 1870 to 1990). Since the end of the Civil War, the central coast region has grown faster than the state as a whole. This is partly due to the rural to urban shift and compounded by the north to south intrastate migration. Coastal region growth, while averaging almost 18 percent per year, has not been steady by any means. The state and the region have had vast fluctuations in the status of their populations as a result of external processes, most notably war and economic upheaval.

The period between the 1980 and 1990 censuses was particularly unusual for Louisiana. For the first time since the Civil War and the World War I years, the state's population growth trend dramatically declined. The average population growth rate for the state dropped from 15.4 percent for the 1970 to 1980 period, to just 0.3 percent for the 1980 to 1990 period. The central coast was similarly affected, dropping from 15.7 percent growth to 1.3 percent for the same periods. The parishes within the region were variously affected. St. Mary Parish was not strongly affected, with only a small decline in growth (11 percent to 7 percent). Lafourche, Terrebonne, and Vermilion Parishes hardly had any growth, all reporting about 3 percent growth, while Iberia Parish lost almost 10 percent of its population (**Figure 4-37**).

Data from 1995 show that the growth rate is now increasing, to 2.4 percent in the central coast region, though parish rates fluctuate widely, with Iberia reporting 22.5 percent growth since 1990, and St. Mary reporting a 16 percent loss. According to a 1994 ranking by total population for all Louisiana parishes, Iberia ranked 16th, Lafourche 13th, St. Mary 19th, Terrebonne 10th, and Vermilion 22nd among the 64 Louisiana parishes.

Population Density

Population density is a simple concept that measures the size of the population relative to an available resource or area. Population density reports can be misleading however, because the figure for land area that is used to calculate population density only represents net land (i.e. non-water) within a given political boundary, rather than land that is actually suitable for human settlement. This has significant repercussions in coastal Louisiana because of the large wetland and lowland areas. To compute more meaningful densities, either the population could be compared to another resource (such as agricultural land) or the approximate land area suitable for settlement could be identified and used for the calculation. As a result of the unique pattern of landforms, settlement is far from uniform throughout the central coast area; instead, it is concentrated on and along development

corridors of high ground; namely, the low terraces and natural levees. The figure for density would be more meaningful if the population density were computed for the areas containing the levees and terraces. While historical population data are not comprehensive enough for a finely detailed analysis of this type, historical data for Police Jury[1] wards can be used for a general comparative analysis.

The Police Jury ward was the smallest area used for population data reported by the U.S. Census for most historical censuses. Though the ward boundaries have changed as the population has grown (i.e., they have been continuously subdivided and occasionally redrawn) they do provide a coherent basis for historical population comparisons within the parishes. The concentration of the population in the areas containing the widest natural levees of the Deltaic Plain and the terraces of the Chenier Plain is represented in **Figure 4-38.** The graph presents population densities for the 100-year period between 1880 and 1980 separated by immediate coastal and non-coastal wards within the five-parish central coast region. The divergence of the trend lines shows that of the 350 percent population growth that has occurred between 1880 and 1980, almost all of it has occurred in non-coastal wards. Within the central coast region, the non-coastal area grew by about 600 percent while the immediate coastal area grew by little more that 100 percent. This trend is attributable to the rural to urban population shift and the concentration of urban areas along the widest natural levees in the more inland area.

In 1990, the population density of the central coast region stood at 76.5 people per square mile, only a slight increase over 1980 (73.7), due to the low population growth. The state reported a population density of 94.8 persons per square mile, making the state's population as a whole denser than the population in the central coast region. This is to be expected considering the large area of uninhabitable land in the central coast region. If the data compared the state population density with the density of the central coast region based on land suitable for settlement, the central coast region would report a substantially higher density than the state.

1990 Population Distribution

Fortunately, more detailed data are available from the most recent census.[2] The 1990 census was the first census to completely enumerate Louisiana with the Tract and Block population mapping system. As a result, a much finer level of detail is readily available for analysis throughout the state. **Figure 4-39** is a population density map of the central coast

[1] The predominant form of parish government in Louisiana, the Police Jury, was established in 1807, and first identified by that name in 1811 (Goins & Caldwell 1995:45). The 1960 "home rule" amendment to the state constitution allowed for exceptions to the jury system (other than existing consolidated city-parish governments). Within the central coast region, Lafourche is the only parish to have opted for home rule.

The Police Jury system of government established wards within the parishes, from which members are, and have been, elected since 1816 (Goins & Caldwell 1995:45). These wards were also used for population enumeration by the Federal Census, designated Minor Civil Divisions (MCDs).

[2] The Census historically used existing political boundaries for enumeration. This worked well until cities increased the population densities to such an extent that the civil boundary was much too large for meaningful analysis. Manhattan Island in New York City, for example, contains more people than the entire state of Louisiana. To cope with this problem, the Census began mapping densely populated areas with its own system, made up of Census Tracts, Block Groups and Blocks.

area for 1990. From this graphic presentation it is clear that the population is concentrated within a relatively narrow corridor bounded by marsh, swamp and other lowland.

Population and Land Forms

The settlement corridor displayed so vividly in the 1990 population density map is the result of a "compromise" between economic processes, the opportunities that the economy can offer, and the constraints of the physical environment (**Figure 4-39**). Various industries and economic processes drew settlement to the central coast region over the years, and the landforms dictated the location of the settlements to the natural levee ridges, low terraces, and coastal cheniers.

Moving west to east across the central coast region, the settlement corridor follows the natural upland areas. The prairie and low terraces of Vermilion Parish adjoin the wide natural levee of Bayou Teche in northwestern Iberia Parish, cutting southeasterly across Iberia and St. Mary Parishes, with southward branches at Bayou Cypremort and Bayou Sale in St. Mary Parish. The corridor joins the narrow Bayou Boeuf and Bayou Black ridges running easterly across northwestern Terrebonne Parish into Bayou Terrebonne. The natural levees extend southward into the marsh in a fan of narrow ridges down bayous du Large, Grand and Petite Caillou, Saint Jean Charles, and Pointe au Chien. Bayou Lafourche, in Lafourche Parish, runs far southward into the marsh with numerous small levee ridges branching to the southeast along its length.

Nearly all of the significant urban areas in the central coast region are located within the settlement corridor on the terraces and natural levees. The concentrated, rapid growth of urban areas has necessitated the expansion of city boundaries, either formally or de facto, yet because they are located on natural levees, they have a finite area in which to expand. The solution to this problem has been to reclaim wetlands by stretching levees out into the surrounding marsh and swamp and placing the areas under forced drainage for the purpose of settlement.

The Lure of Pump Drainage

In terms of population settlement, forced drainage serves two primary purposes: 1) expansion of major cities into surrounding marsh and swamp, and 2) protection of narrow ridges and lowland areas from flooding. Throughout this century, land reclamation projects have succeeded in widening the natural levee areas and webbing the fingers of natural ridges extending into the marsh. For the present study, a comparison was made between population density and the distribution of forced drainage areas. To date, the distribution of forced drainage areas has been plotted only for the east end of St. Mary Parish (i.e., Morgan City) and all of Terrebonne Parish (Kemp and Mashriqui 1996). An analysis of forced drainage areas has not been done for the western half of the study area. Forced drainage areas now encompass virtually all of the larger natural levee ridges and portions of most of the smaller ridges. In some areas, the forced drainage coverage extends laterally to include some of the adjacent swamp and marshlands. **Figure 4-40** is a map showing the natural levees and ridges overlaid with areas under forced drainage. It can be clearly seen that within Terrebonne

Parish, large areas of land adjoining the natural levees have been reclaimed and used to expand human settlement, and, in some cases, agriculture. Because all of the major urban areas and a substantial portion of the more elevated natural levee ridges are under or surrounded by forced drainage, the majority of the population lives within forced drainage boundaries, resulting in a very dense population within these "protected" areas. Modern insurance restrictions require that new homes in flood-prone areas be elevated above the anticipated flood level, even if the homes area located within pump drainage districts. The flood-prone area generally covers most of the study area south of the GIWW.

The distribution of pump drainage areas illustrated in **Figure 3-215** is somewhat misleading because every form of drainage system is included. The condition of the impoundments is variable, with no consistency in either the size of the pumps or the elevation of the surrounding levees. On one extreme, some settled areas are surrounded by floodgates and artificial levees that are over 10 feet (3 m) high. At the other extreme are communities such as Isle de Jean Charles, where pump drainage is little more than a pump-operated sewer system that does not include an impoundment levee.

As the population of the region has exceeded the natural settlement capacity of the more elevated natural levee ridges to the north the forced drainage areas have expanded south and the population has also moved further down the natural levees onto the lower and narrower ridges. A comparison was made between the "inland" wards (i.e., those along the northern edge of the study area) and the "coastal" wards in an attempt to identify major population movements. The density of inland wards containing wide natural levees grew at six times the rate of the coastal areas in the 1880 to 1980 period. The density of the coastal wards doubled during that same period. This comparison indicates that while the population in the more elevated portions of the study area continues to grow, the population is also growing along the smaller ridges that extend out into the area of greatest land loss. The installation of pump drainage and hurricane protection levees serve as enticements for settling in areas where the risk of hurricane surge or flooding may be increasing.

Economic and recreational opportunities within the Louisiana central coast drew the population to a geographically constrained, and in some places, strained area. This has always been the case along the coast, but it is only in recent decades that the population has grown large enough to thoroughly tax the natural levee system. Nowhere is this better illustrated today than in Port Fourchon, at the southern extent of Bayou Lafourche, in Lafourche Parish. The recent boom in the oil industry has provided terrific economic opportunities, but the region has exceeded its natural capacity to support human settlement. The social and physical environments are becoming severe constraints to the opportunities that the region offers. The transportation infrastructure is overused, there is insufficient fresh water, there is insufficient housing, and the entire area is dangerously susceptible to coastal storms. The population is top-heavy, balanced on a foundation of insufficient infrastructure. While both physical constraints and the availability of resources limit the expansion of settlement in the region, the pull of attractive resources is straining the physical capacity in an increasing number of locations.

Today the population movement is clearly different from what it was 100 years ago. Despite obvious subsidence, erosion, and encroachment by water, residents are clinging to homes in areas that may have been considered "safe" from storm surge 50 or 100 years ago, but these buildings are situated in threatened locations today. Both camp and residential construction is booming in impounded areas. Insurance regulations acknowledge the danger of flooding, and this is clearly indicated by the proliferation of elevated structures (on pilings) throughout the lower half of the study area, even within impounded areas.

While there is a clear growth in the coastal residential population within flood prone areas, an even greater change has occurred in the recreational camp construction industry. Recreational sportsmen are building camps throughout the marsh and at the end of the region's roads where marinas, motels and other services have also developed. Due to the sheer numbers involved, the construction of recreational camps within hazardous areas does indicate at least a nominal increase in risk to human lives. Perhaps more significantly, new camp construction represents a significant increase in capital investment in an area periodically devastated by hurricanes. Many of the new campsites are vulnerable to storm damage because the areas being developed are near the coast and are not protected by either hurricane protection levees or pump drainage systems. At Cypremort Point, for example, only two camp structures were standing in 1932. Today over 100 camps and homes are located in the same area, and along the shore of Vermilion Bay, marsh land is being bulkheaded and filled for the planned construction of many more (**Figure 4-40**).

Observations of Individuals Who Live within the Study Area

One of the tasks of this investigation was to interview people who were knowledgeable about the coastal area and could identify changes that they have observed within their lifetime. The interviews were recorded on tape and transcribed (**Appendix A**). In general, the interviews confirm the conclusions reached from available written documents that indicate extensive change has occurred within the last 50 years. The most commonly cited changes are 1) an increase in the number of people utilizing the coastal marshes and water bodies, particularly recreational fishermen, 2) an increase in camp construction along popular distributary bayous, 3) rapid land loss in selected areas, particularly in the Terrebonne Basin, and 4) decreased salinity in Vermilion Bay. Only one of the dozen or so individuals interviewed has moved away from the coast as a result of hurricanes or increased risk of flooding. All the others have either always lived outside the areas of most rapid land loss (i.e. the areas of increasing risk) or they continue to live in the same areas that they have occupied for the last 30 or more years. With regard to the observation that partial diversion of Atchafalaya River flow has decreased salinity in Vermilion Bay, none of the people interviewed were aware of reduced land loss rates within marshes, streams, or bays where salinities had declined. The interviews certainly helped to document a tradition of coastal resources use that seems to hold people to areas that are still productive, particularly for recreational and commercial fishing. Although some individuals are still engaged in some form of commercial exploitation within coastal marshes or water bodies (e.g., trapping or shrimping), all indulge in recreational use of the coastal wetland areas.

Legal Issues

In addition to the physical and cultural impacts of land loss along the coast, there are also some legal issues that are becoming increasingly important. The two most obvious are 1) property ownership and 2) public access. Property ownership issues usually involve disputes between the State, which has claim to the seashore and all natural navigable water bottoms, and a private landowner, who has a title to the property in question. As land turns to water in some areas, the State may exert its claim by issuing oyster leases to oyster fishermen. Many disputes also focus on the distribution of mineral royalties in areas that were once dry land but are now in open water. Landowners may continue to pay taxes on what becomes water bottoms and the State may claim ownership has changed so royalty payments should revert to the State.

The other issue involves the public right of access to streams, lakes, and bays along the coast. As marsh erodes and/or subsides, both commercial and recreational fishermen move into the former marsh areas to fish. Landowners sometimes barricade the newly forming streams because they wish to control access or they wish to exploit the resources themselves.

Access and water bottoms ownership issues are made more complex because of the human factor. For example, should the public have right of access to a lake created in a marsh through saltwater intrusion, which in turn was caused by construction of an oil well access canal?

Summary of Changes that Have Occurred Within the Study Area

Within the study area, the economy originally was subsistence driven. Through time, this subsistence economy was replaced by one that emphasized cash crop production and natural resource extraction. Agricultural products (sugarcane, cattle, rice, and other crops), sulfur, oil and natural gas and the associated infrastructure, fresh- and saltwater fisheries, along with the region's trapping resources developed in response to national and international market demands. The regional economy revolved around a market that is national and international in scope. Consequently, there evolved a large concentration of people confined to wetland-dominated habitats, small, nucleated settlements, sugar plantations, railroad towns and regional distribution centers. As the region's population expanded, rural settlement clusters began to discover their economic niche. Each community acquired its own distinctive employment identity. From agricultural nodal points at Abbeville, Erath, and New Iberia, to oil and gas support centers, ports, and seafood processing centers at Morgan City, Amelia, Houma, Dulac and Port Fourchon, the region's population has experienced the growing pains of economic expansion and the retreats associated with economic downturns.

To succeed and exist in this dynamic and sometimes inhospitable environment, the population developed and utilized innovative engineering techniques, unconventional wisdom, and unique cultural occupancy patterns, always with an eye towards maximizing the region's renewable resource base (Brasseaux 1985, 1987). As a result, local government has invested in barrier island research and restoration, water control structures, levee

fortification, locks and gates on key natural and engineered waterways, extensive pump systems in response to forced drainage projects, canals and ditches to improve flood control, and other pubic works-type endeavors.

Initially, the population expanded by constructing homes, hamlets, villages, towns and industrialized cities on protected and well-drained natural levee land or on the elevated "prairie". As a result, a settlement pattern was initiated that evolved from the region's distinctive morphology and resource base. These wetland inhabitants took advantage of all available high ground, regardless of how small or insignificant, much as their Native American predecessors. While most of the current population continues to reside on these relatively high and flood-free natural features, the high demand for coastal resources has encouraged both residential and camp development in marginal areas that are subject to flooding and storm surge. As hurricane protection levees and local drainage impoundment levees are extended southward and the Gulf shore expands northward, the flood threat is increasing for those who occupy these artificial fingers of dry land.

CHAPTER 5

SUMMARY AND CONCLUSIONS

This investigation was conducted to document changes that have occurred along the central Louisiana coast over the last 100 to 150 years. This historical/geographic approach was used to examine cultural activities common to the study area, to illustrate physical and cultural changes, and to provide insights into probable future trends. The study area is composed of three distinct regions: Terrebonne Basin, Lower Atchafalaya River, and Teche-Vermilion Basin. These three regions are distinguishable primarily according to physical attributes. However, the regions are also distinctive in their cultural adaptations, some of which are reflected by settlement patterns that have in turn modified the landscape in distinctive ways. Physical modifications are inevitable, regardless of human intervention. For at least 150 years, humankind has modified the physical landscape within the study area. As in the past, landscape-altering processes can be influenced, modified, or altered to some degree by engineering decisions, but the forces of erosion, subsidence, and accretion cannot be terminated entirely.

Changes that Have Occurred

South Louisiana's landscape has been remade extensively. Even so, during the eighteenth and early nineteenth centuries change was driven primarily by geological processes.

Natural Physical Changes

Physical change along the Louisiana coast reflects an interaction between two primary physical forces: inland depositional (riverine) and marine processes. Depositional processes embrace the natural formation of levees, deltas, marshes, swamps, and other freshwater flow and sediment deposition features. When the Mississippi River and its extensive network of distributaries were active within the study area, land within the deltaic plain developed both vertically and horizontally. Marine processes, primarily erosion and subsidence, were most influential along the southern portion of the delta. Consequently, as long as the Mississippi was active and sediment-laden fresh water flowed freely, aggradation suppressed erosion. In a sense, the system was in balance. Once flow was terminated by delta switching processes, near shore marine processes began to dominate. With time, coastal marsh and natural levee ridges subsided. They also eroded at differing rates. The greatest land loss, therefore, occurred in those regions that received the least amount of fresh water. These were the areas that were most exposed to marine processes (i.e., delta lobes extending far out into the Gulf). Old marsh and natural levee deposits were reworked by waves and currents, creating cheniers and barrier islands.

After abandonment of the distributary channel network, overbank flow from the Mississippi River continued to enter the study area, primarily from Bayou Lafourche and the Atchafalaya River. Sheet flow during periods of high water renourished vast marsh and swamp regions along the Atchafalaya River and Bayou Lafourche. Due to the nature of the topography, sheet/overbank flow was obstructed from some areas by the natural levee ridges of the abandoned system of distributary channels. By the end of the eighteenth century, erosion/subsidence was impacting the Terrebonne Basin and the Vermilion-Teche Basin. These problems were tied directly to the absence of overbank flow that was blocked to the west by the Bayou Teche ridge and in Terrebonne Basin by a maze of small bayou levees south of Houma. One important characteristic of this early period is that change occurred slowly; the evolution of fresh marsh to salt marsh was gradual, occurring over decades.

Human-Induced or -Influenced Changes
(Deliberate Manipulation of the Environment)

With expansion of human settlement within the lower Mississippi River valley, preexisting natural changes were either accelerated or slowed down through manipulation of the environment. Human intervention has been both direct and indirect. Direct impacts include a variety of activities, including canal excavation, levee, road and house construction, marsh drainage, removal of forest cover, etc. Direct impact is immediate and confined to the vicinity of the activity. Much more difficult to identify, measure and often quantify are the indirect impacts brought about by these activities. For example, construction of the Mississippi River's levees had a direct impact on flood prevention and soil replenishment along the backslopes of the River's natural levees. A more indirect impact was the immediate reduction of sheet flow and replenishment of fresh water in the marshes bordering Barataria Bay many miles south of the levee. As another example, the removal of sub-aqueous shell or sand reefs is an activity with both direct and indirect impacts. Dredging these reefs removes a water bottom feature that serves as a habitat for shellfish and finfish. Reef removal creates an indirect impact on the reef's bay side by accelerating saltwater intrusion and eliminating a natural barricade to waves and storm surge (**Figure 5-1**).

In land loss terms, human intervention accelerates loss in some regions and reduces it in others. The cumulative historical impact is that land loss geographically is greater than land gain. While it could be argued human intervention has exacerbated changes that were inevitable, available data indicates areas impacted and degree of change can be manipulated in either direction. No single landscape modification can be targeted as the most important for affecting land loss. The more influential human modifications include: flood-control and hurricane-protection construction, canal dredging and associated spoil ridge deposition, land reclamation, closure of former Mississippi River distributary channels, barrier island and reef change, removal and modification, erosion from boat wake, etc.

While it is difficult to measure all impacts brought on by humankind, land loss and vegetation changes are two environmental modifications that are both visible and widespread. In areas where saltwater intrusion has brought about a rapid change in vegetation, the marsh is dying because there is insufficient time to replace fresh marsh species with salt or brackish tolerant plants. Under natural conditions, marsh transformations

occur gradually. Vegetation loss (marsh and swamp) on occasion is linked to a single construction project, such as excavation of the Houma Navigation Canal. More commonly, the loss is an accumulation of smaller and more localized impacts.

While no single landscape modification is deemed the most important for changes that occurred in the past, within the study area, the cumulative engineering attempts to control the Atchafalaya River rank as most important. Both physical (land loss and gain) and cultural (settlement patterns) changes are a product of these decisions to control the Atchafalaya River. The Atchafalaya River modification is most important because the direct and indirect impacts have been felt throughout the entire study area. Within the study area's upper margins, a stable physical foundation (substantial natural levees and the prairie terrace), coupled with a well-developed transportation infrastructure (railroads, US Hwy 90, and the Gulf Intracoastal Waterway) insured the population could expand free of the dangers of hurricanes, erosion, land loss, and subsidence. On the other hand, formation of the Atchafalaya Floodway has had an immediate impact on the physical environment within the western two-thirds of the study area. The more obvious physical influences include fresh water flow into Atchafalaya, East Cote Blanche, West Cote Blanche, and Vermilion bays, reduction of land loss in marshes west of the Atchafalaya River, alteration of natural fishery's feeding and breeding grounds, creation of a delta and, sediment deposition within coastal bays to the west. Creation of the Atchafalaya Floodway may not have influenced land loss directly in the Terrebonne Basin. Even so, the current land loss problem could have been substantially different if the floodway and/or a westward diversion had been created through Bayou Lafourche or in the Lake Verret area. From an engineering perspective, Bayou Lafourche is certainly not practical as a major floodway for alleviating high-water pressure along the Mississippi River. Severance of Bayou Lafourche flow has, however, certainly increased land loss in the Terrebonne Basin.

The Atchafalaya Floodway is not a simple conduit that connects the Mississippi River and Red River to the Gulf. Passage into the Gulf is via several routes, and the manipulation of flow through control structures has influenced areas far removed from the river mouth. For example, flow rate within the main channel of the Atchafalaya River was affected by construction of Wax Lake Outlet in 1942, construction of the Wax Lake Outlet Weir in 1987, and removal of the weir in 1995. Each of these modifications also has influenced flow into the Bayou Teche, the GIWW, and coastal bays and marshes immediately to the west.

With regard to physical alterations, particularly in parts of the Terrebonne Basin, canals are the second most important in terms of overall impact. In regions that lack significant sources of fresh water, canals are particularly important, as they encourage, promote and facilitate saltwater intrusion and erosion. Most canals related to land loss are directly or indirectly associated with oil and gas exploration, production, and transportation activities.

General Cultural Patterns, their Influence, and Adapting to Change

Physical landscape alterations are not simply the product of specific construction activities that can be identified, measured and monitored. Some culturally-influenced

environmental impacts are subtle; the change is only apparent over a long period of time. Examples include:

1. reduction of selected fisheries resources through over-fishing, brought about in part by increased demand and a gradual population growth;
2. an increase in reliance on fisheries during the 1980s, caused by an economic downturn in the oil and gas industry;
3. intensive settlement along the natural levees flanking the region's navigable bayous, resulting from the need for water transportation, access to arable farm land, and more significantly in recent years, proximity to coastal fisheries resources and recreational areas; and
4. an increase in the number of camps, encouraged by a stable economy and a growing emphasis on recreational pursuits.

Within the study area, dominant land use has shifted from a rural agricultural base to one characterized by urban growth and natural resource extraction. This transformation occurred when the economic emphasis shifted from primarily upland (natural levee) land-use practices, to more diversified pursuits that included an expansion into wetlands (oil, gas and fisheries). Changes occurring in the lower portion of the study area are a major concern. In this zone, physical change is rapid and extensive. Because the threats are not always obvious, the conservative nature of the culture is slow to react to the problem.

In the eighteenth and early nineteenth centuries, resource extraction had a minimal impact on the physical landscape, particularly within the coastal wetlands. While hunting, fishing, and trapping, humans used the existing environment; they modified it very little. Fishermen simply harvested the abundant aquatic species within the natural water bodies. Prior to 1880, the most substantial landscape modification was row crop cultivation and the associated excavation of drainage canals and ditches. Cattle raising has been one of the few human exploitations that has utilized both high ground and wetlands environments with relatively little adverse impact. In the study area, cattle raising occurs most frequently 1) in areas where features are low in elevation (i.e., less than 5 ft (1.5 m) above MSL) and 2) in marshes adjacent to these features. Within the coastal area, relatively low natural levees and cheniers with their surrounding marshes provide the most common habitat for cattle raising. Coincidentally, many of these areas are also favorable for rice cultivation. With continued land loss in Terrebonne Basin, cattle raising has shifted northward and in some areas is now confined to lands within pump drainage systems. Wetlands cattle raising is most prevalent in the chenier region west of Vermilion Bay, on the fringes of the Prairie terrace region in western Iberia Parish and eastern Vermilion Parish, and along the natural levee fringes (backslope) of Bayou Teche and Bayou Lafourche.

Within the project area's swamp environments, industrial logging removed cypress and tupelo timber from large tracts during the late nineteenth century. To facilitate timber removal, lumber companies excavated an extensive network of canals. Although industrial logging had an immediate impact on many swamps, today saltwater intrusion may have a more devastating and long-term impact on swamp-forest resources.

As far as the overall settlement pattern is concerned, the first major shift occurred during the early twentieth century. Change from a subsistence/agriculture-based economy to one emphasizing resource extraction and manufacturing was facilitated by the numerous businesses associated with the extraction and production of hydrocarbon resources. Since the 1930s, the oil and gas industry, therefore, has served as the region's economic engine, with every community being influenced by this industry. The influence is widespread. Oil and gas exploration and extraction processes have had a direct impact on wetland environments. Well location and access channels, along with pipeline canals, are prevalent throughout the area. They represent the most visible direct impacts on the landscape. Less obvious direct and indirect impacts include transportation canals for service industries, rig/boat construction facilities, construction of service industry facilities, population movement to the vicinity of oil/gas extraction and service industry sites, increased urban growth, construction and expansion of port facilities, etc.

Commercial and recreational fishing is another cultural activity that has a continuous impact on the coastal lowlands. Although boats, docks, residences, and camps appear to dominate the visible landscape, commercial fishing accounts for only a small fraction of the regional economy. Of the various forms of livelihood within the study area, the fishing industry is most responsive to physical changes, except when that change has involved a gradual increase in the risk from natural threats. Fishermen follow their aquatic quarry. Where abrupt changes reduced species availability, the industry moved to sites where the resource was obtainable. For example, decreased salinity in Vermilion Bay resulted in a decline in the shrimp harvest within the bay and abandonment of oyster leases along Southwest Pass. Most commercial shrimpers based along the periphery of Vermilion Bay now trawl outside the bay in the Gulf. Oyster leases are confined to the south side of Marsh Island. Increased salinity in the Barataria-Terrebonne estuary complex forced oystermen to shift their leases further inland. As the zone of productive resources shifted inland, the zone of human habitation has been slow to follow and therefore faces an increased risk from flood or storm damage. For example, on Isle de Jean Charles, early twentieth century oystermen traveled by water several miles to reach their leases. Today, oyster leases have shifted inland, and now the Isle de Jean Charles residents can cultivate oysters literally in what were once their back yards (**Figures 5-2** and **5-3**). Residents cling to this threatened community, even though the low-lying access road cannot be used if the water rises as little as two feet (0.61 m).

As land loss accelerates, fishermen face the greatest danger to life and property. The problem is that people tend to live near their work places. Fishermen work either in the Gulf or in coastal estuaries. They are, therefore, more likely to live in areas at risk. Like the pattern of settlement along the Mississippi River in Plaquemines Parish, residents of the Terrebonne Basin settled along finger-like ridges that project into the marsh. The long-term problem associated with maintaining this settlement pattern is that soon these ridges will extend into open water instead of marsh. In some cases water is encroaching on sites that are protected by extensive levee systems. Installation of pump drainage only reinforces the settlement pattern. These systems encourage movement into naturally subsiding areas. Additionally, where pump drainage extends into adjacent marsh and swamp areas, flood

danger is increased because surface elevations are lowered in conjunction with compaction of the organic-rich soils as drawdown lowers the water table.

With continued land loss, all vegetation lines are retreating north into the estuarine complex; saltwater vegetation is beginning to dominate the landscape. As these retreating fronts approach urbanized and impounded areas, fisheries production will decline for two reasons. First, nursery and feeding areas cannot extend beyond the impoundment levee; there is a finite amount of wetlands available for production of fisheries resources. Second, pollution of fisheries resources will probably increase because of the loss of a marsh buffer zone between the urban runoff areas and preferred fishery habitats.

Wetland recreation is the coast's largest growth industry. While development is linked to the overall economy, it will likely decrease with the inevitable downturn in the oil industry. Wetland recreation will, however, continue as long as the resources are readily available. Moreover, expansion of recreational activities has increased camp construction, particularly in flood-prone areas. Along Four Point Bayou, for example, extensive camp development has extended down the channel beyond the area that is impounded (**Figure 5-4** and **5-5**).

A related trend is the movement of full-time residents into camp communities. While it is unclear whether the percentage of full-time residents, relative to seasonally occupied camps has changed, there is an increase in construction of both, particularly along coastal bayous. Cypremort Point, for example, was originally developed as a recreational camp community. Today, many live there year-round. Aggressive marketing and a desire to live near water transformed this site into a popular area for retirement homes. Settlement expansion along the region's bayous has been partially encouraged by continued urban growth. In fact, many families have moved to the bayous simply to escape urban sprawl in communities like Houma, Morgan City and New Iberia.

Trends for the Future

Continuing the Status Quo

If the present trend continues, several things will likely occur within the next 50 years:

1. The population will continue to grow; that growth will include an increase in permanent residents in areas where risk from flooding and storm damage will increase.
2. As water envelopes settled areas, camps will remain along subsiding natural levee ridges, severed from land access (**Figure 5-6**). Many permanent residents will retreat to the protection of impounded areas.
3. Some residents will attempt to maintain their homes outside impoundments, even if all surrounding marsh is lost.
4. Marshes flanking the natural levee ridges are disappearing at a rapid pace. Within less than 50 years, the occupied natural levees along the lower

reaches of many bayous (e.g., Four Point Bayou, Bayou Terrebonne, Bayou Grand Caillou, etc.) will be little more than camp-lined ridges extending out into open water. Eventually, even the ridges will subside beneath the water, and the old channel locations will be invisible except in areas where remaining storm-resistant camps mark the submerged banks (**Figure 5-7**).

5. As the shoreline approaches population concentrations, the region's infrastructure will be extended to its maximum limits. Further, the potential for fisheries pollution will rise.
6. As water encroaches and occupied land subsides, residents will demand enlargement of hurricane and forced drainage levees.
7. Forced drainage systems will be surrounded completely by water. This will increase their vulnerability to erosion, wave wash, and overtopping by storm surge
8. A gradual decline in the oil and gas industry's importance, a continuation of fisheries, and an increase in recreation pursuits will mark the economy.
9. Atchafalaya River flow will keep Cote Blanche and Vermilion Bays fresh, but at the same time, these bays will become shallower.
10. Marshes bordering the western bays will become progressively fresher.
11. Wildlife resources will increase, as the Atchafalaya delta progrades.
12. Atchafalaya River and Wax Lake Outlet sediments will continue to enlarge the current delta. However, this growth will slow as the delta expands into deeper water and beyond the protected waters of Atchafalaya Bay.
13. In areas of extensive land loss, marsh-dependent activities such as trapping, hunting, and cattle raising will be abandoned, or much less frequently, move into other areas. With declining acreage of wetlands, few unused areas are available. Access to available wetland areas will become much more competitive, expensive, and more likely to fall under strict lease control.

Physical Changes by Region

Terrebonne Basin – This is the area of greatest land loss. If the current trends continue, the population will face increasing risk of flood and/or storm surge. Loss of the marsh buffer will result in increased risk to fisheries from pollution as land loss approaches inhabited areas where populations are projected to expand. There will also be an increased danger of oil spills/contamination as wells and pipelines become exposed to open-water conditions.

Lower Atchafalaya – This area will expand as the delta extends into Atchafalaya Bay. Freshwater from the Atchafalaya River will dominate the coastal environment; new vegetation and wildlife communities will invade the developing delta. Eventually the delta will expand westward, filling in all of Atchafalaya Bay and much of East and West Cote Blanche bays. Atchafalaya River overflow and sediment deposition will continue to nourish

swamp and marsh areas flanking the main channel and distributaries, insuring maintenance of landmass throughout the inland portion of this area.

Teche-Vermilion Basin – Due to the limit of the Atchafalaya River's influence some marsh loss will occur along Vermilion Bay's western edge. The area east of Cypremort Point will remain stable. As marshes at the western end of Vermilion Bay degrade, oyster production may move inland from the Southwest Pass area. Salinity in this area will be influenced by maintenance of existing diversion of Atchafalaya River flow via the GIWW.

Long-term physical changes will be governed by a variety of factors. Of these, the influence of the Atchafalaya River is important, since the Atchafalaya has the greatest regional potential to alter land loss and/or gain. Fresh water and sediment can be viewed as a renewable resource. Given the current state of Atchafalaya River control, it is highly probable the present land loss/gain trends will continue. The only new alteration to flow, worthy of note, is the removal of the Wax Lake Outlet weir. It is projected that this action will increase flow through Wax Lake Outlet. Consequently, freshwater movement into the Teche-Vermilion region will also increase. Because of its east-west orientation, the Gulf Intracoastal Waterway can serve as a freshwater diversion channel. Any addition or removal of a lock or control structure anywhere within the waterway network will alter salinity patterns and, to a lesser extent, sediment deposition. Unless a freshwater diversion project is initiated in the Terrebonne Basin area, this region will continue to lose land at a rapid rate.

Other Alternatives for the Future

As the coast's geography changes, various governing bodies, interested agencies, and the general population must address a number of issues related to settlement, economics, and their collective well being. There are alternatives to the projected changes. The response to these changes should include those mandated by the local citizens with input from the various agencies. It should be a partnership born of necessity.

Manipulation of Atchafalaya River Flow

The Atchafalaya River is the single most important force for change; change can be directed through control of the river. One activity that should be given more attention is the manipulation of deposition/delta formation through artificial means. Another potential modification is the regulation of flow down the Atchafalaya River. Recent studies have demonstrated the value of fresh water diversion projects to rejuvenating marsh and coastal fisheries. Diversion to the west is already occurring to some extent through the Gulf Intracoastal Waterway. Existing and additional control structures could be utilized to this end. Potential diversions include:

1. Diversion to the east. Sediment and fresh water diversions could be directed from the Atchafalaya River to delay or stop land loss in Terrebonne Basin.

2. Diversion to the west. A limited diversion is already at work to some extent via the Gulf Intracoastal Waterway. Additional control structures could be used to increase/decrease flow from the Gulf Intracoastal Waterway into The Jaws, Charenton Drainage Canal, and Weeks Bay. In addition, selected marshes could be made fresher by constructing additional control structures along the south side of the Gulf Intracoastal Waterway.

3. Construction of an Atchafalaya Bay jetty. Some fishermen wish to increase salinity in West Cote Blanche and Vermilion Bays in order to encourage the growth and development of oysters, shrimp, and saltwater finfish. A long jetty is proposed that would extend south from Salt Point. This configuration will deflect Atchafalaya River water into the Gulf east of Marsh Island. If this jetty is constructed, salinities will increase encouraging oyster growth in Vermilion Bay. The trade off is that at the same time, the structure will accelerate loss of coastal marshes bordering the western bays. Vermilion Bay salinities could also be increased by placement of control flow structures at The Jaws and/or breach the Gulf Intracoastal Waterway along Weeks Bay. If a control flow control structure is erected, any increase in salinity should be gradual, otherwise land loss will occur much more rapidly than at present.

4. Creation of new diversions. These could be acomplished by expanding existing canals and control structures or by creating new ones. One potential route is along the Charenton Drainage Canal. Bayou Penchant is an example of a potential diversion route for the Terrebonne Basin.

5. Given present conditions, the Atchafalaya and Wax Lake Outlet deltas will coalesce and prograde beyond Point au Fer. At some point, a decision must be made concerning the manipulation of sediment deposition and flow through this emerging delta. For example, should a distributary(s) be allowed to flow westward towards East Cote Blanche Bay or should the entire flow be directed south beyond Marsh Island?

Other Mississippi River Diversions

In the near future, coastal land loss within the study area will likely be affected to some degree when the Davis Pond Freshwater Diversion Structure is completed (U.S. Army Corps of Engineers 1991). While this structure will have its most significant influence in the Barataria Basin, fresh water entering the Gulf at Caminada Pass also will affect coastal salinities west of Bayou Lafourche. The impact to land loss and fisheries in the Timbalier Bay area will probably be small. The study area would be affected to a much greater extent if an additional diversion(s) were channeled from the Mississippi River directly into Timbalier Bay or some other portion of the Terrebonne Basin.

Salt Water Control Structures

One impact of the construction of north-south oriented transportation canals has been to encourage saltwater intrusion in the vicinity of these channels. One method to control of reduce saltwater intrusion is by constructing gates or control structures along those channels contributing to the saltwater problem. The most obvious example is the Houma Navigation Canal. The gradual enlargement of this channel has resulted in the northern movement of salt water as far inland as Houma. This influx of salt has destroyed hundreds of acres of cypress swamp south of Houma and has endangered the drinking water for several communities in the Houma area.

Maintain Coastal Barrier Islands/Reefs

Protecting and maintaining the region's coastal reefs and barrier islands can minimize saltwater intrusion and storm surge impacts. Even if these features are not exposed above the water surface, their shoals reduce wave intensity on their bay side (**Figures 5-1** and **5-8**). In order to insure shell reef survival, shell dredging must be strictly controlled or eliminated.

Aggressive Approach to Human Occupation in Threatened Areas

To date laws and regulations that stress minimal impact have governed wetland development. With regard to continued economic interests on the region's narrow natural levees, this building trend simply follows traditional settlement patterns that are ingrained into the regional psyche. People are reacting to short-term constraints, such as insurance regulations and regulations governing the impact on wetlands, with little consideration to long-term change. By encouraging settlement within pump drainage districts that are surrounded by areas of extensive land loss, officials and regulating authorities are promoting potential disasters. At some point it may be necessary to "draw a line in the marsh" and aggressively regulate settlement within areas deemed at risk. Such a get-tough policy would certainly be unpopular with those who live in threatened areas (i.e., the fishing community and recreational wetland users). It may, however, be necessary to ensure minimal loss of life and property. Such a policy might include some of the following considerations:

1. Accept that change is inevitable; therefore, some areas may have to be written off because it may be too expensive and impractical to save them. Because the marsh buffer zone is eroding severely, a direct hit by a category three, four, or five hurricane will impact many exposed bayou communities in the Terrebonne Basin or along Cypremort Point.

2. Promote coastal restoration, especially fresh water diversions and those projects designed to promote survival of the marsh buffer zone. Such projects should be initiated in areas deemed most appropriate to save.

3. Examine ownership/public access issues for eroding marshlands, since restoration projects with regional impacts are difficult to establish due to conflicts over jurisdiction, ownership, access rights, etc. Who will lose?

Who will gain? Should anyone be compensated? Should a public agency purchase wetlands to eliminate favoritism in program implementation?

4. Through public forums, select inland areas that will be protected by a well-designed and maintained hurricane levee system.

5. Consider how one can maintain a forced drainage system on lower Bayou Pointe au Chien and other bayous when they will eventually subside.

6. Control and restrict residential and recreational development in areas of increased risk.

7. Monitor fishing, trapping, oil and gas exploration, and other resource extraction industries on a regional level. Proposed canal excavation in the growing Atchafalaya delta should be evaluated differently than proposed excavation in Terrebonne Basin. Control carefully any proposed canal construction within the coastal marshes.

8. Investigate the distribution, condition, effectiveness, elevation, etc. of the region's pump drainage systems.

9. Examine the cumulative impact of increased recreational use throughout the area.

10. Encourage development of a model to predict the changes that will occur along the coast based on known geological processes, human intervention, hurricane tracks, and the associated storm surge.

11. Investigate ways to minimize long-term impacts.

Conclusion

During this investigation, a considerable effort was made to identify major economic activities that have influenced the physical landscape. In examining future trends within the study area, it is important to identify those activities that are most likely to have long-term affects on the physical and cultural setting. Both past and existing policies have encouraged destruction of wetlands whenever short-term economic gain was involved. Mineral extraction involves removal of a non-renewable resource that will be gone in 100 years. Fisheries, on the other hand, will likely still be important long after all the oil and gas is gone. In addition to the fact that the former involves exploitation of a non-renewable resource and the latter a renewable resource, these two activities are distinguishable also in the degree to which they alter the physical environment. If oil and gas activities were to end today, the impacts of canals excavated for that industry would be felt for many years to come. The physical impact of the fisheries industry is minimal, except with regard to residential construction and support facilities. The amount of land loss attributable to the fisheries industry is trivial compared to the loss inflicted by oil and gas interests. In the study

area where rapid physical change is occurring, the long-term rather than the short-term landscape altering processes are the ones that should be examined more closely.

REFERENCES CITED

Abbeville Public Library
1972 Vertical File: Cheniere au Tigre, Clipping, Paul Fortney, Jr. "Chenier au Tigre.The Resort that was and Could Be" in *Abbeville Meridional* Thursday Oct 12, 1972.

Adkins, G.
1972 *A Study of the Blue Crab Fishery in Louisiana.* Technical Bulletin No. 3. Louisiana Wild Life and Fisheries Commission, New Orleans.

_____
1973 Shrimp with a Chinese flavor. *Louisiana Conservationist* 25(7-8):20-25.

The Advocate [Baton Rouge, Louisiana]
1997 Crabbers Trapped in Overfishing Cycle, Study Reveals. *The Advocate* 14 April:3B.

Altschul, J. H.
1978 *Cultural Resources Impact Assessment: Houma-Terrebonne Regional Sewage Plan.* Prepared for U.S. Environmental Protection Agency, Region VI, Dallas, Texas. New World Research, New Orleans.

American's Oil States: Where Laissez-Faire Is Over a Barrel
1987 *Economist.* 303(9 May):31-34.

Anderson, B.
1996 Scientists Say Dead Zone Spans 7,000 Square Miles. *The Advocate* 31 July:2B. Baton Rouge, LA.

_____
1997a Levees Said Not Up to '27 Flood. *The Advocate* 1 April:1B, 2B. Baton Rouge, LA.

_____
1997b State Project Will Try to Convince People That Nutria Are Tasty. *The Advocate* 6 July:1B, 2B. Baton Rouge, LA.

Annual Report of the Chief of Engineers
1908 In *Annual Reports, War Department*, Appendix S, Report of Colonel Ruffner. U.S. Government Printing Office, Washington, D. C.

Arthur, S. C.
1927 Report of the Division of Wild Life. In *Seventh Biennial Report of the Department of Conservation of the State of Louisiana, 1924-1926.* Department of Conservation, New Orleans.

1931 *The Fur Animals of Louisiana.* Bulletin Number 28. Louisiana Department of Conservation, New Orleans.

Bailey, A. M.
1934 Chenier Au Tigre. *Louisiana Conservation Review* 4(2):9-11.

Baker, M.
1946 Cheniere Caminada Comes Back. *Jefferson Parish Yearly Review* pp. 110-123.

Barataria Bay, La., and Connecting Waters
1917 65th Congress, 1st Session, House Document No. 200, (House Document, v. 33, 1917, Serial set 7298). U.S. Government Printing Office, Washington, D.C.

Barde, Alexandre
1981 *The Vigilante Committees of the Attakapas: An Eyewitness Account of Banditry and Backlash in Southwestern Louisiana.* The Acadiana Press, Lafayette, Louisiana.

Barnes, K. B., and L. S. McCaslin
1948 Kerr-McGee, Phillips and Stanolind Develop Spectacular Gulf of Mexico Discovery. *The Oil and Gas Journal* 46(4):96-9, 113-114.

Baron-Mounce, E., W. Keithly, and K. J. Roberts
1991 *Shrimp Facts.* Louisiana State University, Louisiana Sea Grant College Program, Baton Rouge.

Barras, J. A., P. E. Bourgeois, and L. R. Handley
1994 *Land Loss in Coastal Louisiana 1956-1990.* U.S. Department of the Interior, National Biological Survey.

Barrett, B. B.
1970 *Water Measurements of Coastal Louisiana.* Louisiana Wild Life and Fisheries Commission, New Orleans.

Barrett, B. B., and M. C. Gillespie
1973 *Primary Factors Which Influence Commercial Shrimp Production in Coastal Louisiana.* Technical Bulletin No. 9. Louisiana Wild Life and Fisheries Commission, Baton Rouge.

1975 *Primary Factors Which Influence Commercial Shrimp Production in Coastal Louisiana.* Technical Bulletin No. 9. Louisiana Wild Life and Fisheries Commission, Baton Rouge.

Barton, D. C.
1930 Petroleum Potentialities of Gulf Coast Petroleum Province of Texas and Louisiana. *Bulletin of the American Association of Petroleum Geologists* 14(11):1379-1400.

Baumann, R. H., and R. D. DeLaune
1982 Sedimentation and Apparent Sea-level Rise as Factors Affecting Land Loss in Coastal Louisiana. In *Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences and Options*, edited by D. F. Boesch, pp. 2-13. FWS/OBS-82/59. National Coastal Ecosystems Team, U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Becnel, T. A.
1989 The Barrow Family and the Barataria and Lafourche Canal: The Transportation Revolution in Louisiana, 1829-1925. Louisiana State University Press, Baton Rouge.

Begnaud, A.
1980 The Louisiana Sugar Cane Industry: An Overview. In *Green Fields: Two Hundred Years of Louisiana Sugar*, pp. 29-50. The Center for Louisiana Studies, University of Southwestern Louisiana, Lafayette.

Bergerie, Maurine
1956 *Economic and Social History of Iberia Parish 1868-1900.* Unpublished Master's thesis, Louisiana State University, Baton Rouge.

———
1962 *They Tasted Bayou Water: A Brief History of Iberia Parish.* Pelican Publishing, New Orleans.

Bertrand, A. L., and C. L. Beale
1965 *The French and Non-French in Rural Louisiana: A Study of the Relevance of Ethnic Factors to Rural Development.* Bulletin 606. Louisiana State University, Agricultural Experiment Station, Baton Rouge.

Blackburn, Florence, and Fay G. Brown
1972 *Franklin Through the Years.* n.p.

Blaine, C.
1996 Taking Root: Louisiana, New Orleans Bounces Back with a Homegrown Recovery. *The Times Picayune* 24 July:1D, 5D.

Boesch, D. F., D. Levin, D. Nummedal, and K. Bowles
1983 *Subsidence in Coastal Louisiana, Causes, Rates and Effects on Wetlands.* FWS/OBS-83/26. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C.

Boesch, D. F., M. N. Josselyn, A. J. Mehta, J. T. Morris, W. K. Nuttle, C. A. Simenstad, and D. J. P. Swift
1994 Scientific Assessment of Coastal Wetland Loss, Restoration and Management in Louisiana. *Journal of Coastal Research*, Special Issue No. 20.

Bonnot, P.
1932 *The California Shrimp Industry.* Fisheries Bulletin Number 38. Division of Fish and Game of California, Bureau of Commercial Fisheries, Sacramento, California.

Bornholdt, M. A., and E. M. Lear
1995 *Outer Continental Shelf Natural Gas and Oil Resource Management Program: Cumulative Effects 1987-1991.* OCS Report MMS 95-0007. U.S. Department of the Interior, Minerals Management Service, Environmental Policy and Programs Division, Branch of Environmental Operations and Analysis, Herndon, Virginia.

Bourg, J. A.
1968 *A Socio-Economic Profile of Lafourche Parish.* Unpublished Master's thesis, Louisiana State University, Baton Rouge.

Bowie, H. M.
1935 *Bayou Lafourche.* Unpublished Master's thesis, Louisiana State University, Baton Rouge.

Bradshaw, J.
1997a Chenier au Tigre Has Romantic History. *The Daily Advertiser's History of Acadiana* 1(June 24):6.

1997b Was Pecan Island the Man-Eaters' Feasting Place? *The Daily Advertiser's History of Acadiana* 1(June 24):7.

1997c Cajun Cowboys Were At Home on Prairies. *The Daily Advertiser's History of Acadiana* 1(June 24):15.

1997d Delcambre Capitalizes on Link with Gulf. *The Daily Advertiser's History of Acadiana* 1(June 24):14.

1997e Rice Farming a Key to Vermilion Parish. *The Daily Advertiser's History of Acadiana* 1(June 24):8.

1997f Early Settlers Came During Days of Spanish Rule. *The Daily Advertiser's History of Acadiana* 1(June 24):3-4.

Branan. W.
1937 Lady Luck Yields to Science in the New Bonanza Land. *Louisiana Conservation Review* xx(x):6-10.

_____
1938 Muskrat vs. Mink. *Louisiana Conservation Review* (Winter):60-65.

Brasseaux, C. A.
1985 Acadian Life in the Lafourche Country, 1766-1803. In *The Lafourche Country; The People and the Land*, edited by Philip D. Uzee, pp. 33-42. Center for Louisiana Studies, Southwestern Louisiana University, Lafayette.

_____
1987 *The Beginnings of Acadian Life in Louisiana, 1796-1803*. Louisiana State University Press, Baton Rouge.

Britsch, L. D., and J. B. Dunbar
1996 *Land Loss in Coastal Louisiana*. Department of the Army, Waterways Experiment Station, Vicksburg, Mississippi. Set of 7 1:125,000 digital maps.

Britsch, L. K., and E. B. Kemp, III
1990 *Land Loss Rates: Mississippi River Deltaic Plain*. Technical Report GL-90-2. U.S. Army Engineer District, New Orleans.

Broussard, B.
1977 *A History of St. Mary Parish*. Franklin, Louisiana.

Broussard, Beverly Bernard, and Raymond I. Broussard
1955 *A History of St. Mary Parish*. Franklin, Louisiana.

Broutman, M. A., and D. L. Leonard
1988 *National Estuarine Inventory: The Quality of Shellfish Growing Waters in the Gulf of Mexico*. National Oceanic and Atmospheric Administration, Strategic Assessment Branch, Rockville, Maryland.

Brumby, M. P.
1975 Years Ago in Franklin, St. Mary Parish, Louisiana and Some Folk Lore of the Area. n.p.

Burk & Associates
1976 *Louisiana Coastal Vegetation*. 1:150,000 topographic map.

Burkenroad, M. D.
1931 Notes on the Louisiana Conch, *Thais haemostoma Linn*, in Its Relation to the Oyster *Ostrea virginica*. *Ecology* 12(4):656-664.

Burts, H. M., and C. W. Carpenter
1975 *A Guide to Hunting in Louisiana, the Hunter's Paradise*. Louisiana Wild Life and Fisheries Commission, New Orleans.

Byrne, R. J., and G. L. Anderson
1977 *Shoreline Erosion in Tidewater Virginia.* Special Report in Applied Marine Science and Ocean Engineering, Number 111. Virginia Institute of Marine Science, Gloucester Point, Virginia.

Cahoon, D. R. (editor)
1989 *Onshore Oil and Gas Activities Along the Northern Gulf of Mexico Coast: A Wetland Manager's Handbook.* Prepared for Lee Wilson and Associates, Inc. Contract No. 68-04-6104, Work Assignment No. 1-01. U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Cahoon, D. R., and J. H. Cowan, Jr.
Ca. 1986 *Spray Disposal of Dredged Material in Coastal Louisiana: Habitat Impacts and Regulatory Policy Implications.* Louisiana Sea Grant College Program, Baton Rouge.

Cameron Pilot
1977 Trapping Ends in the Parish. DeQuincy, Louisiana (3 March):5-B.

Campbell, T. W.
1914 Oysters. In *Biennial Report of the Department of Conservation from Sept 1st 1912 to April 1st 1914.* Louisiana Department of Conservation, New Orleans.

Canfield, H. S.
1903 Duck Shooting On Southern Bayous. *Outing* 43(1):415-419.

Castille, George J., III
1993 *A Geoforensic Analysis of State-Owned Waterbottoms in South Louisiana.* Ph.D. dissertation, Department of Geography and Anthropology, Louisiana State University, Baton Rouge.

Cavit, R. H.
1979 Dependence of Menhaden Catch on Wetland Habitats: A Statistical Analysis. Prepared for U.S. Fish and Wildlife Service, Ecological Services Field Office, Lafayette, Louisiana.

Census of Population and Housing
1990 Summery Tape Files 1B and 3a Extracts on CD-ROM, Louisiana [machine-readable data files] / Prepared by the Bureau of the Census. – Washington: The Bureau [producer and distributor], 1991.

Centaur Associates, Inc.
1986 *Indicators of the Direct Economic Impact Due to Oil and Gas Development in the Gulf of Mexico.* OCS Study/MMS 86-0015. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans.

Chabreck, R. A.
1988 *Coastal Marshes: Ecology and Wildlife Management.* University of Minnesota Press, Minneapolis.

Chabreck, R. H.
1970 *Marsh Zones and Vegetative Types in the Louisiana Coastal Marshes.* Ph.D. dissertation, Louisiana State University, Baton Rouge.

_____
1982 The Effect of Coastal Alteration on Marsh Plants. In *Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options*, edited by D. F. Boesch and C. L. Cordes, pp. 92-98. U.S. Fish and Wildlife Service FWS/OBS-82/59.

_____
1998 Louisiana State University, Baton Rouge, LA, telephone interview on January 5, 1997.

Chabreck, R. H. and G. Linscombe
1978 *Vegetative Type Map of the Louisiana Coastal Marshes.* Louisiana Department of Wildlife and Fisheries, New Orleans.

_____
1982 Changes in Vegetative Types in Louisiana Coastal Marshes Over a 10-year Period. *Proc. LA Acad. Sci.* 45:98-102.

Chabreck, R. H., T. Joanen, and A. W. Palmisano
1968 *Vegetative Type Map of the Louisiana Coastal Marshes.* Louisiana Wildlife and Fisheries Commission, Baton Rouge.

Chapman, C. R.
1959 Oyster Drill (*Thais haemastoma*) Predation in Mississippi Sound, 1958. *Proceedings of the 49th Conference, National Shellfish Association.*

Chatterton, H. J.
1944 The Muskrat Fur Industry of Louisiana. *The Journal of Geography* 43(2):185-195.

Christmas, J. Y., and D. J. Etzold (editors)
1976 *The Shrimp Fishery of the Gulf of Mexico, United States: A Regional Management Plan.* Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Cipra, David L.
1997 Lighthouses, Lightships, and the Gulf of Mexico. Cypress Communications, Alexandria, Virginia.

Clay, C. L.
1938 The Louisiana Seafood Industry. *Louisiana Conservation Review* (Autumn):45-47.

Coast 2050 Planning Document
1997 Coastal Restoration Division, Louisiana Department of Natural Resources, Baton Rouge.

Cole, C.
1892a Along the Lafourche. *The Daily Picayune* 3 July:12.

_____
1892b An Island Outing. *The Daily Picayune.* New Orleans. 25 September:12.

Coleman, J. M., and S. M. Gagliano
1964 Cyclic Sedimentation in the Mississippi River Deltaic Plain. *Transactions, Gulf Coast Association of Geological Societies* 14:67-80.

Collins, J. W., and H. M. Smith
1893 A Statistical Report on the Fisheries of the Gulf States. In *Bulletin of the United States Fish Commission*, v. 11 for 1891 (52nd Congress, 2d Session, House Miscellaneous Document, Number 112), pp. 93-184. U.S. Government Printing Office, Washington, D.C.

Comeaux, Malcolm L.
1972 *Atchafalaya Swamp Life, Settlement and Folk Occupations.* School of Geoscience, Louisiana State University, Baton Rouge.

Committee on Coastal Erosion Zone Management, Water Science and Technology Board, Marine Board, Commission on Engineering and Technical Systems and National Research Council
1990 *Managing Coastal Erosion.* National Academy Press, Washington, D.C.

Connett, Eugene V. (editor)
1949 *Wildfowling in the Mississippi Flyway.* D. Van Nostrand, New York.

Conrad, G. R., and C. A. Brasseaux
1994 *Crevasse! The 1927 Flood in Acadiana.* The Center for Louisiana Studies, University of Southwestern Louisiana, Lafayette.

Conrad, G. R., and R. F. Lucas
1995 *White Gold: A Brief History of the Louisiana Sugar Industry, 1795-1995.* Louisiana Life Series, No. 8. The Center for Louisiana Studies, University of Southwestern Louisiana, Lafayette.

Conservation Commission of Louisiana
1912- Report of Conservation Commission of Louisiana, Sept. 1st, 1912 to April 1st, 1914.
1914 New Orleans, La.

Cooper, Pete, Jr.
1997 Fishing Lines. *The Watchman* 25 November. Plaquemines Parish.

Cowan, J. H., Jr., R. E. Turner, and D. R. Cahoon
1989 Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA? *Environmental Management* 12(1):37-53.

Cowdrey, A. E.
1977 *Land's End: A History of the New Orleans District, U.S. Army Corps Of Engineers, and Its Lifelong Battle With the Lower Mississippi and Other Rivers Wending Their Way to the Sea.* US Army Corps of Engineers, New Orleans, Louisiana.

Craig, N. J., and J. W. Day, Jr.
1977 *Cumulative Impact Studies in the Louisiana Coastal Zone: Eutrophication, Land Loss*. Final report to Louisiana State Planning Office. Louisiana State University, Center for Wetland Resources, Baton Rouge.

Craig, N. J., L. M. Smith, N. M. Gilmore, G. D. Lester, A. M. Williams
1987 *The Natural Communities of Coastal Louisiana Classification and Description.* Louisiana Department of Natural Resources, Coastal management Division.

Craig, N. J., R. E. Turner, and J. W. Day, Jr.
1979 Land Loss in Coastal Louisiana (U. S. A.). *Environmental Management* 3 (2):133-144.

Crosby, O. T.
1890 Report of Lieutenant O. T. Crosby, Corps of Engineers. In *Bayou Terre Bonne, Louisiana, Letter from the Acting Secretary of War*, House Executive Document, No. 110, 51st Congress, 2d Session, pp. 3-4. U.S. Government Printing Office, Washington, D.C.

Dabney, T. E.
1934 South Louisiana Produces 60 Per Cent More Oil Than Northern Section of State: New Orleans Becomes Capital of Great Petroleum Area With Millions Invested in Industry. *Louisiana Department of Conservation* 4(3):26-32; 43.

_____
1944 Taming the Mississippi. *Jefferson Parish Yearly Review.* pp. 44-52.

The Daily Picayune [New Orleans, Louisiana]
1838 Thursday Oct 18, 1838

_____
1852 Letter from Last Island. 28 July:1, col. 7.

_____
1856 Last Island Inundated: Shocking Loss of Life. 14 August:2, col. 2.

_____
1856 The Last Island Calamity 19 August:1, col. 6.

_____
1856 The Last Island Calamity: Further Particulars. 16 August:1, col. 5.

Dabney, T. E.
1874 Crevasse on Lafourche. 8 April:1.

_____
1905 Louisiana Has Greatest Bird Hatcheries in the World. 31 December:15.

The Daily Review [Morgan City, Louisiana]
1991 Cypress, Wood Eternal Lumber Industry Was Once King Here. 5 March: no pagination.

_____
1991 Cypress, Wood Eternal Greed Doomed Fate of Lumber Trade. 1991. 6 March: no pagination.

The Daily States [New Orleans, Louisiana]
1884 Territory Submerged by the Davis Crevasse. 22 May:4.

Daspit, A. P.
1948 Louisiana's Fur Industry. *Louisiana Conservationist* 1(2):17-19.

_____
1950 "Migrating" Nutria. *Louisiana Conservationist* 2(5):7-8.

Dauenhauer, J. B. Jr.
1938 Shrimp - An Important Industry of Jefferson Parish. *Jefferson Parish Yearly Review.* pp. 109-131.

Davis, Donald W.
1973 *Louisiana Canals and Their Influence on Wetland Development.* Ph.D. dissertation. Louisiana State University, Baton Rouge.

_____
1975 Logging Canals: A Distinct Pattern of the Swamp Landscape in South Louisiana. *Forest and People* 25(1):14-17; 33-35.

_____
1976 Trainasse. *Annals of the Association of American Geographers* 66(3):349-359.

_____
1978 Wetlands Trapping in Louisiana. In *Man and Environment in the Lower Mississippi Valley*, Geoscience and Man Series, Volume XIX, edited by S. B. Hilliard, pp. 81-92. Louisiana State University, School of Geoscience, Baton Rouge.

_____
1981 Cattle Grazing in Louisiana's Coastal Zone. In *Proceedings of the Specialty Group on Marine Geography, 1979-1980*, pp. 42-50. Nicholls State University, Thibodaux, Louisiana.

_____
1982 Economic and Cultural Consequences of Land Loss in Louisiana. In *Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options*, edited by D. F. Boesch and C. L. Cordes, pp. 140-154. U.S. Fish and Wildlife Service FWS/OBS-82/59.

Davis, Donald W.
1985 Canals of the Lafourche Country. In *The Lafourche Country: The People and the Land*, edited by P. D. Uzee, pp. 150-164. Center for Louisiana Studies, University of Southwestern Louisiana, Lafayette.

1986 Venice and New Orleans: Two Sinking Cities. *Thalassas* 4(1):49-56.

1991 Oil in the Northern Gulf of Mexico. In *The Development of Integrated Sea-Use Management*, edited by H. D. Smith and A. Vallega, pp. 139-152. Routledge, New York.

1992 A Pictorial and Historical Review of Louisiana's Barrier Islands. In *Louisiana Barrier Island Erosion Study: Atlas of Shoreline Changes in Louisiana from 1853 to 1989*, edited by Williams, Penland and Sallenger, pp. 8-23. U.S. Geological Survey Miscellaneous Investigation Series 1-2150-A.

1993 Land Reclamation in Coastal Louisiana: From 1718 to the Present. In *Wetlands: Proceedings of the 13th Annual Conference, Society of Wetland Scientist, New Orleans, Louisiana, June 1992*, edited by M. C. Landin, pp. 674-679. SWS South Central Chapter, Utica, Mississippi.

Davis, D. W., and R. A. Detro
1975 Louisiana's Marsh as a Recreational Resource. In *Coastal Resources*, Geoscience and Man Series, Volume XII, edited by H. J. Walker, pp. 91-98. School of Geoscience, Louisiana State University, Baton Rouge.

1975 Presence Growth Trends and Environmental Effects of Louisiana's Wetland Settlements. Unpublished manuscript.

1977 Land-Use Research, One Approach to Coastal Settlement. In *Research Techniques in Coastal Environments*, edited by H. J. Walker, pp. 311-32. School of Geoscience, Louisiana State University, Baton Rouge.

1980 New Orleans Drainage and Reclamation: A 200 Year Problem. *Zeitschrift fur Geomorphology*, Suppl.-Bd. 34: 87-96.

Davis, D. W., and R. A. Detro
1992 *Fire and Brimstone: The History of Melting Louisiana's Sulphur*. Resource Information Series No. 8. Louisiana Geological Survey, Baton Rouge.

Davis, D. W., and J. L. Place
1983 *The Oil and Gas Industry of Coastal Louisiana and Its Effect On Land Use and Socioeconomic Patterns*. Open File Report 83-118, FWS/OBS-82/59. U.S. Department of the Interior, Geological Survey, National Mapping Division, Office of Geographic and Cartographic Research, Reston, Virginia.

Davis, F.
1973 The Outlaw Is Back in Style. *Louisiana Conservationist* 25(1,2):26-30.

de La Harpe, J. B. B.
1971 *The Historical Journal of the Establishment of the French in Louisiana.* Translated by J. Cain and V. Koening, edited and annotated by G. R. Conrad. The Center for Louisiana Studies, University of Southwestern Louisiana, Lafayette.

Dennett, D.
1876 *Louisiana As It Is.* Eureka Press, New Orleans.

Dent, E. J.
1922 Survey of Little Caillou Bayou, Louisiana. In Little Caillou Bayou, Louisiana, Letter from the Secretary of War, House Document, No. 200, 67th Congress, 3rd Session, pp. 4-8. U.S. Government Printing Office, Washington, D.C.

Detro, R. A., and D. W. Davis
1974 Louisiana Marsh Settlement Succession: A Preliminary Report. Paper read before the Association of American Geographers, Seattle. Unpublished manuscript.

_____
1978 Bayou Lafourche. In *A Field Guidebook for Louisiana*, edited by R. H. Kesel and R. A. Sauder, pp. 71-80. Prepared for the 1978 National Meeting of the Association of American Geographers, New Orleans, Louisiana. Moran Industries, Baton Rouge.

Deussen, A.
1923 Development of Gulf Coast Field. *The Oil and Gas Journal* 22(12):100-103.

Deutschman, P.
1949 They Danced Till They Died. *Coronet* 25(Ja):143-145.

deVilliers, M.
1920 A History of the Foundation of New Orleans, 1717-1722. *Louisiana Historical Quarterly* 3(2):157-251.

Din, G. C.
1988 *The Canary Islanders of Louisiana.* Louisiana State University Press, Baton Rouge.

Ditton, R. B., and J. Auyong
1984 *Fishing Offshore Platforms, Central Gulf of Mexico: An Analysis of Recreational and Commercial Fishing Use at 164 Major Offshore Petroleum Structures.* OCS Monograph MMS 84–0006. Minerals Management Service, Gulf of Mexico Regional Office, Washington, D.C.

Doyle, W. Harry, Jr.
1972 *Sediment Transport in a Mississippi River Distributary – Bayou Lafourche, Louisiana.* Geological Survey Water Supply Paper 2008. Prepared in cooperation

with the Louisiana Department of Public Works. United States Government Printing Office, Washington, D.C.

Dozier, H. L., and F. G. Ashbrook
1950 A Practical Drying Frame for Nutria Pelts. *Louisiana Conservationist* 3(2):16-18.

Duffy, M., and C. Hoffpauer
1966 History of Waterfowl Management. *Louisiana Conservationist* 18(7,8):6-11.

Dugas, R. J.
1977 *Oyster Distribution and Density on the Productive Portion of State Seed Grounds in Southeastern Louisiana*. Louisiana Wild Life and Fisheries Commission, Technical Bulletin Number 23.

Dunbar, J. B., L. D. Britsch, and E. B. Kemp III
1992 *Land Loss Rates: Report 3-Louisiana Coastal Plain.* Technical Report GL-90-2. U.S. Army Engineer District, New Orleans.

Dunne, Mike
1997 Gaining Ground. *The Advocate* 4 November 4:A1. Baton Rouge, Louisiana.

_____
1998a Effects of Diversion Studied. *The Advocate* 9 March 9:B1. Baton Rouge, Louisiana.

_____
1998b Atchafalaya to Build More Wetlands. *The Advocate* 25 May:B1. Baton Rouge, Louisiana.

Dupuy, Kenneth A.
1995 Abbeville, Louisiana: A Pictorial History Book, Then and Now. *The Abbeville Meridional*, Abbeville, Louisiana.

Durand, F. V.
1933 Tarpon and Tarpon Rodeos in Louisiana. *Louisiana Conservation Review* 3(3):11-13; 34.

Edwards, Wakeman W.
1905 *Historical Sketches of Vermilion Parish, La.* n.p.

Ellet, C., Jr.
1852 *Report on the Overflows of the Delta of the Mississippi.* Senate Executive Document No. 26, 22nd Congress, 1st Session, pp. 1-106. U.S. Government Printing Office, Washington, D.C.

Elliott, C. G.
1908 Swamp Lands of the United States. In *Swamp Lands of the United States, Letter from the Secretary of Agriculture*, Senate Document, No. 443, 60th Congress, 1st Session, pp. 2-18. U.S. Government Printing Office, Washington, D.C.

Elliott, D. O.
1932 *The Improvement of the Lower Mississippi River for Flood Control and Navigation.* U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. 3 vols.

Ellis, T. H.
n.d. Account of the Storm on Last Island. Typed copy, Butler (Louise) writings, box 5, folder 2, no. 1069, S-19-21. Hill Memorial Library, South Reading Room, Louisiana State University, Baton Rouge.

Ellis.
1876 *Mississippi River Levees.* House Report No. 494, 44th Congress, 1st Session, pp. 1-11. U.S. Government Printing Office, Washington, D.C.

Engle, J. B.
1948 *Investigations of the Oyster Reefs of Mississippi, Louisiana, and Alabama Following the Hurricane of September 19, 1947.* U.S. Department of the Interior, Fish and Wildlife Service, Special Science Report 59. No pagination.

Espina, M. E.
1988 *Filipinos in Louisiana.* A. F. LaBorde and Sons, New Orleans.

Evans, J.
1970 *About Nutria and Their Control.* Resource Publication No. 86. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Washington, D.C.

Ewens, J.
1885 Yazoo, Tensas, and Atchafalaya Basins, Flood of 1884. In *Annual Report of the Mississippi River Commission for 1884,* Gillmore, Q. A., C. B. Comstock, C. R. Suter, H. Mitchell, B. M. Harrod, S. W. Ferguson, and R. S. Taylor, pp. 102-109. U.S. Government Printing Office, Washington, D.C.

Ferstel, V.
1997 Diversion Generating Division. Sunday Advocate 6 April:10A, 11A.

Fiedler, R. H.
1932 Fisheries of Louisiana. *Louisiana Conservation Review* 2(4):3-8:26.

Fisher, A.
1965 History and Current Status of the Houma Indians. *Midcontinent America Studies Journal* 6(2):149-163.

Fisher, J. L.
1931 Crabs Solve Morgan City's Unemployment. *Louisiana Conservation Review* 2(2):18-19.

Fisk, Harold N.
1952 *Geological Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion.* Prepared for the President of the Mississippi River Commission by the Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Mississippi, 2 Vols.

Fisk, W. L.
1890 *Bayou Black, Louisiana.* 51st Congress, 2nd Session, House Executive Document No. 125. U.S. Government Printing Office, Washington, D.C.

Flournoy , K.
1988 Houma-Thibodaux Area Hit Hardest By Slump. *Sunday Advocate* 5 June:1D; 6D.

Fontova, H.
1997 Ducking the Delta. *Louisiana Conservationist* 49(6):12-14.

Forshey, C. G.
1873 Mississippi Levees. House Miscellaneous Document No. 41, 42nd Congress, 3rd Session, pp. 1-25. U.S. Government Printing Office, Washington, D.C.

Fortier, A.
1909 *Louisiana: Comprising Sketches of Counties, Towns, Events, Institutions, and Persons, Arranged in Encyclopedic Form.* 3 vols. Southern Historical Association, Atlanta.

_____
1914 *Louisiana: Comprising Sketches of Parishes, Towns, Events, Institutions, and Persons, Arranged in Cyclopedic Form.* Century Historical Association, New York.

Fountain, W.
1985 Mississippi Oyster Pirates. *Biloxi Press* 9 October (Book 126, M. J. Stevens Collection). Biloxi Public Library, Biloxi, Mississippi.

François, D. K.
1993 *Federal Offshore Statistics: 1992.* U.S. Department of the Interior, Minerals Management Service. OCS Report MMS 93-0066. U.S. Government Printing Office, Washington, D.C.

Frank, A. D.
1930 *The Development of the Federal Program of Flood Control on the Mississippi River.* Columbia University Studies in the Social Sciences No. 323. Ams Press, New York.

Franklin Public Library
n.d. Vertical File. Cote Blanche Island, Franklin History.

Frost, M. O.
1939 Jefferson Parish - Always Original Revolutionizes United States Seafood Industry When Two Women Dip "Seria" Bush in Bayou. *Jefferson Parish Yearly Review*. pp. 52-73.

Fruge, D.
1982 Effects of Wetland Deterioration on the Fish and Wildlife Resources of Coastal Louisiana. In *Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options*, edited by D. F. Boesch and C. L. Cordes, pp. 99-105. U.S. Fish and Wildlife Service FWS/OBS-82/59.

Furlow, W.
1997 US Gulf Boom Leaves Fabrication Yards Scrambling to Meet Rig Demand. *Offshore* 57(5):154-155.

Gagliano, Sherwood M.
1970 *Geologic and Geomorphic Aspects of Deltaic Processes, Mississippi Delta System.* Center for Wetland Resources, Louisiana State University, Baton Rouge.

_____
1973 *Canals, Dredging and Land Reclamation in the Louisiana Coastal Zone.* Report Number 14. Coastal Resources Unit, Center for Wetland Resources, Louisiana State University, Baton Rouge.

Gagliano, S. M., H. J. Kwon, and J. L. van Beek
1970 Deterioration and Restoration of Coastal Wetlands. *Proc. 12^{t} Coastal Engr. Conf.* 3:1767-1781.

Gagliano, S. M., K. J. Meyer-Arendt, and K. M. Wicker
1981 Land Loss in the Mississippi River Deltaic Plain. *Transactions, Gulf Coast Association Geological Societies* 31:295-300.

Gagliano, Sherwood M., and David W. Roberts
1990 *Restoration and Conservation of the Terrebonne Parish, Louisiana Coastal Area.* Prepared for South Terrebonne Tidewater Management and Conservation District. Coastal Environments, Inc., Baton Rouge, Louisiana.

Gagliano, S. M., and J. L. Van Beek
1970 *Geologic and Geomorphic Aspects of Deltaic Processes, Mississippi Delta System.* Hydrologic and Geologic Studies of Coastal Louisiana, Report No. 1. Coastal Studies Institute, Louisiana State University, Baton Rouge.

Gallaway, B. J.
1981 *An Ecosystem Analysis of Oil and Gas Development on the Texas-Louisiana Continental Shelf.* FWS/OBS-81/27. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Galtsoff, P. S.
1964 The American Oyster *Crassostrea virginica* (Gmelin). U.S. Department of the Interior, Fish and Wildlife Service, Fisheries Bulletin 64. No pagination.

Gary, D. L., and D. W. Davis
1978 Mansions on the Marsh. *Louisiana Conservationist* 30(3):10-13.

_____
1979 *Recreation in the Louisiana Marsh.* Center for Wetland Resources, Louisiana State University, Baton Rouge.

Gauthier, H.
1978 *1977-1978 Waterfowl Survey.* Unpublished manuscript. Louisiana Wild Life and Fisheries Commission, Baton Rouge.

George, N.
1980 LOOP Has Many Firsts. *Pipeline and Gas Journal* 207(1):32--36.

Gibson, Jon L.
1982 Archeology and Ethnology on the Edges of the Atchafalaya Basin, A Cultural Resources Survey of the Atchafalaya Protection Levees. Prepared for New Orleans District, U.S. Army Corps of Engineers. Center for Archaeological Studies, University of Southwestern Louisiana, Lafayette.

Gibson, J. L., R. B. Gramling, S. J. Brazda, S. Traux, M. J. Nault, and K. M. Byrd
1978 *Archaeological Survey of the Lower Atchafalaya Region, South Central Louisiana.* The University of Southwestern Louisiana, Center for Archaeological Studies, Report No. 5.

Gillespie, G. L., A. Stickney, T. H. Handbury, H. L. Marindin, B. M. Harrod, R. S. Taylor, and H. Flad
1897 *Annual Report of the Mississippi River Commission for the Fiscal Year Ending June 30, 1897.* U.S. Government Printing Office.

Glenk, R.
1934a Crop Plants of Louisiana; How, When and Where They Originated. *Louisiana Conservation Review* 4(1):23-37, 55.

_____
1934b Milestones of Progress in the Realm of Sugar. *Louisiana Conservation Review* 4(2):23-29.

Goins, Charles R., and John M. Caldwell
1995 *Historical Atlas of Louisiana.* University of Oklahoma Press, Norman.

Gosselink, J. G.
1984 *The Ecology of Delta Marshes of Coastal Louisiana: A Community Profile.* FWS/OBS-84/09. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.

Gosselink, J. G., and R. H. Baumann
1980 Wetland Inventories: Wetland Loss Along the United States Coast. *Zeitschrift fur Geomorphologie. N.F.* 34:173-187.

Gosselink, J. G., C. L. Cordes, and J. W. Parsons
1978 *An Ecological Characterization Study of the Chenier Plain Coastal Ecosystem of Louisiana and Texas. Vol. I: Narrative Report.* FWS/OBS-78/9. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Graham, G.
1829 Quantity and Quality of Inundated Lands in Louisiana, The Cost of Reclaiming Them, and Their Value When Reclaimed. In *American States Papers Document No. 720, 20th Congress, 2d Session*, pp. 614-618. U.S. Government Printing Office, Washington, D.C.

Griggs, T.
1996 Incentives Drive Bides for Offshore Leases in Gulf to Record Number. *Baton Rouge Sunday Advocate* 28 April:1H.

Guarisco, Tom
1998 Offshore Boom Takes Onshore Toll. *Sunday Advocate* 15 March. Baton Rouge, Louisiana.

Guidry, Sherwin
1980 Explorin' Terrebonne with Sherwin Guidry. n.p.

_____
1980 Le Terrebonne: A History of Montegut. n.p.

_____
1997 Interview with William D. Reeves, July 14. #1162 Bayou Road in Montegut, P.O. Box 205, Montegut, LA 70377, Phone 504/594-3117.

Gulf of Mexico Program
1996 *Shellfish Challenge Plan. Part I: Results of Strategic Assessment.* Gulf of Mexico Program, Stennis Space Center, Mississippi.

Guntenspergen, G. R., and B. A. Vairin
1996 *Willful Winds: Hurricane Andrew and Louisiana's Coast.* Louisiana State University, The Louisiana Sea Grant College Program and U.S. Department of the Interior.

Gunter, G. E.
1955 Mortality of Oysters and Abundance of Certain Associates as Related to Salinity. *Ecology* 36(4):601-619.

Gutierrez, C. P.
1988 *The Cultural Legacy of Biloxi's Seafood Industry.* The City of Biloxi, Biloxi, Mississippi.

Hall, John.
1996 Rig Immortal. *The Times-Picayune* 29 August:C-1; C-6.

_____
1997 Oil Barges Are Busy in La. Wetlands. *The Times-Picayune* 3 August:1F.

Harper, J., C. Love, D. Bondurant, A. W. Becket, J. O. Farrell, F. Surget, S. Sprague, W. H. Phipps, G. Gillan, D. Walker, H. C. Haley, J. E. Dunn, A. C. Jameson, H. P. Sury, R. Montgomery, F. McKewen, and W. McKewen
1836 Application for the Construction of Levees on the Mississippi River, and the Reclaiming of Inundated Lands. In *American States Papers, Doc. 1535, 24th Congress, 1st Session*, pp. 709-711.

Harris, Gilbert D., and A. C. Veatch
1899 *A Preliminary Report on the Geology of Louisiana.* State Experiment Station, Baton Rouge.

Harrison, R. W.
1961 *Alluvial Empire. Volume 1. A Study of State and Local Efforts Toward Land Development in the Alluvial Valley of the Lower Mississippi River.* U.S. Department of Agriculture, Economic Research Service, Washington, D.C.

Harrison, R. W., and W. M. Kollmorgan
1974 Drainage Reclamation in the Coastal Marshlands of the Mississippi River Delta. *Louisiana Historical Quarterly* 30(2):654-709.

Hart, W. O.
1913 The Oyster and Fish Industry of Louisiana. *Transactions American Fisheries Society* 42:151-156.

Hawes, S. R.
1986 Beneficial Use of Dredged Material in New Orleans District. In *Proceedings of Tenth National Conference Estuarine and Coastal Management Tools of the Trade, New Orleans, October 12-15, 1987*, edited by Lynch and McDonald, pp. 733-739. The Coastal Society, Bethesda, Maryland.

Hegeman, Roxana
1998 Down on the Farm. *Sunday Advocate* 3 May:I1. Baton Rouge, Louisiana.

Herring, J. L.
1976 Sound Reasons for Hunting Seasons. *Louisiana Conservationist* 26(11, 12):4-8.

Holmes, Lucile Barbour
1966 *Oaklawn Manor Ante-Bellum Plantation Home.* St. Mary Printers, Franklin, Louisiana.

Houma Daily Courier.[Houma, Louisiana]
1906 Magazine Edition for September, 1906. Reprint, May 1967.

_____
1915 Races Attract Great Crowd Despite Stormy Weather. 4 July. On file Houma Public Library Archives, Houma, Louisiana.

_____
1984 1834-1984 Happy 150th Birthday Houma.

Humphreys, A. A., and A. A. Abbot
1861 *Report on the Physics and Hydraulics of the Mississippi River; Upon the Protection of the Alluvial Region Against Overflow; and Upon the Deepening of the Mouths: Based Upon Surveys and Investigations.* Professional Papers of the Corps of Topographical Engineers (No. 4). J.B. Lippincott, Philadelphia.

Industrial Economics, Inc.
1996 *Economic Value Assessment for the Barataria-Terrebonne Estuarine System.* BTNEP-26. Barataria-Terrebonne National Estuary Program, Thibodaux, Louisiana.

International Oil Scouts Association.
1994 *International Oil and Gas Development, Yearbook (Review of 1993), Vol. 64, Production.* Mason Map Service, Inc., Austin, Texas

Jackson, Charles Tenney
1914 *The Fountain of Youth.* Outing, New York.

Jaques, Florence Page
1939 *The Geese Fly High.* The University of Minnesota Press, Minneapolis.

Jaworski, E.
1972 *The Blue Crab Fishery, Barataria Estuary, Louisiana.* Center for Wetland Resources, Louisiana State University, Baton Rouge.

Johnson, F. F., and M. M. Lindner
1934 *Shrimp Industry of the South Atlantic and Gulf States.* U.S. Department of Commerce, Bureau of Fisheries Investigational Report 21.

Johnson, I.
1848 *Erecting Light-Houses at the Mouth of the Sabine and on the West End of Last Island.* 30th Congress, 1st Session, Miscellaneous Report No. 134 (v.1, 1847-48, Serial Set No. 511). U.S. Government Printing Office, Washington, D.C.

Johnson, L. N.
1969 Alligator, Distinction or Extinction. *Louisiana Conservationist* 21(7,8):16-18; 23.

Jordon, D. S.
1887 The Fisheries of the Pacific Coast: The Fisheries of San Francisco County. In *Fisheries and Fishery Industries of the United States*, pp. 612-618. U.S. Government Printing Office, Washington, D.C.

Judice, M.
1996 Demand Outstrips Supply of Workers. *The Times-Picayune* 14 July:A-13.

Judice, M., and B. Nolan
1996 Oil Is Well. *The Times-Picayune* 14 July:A-1, A-12.

Judice, M., and T. Jackson
1997 Workers, Where Are You? *The Times-Picayune* 16 March:F-1, F-4.

Kane, Harnett T.
1943 *The Bayous of Louisiana.* William Morrow, New York.

Keithly, W. R., Jr.
1991 *Louisiana Seafood Industry Study: A Summary.* Louisiana Seafood Promotion and Marketing Board, New Orleans.

Keithly, K., J. Roberts, and D. Brannan
1992 Oyster Lease Transfers and Lending; Roles in Rehabilitation of Louisiana's Oyster Industry. *Journal of Shellfish Research* 11(1):125-131.

Kemp, G. Paul, and Hassan S. Mashriqui
1996 *Forced Drainage in the Mississippi River Delta Plain Compared to the Sacramento-San Joaquin Delta and Everglades.* Prepared for U.S. Geological Survey, Reston, Virginia. Center for Coastal, Energy, and Environmental Resources, Louisiana State University, Baton Rouge.

Keown, M. P., E. A. Dardeau, Jr., and E. M. Causey
1956 Historic Trends in the Sediment Flow Regime of the Mississippi River. *Water Resources Research* 22:1555-1564.

Kerns, W. R., R. J. Byrne, and C. H. Hobbs
1980 An Economic Analysis Strategy for Management of Shoreline Erosion. *Journal Coastal Zone Management* 8(2):165-184.

Kesel, R. H.
1988 The Role of the Mississippi River in Wetland Loss in Southeastern Louisiana, U.S.A. *Environmental Geology and Water Science* 13(3):183-193.

Knapp, F. A., Jr.
1991 *A History of Vermilion Corporation and Its Predecessors (1923-1989).* Vermilion Corporation, Abbeville, Louisiana.

Kniffen, F. B.
1936 Louisiana House Types. *Association of American Geographers Annals* 26:179-193.

Kniffen, F. B., H. F. Gregory, and G. A. Stokes
1987 *The Historic Indian Tribes of Louisiana: From 1542 to the Present.* Louisiana State University Press, Baton Rouge.

Kniffen, Fred B., and Sam B. Hilliard
1988 *Louisiana, Its Land and People.* Louisiana State University Press, Baton Rouge.

Knipmeyer, W. B.
1956 *Settlement Secession in Eastern French Louisiana.* Unpublished Ph.D. dissertation. Louisiana State University, Baton Rouge.

Kupfer, Donald H.
1998 *Geology and History of the Belle Isle Salt Mine.* Louisiana Geological Survey, Geological Pamphlet 11, Baton Rouge, Louisiana.

Kutkuhn, J. H.
1966 The Role of Estuaries in the Development and Preparation of Commercial Shrimp Resources. In *American Fisheries Society*, Special Publication 3, pp. 1-36.

Labouisse, F. M., Jr.
1985 The Lafourche Country's Plantation "Big House." In *The Lafourche Country; The People and the Land*, edited by Uzee, pp. 188-206. Center for Louisiana Studies, Southwestern Louisiana University, Lafayette.

Lamb, B.
1987 Oil States Have Pain in Common. *Sunday Advocate* 12 April:7I-8I.

———
1988 Problems Plague La. Fur Projects. *Sunday Advocate* 8 May:1E-2E.

Landreth, J.
1819 *The Journal of John Landreth Surveyor.* Edited by M. B. Newton, Jr. Department of Geography and Anthropology, Louisiana State University, Baton Rouge.

Larson, D. K., D. Davis, R. Detro, P. Dumond, E. Liebow, R. Motschall, D. Sorensen, and W. Guidroz
1980 *Mississippi Deltaic Plain Region Ecological Characterization: A Socioeconomic Study. Vol. 1. Synthesis Papers.* FWS/OBS-79/05. U.S. Fish and Wildlife Service, Office of Biological Services.

Leatherman, S. P.
1982 *Barrier Island Handbook.* Coastal Publications, Charlotte North Carolina.

Le Blanc, L.
1997 1947-1997: An Industry Profile. *Offshore* 57(5):82-102.

Leeper, C. D.
1976 *Louisiana Places: A Collection of the Columns From the Baton Rouge Sunday Advocate, 1960-1974.* Legacy Publishing Company, Baton Rouge.

Leonard, D. L., M. A. Broutman, and K. E. Harkness
1989 *National Estuarine Inventory The Quality of Shellfish Growing Waters on the East Coast of the United States.* National Oceanic and Atmospheric Administration, Strategic Assessment Branch, Rockville, Maryland.

Leonard, D. L., and E. A. Slaughter
1990 *National Estuarine Inventory The Quality of Shellfish Growing Waters on the West Coast of the United States.* National Oceanic and Atmospheric Administration, Strategic Assessment Branch, Rockville, Maryland.

Le Page du Pratz, M.
1758 Histoire de la Louisiana. 3 vols. De Bure, Paris.

_____
1774 *The History of Louisiana.* Edited by J. G. Tregle, Jr. Louisiana State University Press, Baton Rouge.

Lewis, Fielding
1988 *Tales of a Louisiana Duck Hunter.* Little Atakapas, Franklin, Louisiana.

Lewis, P. F.
1976 *New Orleans: The Making of an Urban Landscape.* Ballinger, Cambridge, Massachusetts.

Liddell, M.
1849 Letter Describing Last Island as a Popular Resort. (Liddell [Moses, St. John R. and family] papers, No. 531, U-200-209, G-21-98i). Hill Memorial Library, South Reading Room, Louisiana State University, Baton Rouge.

Lindner, M. J.
1936 A Discussion of the Shrimp Trawl; Fish Problem. *Louisiana Conservation Review* 5(4):12-17;51.

Lindstedt, D. M., and J. C. Holmes
1988 *Litter in Coastal Louisiana.* Report submitted to Louisiana Department of Natural Resources, Coastal Management Division, Baton Rouge.

Lindstedt, D. M., and L. L. Nunn
1985 Petroleum Development in Louisiana's Coastal Zone and an Overview of Impacts. In *Coastal Zone '95: Proceedings of the Fourth Symposium on Coastal and Ocean*

Management, Vol. 2., edited by O. T. Magoon, H. Converse, D. Miner, D. Clark, and L. T. Tobin, pp. 1410-1416. American Society of Civil Engineers, New York.

Lindstedt, D. M., L. L. Nunn, J. C. Holmes, and E. E. Willis
1991 *History of Oil and Gas Development in Coastal Louisiana.* Resource Information Series No. 7. Louisiana Geological Survey, Baton Rouge.

Linscombe, G.
1998 Louisiana Department of Wildlife and Fisheries, LDWF Field Office, New Iberia, Louisiana, telephone interview on January 31, 1998.

List, Jeffrey H., Bruce E. Jaffe, Asbury H. Sallenger, Jr., S. Jeffress Williams, Randolph A. McBride and Shea Penland
1994 *Louisiana Barrier Island Erosion Study, Atlas of Sea-Floor Changes from 1878 to 1989.* U.S. Geological Survey.

Londenberg, R.
1972 Man, Oil and the Sea. *Offshore* 32(11):54-79.D-20-D-26.

La. 1 Coalition
1997 La. 1 Coalition: Highway Improvement Proposal. La 1 Coalition, Thibodaux, Louisiana.

Louisiana Conservationist
1948 First nutria fur coat. 1(4):14-15; 26.

_____
1956 Managing the mysterious Louisiana marshland. 8(1):8-11.

Louisiana Conservation Review
1937 The mysterious but productive shrimp. Autumn:11-17.

_____
1937 The Spaniard's beard goes to market. (Autumn):21-26.

_____
1938 World's largest shrimp cannery. (Spring):21-24.

Louisiana Cooperative Extension Service
1991 *Louisiana Summary Agriculture and Natural Resources.* Louisiana State University, Agricultural Center, Louisiana Cooperative Extension Service, Baton Rouge.

Louisiana Department of Conservation
1932 Tenth Biennial Report of the Department of Conservation of the State of Louisiana, 1930-1931. Department of Conservation, New Orleans.

Louisiana Department of Conservation
1934 *Eleventh Biennial Report of the Department of Conservation of the State of Louisiana, 1932-1933.* Department of Conservation, New Orleans.

_____
1938 *Thirteenth Biennial Report of the Department of Conservation of the State of Louisiana, 1936-1937.* Department of Conservation, New Orleans.

Louisiana Department of Health and Hospitals
1997 *Louisiana Oyster Harvesting Regulations.* Louisiana Department of Health and Hospitals, Office of Public Health Molluscan Shellfish Program, New Orleans.

Louisiana Department of Wildlife and Fisheries
1991 *Annual Report, Fiscal Year 1990-91.* Louisiana Department of Wildlife and Fisheries, Baton Rouge.

_____
1995 Summary data for annual duck harvest. Baton Rouge, Louisiana.
Louisiana Department of Wildlife and Fisheries

_____
1997 Sports License Sales Data. Baton Rouge, Louisiana.

Louisiana Planter and Sugar Manufacturer
1888 *Louisiana Planter and Sugar Manufacturer.* Louisiana Planter and Sugar Manufacturer Co., New Orleans, Louisiana

Louisiana Seafood Promotion and Marketing Board
1995 Louisiana Seafood: Facts and Figures. New Orleans, Louisiana.

Louisiana Wildlife and Fisheries Commission
var. Fishing Licenses Sold by Parish for Various Seasons. Unpublished manuscript.
years Louisiana Wildlife and Fisheries Commission, Baton Rouge.

_____
var. Hunting Licenses Sold by Parish for Various Seasons. Unpublished manuscript.
years Louisiana Wildlife and Fisheries Commission, Baton Rouge.

Love, T. D.
1967 Survey of the Sun-Dried Shrimp Industry of the North Central Gulf of Mexico. *Commercial Fisheries Review* 29(4):58-61.

Lowery, G. H., Jr., and R. J. Newman
1954 The Birds of the Gulf of Mexico. In *Gulf of Mexico Its Origin, Waters, and Marine Life*, edited by P. S. Galtsoff, pp. 519-40. Fishery Bulletin 89. U.S. Fish and Wildlife Services, Washington, D.C.

Ludlum, D. M.
1963 *Early American Hurricanes, 1492-1870.* American Meteorological Society, Boston.

Lytle, S. A., C. W. McMichael, T. W. Green, and E. L. Francis
1960 *Soil Survey of Terrebonne Parish, Louisiana.* U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

Mager, A., Jr., and L. H. Hardy
1986 *National Marine Fisheries Service Habitat Conservation Efforts in the Southeastern Region of the United States for 1985.* National Marine Fisheries Service, Habitat Conservation Division, St. Petersburg, Florida

Malone, Ann Patton
1992 *Sweet Chariot: Slave Family and Household Structure in Nineteenth-Century Louisiana.* The University of North Carolina Press, Chapel Hill.

Mancil, Ervin
1972 An Historical Geography of Industrial Cypress Lumbering in Louisiana. PhD. Dissertation, Department of Geography and Anthropology, Louisiana State University, Baton Rouge.

Marston, B. W.
1932 Tarpon Fishing on the Coast of Southwest Louisiana. *Louisiana Conservation Review* 2(4):9-10.

Martin, F. X.
1827 *The History of Louisiana From the Earliest Period.* J. A. Gresham, New Orleans. 1975 reprint. Pelican Publishing, Gretna, Louisiana.

_____
1882 *The History of Louisiana From the Earliest Period.* J. A. Gresham, New Orleans. 1963 reprint. Pelican Publishing, Gretna, Louisiana.

Mathews, P. F.
1977 Morgan City Contributes Greatly to Development of Oil Industry Technology. *Acadiana Profile* 6(1):76-82.

May, J. R., and L. D. Britsch
Geological Investigation of the Mississippi River Deltaic Plain Land Loss and Land Accretion. Technical Report GL-87-13. Department of the Army, Waterways Experiment Station, Corps of Engineers.

McClain, R.
1997 Bumper Crop Cuts Crawfish Costs. *The Advocate* 10 April:1D, 2D.

McConnell, James N.
1930 Possibilities of Oyster Production in Louisiana. *Louisiana Conservation Review* 1(2):13.

_____
1932 Report of Division of Oysters. In *State of Louisiana Department of Conservation Tenth Biennial Report, 1930-1931.* Department of Conservation, New Orleans.

McConnell, James N.
1933 Report of the Division of Oysters. Eleventh Biennial Report of the Department of Conservation, State of Louisiana.

_____
1934 The Louisiana Oyster, Its Habits and Value. *Louisiana Conservation Review* 4(3):33-37.

_____
1936 Report of Division of Oysters. In *State of Louisiana Department of Conservation Twelfth Biennial Report, 1934-1935*. Department of Conservation, New Orleans.

McConnell, J. N., and L. D. Kavanagh
1941 *The Louisiana Oyster*. Louisiana Department of Conservation, Bulletin 1.

McDaniel, A. B.
1930 Flood Waters of the Mississippi River. In *Senate Document No. 127, 71st Congress, 2nd Session*, pp. 1-84. U.S. Government Printing Office, Washington, D.C.

McGhee, E., and C. Hoot
1963 Mighty Dredges, Little-Known Work Horses of Coastal Drilling, Producing, Pipelining, Now 25 Years Old. *Oil and Gas Journal* 61(3):150-152.

McIlhenny, E. A.
1930 The Creating of the Wild Life Refuges in Louisiana. *Louisiana Conservation Review* 4(4):23-24.

McIlhenny vs. Broussard
1931 Louisiana Supreme Court decision. *Southern Reporter* 135:669-670.

McIntire, William G.
1958 *Prehistoric Indian Settlements of the Changing Mississippi River Delta*. Coastal Studies Series, Number 1. Louisiana State University, Baton Rouge.

McIntire, William G., Marc J. Hershman, Rodney D. Adams, Kai D. Midboe, and Barney B. Barrett
1975 *A Rationale for Determining Louisiana's Coastal Zone*. Report No. 1, Coastal Zone Management Series. Center for Wetland Resources, Louisiana State University, Baton Rouge.

McKenzie, L. S., III, and D. W. Davis
1994 *Louisiana Gulf of Mexico Outer Continental Shelf Offshore Oil and Gas Activity Impacts*. Louisiana Mid-Continent Oil and Gas Association, Baton Rouge, Louisiana.

McKenzie, L. S., III, P. J. Zander, M. T. C. Johnson, B. Baldwin, and D. W. Davis
1993 *Socioeconomic Impacts of Declining Outer Continental Shelf Oil and Gas Activities in the Gulf of Mexico*. OCS Study MMS 93-0028. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, Louisiana.

McKenzie, L. S., III, et al.
1995 *Land Use and Socioeconomic Status and Trends in the Barataria-Terrebonne Estuarine System.* BTNEP-23. Barataria-Terrebonne National Estuary Program, Thibodaux, Louisiana.

McPhee, John
1987 February 23, 1987 "The Control of Nature: Atchafalaya" in The New Yorker (clipping Vertical File, Tulane, LA Collection, Atchafalaya)

Meade, R. H., and R. S. Parker
1985 *Sediment in Rivers of the United States.* U.S. Geological Survey Water-Supply Paper 2275. U.S. Geological Survey, Washington, D.C.

Means, T. H.
1901 *Reclamation of Salt Marsh Land.* U.S. Soils Bureau, Circular No. 8. U.S. Government Printing Office, Washington, D.C.

Memoires Du Bayou Lafourche, Les
1984 June 1984 (vol 5 No. 2). La Societé des Cajuns, Golden Meadow, Louisiana.

Memories of Terrebonne.
1990 Archive of the Terrebonne Parish Police Jury's Oral History Program. Produced by Cote Blanche Productions, Inc. 226 reels and 4 volumes of guides.

Merry, J. F.
1910 *Louisiana Reclaimed Lands Make Fertile Farms: A Pamphlet Full of Information Concerning the Prairie Marshes and Cypress Swamp Lands of Louisiana and How They Are Being Reclaimed.* Illinois Central Railroad Company, Iowa.

Minerals Management Service
1995 *Gulf of Mexico Sales 175 and 161: Central and Western Planning Areas. Draft Environmental Impact Statement. Volume 1: Sections I through IV.C.* OCS EIS/EA MMS 95-0017. Minerals Management Service, New Orleans.

Moore, H. F.
1899 Report on the Oyster-Beds of Louisiana. United States Commission of Fish and Fisheries, Part 24. Report of the Commission for the year ending June 20, 1898. U.S. Government Printing Office, Washington, D.C. pp. 29-100.

Morehouse, A. D.
1910 Reclamation of the Southern Louisiana Wet Prairie Lands. In *Annual Report of the Office of Experiment Stations*, pp. 415-439. U.S. Government Printing Office, Washington, D.C.

Moresi, C. K.
1935 Conservation of Louisiana's Mineral Resources, 1906 to 1935. Louisiana Department of Conservation 4(5):14-34, 45.

Morey
1872 Levees of the Mississippi River. In House Report No. 44, 42nd Congress, 2nd Session, pp. 1-16. U.S. Government Printing Office, Washington, D.C.

_____
1874 Mississippi Levees. In House Report No. 418, 43rd Congress, 1st Session, pp. 1-22. U.S. Government Printing Office, Washington, D.C.

Morgan, J. P.
1972 Impact of Subsidence and Erosion on Louisiana Coastal Marshes and Estuaries. In *Marsh and Estuary Management Symposium Proceedings*, edited by R. H. Chabreck, pp. 217-233. Louisiana State University Division of Continuing Education, Baton Rouge.

Morgan, T. D., and T. O'Neil
1976 Stalking the Wild Fur. *Louisiana Conservationist* 28(9, 10):22-27.

Morrison, Phoebe Chauvin (editor)
1984 *Pioneers*. Terrebonne Genealogical Society, Houma.

Morse, G. W.
1854 Report on Bayou Lafourche. *Thibodaux Minerva* 11 March:1, col. 3.

Murchison, J.
1978 Bioscope - fur. *Louisiana Conservationist* 30(1):4-7.

Nash, M. E.
1933 Louisiana's Gas Fields: History of Development and Possibilities. Louisiana Department of Conservation 3(2):54-56.

Nesbit, D. M.
1885 *Tide Marshes of the United States*. U.S. Department of Agriculture, Miscellaneous Special Report No. 7. U.S. Government Printing Office, Washington, D.C.

New Orleans Christian Advocate
1856 Louisiana Intelligence. 23 August. (Typed copy) Nicholls State University Archives, Thibodaux, Louisiana.

The New Orleans Daily Delta
1850 Country Correspondence of the Delta. 11 February:1, col. 4.

Newton, M. B., Jr.
1972 *Atlas of Louisiana; A Guide for Students.* Miscellaneous Publication 72-1. School of Geoscience, Louisiana State University, Baton Rouge.

Newton, M. B., Jr. (editor)
1985 *The Journal for John Landreth Surveyor to Agency of James L. Cathcart and James Hutton Esquire Agents for Selecting Any Unappropriated Lands of the United States As May Be Found to Produce Live Oak and Red Cedar Timbers Suitable for Naval Purposes Commenced in 1818 and Ended in 1819.* Department of Geography and Anthropology, Louisiana State University, Baton Rouge.

Newton, Milton B., Jr., and Ernest St. C. Easterly, III
1977 *Louisiana Parish Boundaries Through Lakes, Bays, and Sounds.* Center for Wetland Resources, Louisiana State University, Baton Rouge.

Nichols, J. D., L. Vieham, R. H. Chabreck, and B. Fenderson
1976 *Simulation of a Commercially Harvested Alligator Population in Louisiana.* Agricultural Experiment Station, Bulletin Number 691. Louisiana State University, Baton Rouge.

The Office of the Democrat
[1878] Acts passed by the General Assembly of the state of Louisiana the second session of the fifth legislature, begun and held in New Orleans, January 7, 1878. The Office of the Democrat, New Orleans.

Office of Technology Assessment, U.S. Congress
1984 *Wetlands: Their Use and Regulation.* OTA-0-206. United States Congress, Office of Technology Assessment, Washington, D.C.

Oglesby, J. H.
1873 Memorial of the Chamber of Commerce of New Orleans, Louisiana, asking that the National Government assume the construction and care of the levees of the Mississippi River. In Senate Miscellaneous Document No. 42, 42nd Congress, 3rd Session, pp. 1-2. U.S. Government Printing Office, Washington, D.C.

Okey, C. W.
1914 *The Wetlands of Southern Louisiana and Their Drainage.* U.S. Department of Agriculture, Bulletin No.71.

_____
1918 *Wetlands of Southern Louisiana and Their Drainage.* U.S. Department of Agriculture, Bulletin No. 652.

_____
1918b The Subsidence of Muck and Peat Soils in Louisiana and Florida. *Transactions of the American Society of Civil Engineers* 82:396-432.

O'Neil, T.
1949 *The Muskrat in the Louisiana Coastal Marshes.* Louisiana Wild Life and Fisheries Commission, New Orleans.

_____
1969 He Must Walk the Marshes. *Louisiana Conservationist* 21(11, 12):8-11.

O'Neil, T., and G. Linscombe
1975 *The Fur Animals, the Alligator, and the Fur Industry in Louisiana.* Louisiana Wild Life and Fisheries Commission, New Orleans.

Padgett, H. R.
1960 *The Marine Shell Fisheries of Louisiana.* Unpublished Ph.D. dissertation. Louisiana State University, Baton Rouge.

Patterson High School, Eighth Grade Louisiana History Class
1965 *A History of Patterson, Louisiana.* n.p.

Payne, F. T.
1918 Report of the Oyster Division. In *Biennial Report of the Department of Conservation from April 1st 1916 to April 1st 1918.* Department of Conservation, New Orleans.

_____
1920 Division of Oysters and Water Bottoms. *In Fourth Biennial Report of the Department of Conservation from April 1, 1918 to April 1, 1920.* Department of Conservation, New Orleans.

_____
1924 Report of the Oyster Division. In *Sixth Biennial Report of the Department of Conservation from January 1, 1922 to December 31, 1923.* Department of Conservation, New Orleans.

Pearson, C. E., G. J. Castille, D. W. Davis, T. E. Redard, and A. R. Saltus
1989 *A History of Waterborne Commerce and Transportation Within the U.S. Army Corps of Engineers New Orleans District and an Inventory of Known Underwater Cultural Resources.* Coastal Environments, Inc., Report Number: COELMN/PD 88/11. U.S. Army Corps of Engineer, New Orleans District.

Pelletier, G. J.
1972 *Ile Jean Charles.* Pelletier, New Orleans.

Penland, S., I. Mendelssohn, L. Wayne, and D. Britsch
1996 *Natural and Human Causes of Coastal Land Loss in Louisiana.* Coastal Studies Institute, Wetland Biogeochemistry Institute, Louisiana State University, Baton Rouge.

Penland, S., K. E. Ramsey, R. A. McBride, J. T. Mestayer, and K. A. Westphal
1988 *Relative Sea Level Rise and Delta-Plain Development in the Terrebonne Parish Region.* Coastal Geology Technical Report No. 4. Louisiana Geological Survey, Baton Rouge.

Penland, S., H. H. Roberts, S. J. Williams, A. H. Sallenger, Jr., D. R. Cahoon, D. W. Davis, and C. G. Groat
1990 Coastal Land Loss in Louisiana. *Transactions Gulf Coast Association of Geological Societies* 40:685-700.

Perret, W. S., B. B. Barrett, W. R. Latapie, J. F. Pollard, and W. R. Mock
1971 *Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana, Phase I, Area Description, and Phase IV, Biology.* Louisiana Wild Life and Fisheries Commission, New Orleans.

Perrin, P.
1985 Folklore in the Lafourche Country. In *The Lafourche Country; The People and the Land*, edited by Philip D. Uzee, pp. 76-87. Center for Louisiana Studies, Southwestern Louisiana University, Lafayette.

Pharr, V. V.
1923 *Brahman (Zebu) Cattle.* Farmer's Bulletin No. 1361. U.S. Department of Agriculture, Washington, D.C.

Pillsbury, R.
1964 The Production of Sun-dried Shrimp in Louisiana. *Journal of Geography* 63(Sept):254-258.

Pipelines supplant waterways in coastal Louisiana district.
1937 *Oil and Gas Journal* 36 (October 7):180, 183-4.

Planters' Banner
1849 Fishing Frolic. 9 August. Franklin, Louisiana.

Postgate, J. C.
1949 History and Development of Swamp and Marsh Drilling Operations. *The Oil and Gas Journal* 47(48):87.

Prindiville, A. B.
1955 The Dim, Cool World That Is Your Oyster. *Down South* (March/April). (Book 126, M. J. Stevens Collection). Biloxi Public Library, Biloxi, Mississippi.

Pugh, W. W.
1881 Reminiscences of an Old Fogy. (Typed copy). Nicholls State University Archives, Thibodaux, Louisiana.

Randall, D. A., T. Landry, and I. Johnson
1846 Survey of Bayou Lafourche and Bayou Bleu. House Report No. 837, 29th Congress, 1st Session. U.S. Government Printing Office, Washington, D.C.

Read, W.
1937 *Louisiana French.* Louisiana State University Press, Baton Rouge.

Redington, P. G.
1933 Keep Marshlands for Wild Fowl. *Louisiana Conservation Review* 3(4):xx

Reggio, V. C.
1987 *Rigs-to-Reefs: The Use of Obsolete Petroleum Structures as Artificial Reefs*. OCS Report MMS 87-0015. Minerals Management Service, U.S. Department of the Interior, New Orleans, Louisiana.

Rehder, J. B.
1971 *Sugar Plantation Settlements of Southern Louisiana: A Cultural Geography*. Unpublished Ph.D. dissertation. Louisiana State University, Baton Rouge.

The Republican Office
1871 Acts passed by the General Assembly of the state of Louisiana the first session of the second legislature, begun and held in New Orleans, January 2, 1871. The Republican Office, New Orleans.

Richardson, H. B.
1901 Louisiana Levees. In *Riparian Lands of the Mississippi River Past, Present, Prospective*, edited by F. H. Tompkins, pp. 333-344. Frank M. Tompkins, New Orleans.

Rinderle, P. J.
1930 Louisiana Leads world in Production of Shrimp. *Louisiana Conservation Review* 1(2):11-12.

Roberts, B. S.
1866 Letter of the Secretary of War, communicating, in compliance with a resolution of the Senate of the 5th instant, a copy of the memorial of Brevet Brigadier General B. S. Roberts, United States Army, setting forth his views of a plan for reclaiming the swamp and waste lands of the basin of the lower Mississippi river. In Senate Executive Document No. 22, 39th Congress, 1st Session, pp. 1-6. U.S. Government Printing Office, Washington, D.C.

Roberts, K. J., and P. W. Pawlyk
1986 *Louisiana's Commercial Fishing Licenses Issued from 1976 to 1985*. Report LSU-TL-86-003. Louisiana State University, Sea Grant College Program, Baton Rouge.

Roy, Edison Peter
1959 *The Indians of Dulac: A Descriptive Study of a Racial Hybrid Community in Terrebonne Parish, Louisiana*. Masters Thesis, Louisiana State University.

Rule. G.
1960 62 Years of Oil Prospecting in Morgan City. In G. Rule. Oil, gas, shrimp, "sass.", no pagination. King-Hannaford Company, Morgan City, Louisiana.

Russell, Richard J.
1942 Flotant. *Geographical Review* 32:74-98.

Sass, M. E., and K. S. Roberts
1979 *Characteristics of the Louisiana Shrimp Fleet, 1978.* Sea Grant Publication No. LSU-TL-79-006. Louisiana State University, Baton Rouge.

Sayre, A.
1997a Morgan City Warily Waiting Behind Flood Wall. *Sunday Advocate* 30 March:16A. Baton Rouge, Louisiana.

_____
1997b Skilled Jobs Going Begging in La. Oil Patch: Once-Devastated Industries Now Seeking New Workers. *Sunday Advocate* 4 May:21. Baton Rouge, Louisiana.

Schlatre, M.
1937 The Last Island Disaster of August 10, 1856: A Personal Narrative of One of the Survivors. *Louisiana Historical Quarterly* 20(3):1-50.

Schneider, G. R.
1952 *The History and Future of Flood Control.* American Society of Civil Engineers, Waterways Division, Chicago.

Schultz, B.
1997a Just Don't Call It a Boom: Oil, Gas Industry Happy, But Cautious. *Sunday Advocate* 26 January:18C. Baton Rouge, Louisiana.

_____
1997b Trapping Incentive. *Sunday Advocate* 6 April:1A, 6A. Baton Rouge, Louisiana.

Scofield, N. B.
1919 Shrimp Fisheries of California. *California Fish and Game* 5(1):1-2, 55-60.

Seglund, J. A.
1956 Geologically Speaking, Here's the Picture in South Louisiana. *The Oil and Gas Journal* 54(June 18):217-222.

Sevier, M. B.
1990 *Land Use of Terrebonne Parish: An Historical Geography.* Master's thesis. The University of Southwestern Louisiana, Lafayette.

Seydlitz, R., and S. Laska
1994 *Social and Economic Impacts of Petroleum "Boom and Bust" Cycles.* OCS Study/MMS 94-0016. U.S. Department of Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans.

Shaw, J. A.
1930 Report of the Division of Minerals. In *Ninth Biennial Report of the Department of Conservation State of Louisiana, General Conservation Bulletin, 1928-1929.* Department of Conservation, New Orleans.

_____
1933 Annual Report Minerals Division of the State Conservation Department, 1932. Louisiana Conservation Review 3(2): 5-12, 22.

Sheffield, D. A., and D. L. Nicovich
1979 *When Biloxi Was the Seafood Capital of the World.* The City of Biloxi, Biloxi, Mississippi.

Shelton, M.
1987 Tradition Endures, Low Prices, Foreign Control Limiting La. Fur Industry. *Sunday Advocate* 8 February:1A, 12A.

Shoopman, Don
1998 Good Bass Fishing Is Reported in the Swamp and Marsh Areas Immediately East of Bayou Sale in St. Mary Parish. *Louisiana Sportsman* 18(3)

_____
1998 No Place Like Home. *Louisiana Sportsman* 18(3):30-40

Silas, U.
1890 Last Island. *The Weekly Thibodaux Sentinel* 9 August. (Typed copy). Nicholls State University Archives, Thibodaux, Louisiana.

Simplich, F.
1927 The Great Mississippi Flood of 1927. *The National Geographic Magazine* 52(3):243-289.

Snowden, J. O., W. B. Simmons, E. B. Traughber, and R. W. Stephens
1977 Differential Subsidence of Marshland Peat as a Geologic Hazard in the Greater New Orleans Area, Louisiana. *Transactions Gulf Coast Association of Geological Societies* 27:169-179.

The Southern Manufacturer
1910 A sketch of the Louisiana inter-coastal canal route from Morgan City to New Orleans via Houma and Lockport. *The Southern Manufacturer*, New Orleans.

Spitzer, Nicholas R. (editor)
1979 *Mississippi Delta Ethnographic Overview.* Prepared for the National Park Service by the National Council for the Traditional Arts.

_____
1985a *Louisiana Folklife, A Guide to the State.* (Editor) Louisiana Folklife Program/Divison of the Arts, and the Center for Gulf South History and Culture. Louisiana Department of Culture, Recreation and Tourism, Baton Rouge.

Spitzer, Nicholas R. (editor)
1985b South Louisiana: Unity and Diversity in a Folk Region. In *Louisiana Folklife, A Guide to the State.* Nicholas Spitzer, editor. Louisiana Folklife Program/Division of the Arts, and the Center for Gulf South History and Culture. Louisiana Department of Culture, Recreation and Tourism, Baton Rouge. Pp. 75-86.

St. Amant, L. S.
1959 *Louisiana Wildlife Inventory and Management Plan.* Pittman-Robertson section–Fish and Game Division, Louisiana Wild Life and Fisheries Commission, New Orleans.

Stanton, M. E.
1971 *The Indians in the Grand Caillou-Dulac Community.* Unpublished Master's thesis. Department of Geography and Anthropology, Louisiana State University, Baton Rouge.

Stearns, S.
1887a Fisheries of the Gulf of Mexico: The Fishery Interests of Louisiana. In *Fisheries and Fishery Industries of the United States*, pp. 575-582. U.S. Government Printing Office, Washington, D.C.

———
1887b Gulf of Mexico. In *The Sea Fishing Grounds of the Eastern Coast of North America from Greenland to Mexico*, edited by J. W. Collins and R. Rathbun, pp. 55-60. U.S. Government Printing Office, Washington, D.C.

Stickney, A.
1882 Removing Obstructions to Navigation at the Mouth of Bayou La Fourche, Louisiana. In Senate Executive Document No. 151, 47th Congress, 1st Session, pp. 2. U.S. Government Printing Office, Washington, D.C.

The Oil and Gas Journal
1935 Submerged regions of the coast explored by special methods. 33(46):69-71.

Surrey, N. M.
1916 *The Commerce of Louisiana During the French Regime, 1699-1763.* Columbia University Press, New York.

Swanton, J. R.
1911 *Indian Tribes of the Lower Mississippi Valley and Adjacent Coast of the Gulf of Mexico.* Bulletin No. 43. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

———
1952 *The Indian Tribes of North America.* Bulletin No. 145. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Terrebonne Parish Development Board
1953 Terrebonne Parish Resources and Facilities. Department of Public Works, Planning Division, Baton Rouge, Louisiana.

Terrebonne Parish Police Jury
1983 Coastal Management Program, Volume 3. June. Terrebonne Parish Police Jury, Houma, Louisiana.

Thibodaux Minerva [Thibodaux, Louisiana]
1853 Levee Ordinance. 3 September:2.

_____
1853 The Grand Levee. 22 October:2

_____
1854 Crevasse at Lockport. 25 March:1.

_____
1854 All Hopes of Stopping the Crevasse at Lockport Have Been Abandoned. 1 April:1.

Thibodaux Minerva [Thibodaux, Louisiana]
1854 The Crevasse. 6 May:1

_____
1855 The Gulf Hotel. 14 July:2.

Thorndale W., and W. Dollarhide
1987 Map Guide to the U.S. Federal Censuses, 1790-1920. Genealogical Publishing Co., Baltimore, Maryland.

The Times-Picayune
1997 Groups Step in to Provide Housing on Gulf Coast to Support Oil Boom. 16 March:F-4. New Orleans, Louisiana.

_____
1997 Labor Pains. 13 April:A-1.

Tomlinson, F.
1926 The Reclamation and Settlement of Land in the United States. *International Review of Agricultural Economics* (Rome, Italy) 4:225-272.

True, F. W.
1884 The Useful Aquatic Reptiles and Batrachians: the Alligator and Crocodile. In *The Fisheries and Fishery Industries of the United States*, Section 1, pp. 141-146. U.S. Government Printing Office, Washington, D.C.

Turner, R. E.
1982 Wetland Losses and Coastal Fisheries: An Enigmatic and Economically Significant Dependency. In *Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options*, edited by D. F.

Boesch and C. L. Cordes, pp. 112-120. U.S. Fish and Wildlife Service FWS/OBS-82/59.

1987 *Relationship Between Canal and Levee Density and Coastal Land Loss in Louisiana.* U.S. Fish and Wildlife Service, Biological Report 85(14).

Turner, R. E., and D. R. Cahoon
1987 *Causes of Wetland Loss in the Coastal Central Gulf of Mexico. Vol. II: Technical Narrative.* Final report submitted to Minerals Management Service. .Contract no. 14-12-0001-3252. OCS Study/MMS 87-0120. Minerals Management Service, Metairie, Louisiana.

Turni, Karen
1997 Diversion Tactic. *The Times-Picayune* 20 November:A1. New Orleans, Louisiana.

Twain, M.
1901 *Life on the Mississippi.* Original copyright, 1874, Harper and Brothers, New York.

U.S. Army Corps of Engineers, Chief of Engineers (CE)
1871 Report of the Chief of Engineers.

1882 Report of the Chief of Engineers, U.S. Army. M 19 Amos Stickney, Major of Engineers. Survey of Atchafalaya River, Louisiana, From Berwick's Bay to mouth of Red River. April 26, 1882.

1889a Report of the Chief of Engineers, T 16 Preliminary Examination of Atchafalaya River, Louisiana, from Berwick's Bay to Gulf of Mexico, to secure a Channel of Twenty Feet Depth. By W. L. Fisk, Captain of Engineers, Office U.S. Engineer, New Orleans, La Nov 16, 1888, Part 2, 1510-11.

U.S. Army Corps of Engineers, Chief of Engineers (CE)
1889b Report of the Chief of Engineers, Review of Bayou Terrebonne project. By W. L. Fisk, Captain of Engineers. Part 1, 197.

1908a HR Committee on Rivers and Harbors. 61 Cong 2nd Sess. Comm Doc #17. Report of the Board of Engineers for Rivers and Harbors on Atchafalaya Bay, Louisiana. September 23, 1908.

1908b *Annual Report of the Chief of Engineers U.S. Army Corps of Engineers.* Report to the Chief of Engineers. Office of the Chief of Engineers, U.S. Army Corps of Engineers, Washington, D.C.

1909 HR 61Cong 2nd Session Doc No. 669. Preliminary Examination of Atchafalaya River, Louisiana by Lansing H. Beach, Engineers Office, NO Nov 5, 1909.

U.S. Army Corps of Engineers, New Orleans District (NOD)
1975 Record of Public Hearing to Discuss Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana--Dredge Material Disposal Plans and Procedures. 11 & 18 January 1975. 2 vols.

1982 *Draft Environmental Impact Statement: Terrebonne Parish-wide Forced Drainage System, Terrebonne Parish, Louisiana.* U.S. Army Corps of Engineers, New Orleans.

1983 *Final Environmental Impact Statement: Terrebonne Parish-wide Forced Drainage System, Terrebonne Parish, Louisiana.* U.S. Army Corps of Engineers, New Orleans.

1984 1983 Project Maps – Rivers and Harbors Flood Control Projects Flood Control M.R.&T.

1987 *Oyster Shell Dredging in Atchafalaya Bay and Adjacent Waters, Louisiana.* Final Environmental Impact Statement.

1991 Freshwater Diversion.

1993 *Oyster Shell Dredging in Gulf of Mexico Waters, St. Mary and Terrebonne Parishes, Louisiana.* Draft Environmental Impact Statement and Appendices.

1995 *Water Resources Development in Louisiana 1995.*

1996 Lower Mississippi Valley Division Work, River and Harbor Projects - Project Maps.

U.S. Army Corps of Engineers, Vicksburg District (VD)
1955 Water Resources Development by Corps of Engineers in Louisiana. Lower Mississippi Valley Division, Vicksburg, Mississippi.

U.S. Bureau of the Census.
1990 U.S. Census of Population: (decennial censuses 1840 to 1990), Characteristics of the Population, Louisiana. U.S. Government Printing Office, Washington, D.C.

U.S. Department of Agriculture
1986 *Lafourche-Terrebonne Cooperative River Basin Study Report.* U.S. Department of Agriculture, Soil Conservation Service, Alexandria, Louisiana.

U.S. Department of Commerce
1995 U.S. Census Data.

U.S. Department of the Interior, Fish and Wildlife Service
1950 *Curing of Fishery Products.* Research Report 18. U.S. Department of the Interior, Fish and Wildlife Service.

U.S. Department of the Interior, Minerals Management Service
1994 *Current Facts and Figures, Minerals Management Service, Offshore Oil and Gas Operations, Gulf of Mexico OCS Region.* U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana.

U.S. Government Printing Office
1887 Levees of the Mississippi River. In House Report No. 4176, 49th Congress, 2nd Session, pp. 1-13. U.S. Government Printing Office, Washington, D.C.

1891 Levees of the Mississippi River. In House Report No. 3598, 51st Congress, 2nd Session, pp. 1-14. United States Government Printing Office, Washington, D.C.

1905 Levees. In *Annual Report of the Mississippi River Commission for the Fiscal Year Ending June 30,1905*, pp. 18-23. U.S. Government Printing Office, Washington, D.C.

1912 Levees. In *Report of the Mississippi River Commission Appendix MMM*, pp. 3964-3967. United States Government Printing Office, Washington, D.C.

U.S. Government Printing Office
1917 Barataria Bay, La., and Connecting Waters. 65th Congress, 1st Session, House Document No. 200, (House Document, v. 33, 1917, Serial set 7298). U.S. Government Printing Office, Washington, D.C.

U. S. Mine Safety and Health Administration (USMSHA)
1980 *Final Report of Mine Explosion Disaster, Belle Isle Mine, Cargill, Inc., Franklin, St. Mary Parish, Louisiana, June 8, 1979.* U. S. Department of Labor, Salt Lake City, Utah.

Van Heerden, Ivor Ll.
1993 Managing the Mississippi River to Ensure Long-Term Restoration and Creation of Wetlands in Coastal Louisiana. *The Eighth Symposium on Coastal and Ocean Management, New Orleans, LA.* (July 19-23, 1993). Center for Coastal Energy and Environmental Resources, Louisiana State University, Baton Rouge, LA.

1994 *A Long-Term, Comprehensive Management Plan for Coastal Louisiana to Ensure Sustainable Biological Productivity, Economic Growth, and the Continued Existence of its Unique Culture and Heritage.* Center for Coastal, Energy, and Environmental Resources, Louisiana State University, Baton Rouge.

Van Sickle, V. R., B. B. Barrett, L. J. Gulick, and T. B. Ford
1976 *Barataria Basin: Salinity Changes and Oyster Distribution.* Center for Wetland Resources, Louisiana State University, Baton Rouge.

Vermilion Historical Society
1983 *History of Vermilion Parish Louisiana.* Taylor, Dallas.

Vice, E.A.
1987 The Grand Old Lady of the Gulf. *Lafayette Magazine* (September): 16-24.

Viosca, P.
1928 Louisiana Wetlands and the Value of Their Wildlife and Fishery Resource. *Ecology* 9:216-229.

Vogel, H. D.
1930 Report on control of floods in the alluvial valley of the Lower Mississippi River, Annex no. 5. Basic data Mississippi River, War Department, Washington, D.C.

_____
1931 Annex No. 5, Basic Data Mississippi River. In Control of Floods in the Alluvial Valley of the Lower Mississippi River, v. 1, House Document 798, 71st Congress, 3rd Session: U.S. Government Printing Office, Washington, D.C.

Waddill, R. D.
1945 *History of the Mississippi River Levees, 1717 to 1944.* Memorandum. Vicksburg, War Department Corps of Engineers, Mississippi River Commission. pp. 1-10.

Waldo, E.
1957 *The Louisiana Oyster Story.* Louisiana Wild Life and Fisheries Commission, Wild Life Education Bulletin 32.

_____
1958 The Nutria in Louisiana. *Louisiana Conservationist* 10(3):45-50.

_____
1965 Louisiana Pioneer: the Pirogue. *Louisiana Conservationist* 17(1,2):6-9.

Wales
1854 Letter describing Last Island. (Liddell [Moses, St. John R. and family] papers, Box 10, folder 66, U-200-209, G-21-98i). Hill Memorial Library, South Reading Room, Louisiana State University, Baton Rouge.

Warfield, A. G.
1876 Mississippi River Levees. In House Report No. 494, 44th Congress, 1st Session, pp. 11-26. U.S. Government Printing Office, Washington, D.C.

Washburn, M.
1951 Evolution of the Trapping Industry. *Louisiana Conservationist* 3(1, 2):8-9, 24.

Watkins, M. E.
1939 *History of Terrebonne Parish to 1861.* Master's thesis. Louisiana State University, Baton Rouge.

Weber, M., R. T. Townsend, and R. Pierce
1992 *Environmental Quality in the Gulf of Mexico: a Citizen's Guide.* Center for Marine Conservation, Washington, D.C.

The Weekly Thibodaux Sentinel
1893 Cheniere's Priest Tells Sad Story. 14 October 14. Nicholls State University Archives, Thibodaux, Louisiana.

Weinstein, R. A., and S. M. Gagliano
1985 The Shifting Deltaic Coast of the Lafourche Country and Its Prehistoric Settlement. In *The Lafourche Country; the People and the Land*, edited by Uzee, pp. 122-148. Center for Louisiana Studies, Southwestern Louisiana University, Lafayette.

Weinstein, Richard A., and David B. Kelley
1992 *Cultural Resources Investigations in the Terrebonne Marsh, South-Central Louisiana*. Final Report. Coastal Environments, Inc. for U. S. Army Corps of Engineers.

White, C. J.
1975 *Effects of 1973 Flood Waters on Brown Shrimp in Louisiana Estuaries*. Louisiana Wild Life and Fisheries Commission, Technical Bulletin 22.

Wicker, K. M.
1979 *The Development of the Louisiana Oyster Industry in the 19th Century*. Ph.D. dissertation. Louisiana State University, Baton Rouge.

1980 *Mississippi Deltaic Plain Region Ecological Characterization: A Habitat Mapping Study. A User's Guide to the Habitat Maps*. FWS/OBS-79/07U.S. Fish and Wildlife Service, Office of Biological Services.

Wicker, K., M. DeRouen, D. O'Connor, E. Roberts, and J. Watson
1980 *Environmental Characterization of Terrebonne Parish: 1955-1978*. Final Report for the Terrebonne Parish Police Jury. Coastal Environments, Inc., Baton Rouge.

Wicker, K. M., S. M. Gagliano, and J. L. van Beek
1992 *Pioneer Studies of Land Loss in Coastal Louisiana 16 mi^2/yr. to 50 mi^2/yr. Land loss Analysis*. Presented at the 8th Annual Remote Sensing/GIS Workshop, John C. Stennis Space Center, Mississippi.

Williams, C. D., D. M. Nelson, L. C. Clements, M. E. Monaco, S. L. Stone, L. R. Settle, C. Iancu, and E. A. Irlandi
1990 *Distribution and Abundance of Fishes and Invertebrates in Eastern Gulf of Mexico Estuaries*. ELMR Report No. 6. National Oceanic and Atmospheric Administration, Strategic Assessment Branch, Rockville, Maryland.

Williams, N.
1929 Drilling for Oil in the Out of the Way Marshlands of Terrebonne Parish, Louisiana. *The Oil and Gas Journal* 28(December 19):40-41.

1957 Offshore Boom: 100 Fields Found, 58 Producing Oil: Louisiana's Continental Shelf. *The Oil and Gas Journal* 55(April 1):142-143.

Williams, R. E.
1955 Development and Improvement of Coastal Marsh Ranges. In *Water: Yearbook of Agriculture*, pp. 444-450. U.S. Department of Agriculture, Washington, D.C.

Williams S. J., and H. A. Cichon
1994 *Processes of Coastal Wetlands Loss in Louisiana.* Results from a multi-year collaborative study by the U.S. Geological Survey, National Biological Survey, and Louisiana State University, as presented at Coastal Zone '93, New Orleans, Louisiana. Open-File Report 94-275. U.S. Geological Survey, Reston, Virginia.

Williams, S. J., S. Penland, A. H. Sallenger, Jr. (editors)
1992 *Louisiana Barrier Island Erosion Study – Atlas of Barrier Island Changes in Louisiana from 1853 to 1989.* U.S. Geological Survey Miscellaneous Investigations Series I-2150-A.

Wilson, C. A., V. Van Sickle, and D. Pope
n.d. The Louisiana Artificial Reef Plan: Executive Summary. Draft report. *Louisiana Geological Survey* 3(4):3-6, 38. Louisiana Geological Survey, Baton Rouge.

Wilson, J. N. O.
1850 Report of the acting secretary of the interior, relative to the swamp and overflowed lands in Louisiana. Senate Executive Document No. 68, 31st Congress, 1st Session: Washington, D.C., William L. Beln (?). pp. 1-8.

Wright, J. O.
1907 Reclamation of Tide Lands. In *United States Department of Agriculture, Annual Report of the Office of Experiment Stations for the year ended June 30, 1906.* U.S. Government Printing Office, Washington, D.C.

Wurzlow, Helen Emmeline
1976a Cypress Trees Once Abounded: Forest Decline Was Predicted. *The Houma Daily Courier* (November 28):1A, 2C.

Wurzlow, Helen Emmeline
1976b Spiderweb Trails Still Visible: Pull Boats Left Their Scars. *The Houma Daily Courier* (December 26):10-F.

_____
1984 I Dug Up Houma Terrebonne. 7 vols. Houma, Louisiana.

Zacharie, F. C.
1898 The Louisiana Oyster Industry. In *Bulletin of the United States Fish Commission*, 17 (1897), pp. 297-304. U.S. Government Printing Office, Washington, D.C.

FIGURES CITED IN TEXT

LIST OF FIGURES

1-1. Location of the study area in south Louisiana.

2-1. Mississippi River delta sequence over the past 9000 years.

2-2. Map of Atchafalaya Basin showing control structures.

2-3. Major physical features within the study area.

2-4. Lower Bayou Pointe au Chien ridge and surrounding marsh.

2-5. Cheniere au Tigre and surrounding marsh, Vermilion Parish.

2-6. Wetland loss along the Louisiana Coast.

2-7. Artificial levee and drainage canal separating marsh (at left) from pump drainage area (at right) along lower Bayou Pointe au Chien, Terrebonne Parish.

2-8. These dying trees at Burns Point at the south end of Bayou Sale in St. Mary Parish are an indicator of the erosion problems along the shoreline of East Cote Blanche Bay.

2-9. East Timbalier Island, facing north. Note broken segments of island and walls installed as restoration measures.

2-10. Deteriorated marsh along the road between Bayou Pointe au Chien and Isle de Jean Charles, Terrebonne Parish.

2-11. This Christmas tree coastal restoration project is located in Hammock Lake east of Cypremort Point in St. Mary Parish.

2-12. Intermediate/fresh marsh and drainage channels between Weeks Island and Cypremort Point, Iberia Parish.

2-13. Cheniere au Tigre, Vermilion Parish.

2-14. Saltwater intrusion and other environmental factors have adversely effected the wetland's plant communities, as evident by this dead cypress swamp along east side of Bayou Pointe au Chien east of the community of Montegut.

2-15. Lower Bayou Pointe au Chien channel with forested natural levees. A small farming community existed here during the nineteenth century.

2-16. Hurricane Audrey's damage to several logistic support sites in the vicinity of Morgan City disrupted the flow of goods and services offshore.

2-17. Although best known for inundating Cameron, Louisiana in 1957, hurricane Audrey also flooded parts of St. Mary and Iberia Parishes as well. This photo illustrates hurricane Audrey flooding on Vacherie Plantation near Franklin.

2-18. In south Louisiana, hurricanes are always of some concern, as witnessed by this debris-laden site.

2-19. An old Creole-style house along lower Bayou Terrebonne.

2-20. Map of lower Bayou Terrebonne below Seabreeze Pass in 1935.

2-21. Remnant of lower Bayou Terrebonne natural levee in Lake Barre.

2-22. One of the fastest building deltas in the world is at the mouth of the Atchafalaya River.

2-23. The emerging bifurcating delta at the mouth of Wax Lake Outlet has a distinct shape visible from the air.

2-24. The Belle Isle salt mine is a relatively small mining operation.

2-25. This ferry across the Gulf Intracoastal Waterway is the only means of vehicular access to the salt mine at Cote Blanche Island.

2-26. The eroding bluff along the south side of Cote Blanche Island is another example of south Louisiana's land loss problem.

2-27. The Weeks Island salt mine and oil and gas activity are an impressive industrial complex.

2-28. In this aerial view of the south side of Avery Island the salt mine and the associated oil and gas canals that outline the dome are clearly visible.

2-29. The salt mine at Avery Island, Louisiana.

2-30. Workers picking Tabasco peppers in McIlhenny's fields at Avery Island, Louisiana.

2-31. Jefferson Island, Louisiana. Oil installations in the lake.

3-1. Parishes and selected settlements within the study area.

3-2. Aerial view of downtown Franklin.

3-3. Isle de Jean Charles in Terrebonne Parish is accessible by one road that is often flooded, making highway access nearly impossible.

3-4. Camps and houses are strung along Isle de Jean Charles in Terrebonne Parish.

3-5. Isle de Jean Charles is an Indian community proud of its heritage, as indicated by this sign proclaiming the "Island" is the "Home of Biloxi Chitimacha Choctaw".

3-6. The natural levee ridges along Mauvais Bois Bayou once supported a thriving agricultural settlement.

3-7. East Timbalier Island, facing north. Note broken segments of island and walls installed as restoration measures.

3-8. Portion of a map entitled "Western Part of Isle Dernier, La.".

3-9. Subsided lower Bayou Terrebonne.

3-10. Cheniere au Tigre in Vermilion Parish continues to serve as a foundation for recreational camps and the cattle industry.

3-11. The mailman gets a present of a melon at Cheniere Au Tigre, where he delivers the mail by boat once a week.

3-12. When the weekly mail boat comes to Chenier Au Tigre, an island farm down in the marsh near the Gulf, all the residents come on horse back or in wagons to get the mail and to visit.

3-13. Cattle freely graze throughout south Louisiana's marsh.

3-14. Cattle trails in marsh near Cheniere au Tigre, Vermilion Parish.

3-15. Cooperative stock auction at Abbeville, Louisiana.

3-16. Plane planting rice near Perry, Louisiana.

3-17. Rice harvest. Man who sews up bags of threshed rice counts bags [on the] Erlay Trahan farm, Kaplan, Louisiana.

3-18. This sugar mill at Patoutville, Louisiana, is one of the few remaining in south Louisiana.

3-19. Aerial view of a sugar mill along Bayou Teche in the vicinity of Franklin, Louisiana.

3-20. Sugar cane harvesting was originally done by hand when large field crews used cane knives to top and cut the cane.

3-21. Portable hoist loads sugar cane cut for seed purposes onto trailer truck drawn by tractor.

3-22. Since the late 1800s, oranges have been described in the literature related to the wetlands.

3-23. This sign at the Port of West St. Mary indicates the presence of Vietnamese in the region's fisheries.

3-24. At the St. Helena Catholic Church, Saturday mass is in English, while Sunday services are in Vietnamese.

3-25. The Montegut Tribal Center is one symbol of unity among the region's Native Americans.

3-26. Camp used by Houma Indian family along lower Bayou Pointe au Chien.

3-27. This sign on a Houma Indian camp is one indication of recent requests for official tribal recognition.

3-28. A shrimp boat on Bayou Du Large heads out towards the Gulf of Mexico.

3-29. On the Intracoastal Canal, the Pax Two, a typical canal tug pulling a tow of loaded oil barges.

3-30. Near the Port of West St. Mary, this pump and associated canal is designed to help drain the region's sugar cane fields.

3-31. The dredge "*Zoe B*" was purchased and used by Terrebonne Parish to keep its waterways free of navigational hazards, ca. 1910.

3-32. The Canal St. Jean Charles appears on maps from the early 1900s and it continues to serve the members of this relatively isolated fishing and trapping community.

3-33. Intracoastal City, Louisiana.

3-34. To gain access to trapping and hunting leases, trappers dug small pirogue trails called trainasse, like this one near the Leland Bowman Lock, in Vermilion Parish.

3-35. Trainasse in marsh adjacent to Leland Bowman Lock near Intracoastal City.

3-36. Oil well location slip which has been newly dredged in marshes northeast of Pecan Island.

3-37. Canals are an integral part of the onshore history of oil and gas exploration in Louisiana's alluvial wetlands.

3-38. Workman applies somastic compound by hand to pipeline built through [Vermilion Parish in] Louisiana.

3-39. Oil collecting station in the marshes west of Intracoastal City.

3-40. Aerial view of the linear settlements strung out along Bayou Black west of Houma, showing how all homes had access to the Bayou.

3-41. This "Buy Garfish" sign nailed to a tree in the swamp adjacent to Highway 82 in Vermilion Parish is an indicator of the importance of this fishery, since the buyer is willing to pay "top price" for this fish.

3-42. Tarring fishing nets being spread out to dry by fisherman living along Bayou Sorrel, Iberville Parish, Louisiana.

3-43. View of a fish car commonly used to transport fish to market prior to the introduction of refrigeration.

3-44. Steel-hulled shrimp boats at one of the seafood processing facility docks in Intracoastal City.

3-45. Although overshadowed by other fisheries, part of Louisiana's tuna fleet operates from docks along Bayou Grand Caillou within the community of Lower Dulac in Terrebonne Parish.

3-46. Part of a day's catch by a mullet fisherman operating out of Chauvin in Terrebonne Parish.

3-47. A new fishery in south Louisiana is mullet. Mullet are prized for their roe, which is exported to Asia.

3-48. Shrimp fisherman's houses and shrimp-drying platform on high ground in Barataria Bay.

3-49. On this shrimp drying platform south of Houma, men and women "danced the shrimp" to remove the shell during the drying process. The shells were sold as "bran" and used as an additive to chicken feed.

3-50. This conveyor is transferring shrimp from a shrimp boat at a seafood-processing house near Cocodrie in Terrebonne Parish.

3-51. By dollar value, shrimp is the most important shellfish in Louisiana. Eighteen-wheelers carry the unprocessed shrimp to packing houses and to markets throughout the country.

3-52. Tonging for oysters in the oyster beds of the Golden Meadow fisheries.

3-53. Before mechanization, a pair of tongs was used to harvest Louisiana's oyster beds.

3-54. To facilitate processing, oyster shops were often built on isolated sites near productive oyster leases.

3-55. The region's fishing tradition is evident by this sign on a truck near Chauvin in Terrebonne Parish.

3-56. Since the early 1900s oysters have been an important part of the Terrebonne/Lafourche parish economies. This oyster shucking house near Chauvin in Terrebonne Parish continues an industry that is nearly 100 years old.

3-57. Unloading a boat load of oysters onto conveyer which carries them into the oyster house.

3-58. Main street in Houma, Louisiana.

3-59. An oyster boat tied to the dock at the Port of West St. Mary.

3-60. Abandoned Bay Junop Oyster Co. building along lower Bayou du Large.

3-61. Distribution of oyster producing areas in 1920.

3-62. Distribution of oyster leases in March 1998.

3-63. Deteriorated marsh along Isle de Jean Charles road, Terrebonne Parish.

3-64. Oysters growing on the bulkhead of the public landing at Isle de Jean Charles in Terrebonne Parish.

3-65. This February 1978 aerial view of Diamond Reef, south of Marsh Island, shows the extent of this exposed feature.

3-66. Oysters are dredged using both large luggers and small boats like these, docked along lower Bayou du Large in Terrebonne Parish.

3-67. The abandoned Bay Junop Oyster Company building on lower Bayou du Large in Terrebonne Parish.

3-68. Although most of Louisiana's oyster activity is in the region east of Point Au Fer, these oyster luggers, docked at Cypremort Point, are a reminder of the oyster habitats associated with the Vermilion Bay estuarine complex.

3-69. Sign for a seafood establishment at the Port of West St. Mary. It is one of the few oyster-processing facilities west of Houma.

3-70. Aerial view of a menhaden processing plant along the Vermilion River at Intracoastal City in Vermilion Parish.

3-71. Crabber with an example of the type of crabs being delivered to processing plants along Bayou Grand Caillou.

3-72. Fisheries resources have been an important part of the coastal economy. In the 1930s blue crabs were scooped up from baited lines and placed in wooden baskets for market.

3-73. A stack of crab traps adjacent to a seafood house at Cypremort Point, St. Mary Parish.

3-74. Boxes and boxes of catfish heads are sold to crabbers as bait for their traps.

3-75. This typical crab boat is used to harvest crabs from the Vermilion Bay estuarine complex and is based in Cypremort Point in St. Mary Parish.

3-76. The distinctive design of these boats is a clue to their crab harvesting function.

3-77. A crab fisherman moving his traps along Bayou Pointe au Chien near Pointe au Chien Marina in Terrebonne Parish.

3-78. A box of live crabs waiting shipment to market from a crab house at Cypremort Point in St. Mary Parish.

3-79. Boxes of crabs waiting shipment to market in the foreground with the associated traps in the background, at Cypremort Point in St. Mary Parish.

3-80. A typical trapper's camp on Belle Isle Bayou.

3-81. Distribution of marsh structures during the 1930s

3-82. The shrimping fleet docked at the Morgan City waterfront during the May 1959 season.

3-83. Shrimp fishing fleet at Bayou Delcambre.

3-84. The boat-oriented community of Dulac is a typical south Louisiana bayou settlement.

3-85. The oyster lugger "Danny Boy" being hauled up on dry dock at a Bayou du Large marine service facility in Terrebonne Parish.

3-86. Dwight Naquin skinning a nutria in his processing shed along Bayou Pointe au Chien in Terrebonne Parish.

3-87. Trappers have used marsh fires for nearly 100 years to improve their trapping leases.

3-88. Oil well canal and trainasse in Vermilion Parish.

3-89. This 15 1/2 ft long alligator was caught along Ivanhoe Canal near Cote Blanche Island, St. Mary Parish, in 1958.

3-90. An example of the size of alligators trapped during the September harvest.

3-91. This alligator farm along Highway 82 north of the Gulf Intracoastal Waterway is one example of an industry that includes more than 100 commercial operators.

3-92. A trainasse machine digs marsh ditches with two rotating blades that spin in opposite directions.

3-93. Trapper's camp on Bayou Belle Isle.

3-94. Nutria skins drying at a fur collection facility on Bayou du Large in Terrebonne Parish.

3-95. Nutria skins on metal frames in a drying shed on Bayou du Large in Terrebonne Parish.

3-96. Log raft being towed on the Intracoastal Canal to a lumber mill at Morgan City.

3-97. A part of the town of Patterson, located on the lower reach of Bayou Teche, with the shrimping fleet in the foreground.

3-98. This example of a dying cypress swamp is along the Houma Navigation Canal just north of Falgout Canal in Terrebonne Parish.

3-99. More than 50 years ago, the first commercial oil well out-of-sight-of-land was completed in the Gulf of Mexico.

3-100. Detonating a charge in association with a seismic survey in the marshes near Golden Meadow, Louisiana.

3-101. Seismographic operations in the Gulf of Mexico.

3-102. Tracks of swamp buggies (amphibious tractors) in the marsh south of Intracoastal City, Louisiana.

3-103. This geophysical-survey marsh buggy is used to help develop 3-D seismic profiles of the subsurface marsh geologic structure.

3-104. Geophysical survey team operating on an airboat during a recent 3-D seismic survey.

3-105. This aerial view of a cluster of oil and gas well locations in the Gulf of Mexico near the mouth of Freshwater Bayou Canal shows a small portion of the structures anchored to the Gulf's floor.

3-106. Graph showing crude oil and condensate production in 1993.

3-107. Graph showing percent dry and casinghead gas production in 1993.

3-108. The "Henry Hub" is an important gas processing facility south of Erath in Vermilion Parish.

3-109. Pumping rig and storage tanks at the recycling plant at Erath, Louisiana.

3-110. The Aztec Oil and Gas Company's Rathborne #1 drilling in south Louisiana's swamps.

3-111. The first oil well was completed in Houma on March 18, 1927.

3-112. Once the Texas company (Texaco) had discovered oil at its Lake Barre field in 1929, there was a storage problem.

3-113. Since the 1930s, pipelines have evolved into an important component in the marketing strategy of oil and gas and their associated products.

3-114. After purchasing a fleet of sea planes used to carry mail from ships anchored in the Mississippi delta to New Orleans, Texaco became a pioneer in using aircraft to support their marsh operations, ca. 1930.

3-115. Aerial view of a small oil and gas processing plant along Bayou Black northwest of Houma.

3-116. Signs near J. Ray McDermott's facility in Amelia, Louisiana are one indicator of the health of the local economy.

3-117. Small ship-building facilities are a part of south Louisiana's commercial landscape.

3-118. This sign lists only a fraction of the offshore oil and gas service companies operating in the Intracoastal City.

3-119. These supply boats transport supplies and crew between Intracoastal City and offshore oil and gas platforms south of Marsh Island.

3-120. These mud tanks at Intracoastal City are one example of some of the expendables associated with the offshore oil and gas business.

3-121. A small part of the logistic support center for the offshore oil and gas industry that has developed at Intracoastal City.

3-122. The Port of West St. Mary near Louisa, in St. Mary Parish, is an emerging industrial center.

3-123. During the 1960s drilling companies were active off Louisiana's coast looking for marketable hydrocarbons.

3-124. Along Bayou Grand Caillou at Lower Dulac in Terrebonne Parish, tuna boats, shrimp boats, and offshore service bases are aligned along the available wharf space.

3-126. Like Amelia, the industrial complex within the Port of Iberia has evolved around the multifaceted and diverse needs of the offshore oil and gas business.

3-126. Aerial view of Intracoastal City in Vermilion Parish with shrimp boats, offshore service industries and a heliport clearly shown.

3-127. Aerial view of the Amelia industrial complex associated with meeting the fabrication needs of the offshore oil and gas industry.

3-128a. Aerial view of the Amelia industrial complex associated with meeting the fabrication needs of the offshore oil and gas industry.

3-128b. The fabrication facilities in the Amelia/Morgan City area have evolved since the 1950s into an innovator in the design and construction of offshore exploration and production platforms.

3-129. Port Fourchon has developed into one of the most important ports in Louisiana. In less than three years it has evolved into the central hub for deep water drilling and production activity.

3-130. Bayou Lafourche has been characterized as "The Longest Main Street in the World" and the local tourist office has taken advantage of this slogan in some of its promotions.

3-131. C-Port at Port Fourchon is a state-of-the-art loading facility designed to meet the logistic support needs of the exploration and production structures working in the deep waters off Louisiana's coast.

3-132. An example of a deep-water drilling rig under construction near Morgan City.

3-133. With the rebirth of the Gulf of Mexico as a major source of marketable hydrocarbons, fabricators are trying to handle a backlog of business.

3-134. Offshore fabrication yard along the Houma Navigation Canal near Houma, Louisiana.

3-135. "Now Hiring" signs like this one near Morgan City, can be found throughout south Louisiana, as fabricators try to meet the demands of the oil and gas industry.

3-136. There are numerous public boat landings throughout south Louisiana, such as this site at Isle de Jean Charles in Terrebonne Parish.

3-137. An example of a new raised camp on lower Bayou Terrebonne.

3-138. Nearly anytime of year south Louisiana's boat launches are full of cars, trucks and sport utility vehicles and their empty boat trailers, such as this site at the Pointe au Chien Marina.

3-139. Louisiana's oyster reefs serve as important fisheries habitats, as witnessed by the variety of game fish caught in 1968 at Outside Reef.

3-140. A *poupier* mounted on a floating platform near lower Bayou Lafourche in Lafourche Parish.

3-141. Cleaning ducks at Guidry's Bait Shop along Bayou Pointe au Chien

3-142. This "We clean ducks" sign is unique to south Louisiana and indicates the importance and size of the region's duck hunting harvest.

3-143. Hunting clubs are an important part of the hunting culture of south Louisiana.

3-144. Annual recreational cycle based on the period of greatest activity.

3-145. An example of a small floating camp along lower Bayou du Large.

3-146. Originally, most of south Louisiana's camps were built on the ground. However, experience and new lending regulations now make it prudent to build above the marsh surface.

3-147. A new camp development along Bayou du Large at Falgout Canal in Terrebonne Parish.

3-148. A double row of boat sheds used by sportsmen and commercial businesses to store their boats at a marina along Bayou du Large in Terrebonne Parish.

3-149. Some marinas build multipurpose boat storage/accommodations to meet the needs of their customers.

3-150. The narrow natural levee associated with the lower reach of Bayou Petit Caillou in Terrebonne Parish is shown, with the undeveloped east bank of the bayou, a large marina, and the headquarters of the laboratory of the Louisiana Universities Marine Consortium clearly visible.

3-151. A dense cluster of camps has developed along Bayou Decade in an area accessible only by boat.

3-152. This aerial view is centered on Falgout Canal where it intersects Bayou du Large. The canal, bayou, subsiding/eroding marsh, area under pump drainage, and a drainage pump represent elements found on almost any bayou in south Louisiana.

3-153. Aerial view of the intersection of the Houma Navigation Canal and Four Point Bayou in Terrebonne Parish, with a marina and boat landing shown as well.

3-154. Map of Cypremort Point, St. Mary Parish in 1932.

3-155. Map of Cypremort Point, St. Mary Parish, showing camp locations in 1948.

3-156. Aerial view of the recreation and commercial complex that has developed at Cypremort Point in St. Mary Parish.

3-157. The Cypremort Point State Park boat landing and new camp development extend out into marsh flanking Bayou Cypremort.

3-158. This sign, on the Bayou Sale road in St. Mary Parish, is an indicator of one oil company's history, as shown by the change in operating names.

3-159. Map of lower Bayou Sale, St. Mary Parish in 1957.

3-160. Ecotourism supports a number of local entrepreneurs, such as this tour on Bayou Black west of Houma.

3-161. Aerial view of the Atchafalaya River at Morgan City and the three bridges that cross the river at this point.

3-162. Point-Au-Fer lighthouse was located at the mouth of Atchafalaya Bay.

3-163. After being cut in nearby swamps, logs were lashed together with "chain-dogs," forming rafts that were then pulled by a steamboat to lumber mills for processing.

3-164. A portion of the Magnolia Petroleum Company's (now Mobile) offshore operation at Block 126.

3-165. This Gulf Refining Company "float" was part of an early 1900s Mardi Gras parade.

3-166. This photograph of the Magnolia Petroleum Company's (now Mobil) support center in Morgan City was taken less than 10 years after establishment of the world's first offshore oil well.

3-167. As the offshore industry matured, steel fabrication facilities, such as this site near Amelia, in St. Mary Parish, were expanding to meet their long and short-term contractual obligations.

3-168. These Large drilling and exploration platforms being constructed at facilities along Bayou Black in Amelia, Louisiana are part of the economics of the offshore industry.

3-169. South Louisiana is a labyrinth of pipelines, such as this gas line crossing at the Charenton Navigation and Drainage Canal near Baldwin in St. Mary Parish.

3-170. In order to live in parts of south Louisiana it is necessary to improve drainage with a system of pumps.

4-1. Shoal in Little Pass Timbalier between Timbalier Island and East Timbalier Island.

4-2. Using convict labor and scaffolding-supported ramps the Morganza Crevasse was closed.

4-3. Repairing a levee during the flood of 1927.

4-4. Although waters from the 1927 flood inundated a large portion of Morgan City, the Norman-Breaux Lumber Company's ring levee clearly protected the property from flooding.

4-5. When unusually high water occurred in 1973, 10 bays on the Morganza Control Structure were opened to relieve potential flooding problems down river .

4-6. Calumet floodgates were constructed to prevent high water on Wax Lake Outlet from entering Bayou Teche. The Wax Lake Outlet flows right to left in this photo.

4-7 In 1988 the stone weir in this photo was constructed across Wax Lake Outlet. The weir was removed in 1995.

4-8. During the high water period of 1973, the Morgan City flood wall protected much of the city. Those areas not protected were flooded.

4-9. Aerial view of the Bayou Boeuf locks along the Gulf Intracoastal Waterway near Morgan City.

4-10. This aerial view shows "The Jaws" facing south towards the Gulf in St. Mary Parish. This opening serves as a minor Gulf outlet for waters of the Atchafalaya River.

4-11. Near Weeks Island, erosion has created a breach between the Gulf Intracoastal Waterway and Weeks Bay.

4-12. The Corps of Engineers dredge Grosse Tete at work in south Louisiana.

4-13. Aerial view of the lock on the Gulf Intracoastal Waterway near Intracoastal City, with a portion of the old Vermilion Lock visible in the lower right corner.

4-14. Small towboat on the Intracoastal Canal east of Intracoastal City.

4-15. The locks on Freshwater Bayou Canal have promoted development of a small port for fishing and offshore service vessels, visible in the lower right corner of the photograph.

4-16. Originally designed to control water levels in the Freshwater Bayou canal, the locks are now clogged with offshore service vessels that transport supplies from supply bases and yards in Intracoastal City, to offshore fields.

4-17. Houma Navigation Canal and dead cypress swamp in bottom half of photo.

4-18. Aerial view of Bayou du Large showing a flood control structure on the bayou, the region's hurricane protection levee, and impoundment area.

4-19. Although common in a country like the Netherlands, these large floodgates on the bayous of Terrebonne Parish are not expected, but are a vital part of the local hurricane flood protection system.

4-20. A canal is dredged to a new drilling operation.

4-21. A new well is being drilled in the Weeks Island oil field near the Gulf Intracoastal Waterway in Iberia Parish.

4-22. Part of Terrebonne Parish's drainage system is illustrated by these pumps just north of Montegut.

4-23. Aerial view of Bayou du Large showing area impounded by hurricane protection levee, marsh land, and the undeveloped west bank of the bayou.

4-24. An example of an impoundment levee that is part of the Terrebonne Parish engineered landscape.

4-25. The southernmost impoundment drainage pump located near the Isle de Jean Charles road, along the west side of Bayou Pointe au Chien.

4-26. Lower Bayou du Large at end of artificial levee.

4-27. Along Bayou Pointe au Chien, vegetation protected by the drainage levee is within part of a healthy ecosystem; however, outside the levee the cypress swamp is dying.

4-28. In order to secure a home loan, many house trailers – depending on their location – must be elevated to protect them from potential flood waters.

4-29. New house construction along Bayou Black in Houma.

4-30. Linear patterns highlight the erosion prevention structures associated with this Christmas tree project near the Gulf Intracoastal Waterway south of Franklin.

4-31. This 1983 photograph, view to the south, shows a clear distinction between Avoca and Bateman Islands on the south and Morgan City on the north.

4-32. This abandoned pumping station is a visual reminder of the land reclamation effort associated with Avoca Island near Morgan City.

4-33. Outside Reef, also known as Nickel Reef, was located southeast of Marsh Island in East Cote Blanche Bay and is part of a barrier reef system that has been devastated by shell dredging, sedimentation, and increased fresh water flow from the Atchafalaya River.

4-34. The emerging Atchafalaya delta continues to expand.

4-35. This abandoned plantation house along Highway 83 near Freetown in St. Mary Parish, may be an indicator of the precarious future of the sugar business in Louisiana.

4-36. Old structure associated with an abandoned farm site along lower Bayou Pointe au Chien.

4-37. Graph showing population growth rates.

4-38. Graph showing average population densities.

4-39. Map showing population density in 1990.

4-40. Map showing population density and forced drainage.

4-41. The new camp development at Cypremort Point will increase dramatically the size of this camp-oriented community.

5-1. On the Mississippi River, high water was always of some concern. In 1890, this convict-labor wheelbarrow brigade worked to close the Morganza crevasse.

5-2. Isle de Jean Charles is threatened by land loss.

5-3. Houses and camps at the north end of Isle de Jean Charles.

5-4. Natural levee ridges along Four Point Bayou.

5-5. Four Point Bayou at Houma Navigation Canal.

5-6. Camps along bayou at intersection with canal near Lost Lake, Terrebonne Parish.

5-7. "Stranded" camps along subsided natural levees flanking Bayou Cook in Plaquemines Parish.

5-8. Aerial view of oyster reefs along the south side of Marsh Island near the first point west of Mound Point, about two miles from Mound Point, facing northwest.

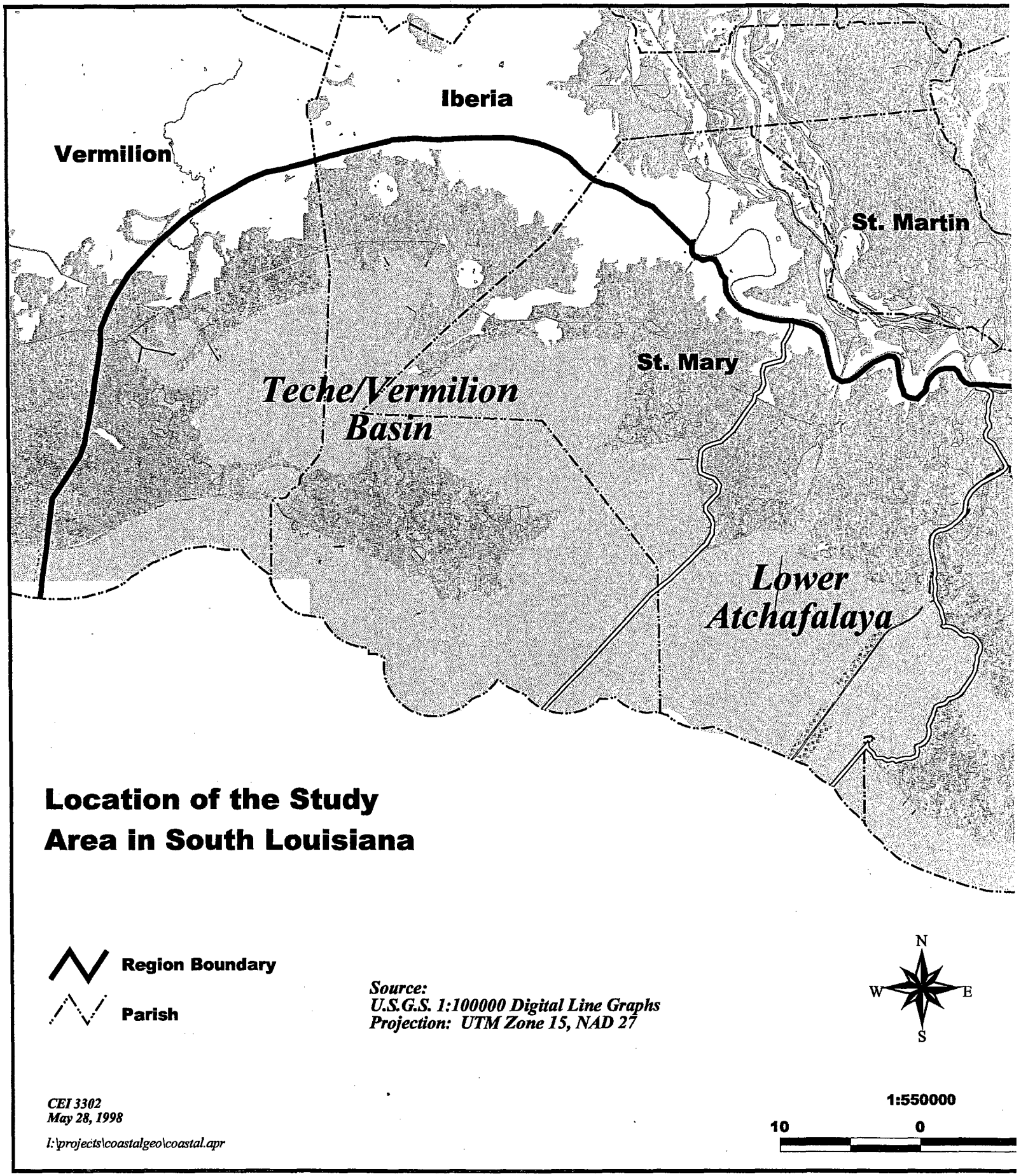
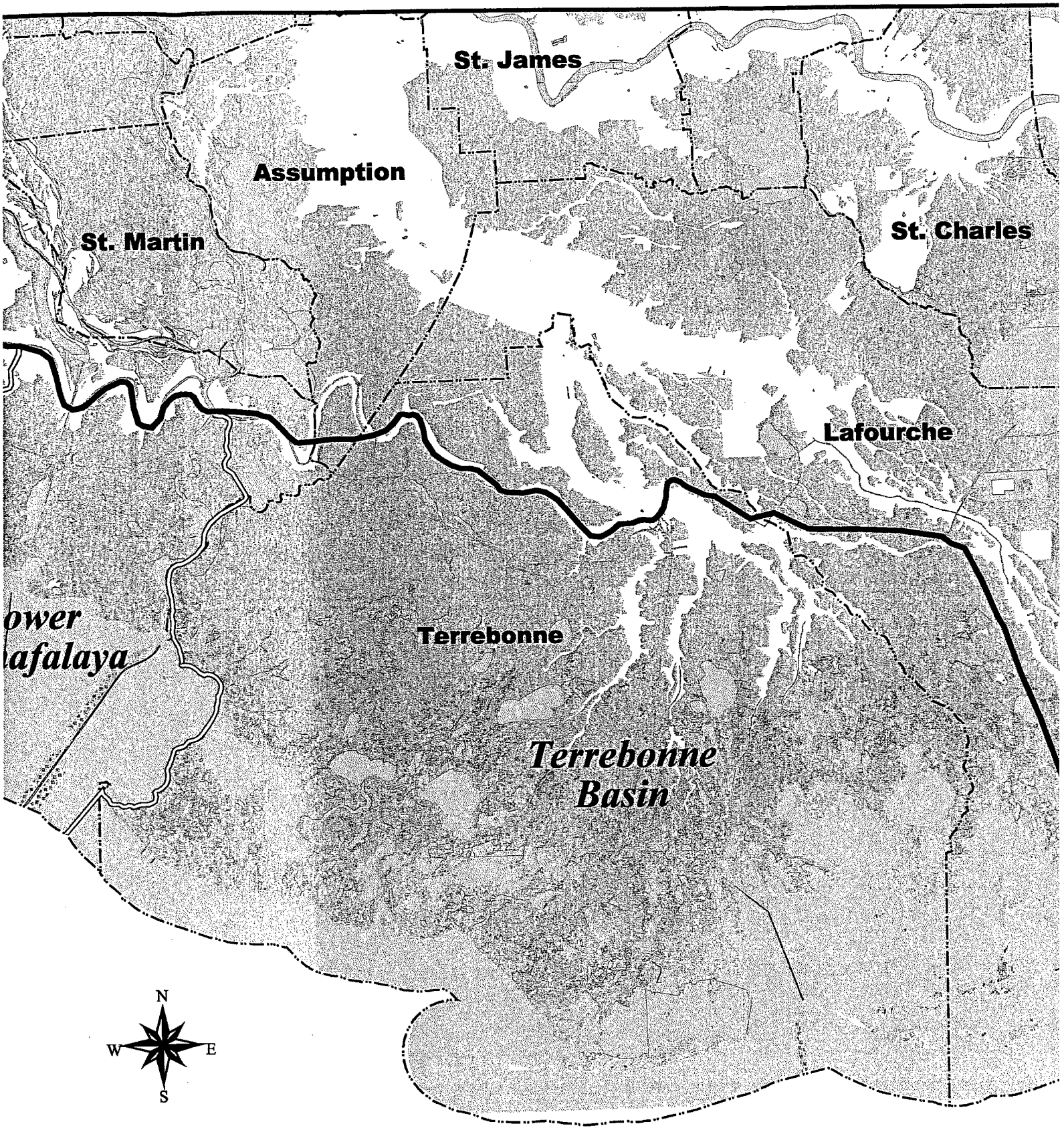
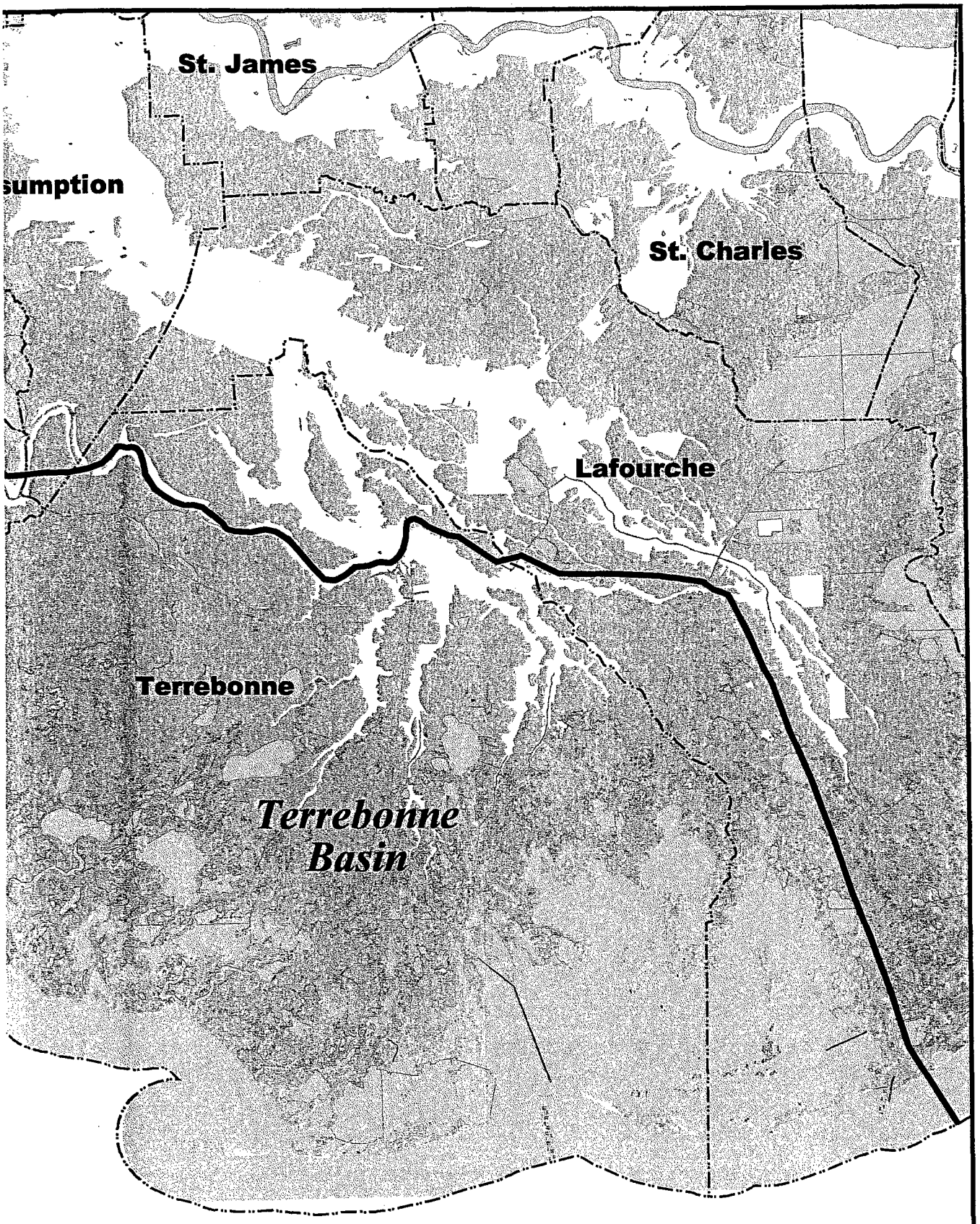


Figure 1-1. Location of the study area in south Louisiana.


St. James
Assumption
St. Martin
St. Charles
Lafourche
ower
afalaya
Terrebonne
Terrebonne
Basin
N
W
E
S
1:550000
10
0
10 Miles


St. James
sumption
St. Charles
Lafourche
Terrebonne
Terrebonne
Basin
10 Miles

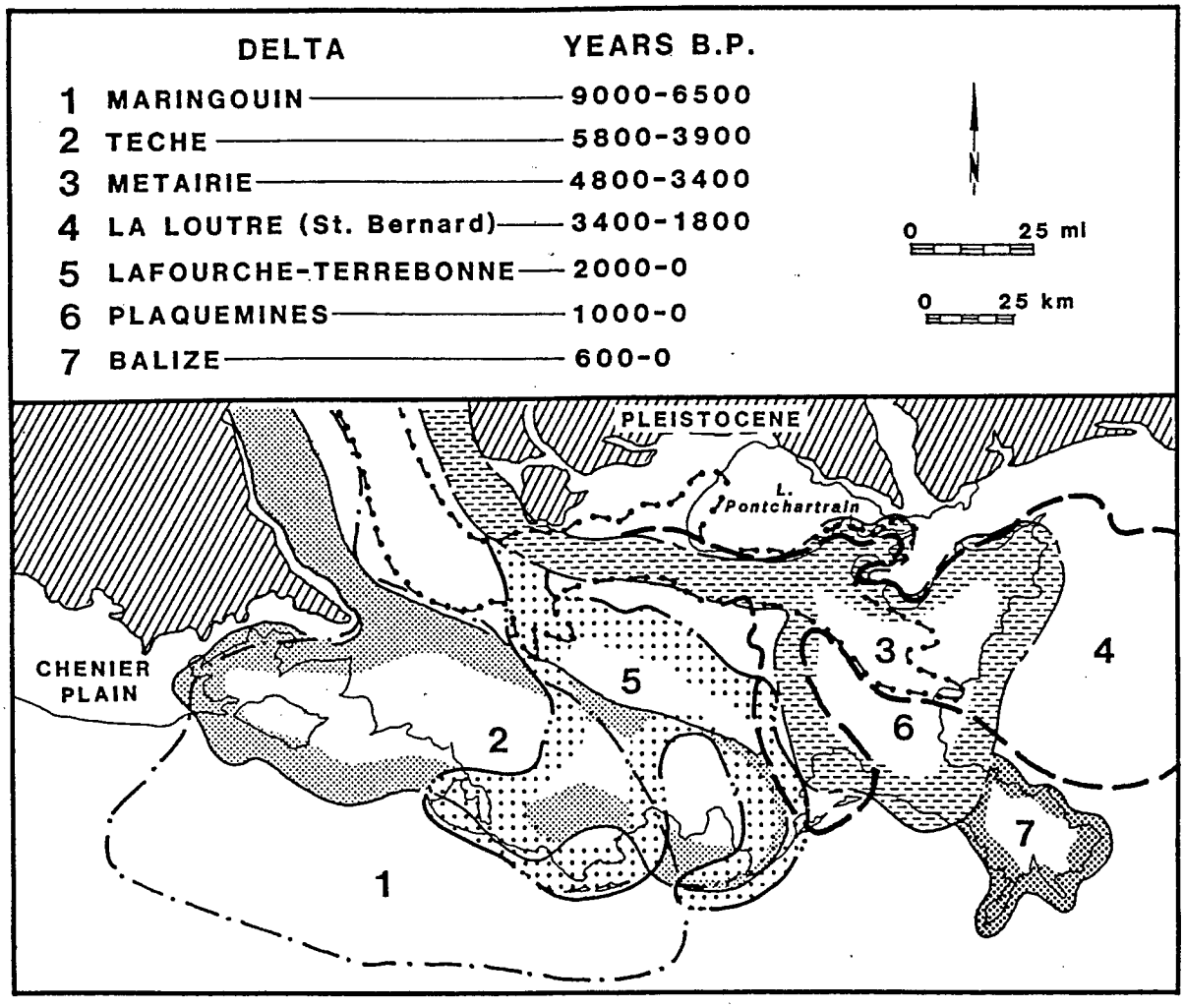


Figure 2-1. Mississippi River delta sequence over the past 9000 years (source: Weinstein and Gagliano 1985:Fig. 1)

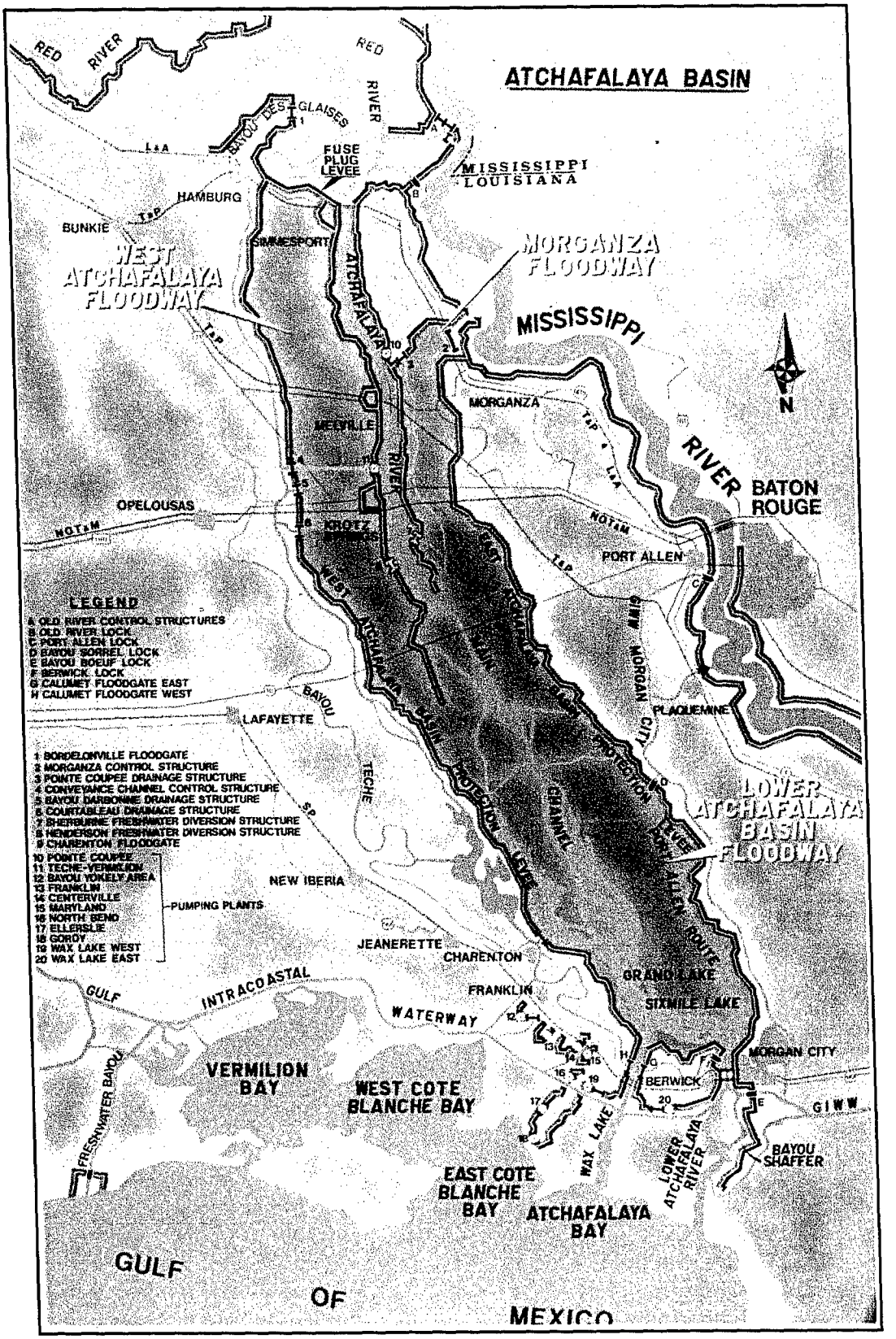


Figure 2-2. Map of Atchafalaya Basin showing control structures (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 18126).

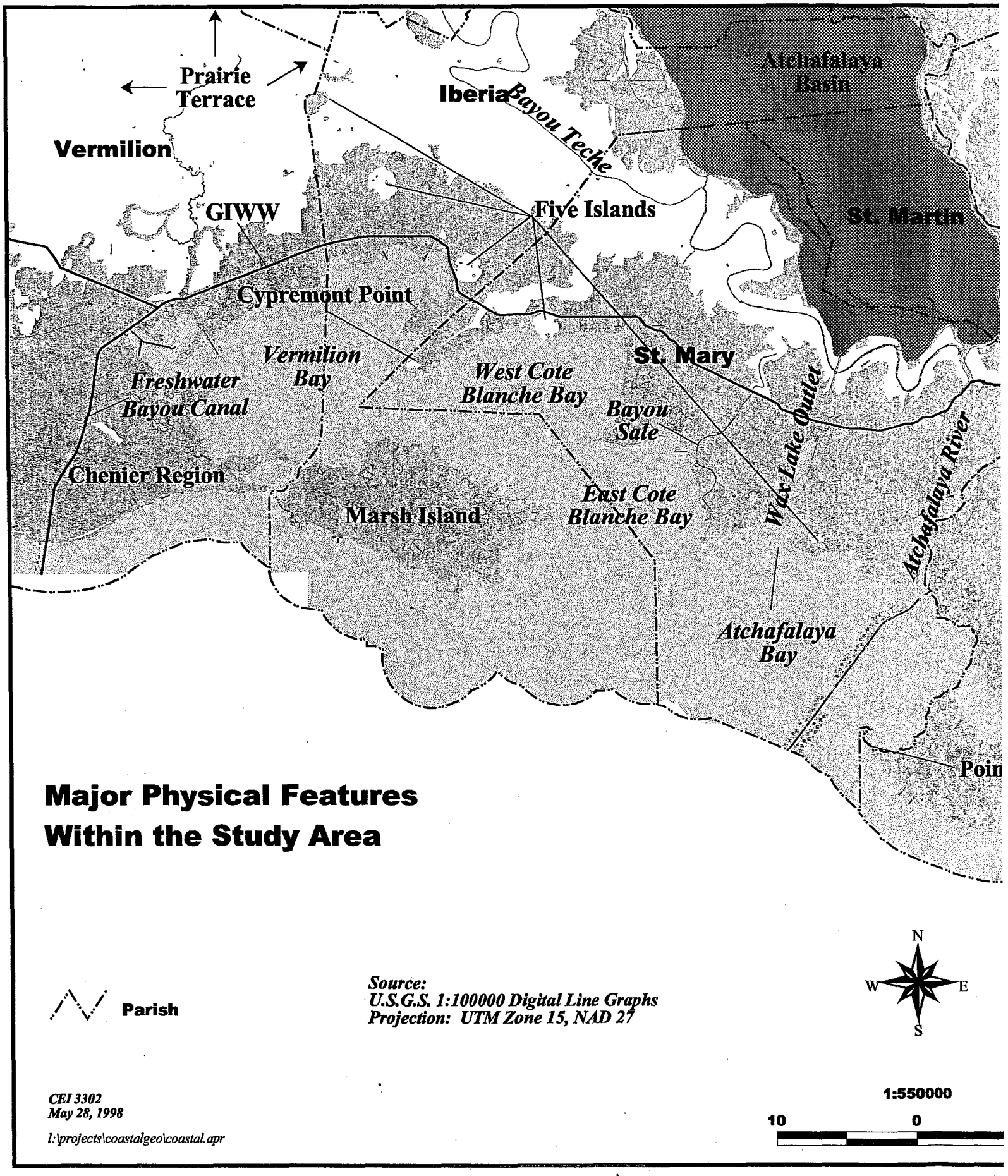
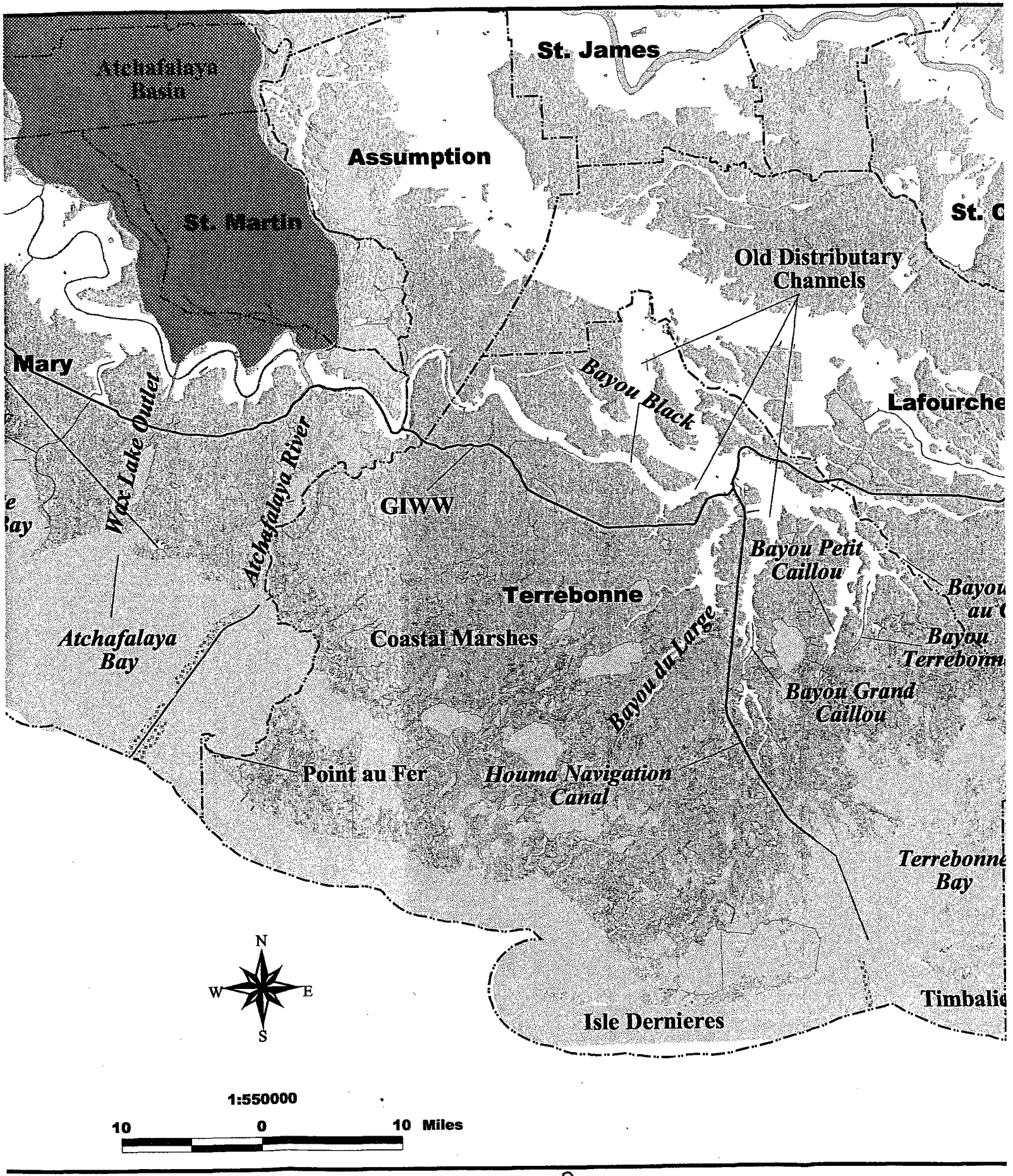
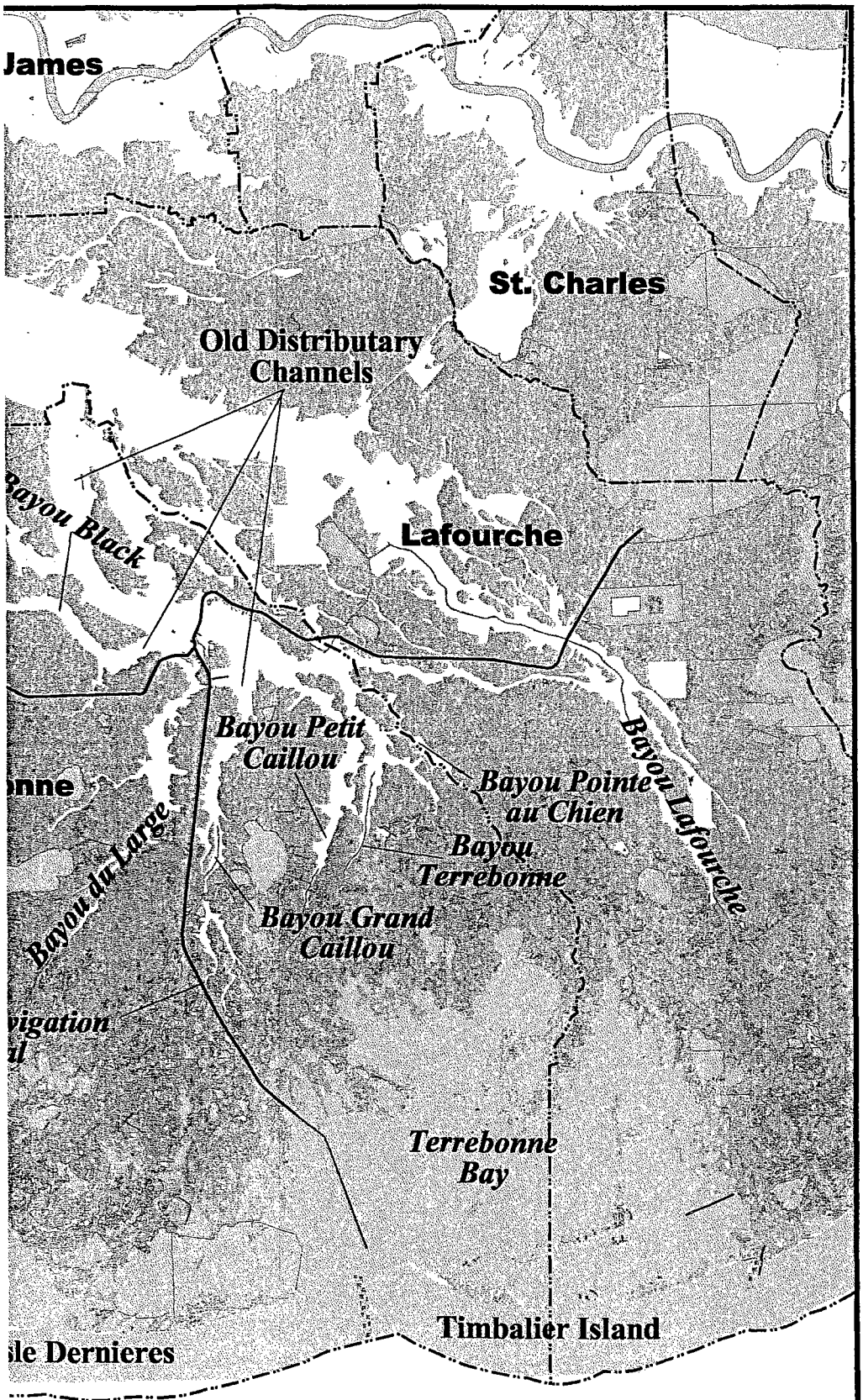


Figure 2-3. Major physical features within the study area.


Atchafalaya Basin
St. James
Assumption
St. Martin
St. C
Old Distributary Channels
Mary
Bayou Black
Lafourche
Wax Lake Outlet
Atchafalaya River
GIWW
Bayou Petit Caillou
Terrebonne
Coastal Marshes
Atchafalaya Bay
Bayou du Large
Bayou Grand Caillou
Point au Fer
Houma Navigation Canal
Terrebonne Bay
N
W
E
S
Isle Dernieres
Timbalie
1:550000
10 0 10 Miles


James
St. Charles
Old Distributary
Channels
Bayou Black
Lafourche
Bayou Petit
Caillou
Bayou Pointe
au Chien
Bayou Lafourche
Bayou
Terrebonne
Bayou Grand
Caillou
Bayou du Large
Terrebonne
Bay
Timbalier Island

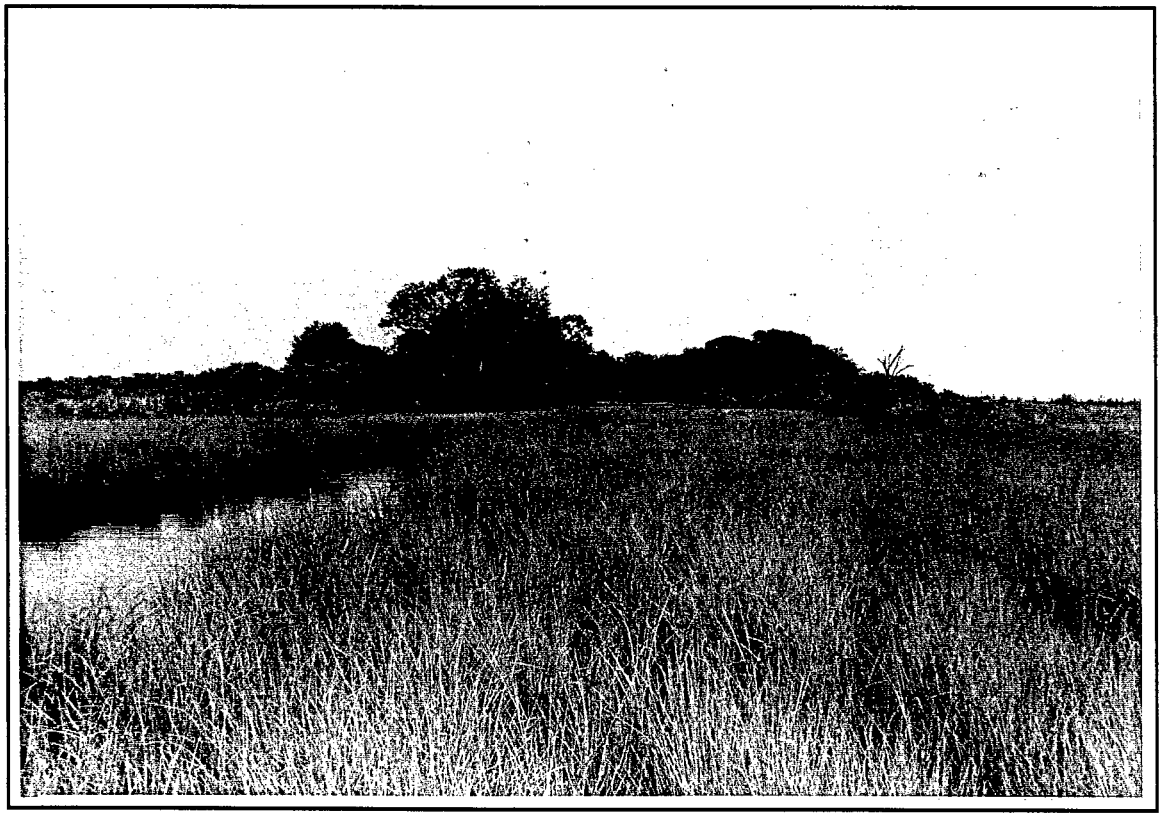
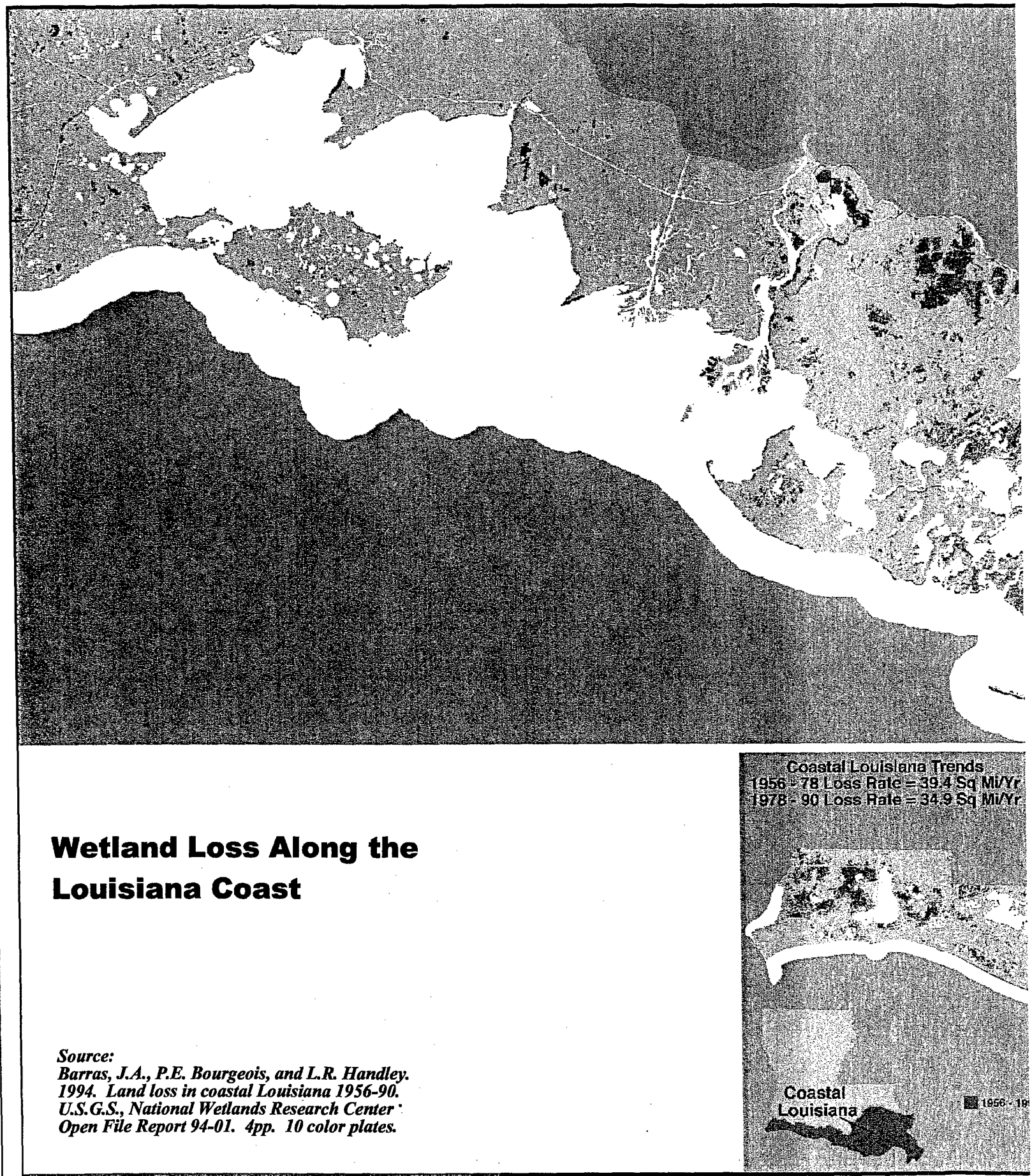


Figure 2-4. **Lower Bayou Pointe au Chien ridge and surrounding marsh. Note that natural levee ridge has subsided below the marsh in the foreground and is elevated in the distance, creating an "island" that supported farms during the nineteenth century. Date: August 16, 1995.**



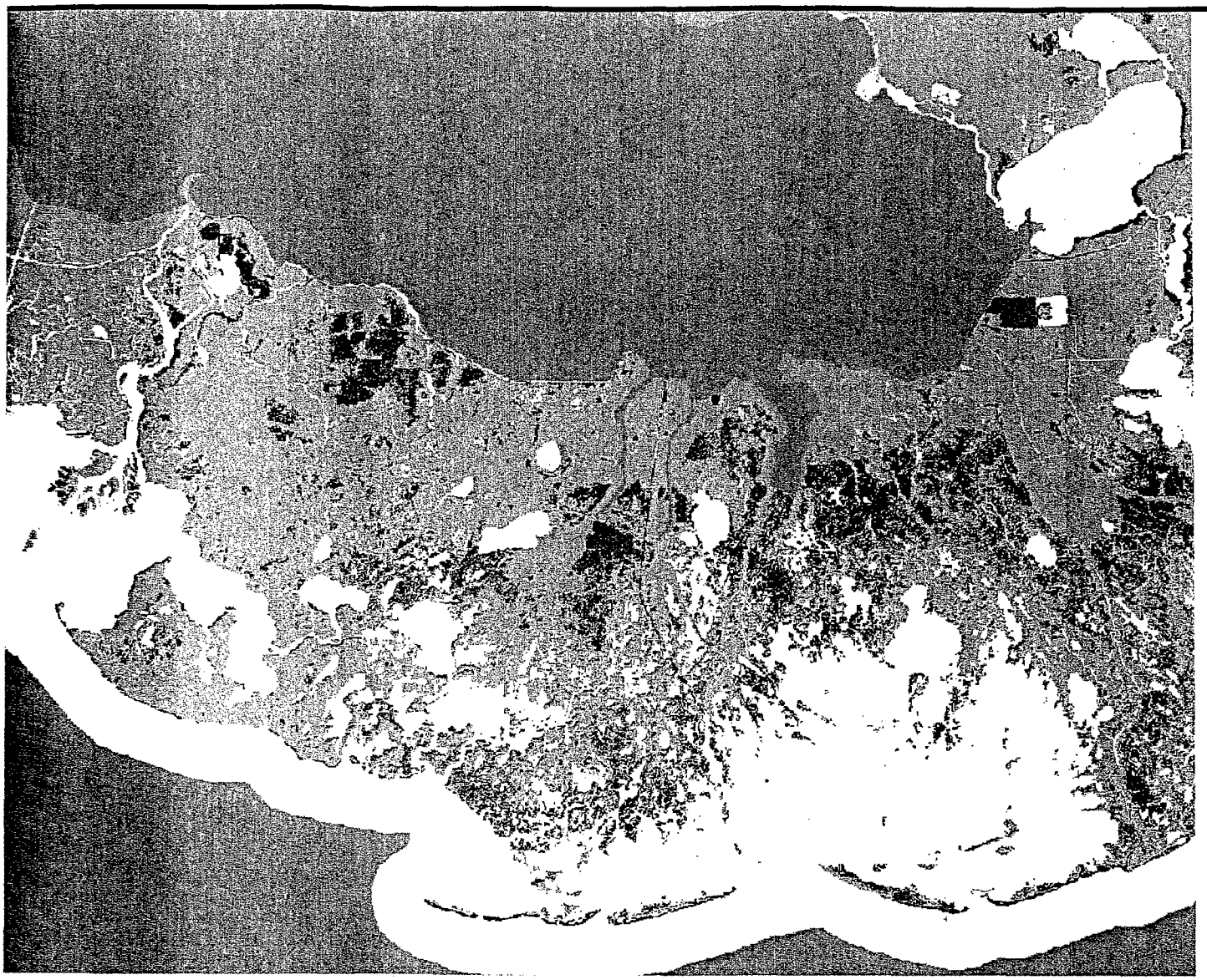
Figure 2-5. Cheniere au Tigre and surrounding marsh, Vermilion Parish. Date: March 11, 1998.



Wetland Loss Along the Louisiana Coast

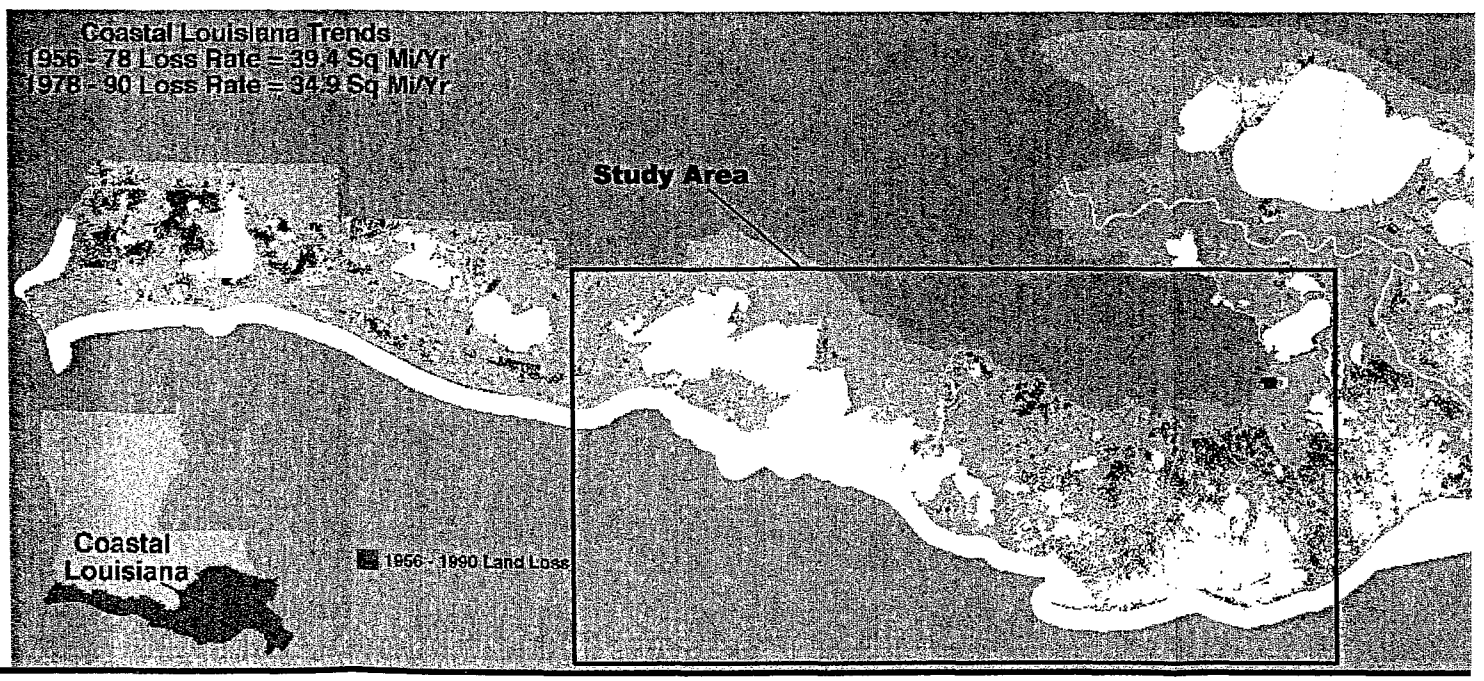
Source:
Barras, J.A., P.E. Bourgeois, and L.R. Handley. 1994. Land loss in coastal Louisiana 1956-90. U.S.G.S., National Wetlands Research Center Open File Report 94-01. 4pp. 10 color plates.

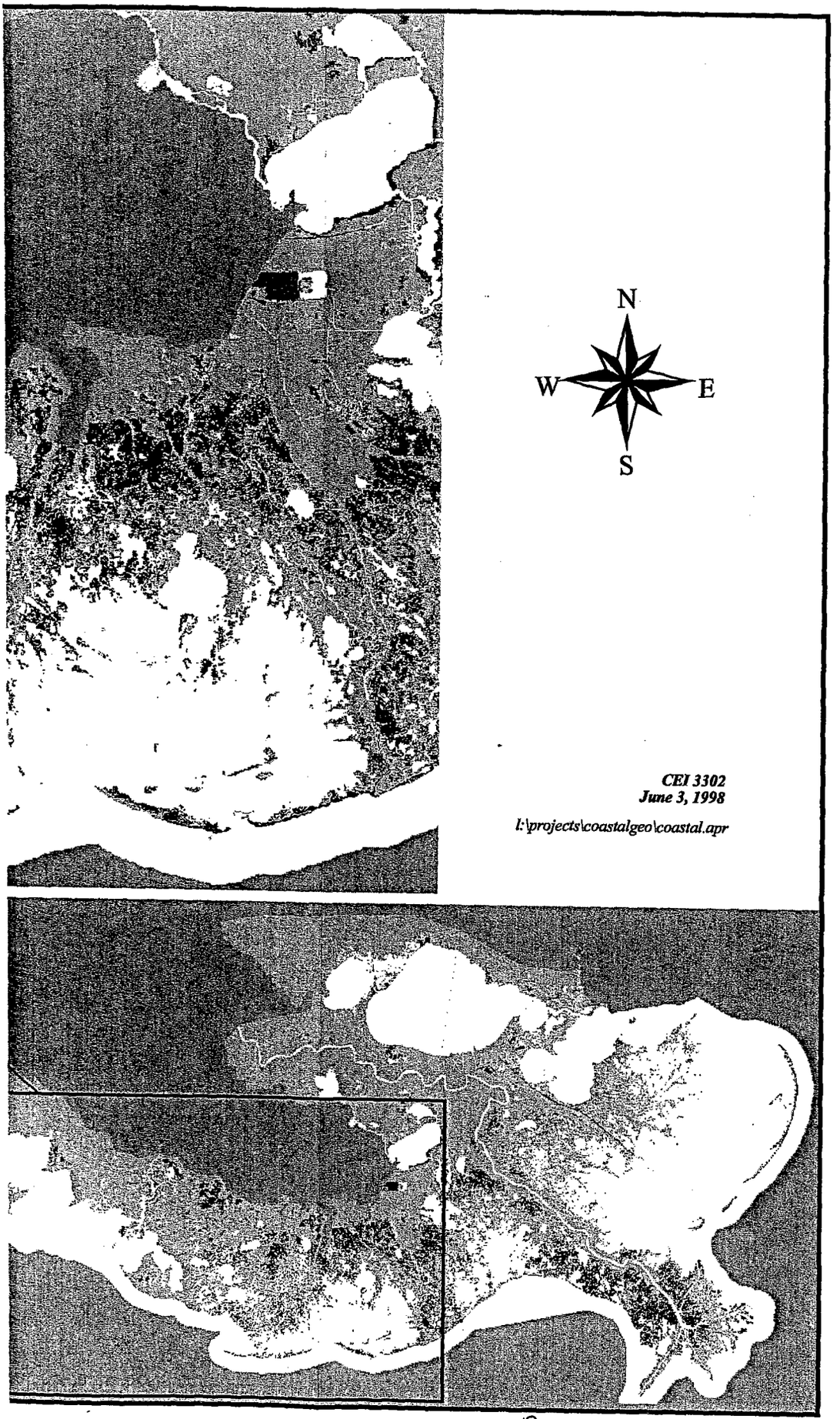
Figure 2-6. Wetland loss along the Louisiana coast.



W

l:\proj


Coastal Louisiana Trends
1956 - 78 Loss Rate = 39.4 Sq Mi/Yr
1978 - 90 Loss Rate = 34.9 Sq Mi/Yr
Study Area
Coastal Louisiana
1956 - 1990 Land Loss


N
W
E
S
CEI 3302
June 3, 1998
l:\projects\coastalgeo\coastal.apr

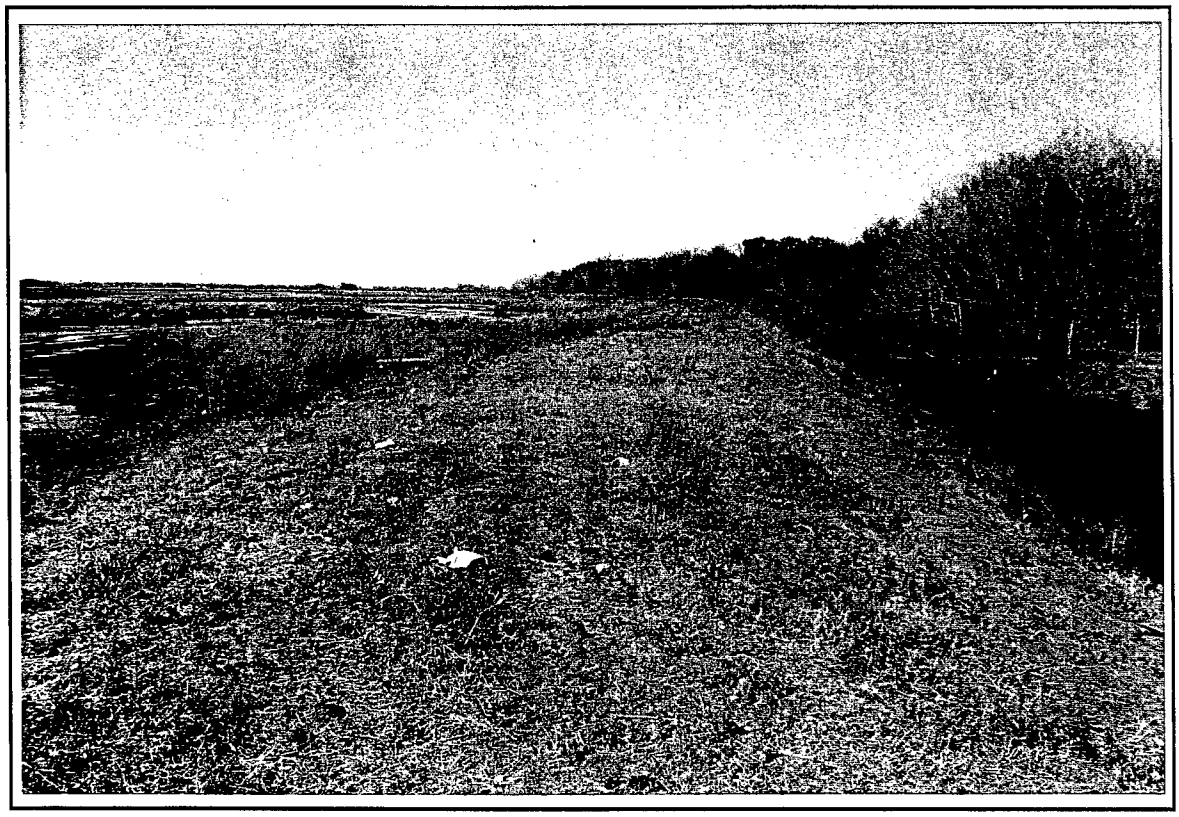


Figure 2-7. Artificial levee and drainage canal separating marsh (at left) from pump drainage area (at right) along lower Bayou Pointe au Chien, Terrebonne Parish. Water level in the drainage canal is about five feet below the marsh. Date: December 30, 1997.



Figure 2-8. These dying trees at Burns Point at the south end of Bayou Sale in St. Mary Parish are an indicator of the erosion problems along the shoreline of East Cote Blanche Bay. Date: December 11, 1997.

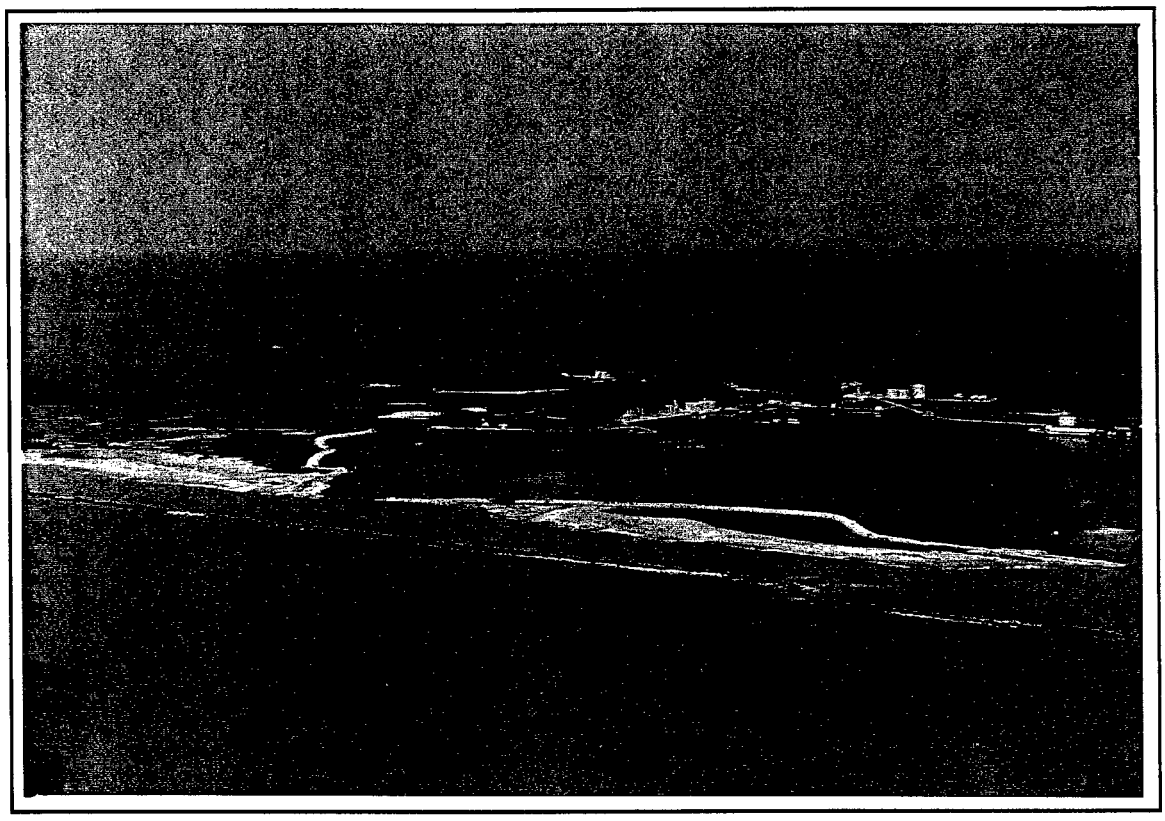


Figure 2-9. East Timbalier Island, facing north. Note broken segments of island and walls installed as restoration measures. Date: April 16, 1993.

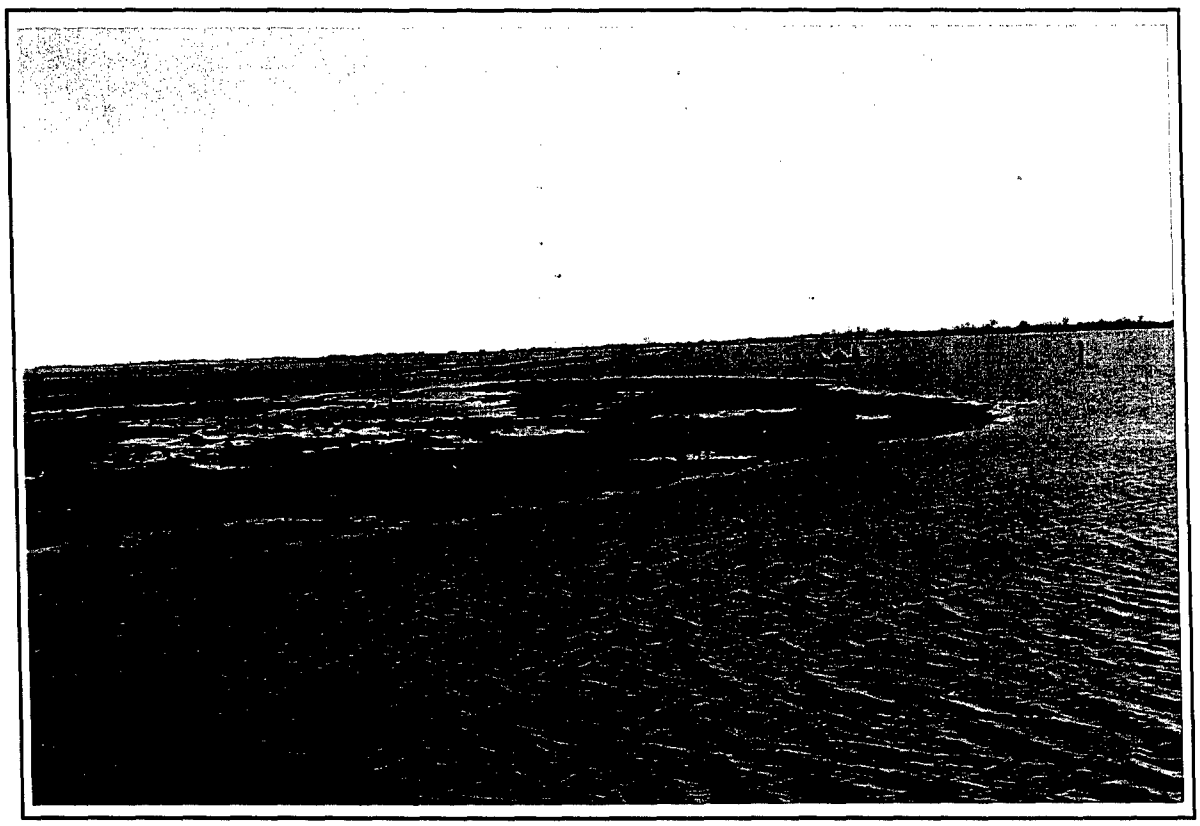


Figure 2-10. Deteriorated marsh along the road between Bayou Pointe au Chien and Isle de Jean Charles, Terrebonne Parish. Due to salt water intrusion, oysters are now living in this area. Date: December 30, 1997.



Figure 2-11. This Christmas tree coastal restoration project is located in Hammock Lake east of Cypremort Point in St. Mary Parish. Date: March 11, 1998.

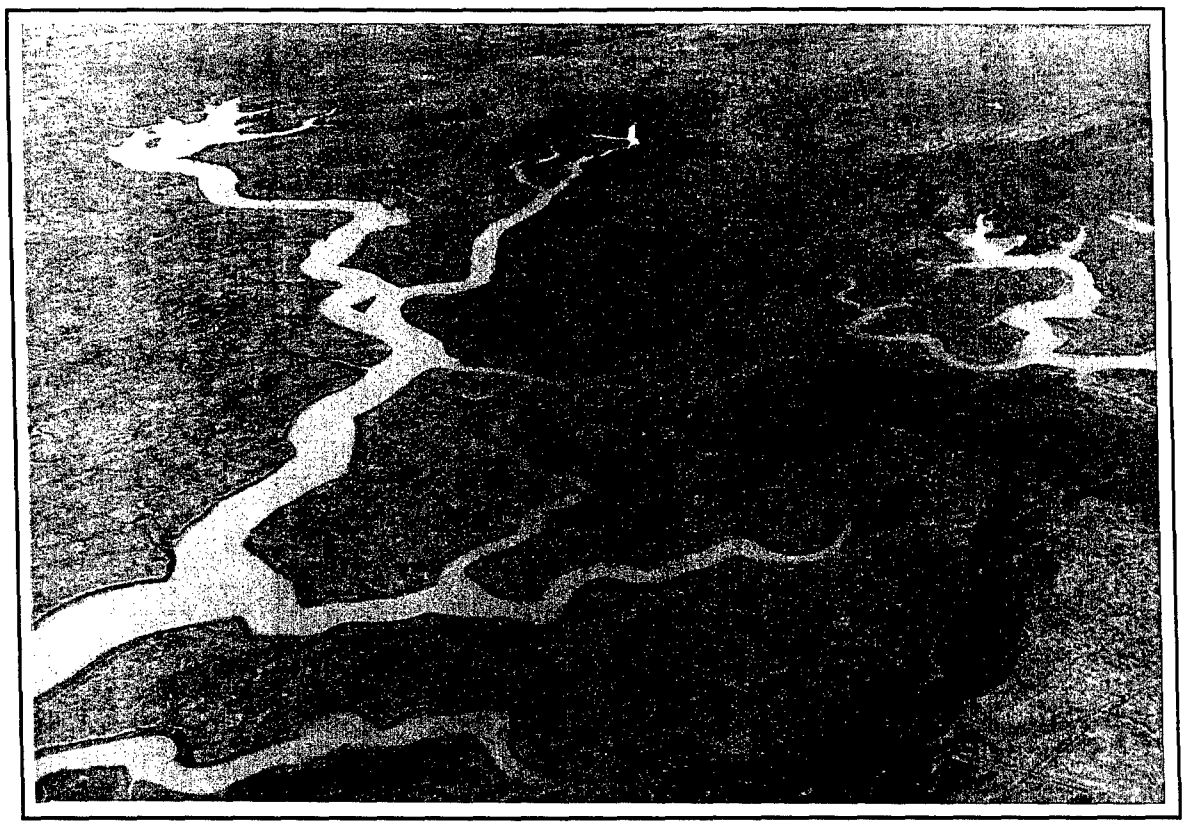


Figure 2-12. Intermediate/fresh marsh and drainage channels between Weeks Island and Cypremort Point, Iberia Parish. Date: March 11, 1998.

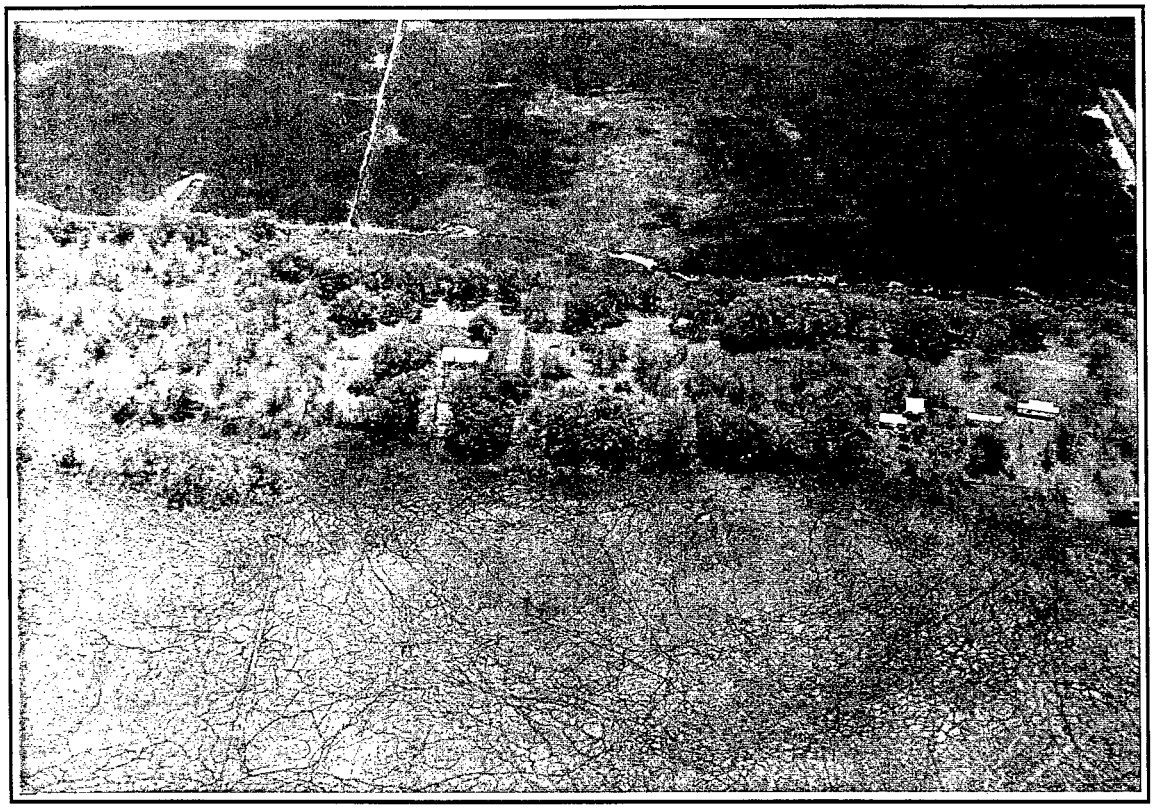


Figure 2-13. Cheniere au Tigre, Vermilion Parish. Note the cattle trails in marsh along lower part of photo and camps along the tree-covered ridge. Date: March 11, 1998.



Figure 2-14. Saltwater intrusion and other environmental factors have adversely effected the wetland's plant communities, as evident by this dead cypress swamp along east side of Bayou Pointe au Chien east of the community of Montegut. Date: December 30, 1997.



Figure 2-15. Lower Bayou Pointe au Chien channel with forested natural levees. A small farming community existed here during the nineteenth century. Date: August 16, 1995.



Figure 2-16. Hurricane Audrey's damage to several logistic support sites in the vicinity of Morgan City disrupted the flow of goods and services offshore (source: Morgan City Library Historic Archives, *Jessie Grace Collection*, Image No. 707-29, 11/21/62).

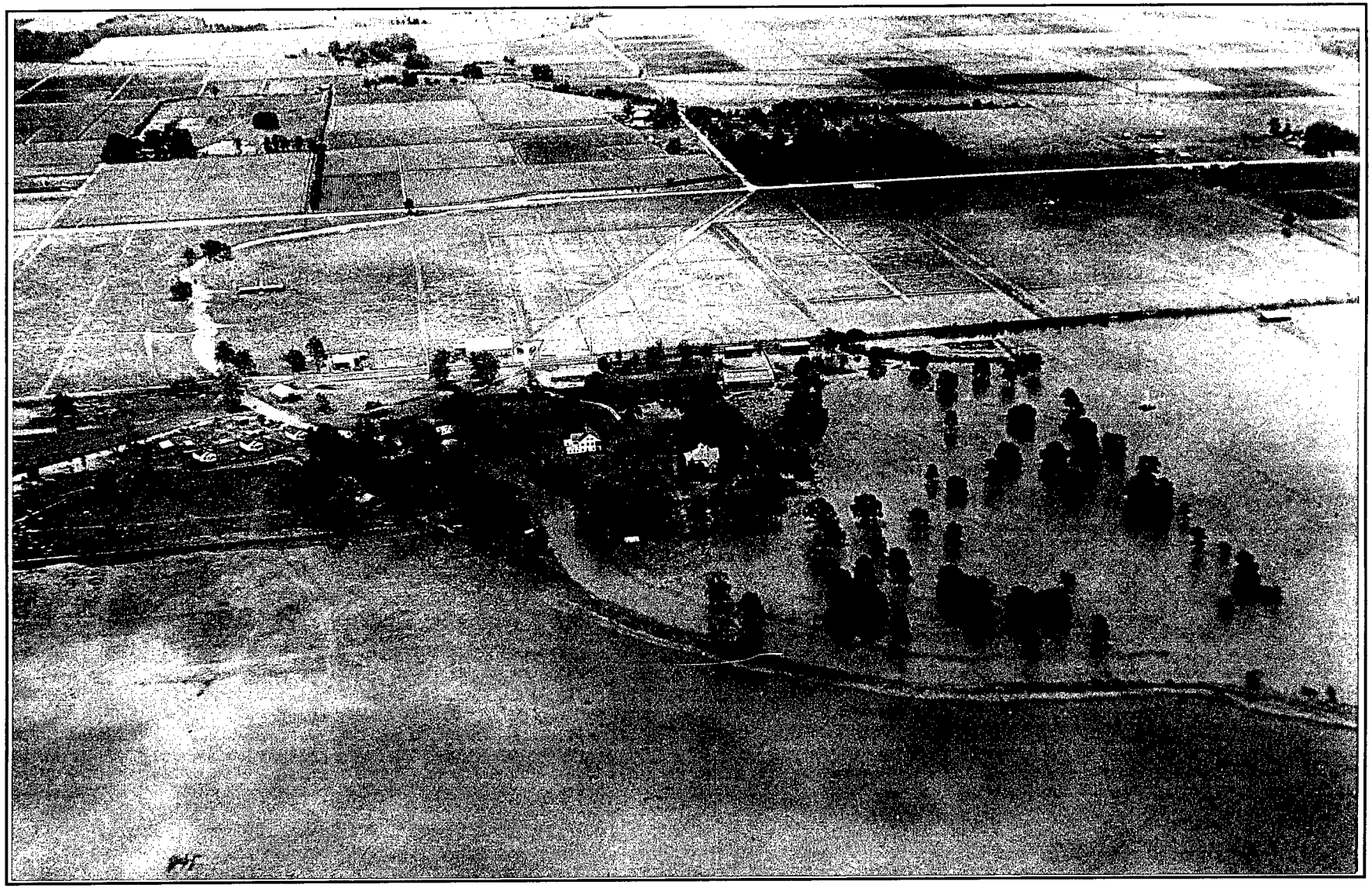


Figure 2-17. Although best known for inundating Cameron, Louisiana in 1957, hurricane Audrey also flooded parts of St. Mary and Iberia Parishes as well. This photo illustrates hurricane Audrey flooding on Vacherie Plantation near Franklin (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).



Figure 2-18. **In south Louisiana, hurricanes are always of some concern, as witnessed by this debris laden site. This is all that remains of a camp destroyed by Hurricane Andrew near Cocodrie in Terrebonne Parish. Date: December 18, 1997.**



Figure 2-19. An old Creole-style house along lower Bayou Terrebonne. Date: December 30, 1997.

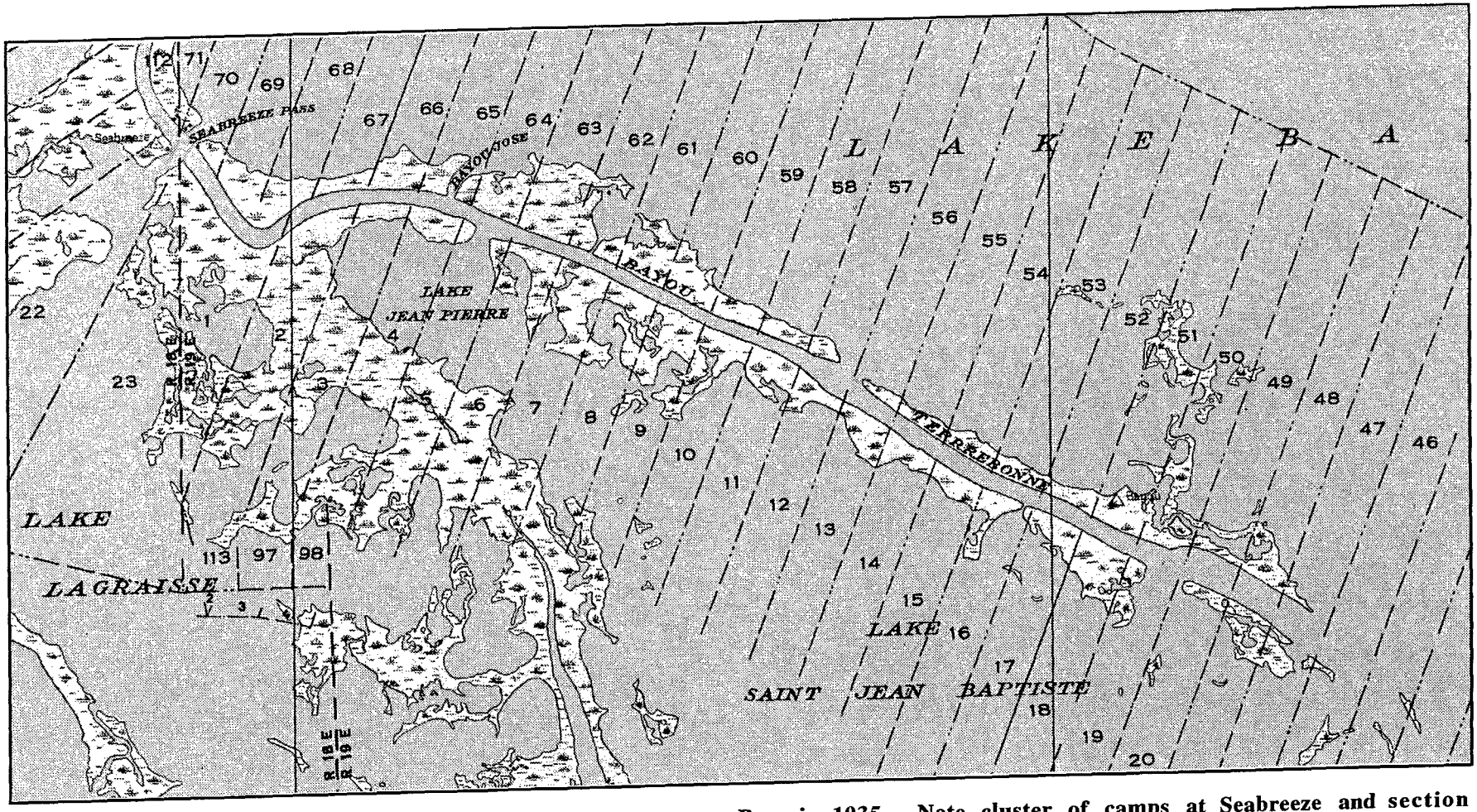


Figure 2-20. Map of lower Bayou Terrebonne below Seabreeze Pass in 1935. Note cluster of camps at Seabreeze and section lines depicting former marsh areas now submerged beneath Lake Barre (from USGS Lake La Graisse quadrangle map).

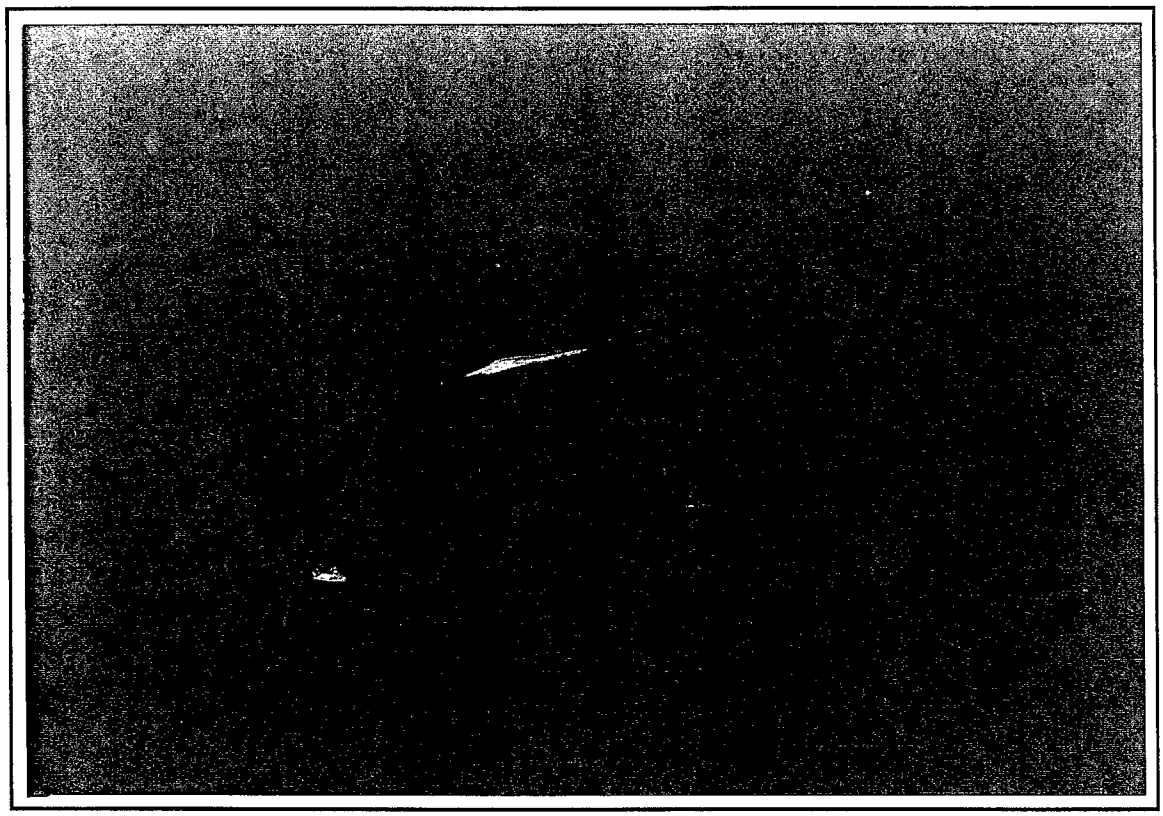


Figure 2-21. Remnant of lower Bayou Terrebonne natural levee in Lake Barre. This area was surveyed and sold as marsh during the nineteenth century. The island is in Section 51 on modern quadrangle maps. April 16, 1993.

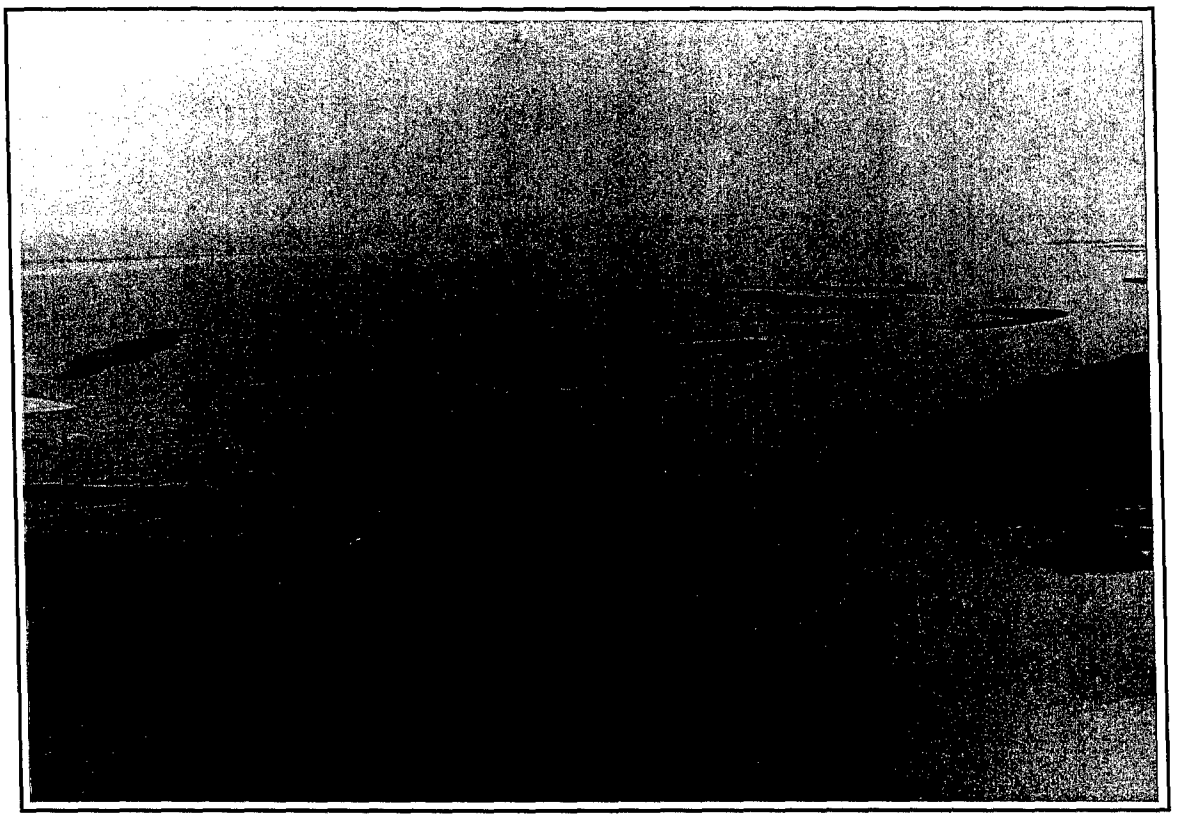


Figure 2-22. One of the fastest building deltas in the world is at the mouth of the Atchafalaya River. The new emerging land associated with this delta is shown in this photograph. Date: March 11, 1998.



Figure 2-23. The emerging bifurcating delta at the mouth of Wax Lake Outlet has a distinct shape visible from the air. Date: March 11, 1998.

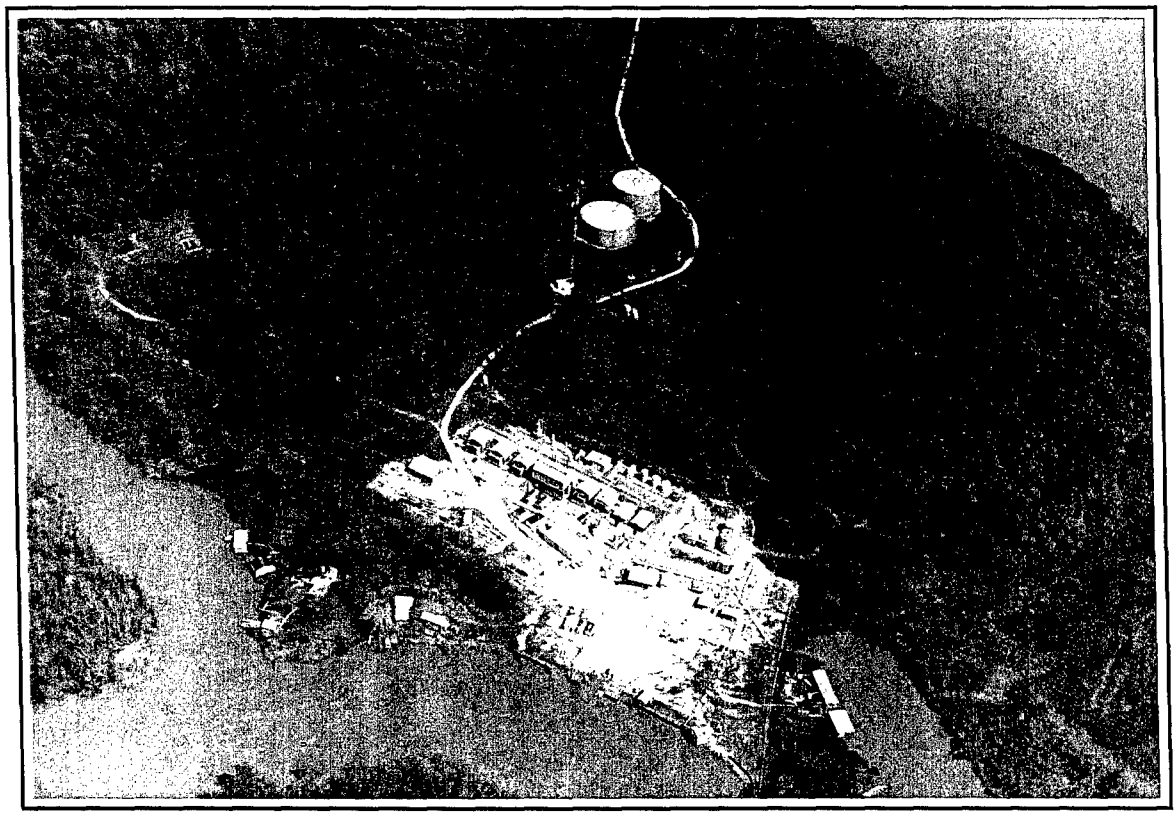


Figure 2-24. The Belle Isle salt mine is a relatively small mining operation. Date: March 11, 1998.



Figure 2-25. This ferry across the Gulf Intracoastal Waterway is the only means of vehicular access to the salt mine at Cote Blanche Island. Date: December 10, 1997.

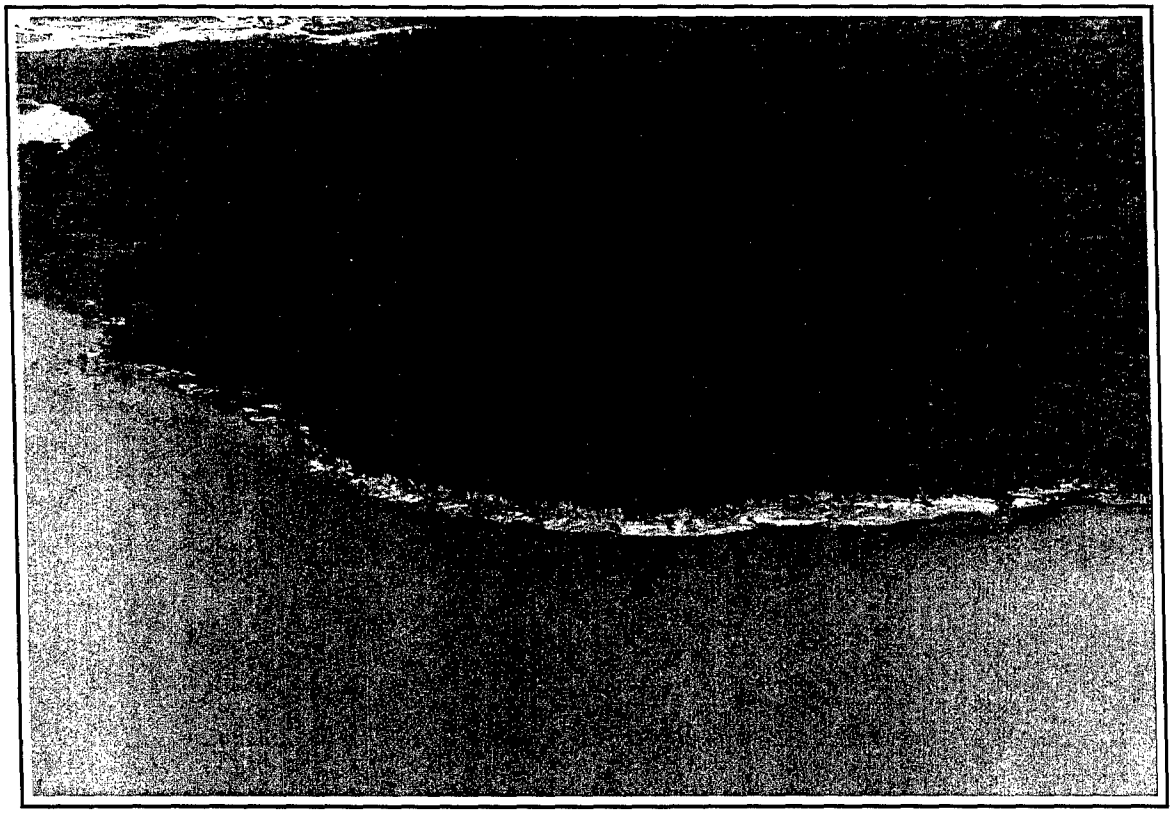


Figure 2-26. The eroding bluff along the south side of Cote Blanche Island is another example of south Louisiana's land loss problem. Date: March 11, 1998.

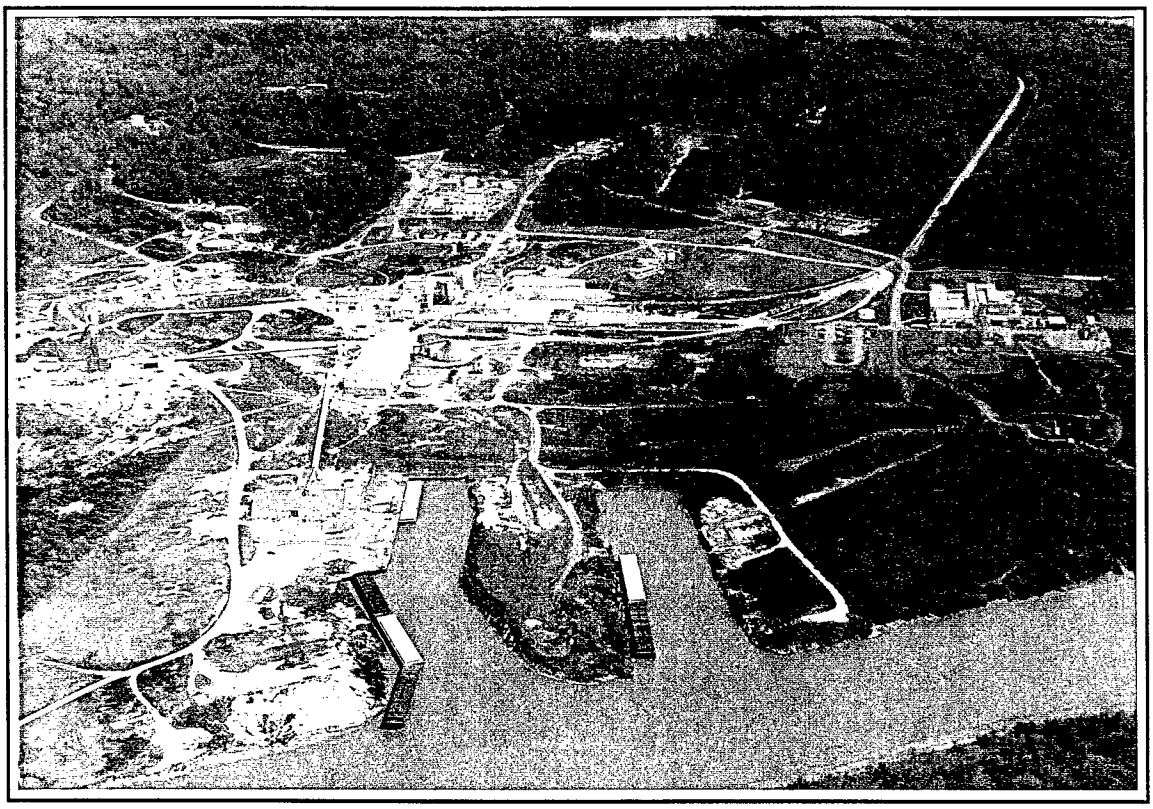


Figure 2-27. The Weeks Island salt mine and oil and gas activity are an impressive industrial complex. Date: March 11, 1998.



Figure 2-28. **In this aerial view of the south side of Avery Island the salt mine (A) and the associated oil and gas canals that outline the dome (B) are clearly visible. Date: March 11, 1998.**

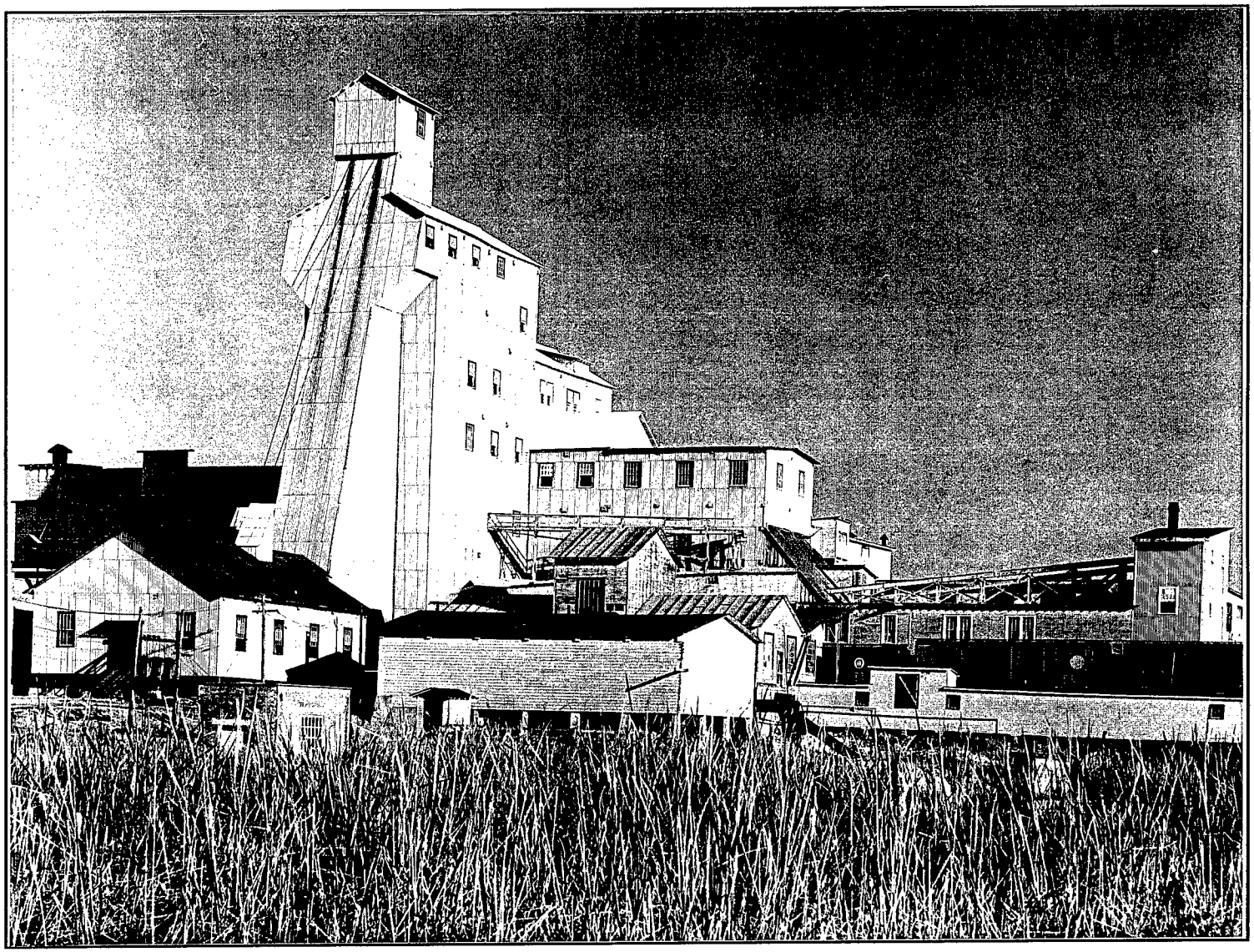


Figure 2-29. The salt mine at Avery Island, Louisiana. This mine was fought for by Union and Confederate troops during the Civil War. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50330. Photographer: Webb, December, 1947.

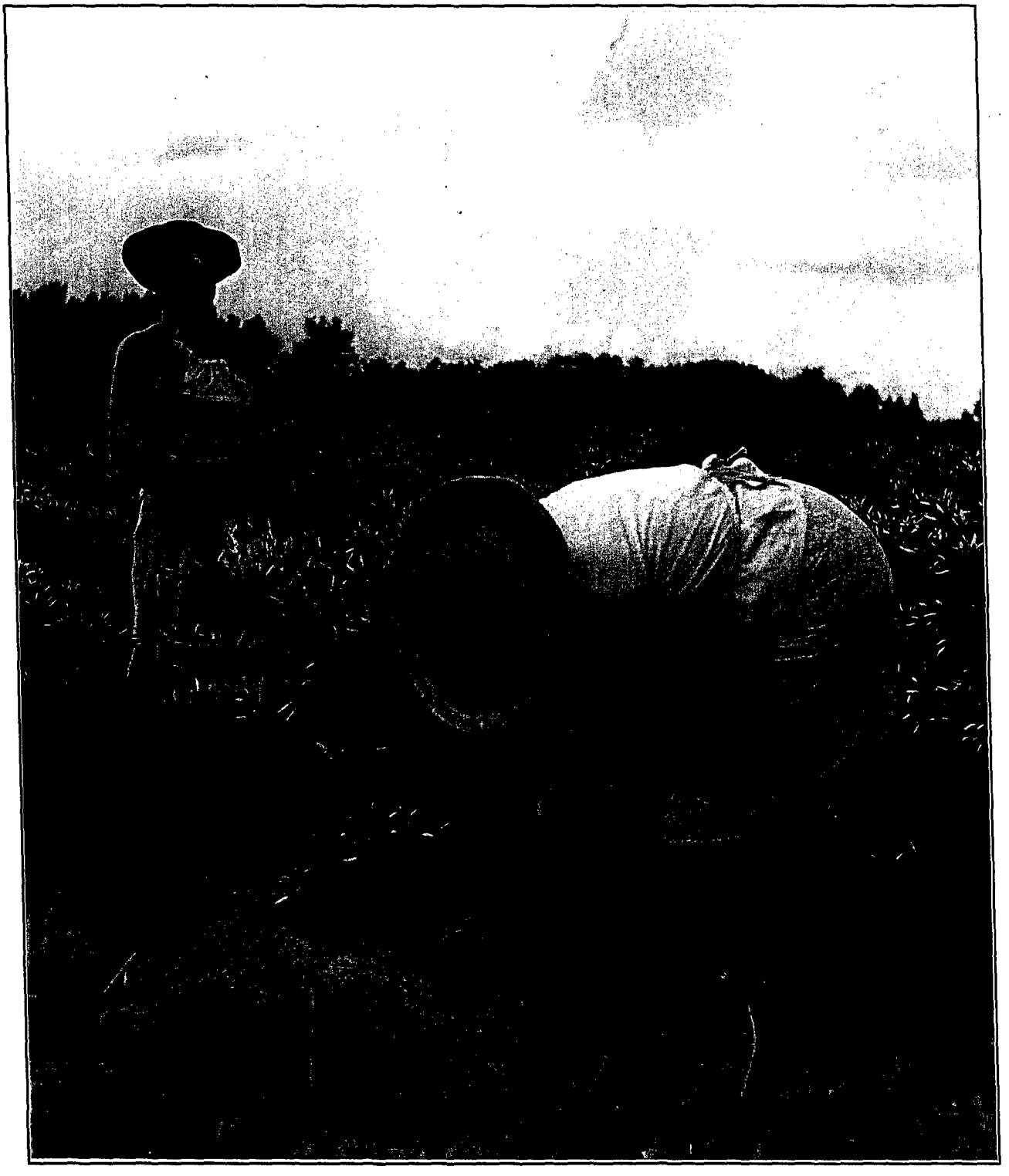


Figure 2-30. Workers picking Tabasco peppers in McIlhenny's fields at Avery Island, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50330. Photographer: Webb, August, 1947.

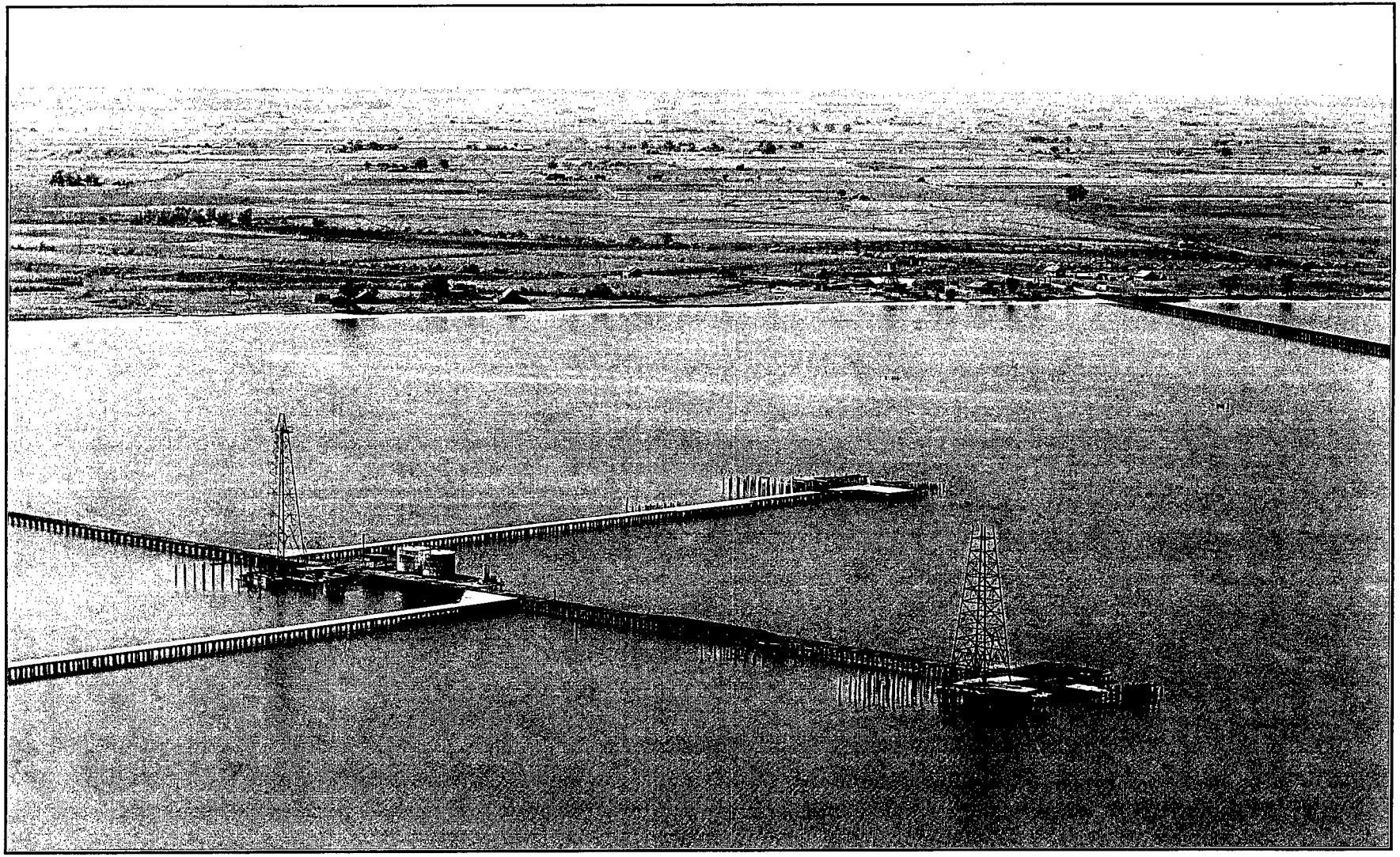


Figure 2-31. Jefferson Island, Louisiana. Oil installations in the lake. [This lake overlies a salt dome that contained a maze of salt mining caverns. In 1980 the mine was accidentally punctured by an oil well being drilled into a salt cavity. The lake was temporarily drained when water flowed into the mining caverns. Salt mining ceased after the accident.] University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62228. Photographer: Rotkin, November, 1948.

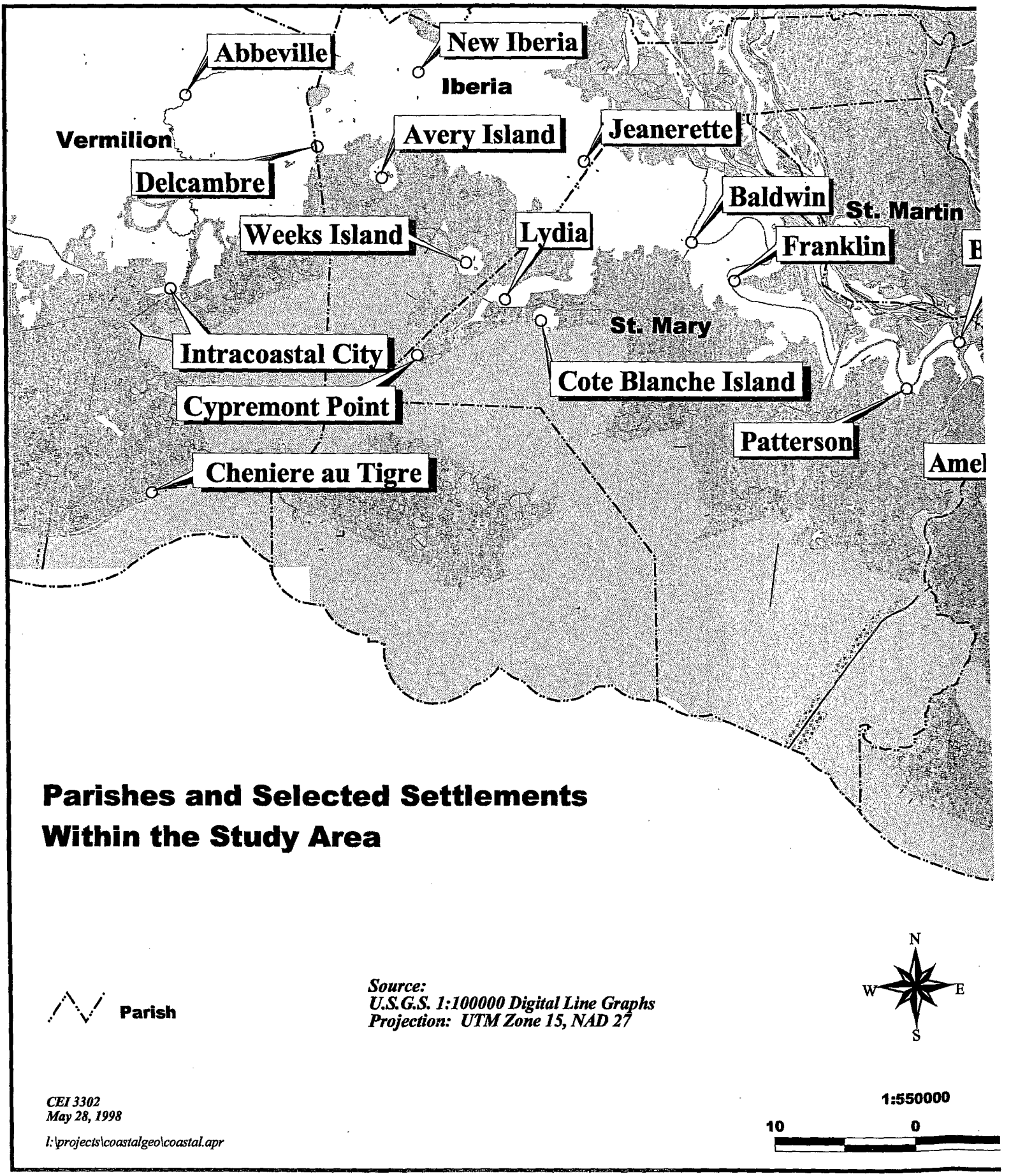
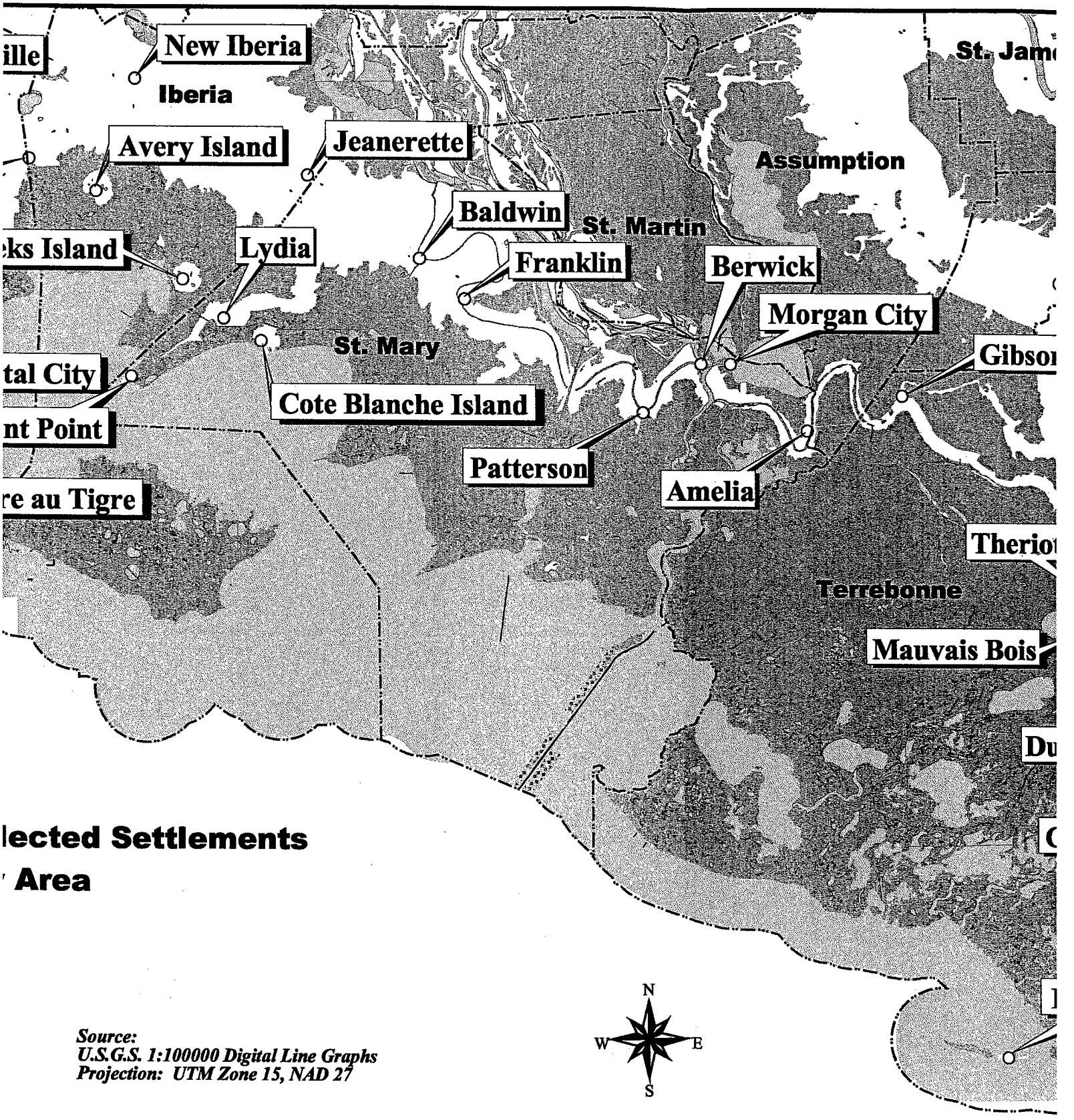
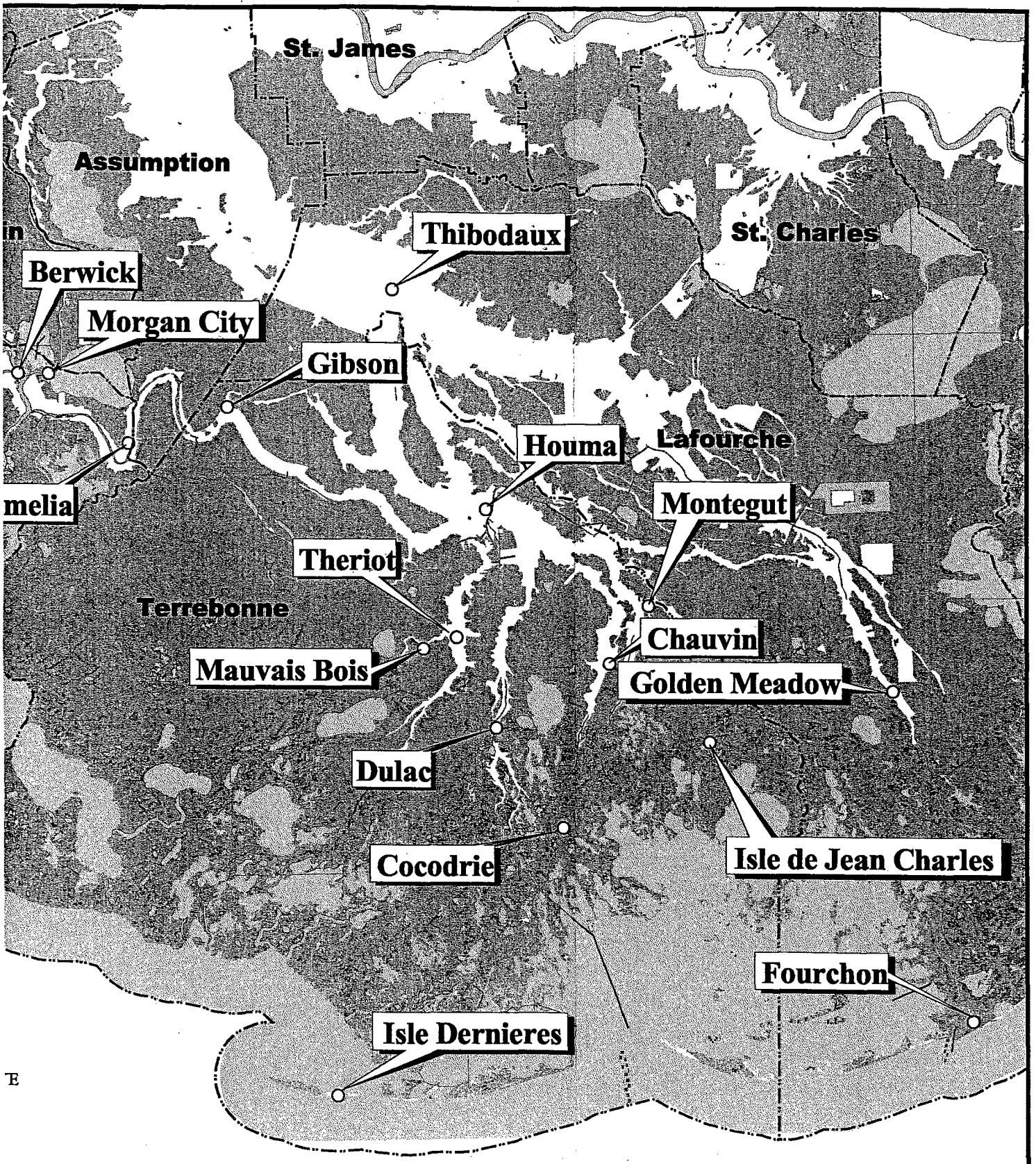


Figure 3-1. Parishes and selected settlements within the study area.



settlements within the study area.


St. James
Assumption
in
Thibodaux
St. Charles
Berwick
Morgan City
Gibson
Houma
Lafourche
melia
Montegut
Theriot
Terrebonne
Chauvin
Mauvais Bois
Golden Meadow
Dulac
Isle de Jean Charles
Cocodrie
Fourchon
Isle Dernieres
E
10 Miles

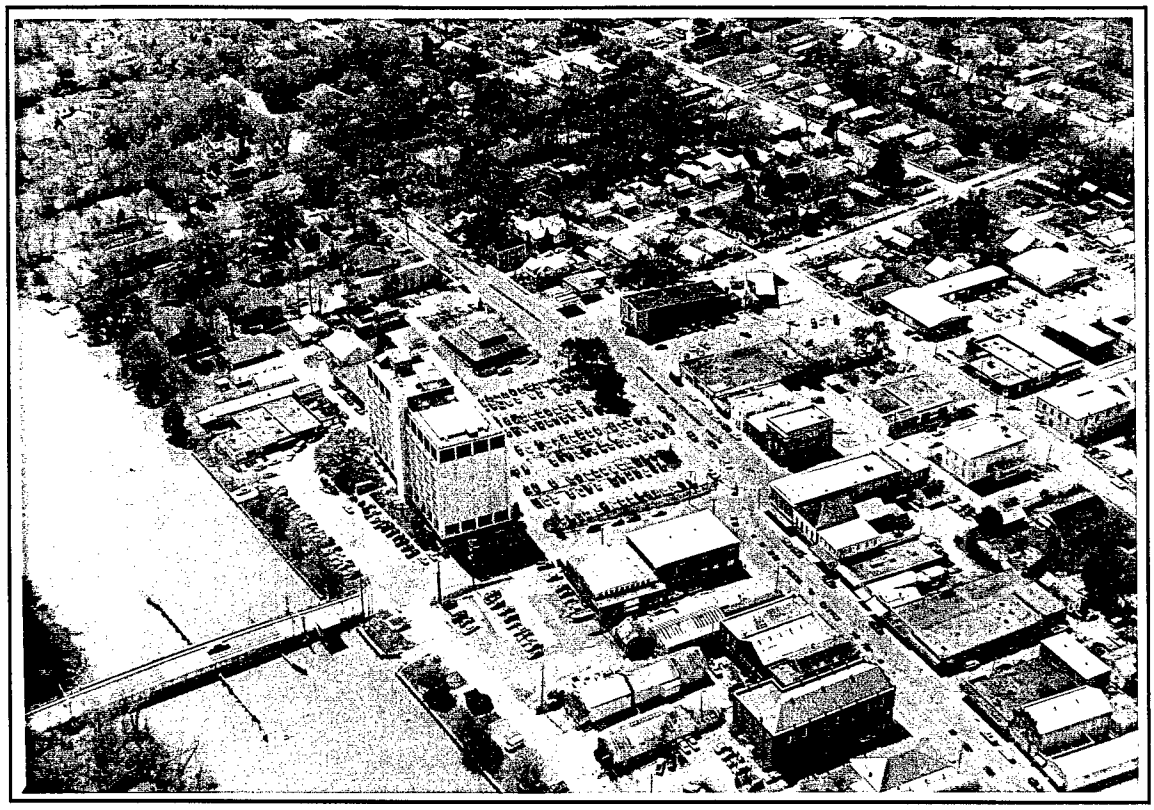


Figure 3-2. Aerial view of downtown Franklin. Date: March 11, 1998.

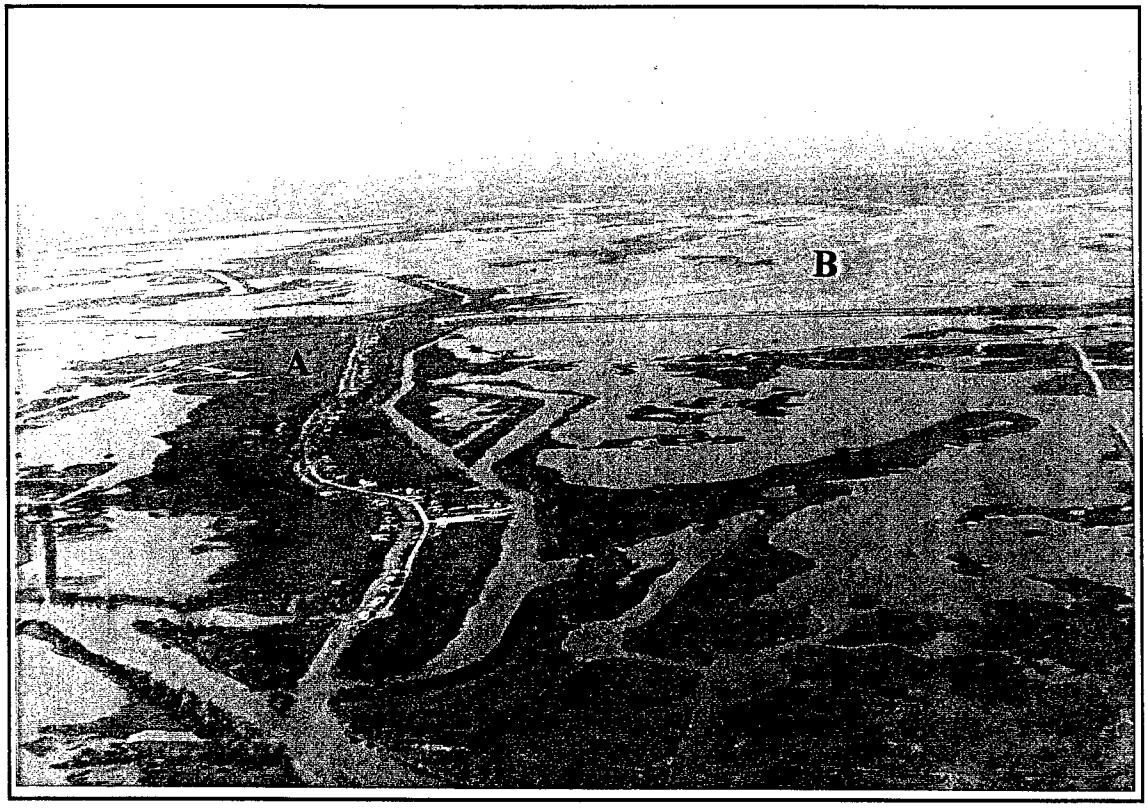


Figure 3-3. Isle de Jean Charles (A) in Terrebonne Parish is accessible by one road (B) that is often flooded, making highway access nearly impossible. Date: March 11, 1998.

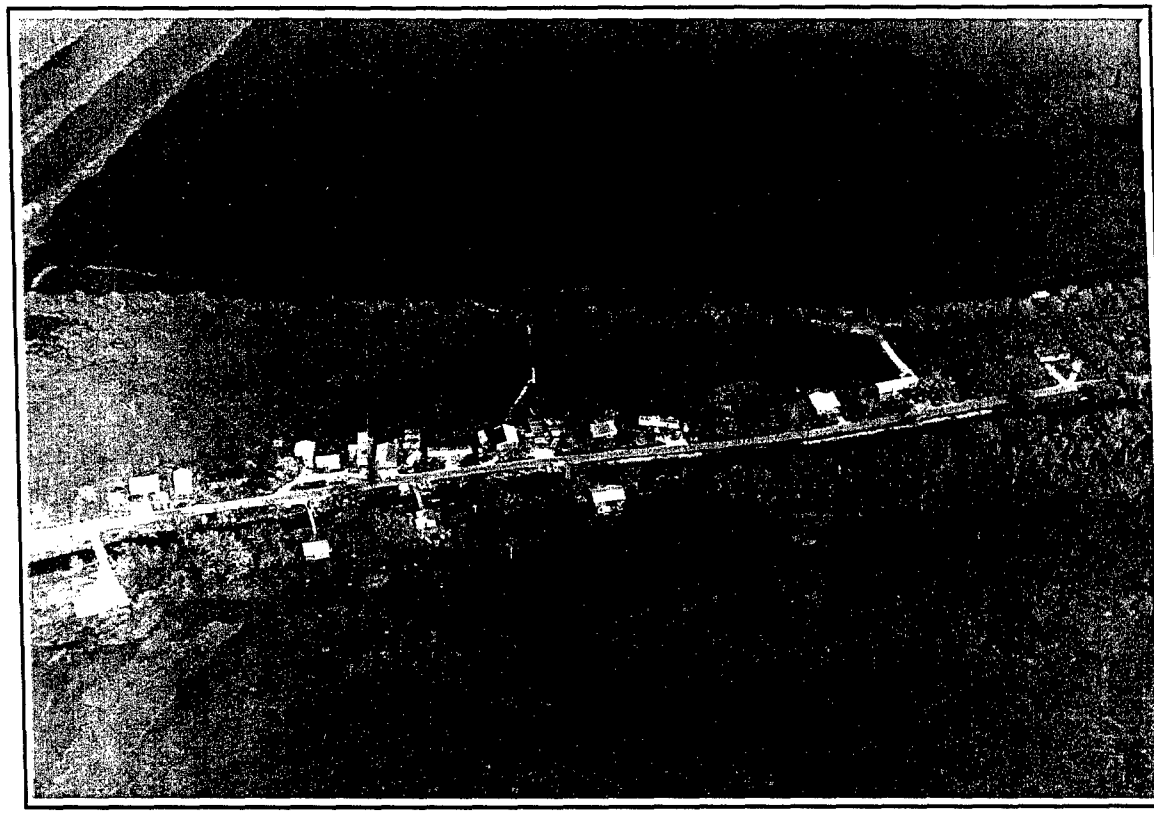


Figure 3-4. Camps and houses are strung along Isle de Jean Charles in Terrebonne Parish. Date: March 11, 1998.

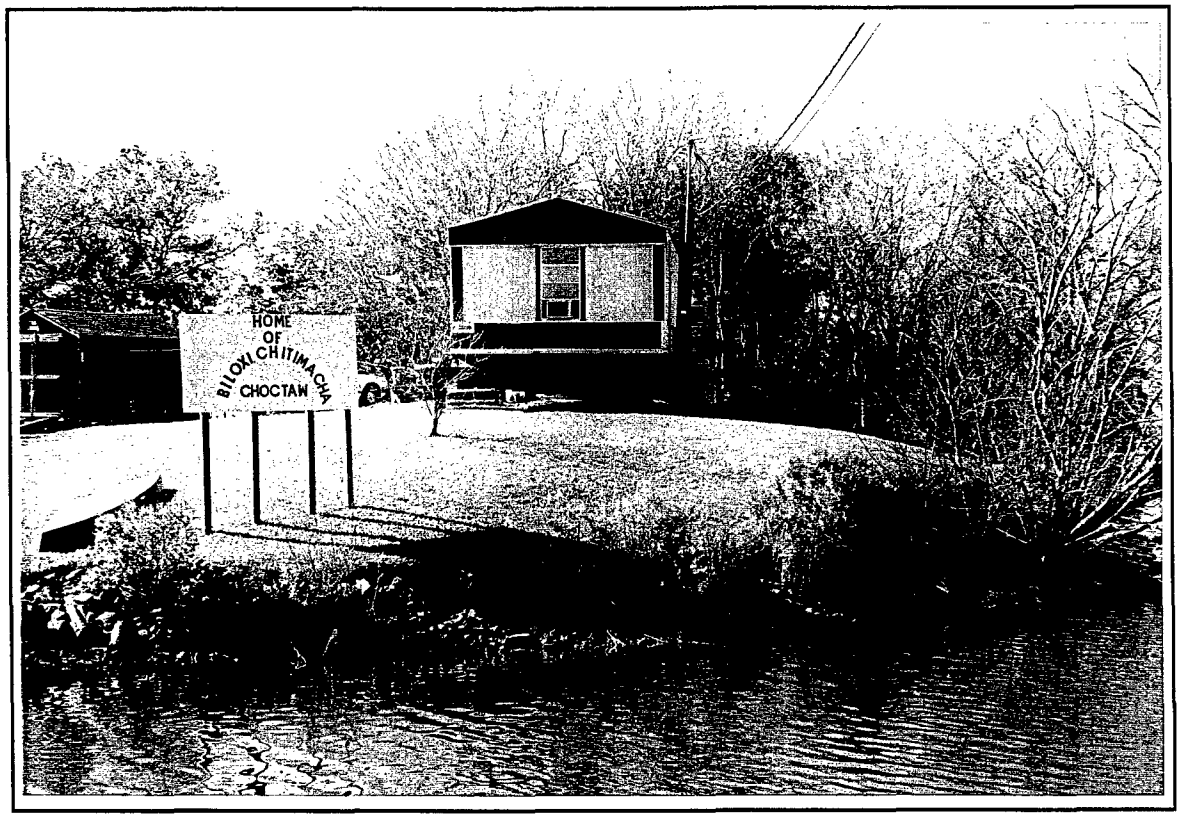


Figure 3-5. Isle de Jean Charles is an Indian community proud of its heritage, as indicated by this sign proclaiming the "Island" is the "Home of Biloxi Chitimacha Choctaw." Date: December 30, 1997.



Figure 3-6. The natural levee ridges along Mauvais Bois Bayou once supported a thriving agricultural settlement. Today the ridges support only camp sites. Visible in this aerial view are camps along the ridge (A), Peoples Canal (B) and the trapping trainasse (C). Date: March 11, 1998.



Figure 3-7. East Timbalier Island, facing north. Note broken segments of island and walls installed as restoration measures. Date: April 16, 1993.

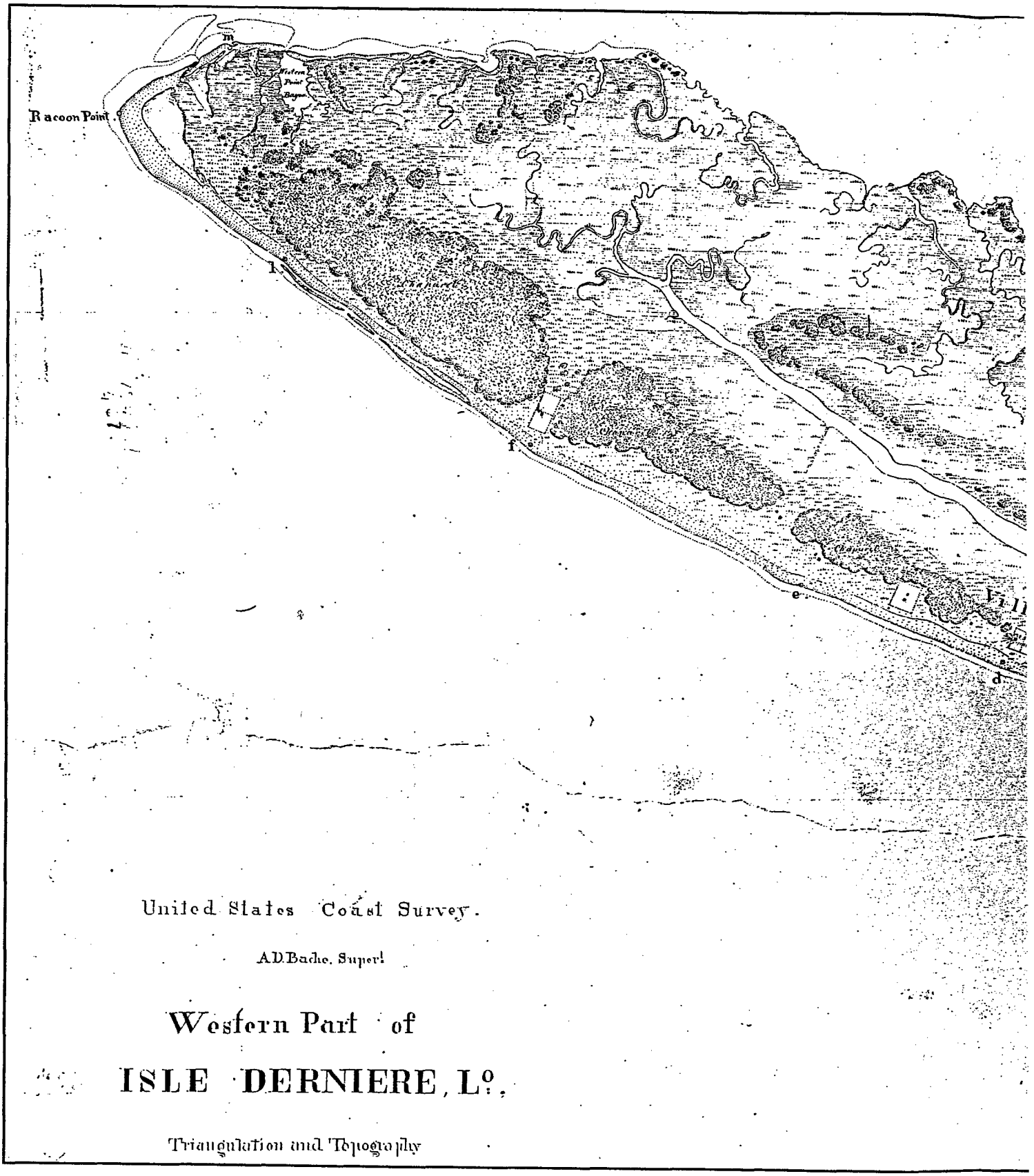
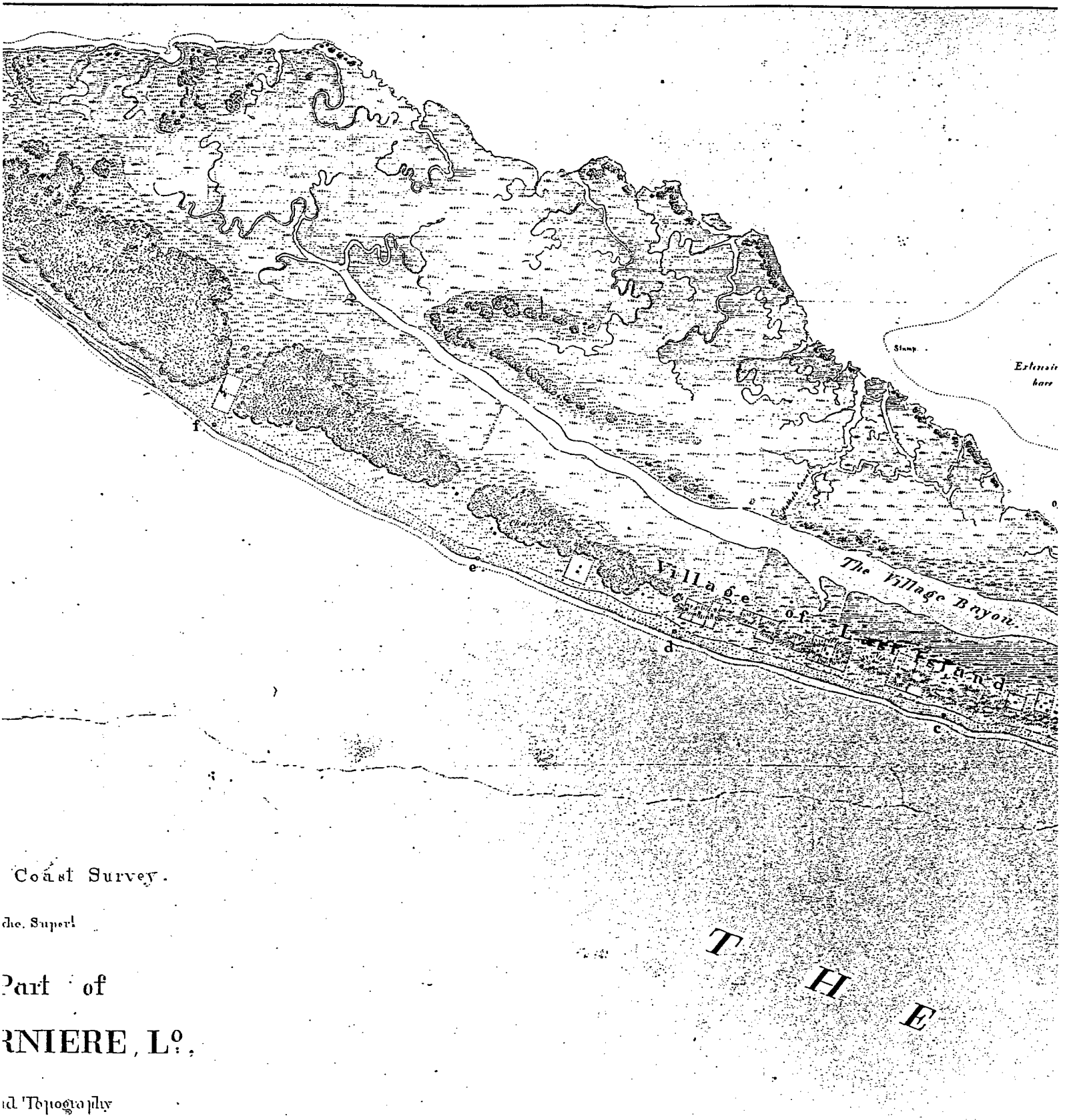
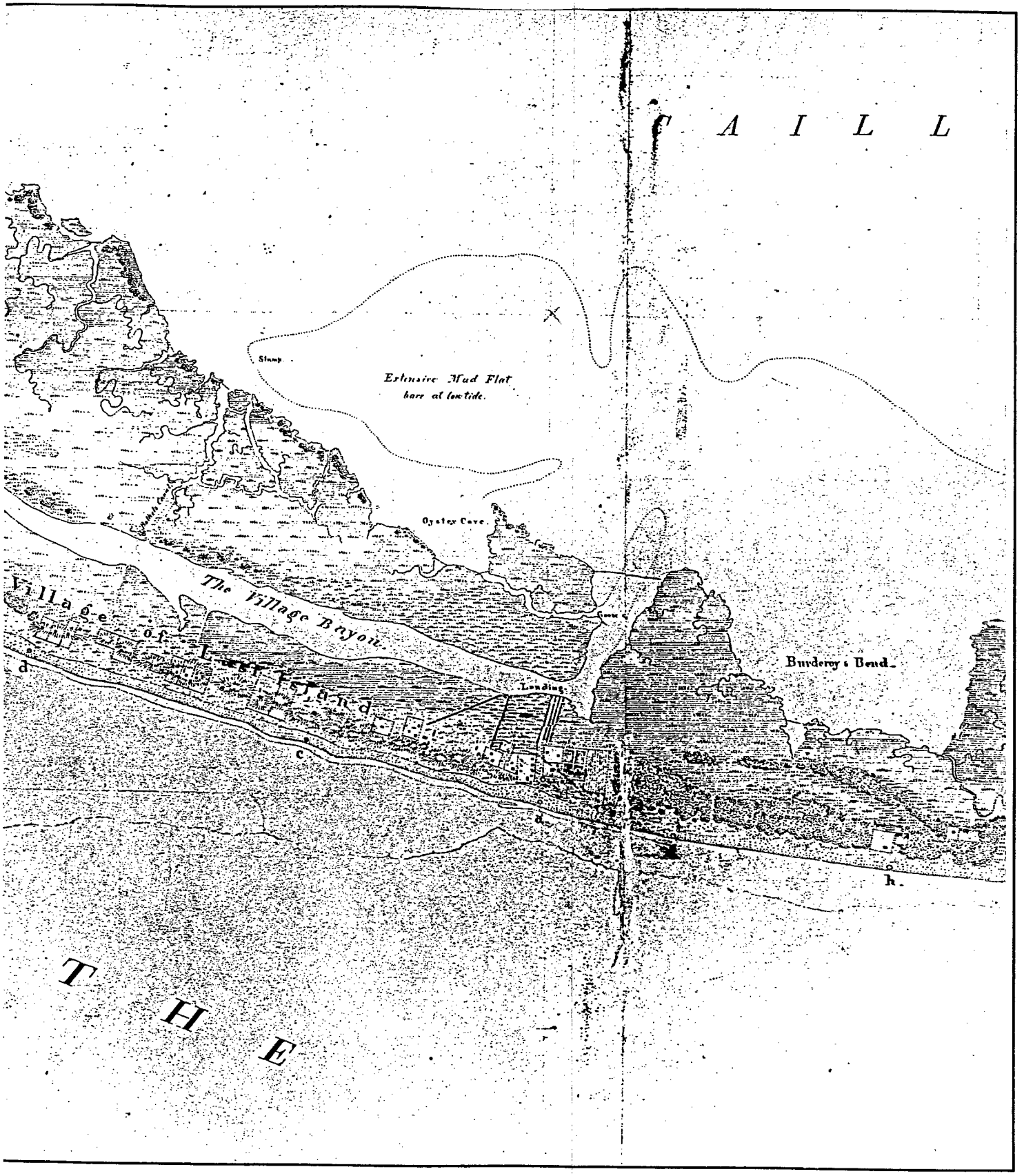


Figure 3-8. Portion of a map entitled "Western Part of Isle Dernier, Lo." (source: U.S. Coast and Geodetic Su



ıtitled "Western Part of Isle Dernier, Lo." (source: U.S. Coast and Geodetic Survey 1853).



tic Survey 1853).

3

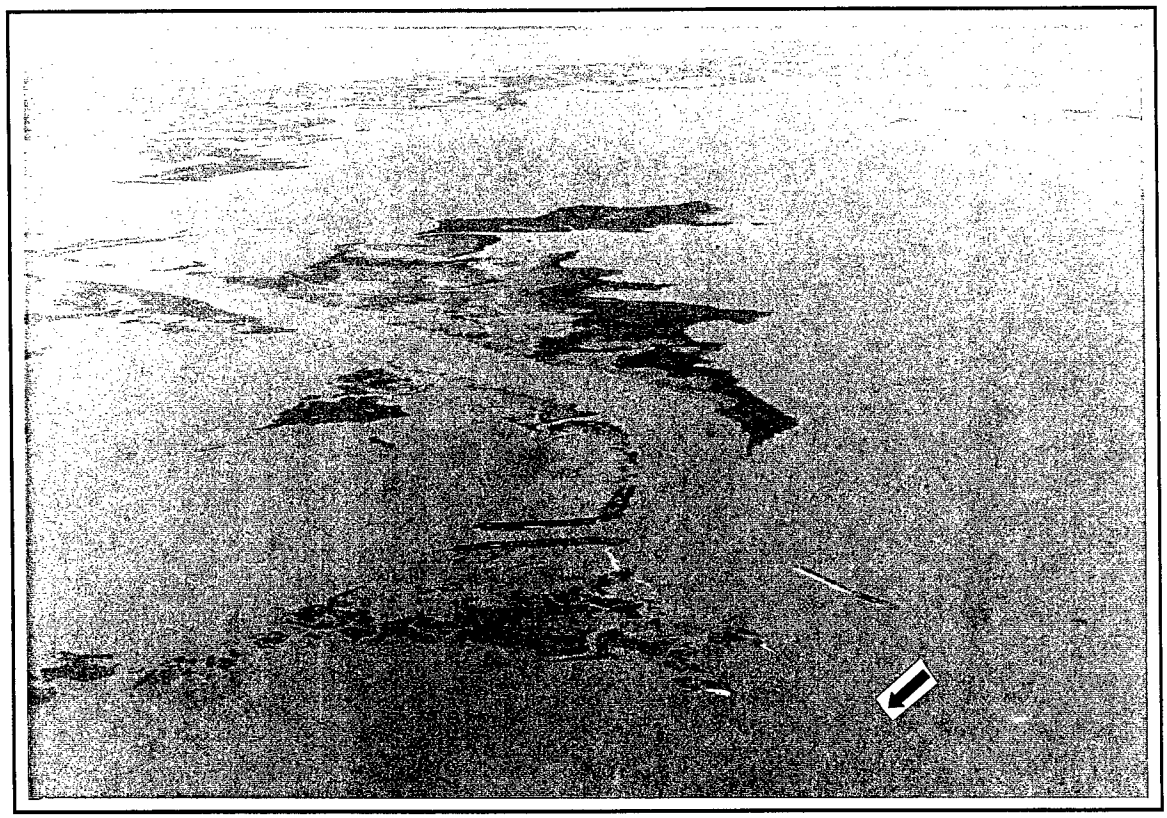


Figure 3-9. Subsided lower Bayou Terrebonne. Sea Breeze Pass is at lower right in photo. Date: March 11, 1998.

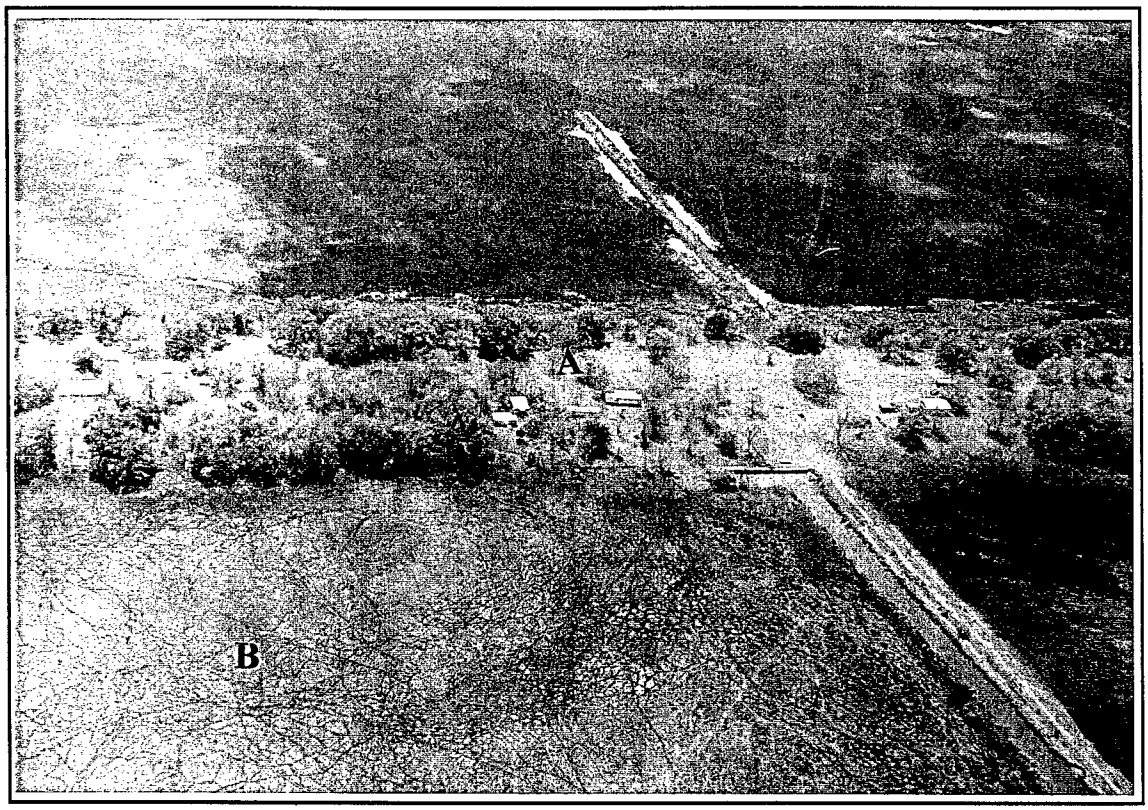


Figure 3-10. Cheniere au Tigre in Vermilion Parish continues to serve as a foundation for recreational camps (A) and the cattle industry (B). Date: March 11, 1998.

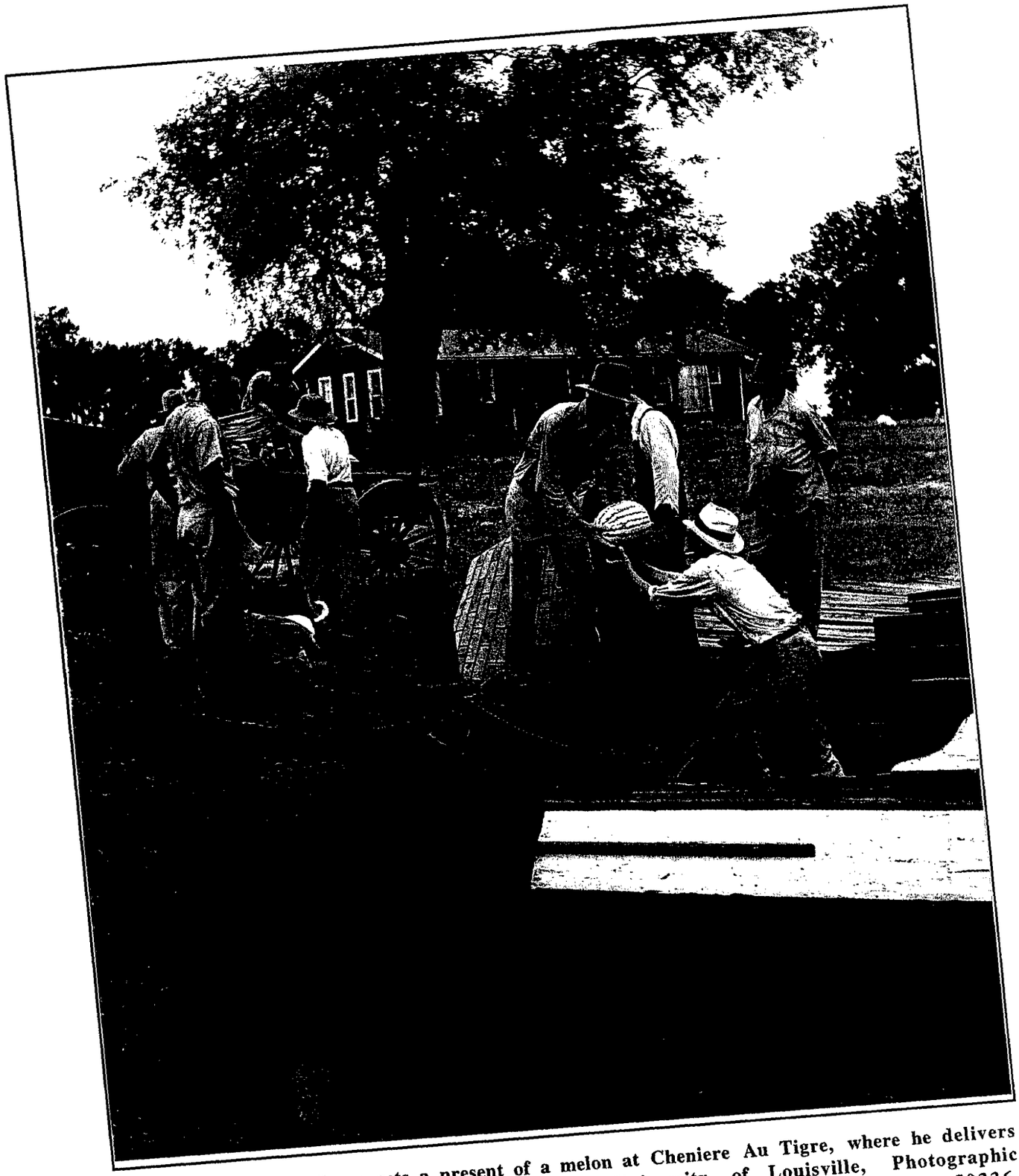


Figure 3-11. The mailman gets a present of a melon at Cheniere Au Tigre, where he delivers the mail by boat once a week. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50336. Photographer: Webb, August, 1947.



Figure 3-12. When the weekly mail boat comes to Chenier Au Tigre, an island farm down in the marsh near the Gulf, all the residents come on horse back or in wagons to get the mail and to visit. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50337. Photographer: Webb, August, 1947.



Figure 3-13. Cattle freely graze throughout south Louisiana's marsh. Date: December 30, 1997.

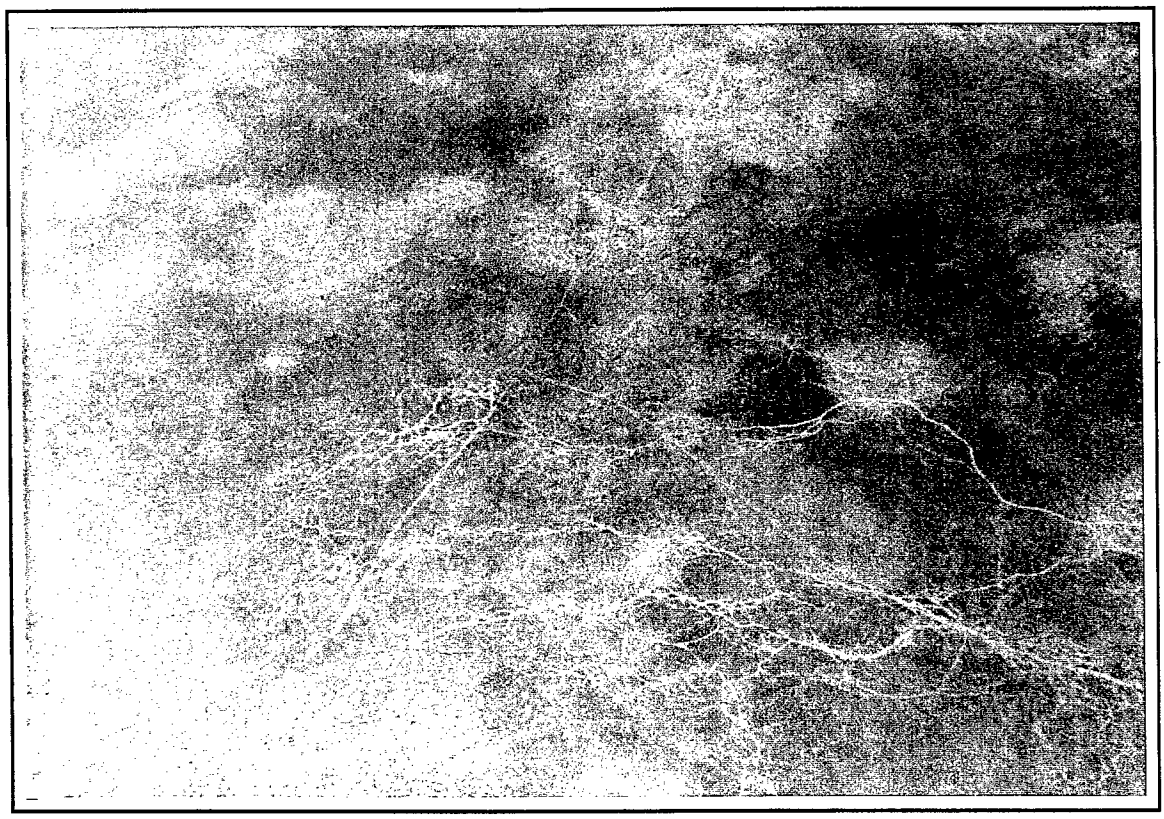


Figure 3-14. Cattle trails in marsh near Cheniere au Tigre, Vermilion Parish. Date: March 11, 1998.

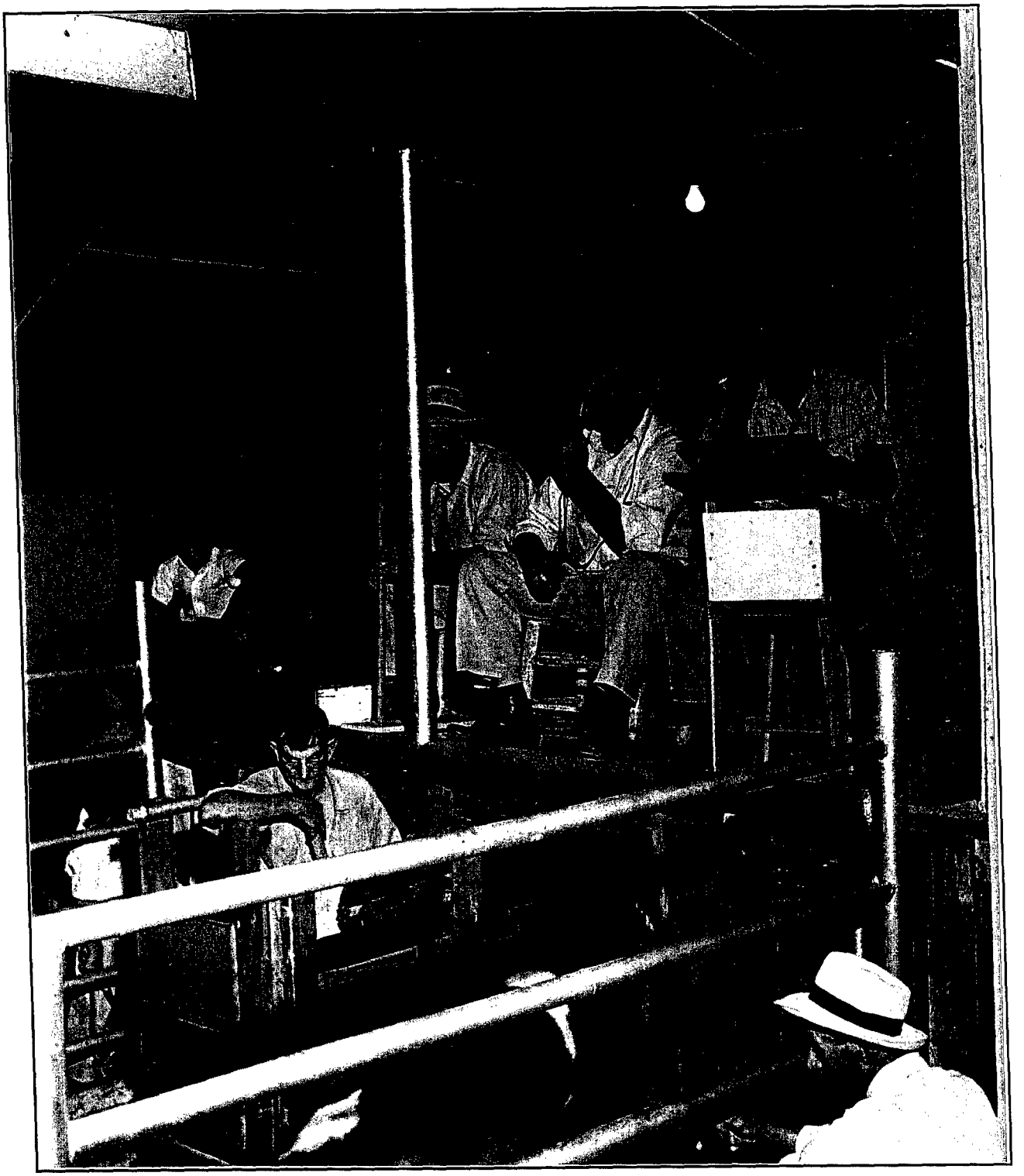


Figure 3-15. Cooperative stock auction at Abbeville, Louisiana. The auctioneer sits high up over the stock chutes. Farmers bring in their stock once a week for sale to butchers and meat packers from all over southwestern Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50330. Photographer: Webb, August, 1947.

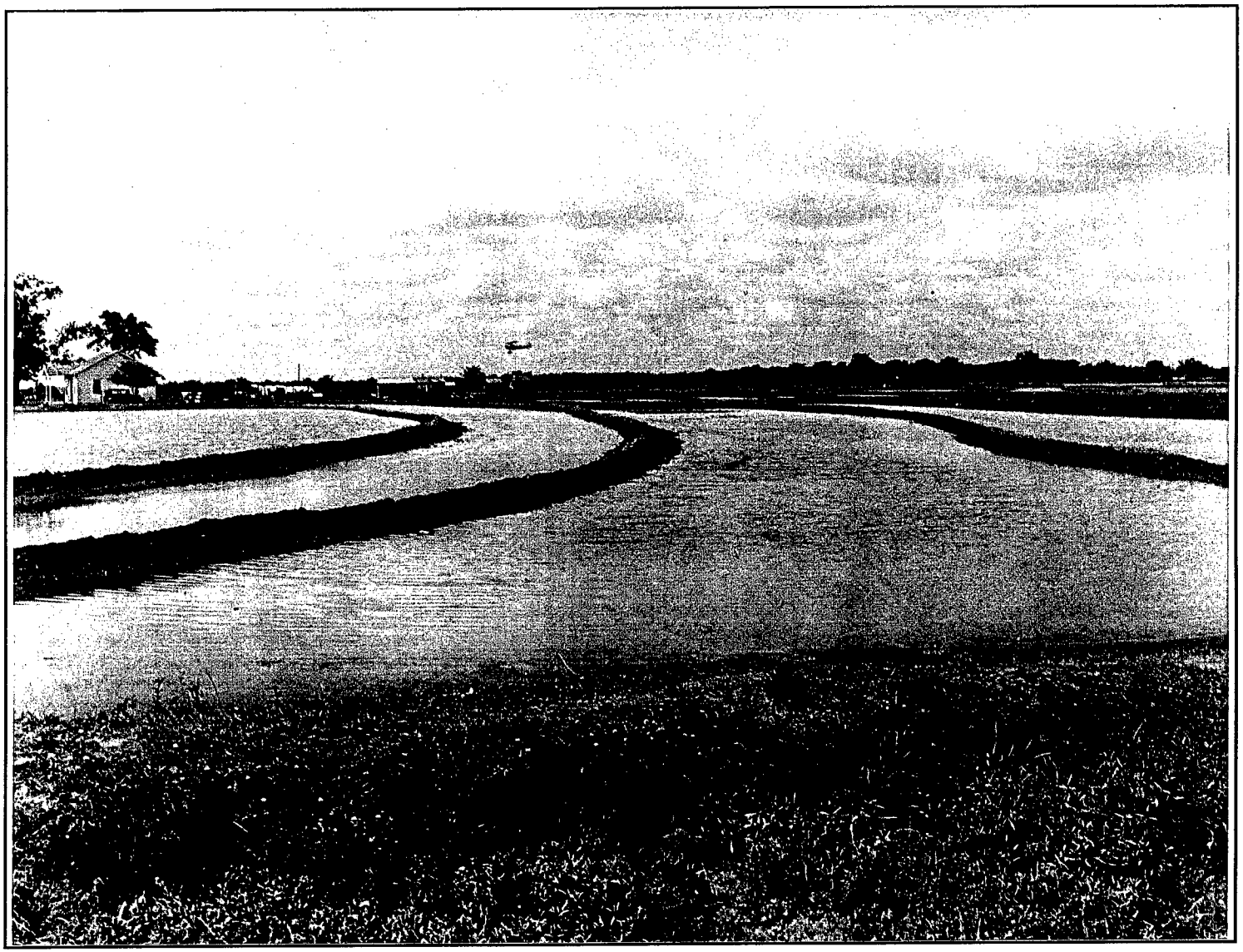


Figure 3-16. Plane planting rice near Perry, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 49963. Photographer: Webb, June, 1947.



Figure 3-17. Rice harvest. Man who sews up bags of threshed rice counts bags [on the] Erlay Trahan farm, Kaplan, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 28506. Photographer: Libsohn, November, 1945.

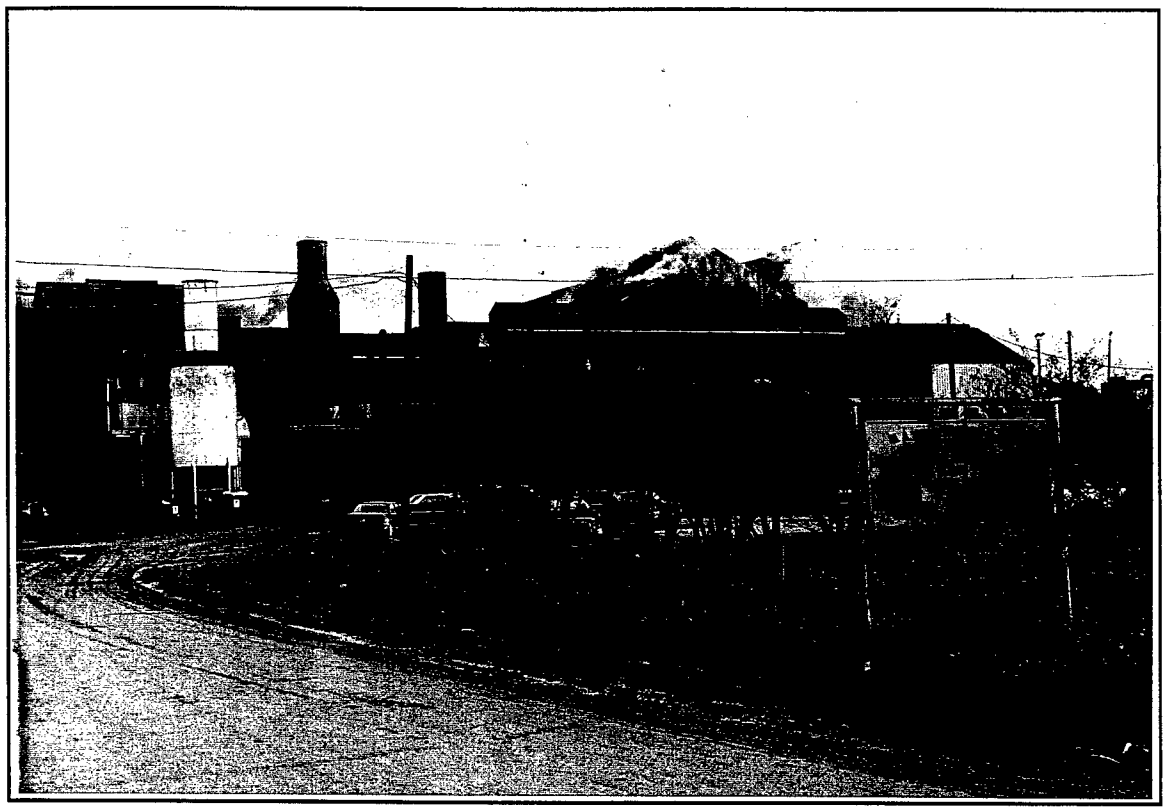


Figure 3-18. This sugar mill at Patoutville, Louisiana, is one of the few remaining in south Louisiana. The mill serves farmers harvesting sugarcane in the south central Louisiana sugar belt. Date: December 3, 1997.

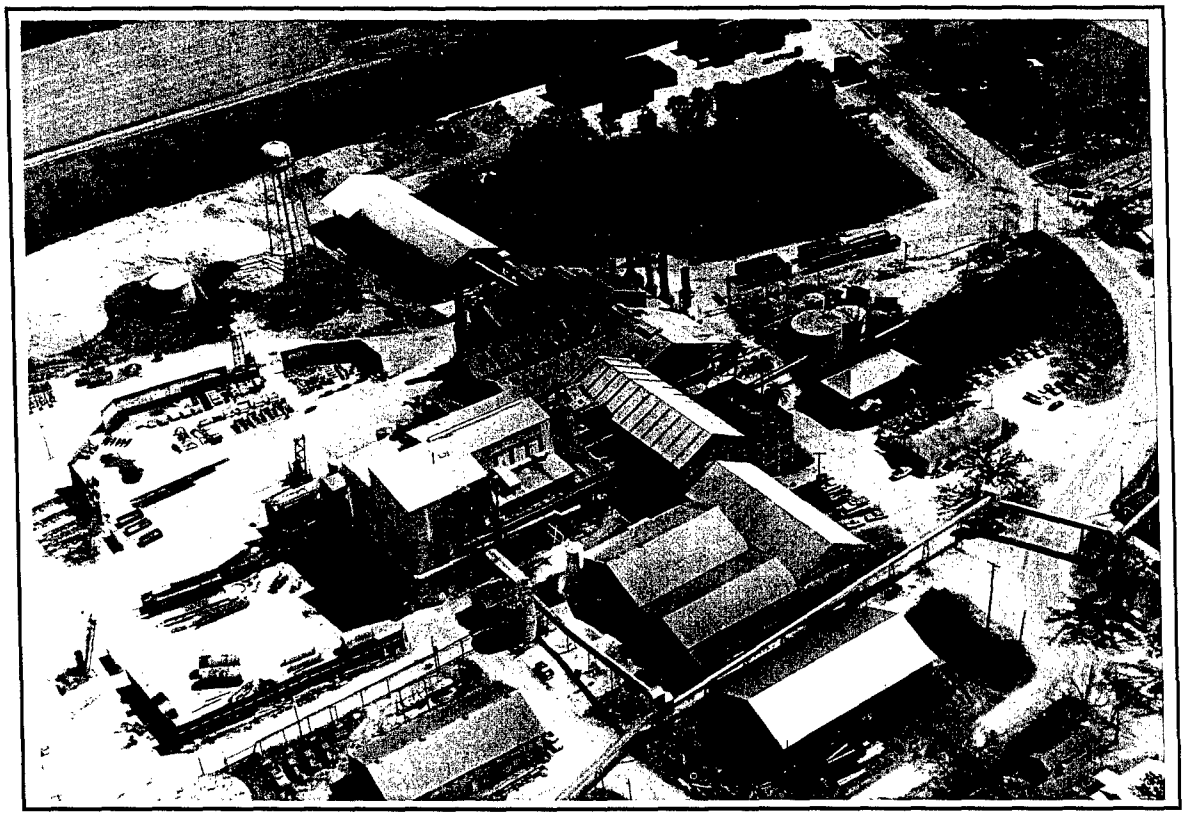


Figure 3-19. Aerial view of a sugar mill along Bayou Teche in the vicinity of Franklin, Louisiana. Date: March 11, 1998.

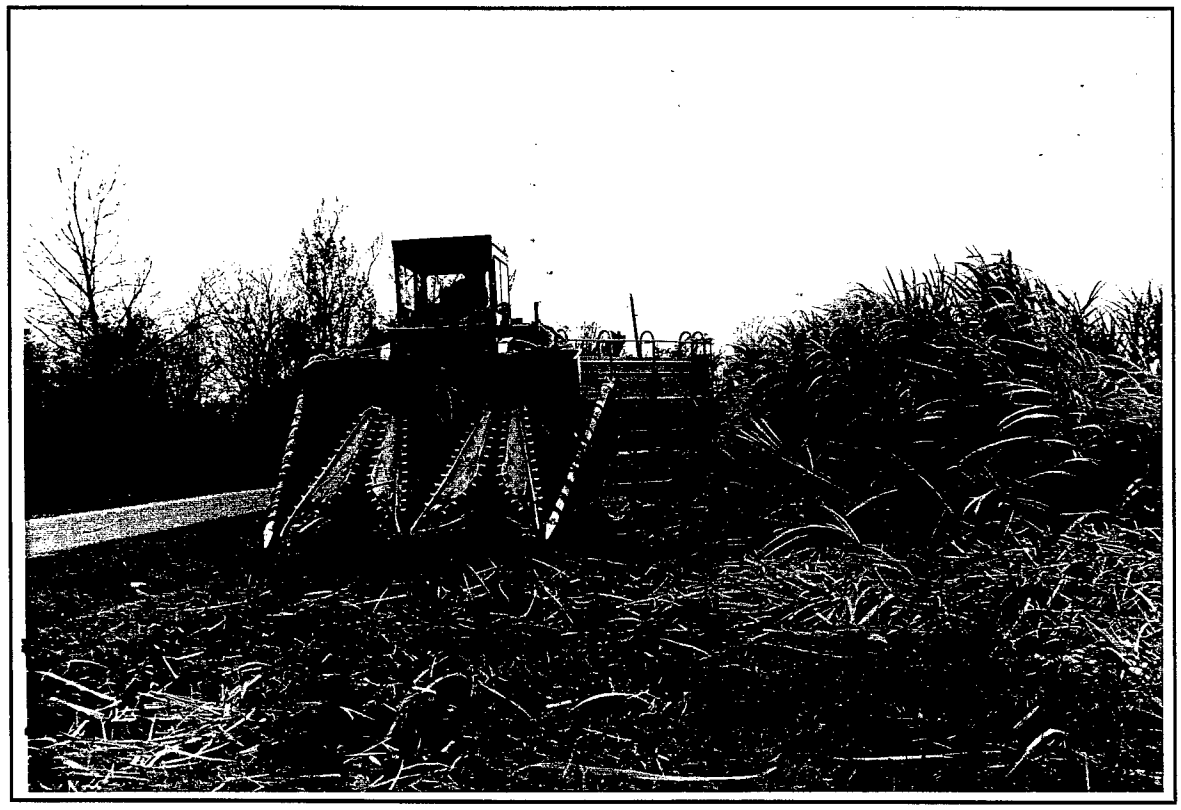


Figure 3-20. Sugar cane harvesting was originally done by hand when large field crews used cane knives to top and cut the cane. Today cane farmers use mechanical cane cutters like this one along Highway 83 near Freetown in St. Mary Parish. Date: December 11, 1997.

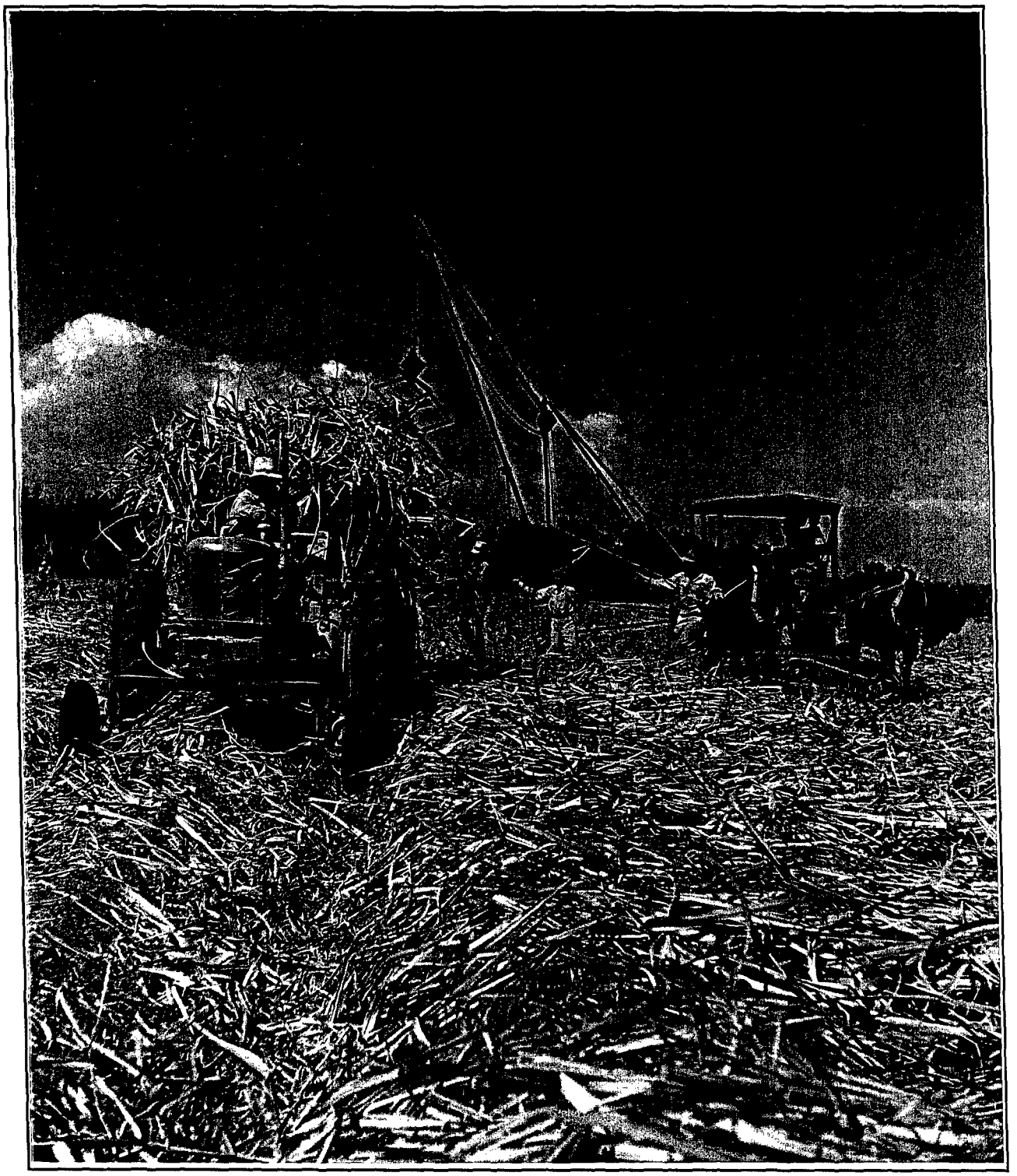


Figure 3-21. Portable hoist loads sugar cane cut for seed purposes onto trailer truck drawn by tractor. Photo is on Johnson sugar plantation at Bayou Sale. [Note mules used to move the hoist through the field.] University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 15442. Photographer: Libsohn, September, 1944.



Figure 3-22. Since the late 1800s, oranges have been described in the literature related to the wetlands. This coastal area can support the crop, but it is at the northern limit of their growth. This grove of satsumas is along Bayou Terrebonne at Point Barre. Date: December 30, 1997.

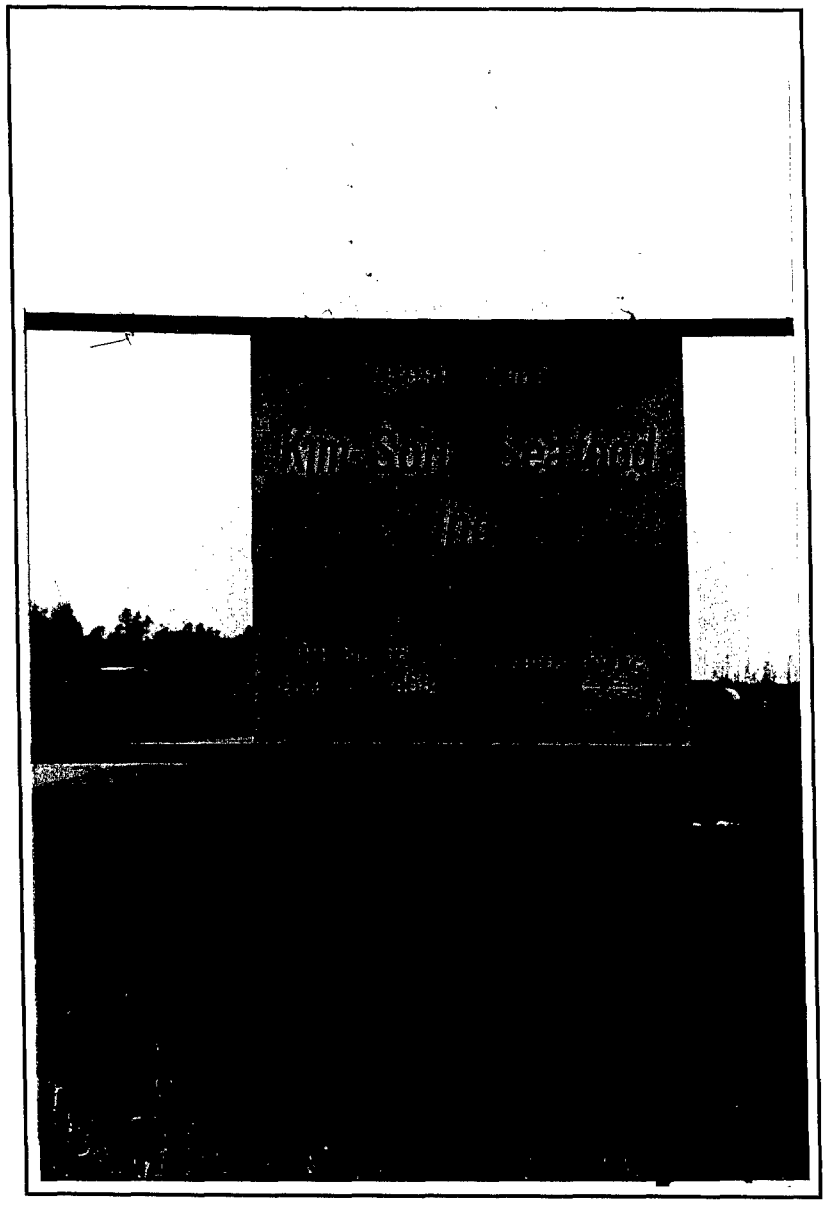


Figure 3-23. This sign at the Port of West St. Mary indicates the presence of Vietnamese in the region's fisheries. Date: December 11, 1997.

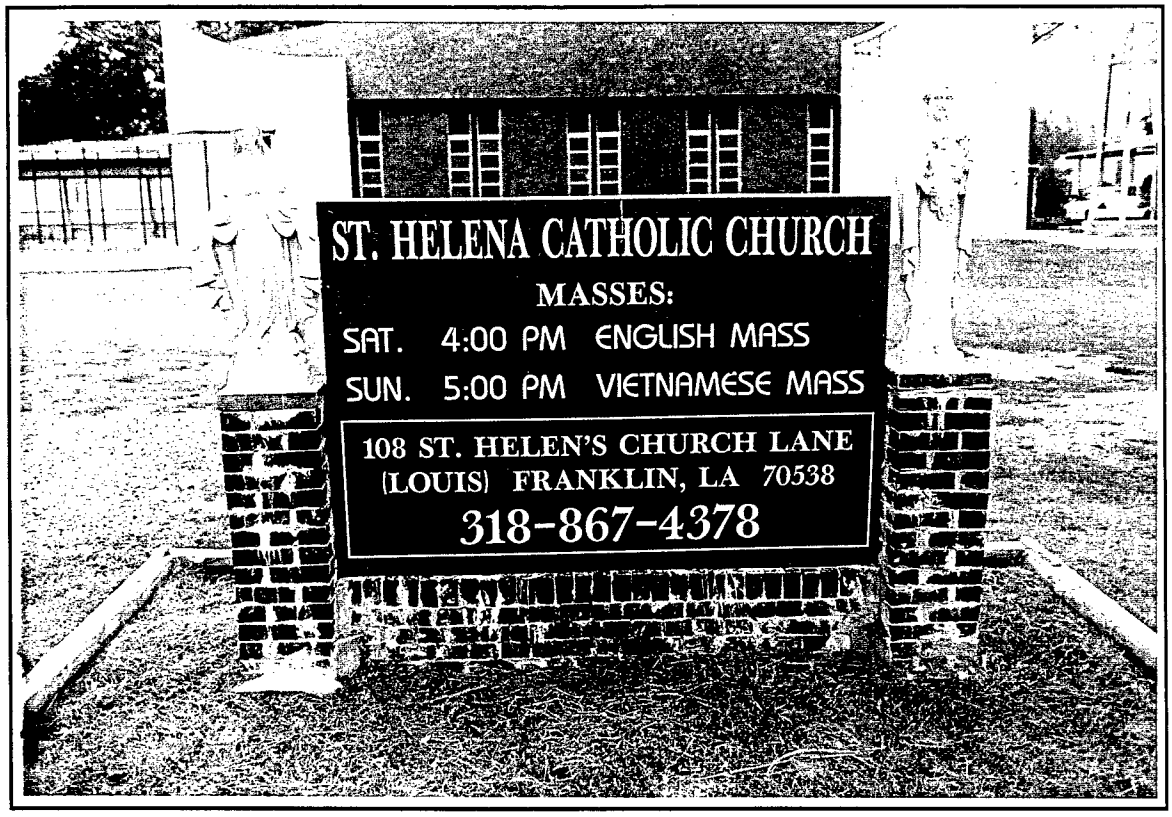


Figure 3-24. At the St. Helena Catholic Church, Saturday mass is in English, while Sunday services are in Vietnamese. The church is located in Louisa in St. Mary Parish. Date: December 11, 1997.



Figure 3-25. The Montegut Tribal Center is one symbol of unity among the region's Native Americans. Date: December 30, 1997.

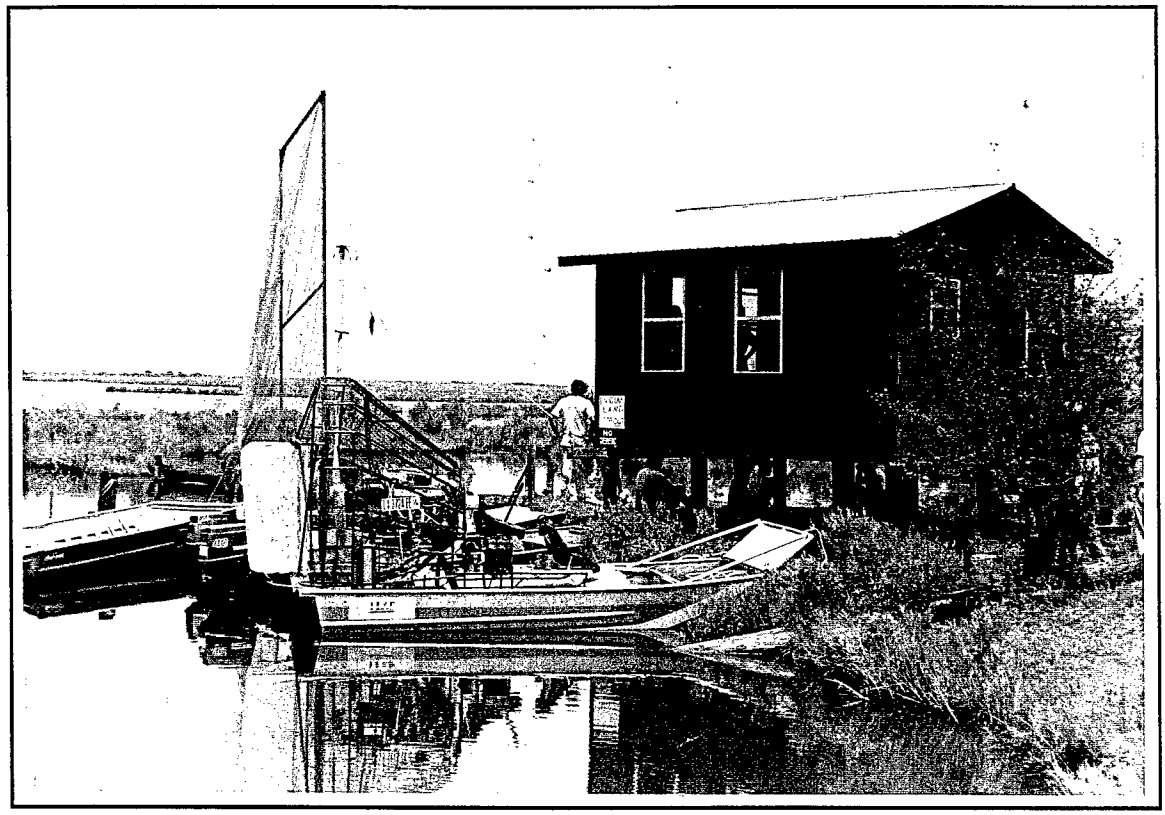


Figure 3-26. Camp used by Houma Indian family along lower Bayou Pointe au Chien. August 16, 1995.

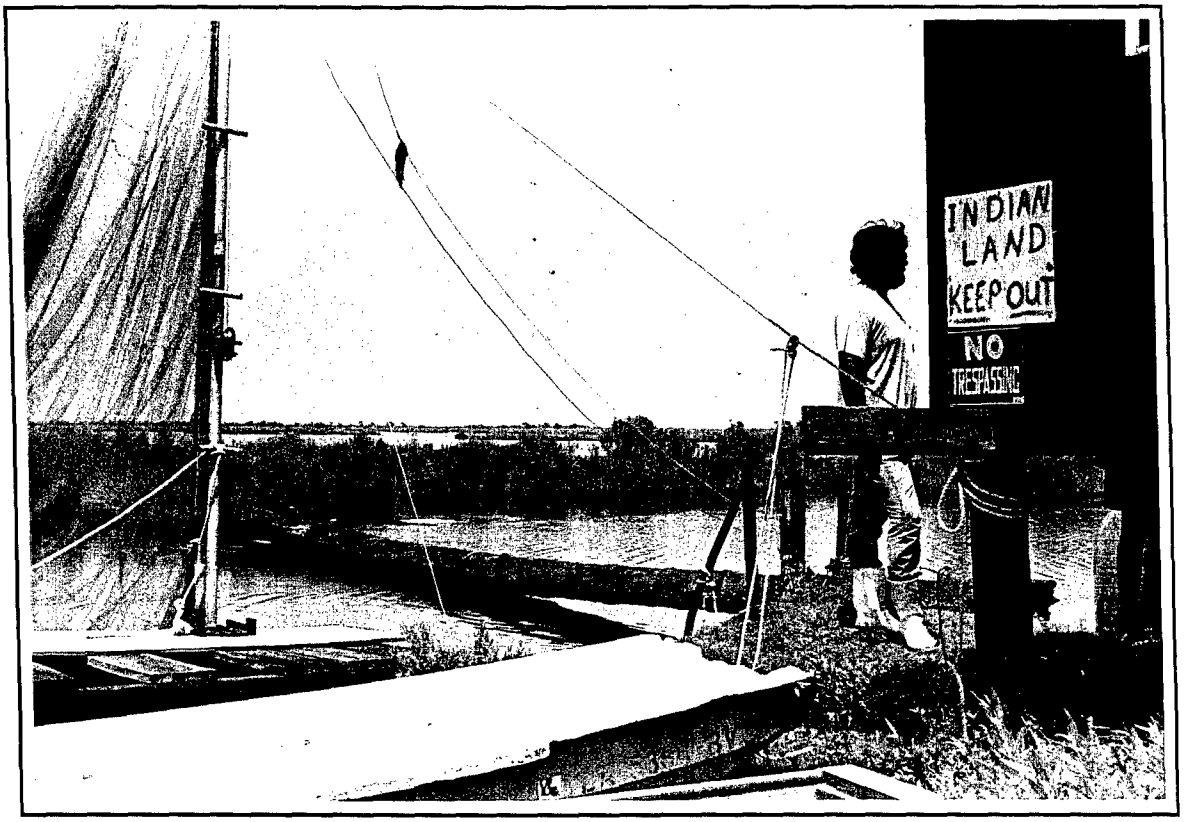


Figure 3-27. This sign on a Houma Indian camp is one indication of recent requests for official tribal recognition. August 16, 1995.

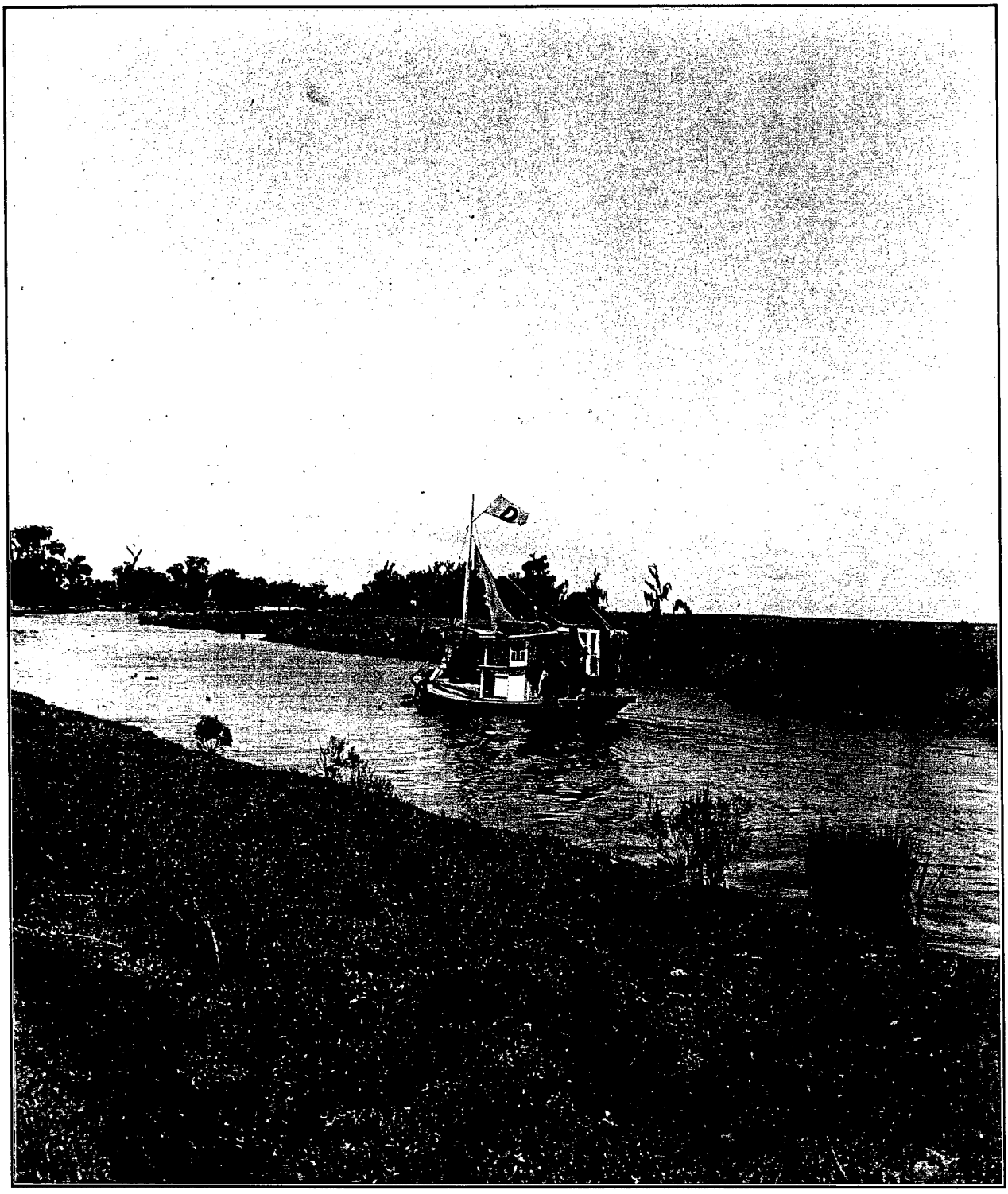


Figure 3-28. A shrimp boat on Bayou Du Large heads out towards the Gulf of Mexico. Ca. 1946. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50730. Photographer: Roberts.

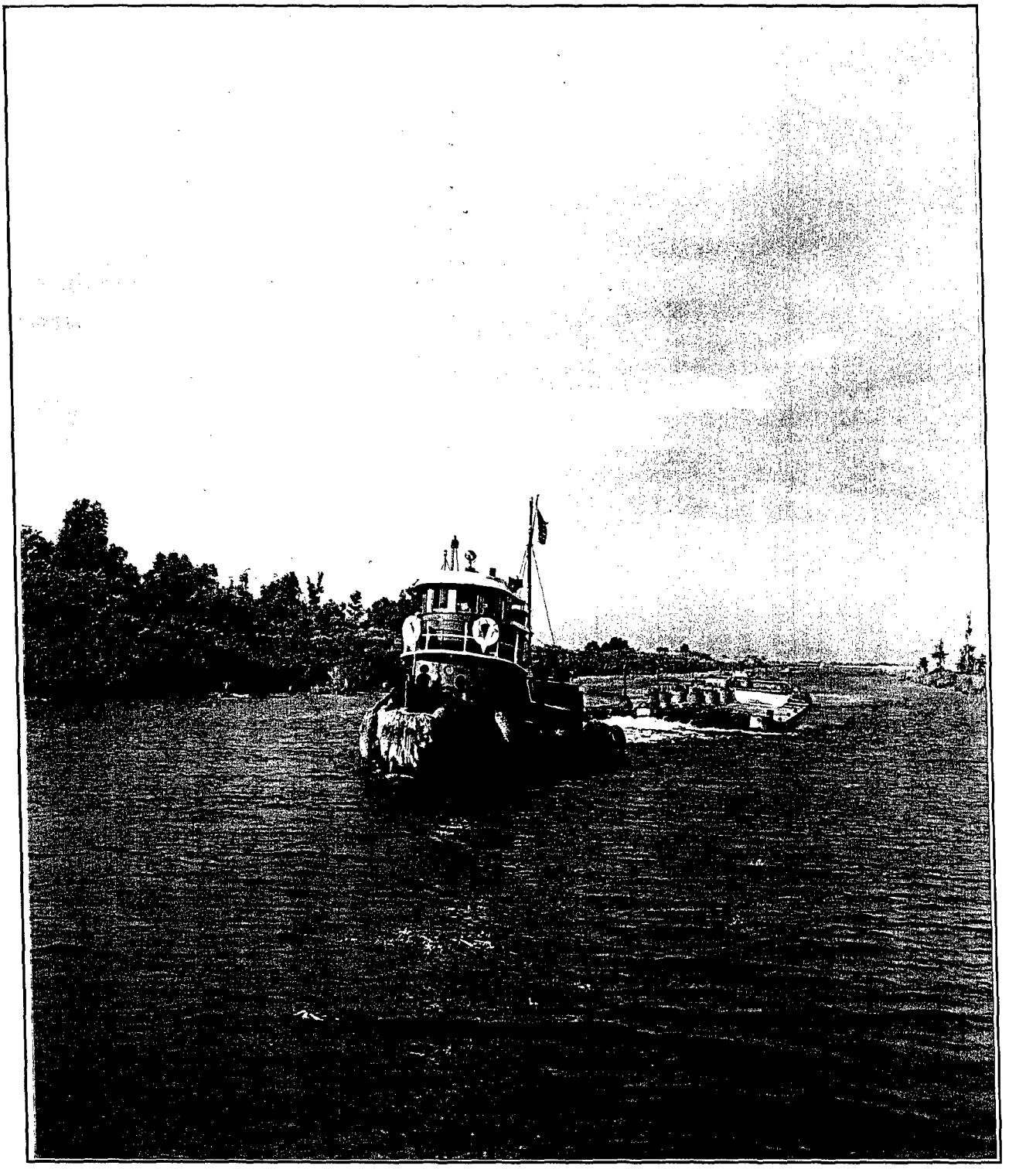


Figure 3-29. On the Intracoastal Canal, the *Pax Two*, a typical canal tug pulling a tow of loaded oil barges. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 25930. Photographer: Rosskam, June 1945.

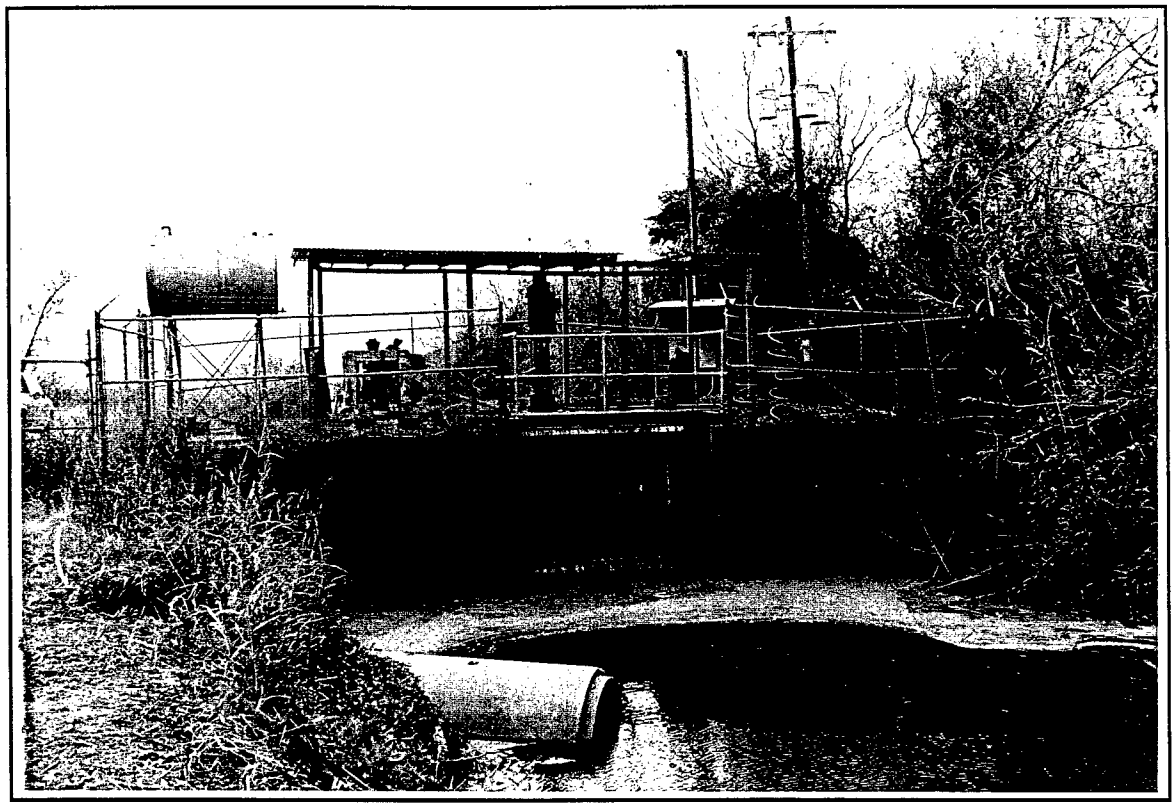


Figure 3-30. Near the Port of West St. Mary, this pump and associated canal is designed to help drain the region's sugar cane fields. Date: December 11, 1997.

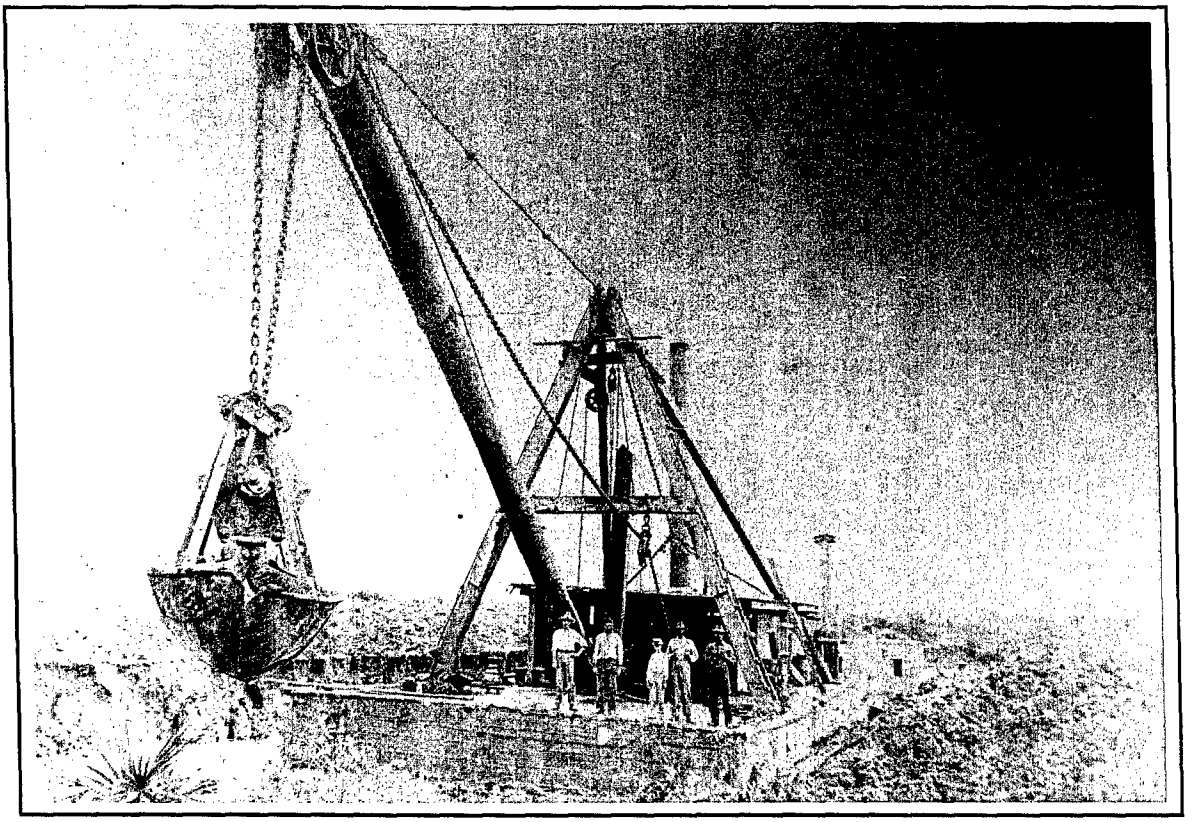


Figure 3-31. The dredge "Zoe B" was purchased and used by Terrebonne Parish to keep its waterways free of navigational hazards, ca. 1910. The dredge became an important part of the region's navigational history and predates significant state and federal interest is many of the area's waterways (source: Randolph Bazet Collection, Houma Louisiana).

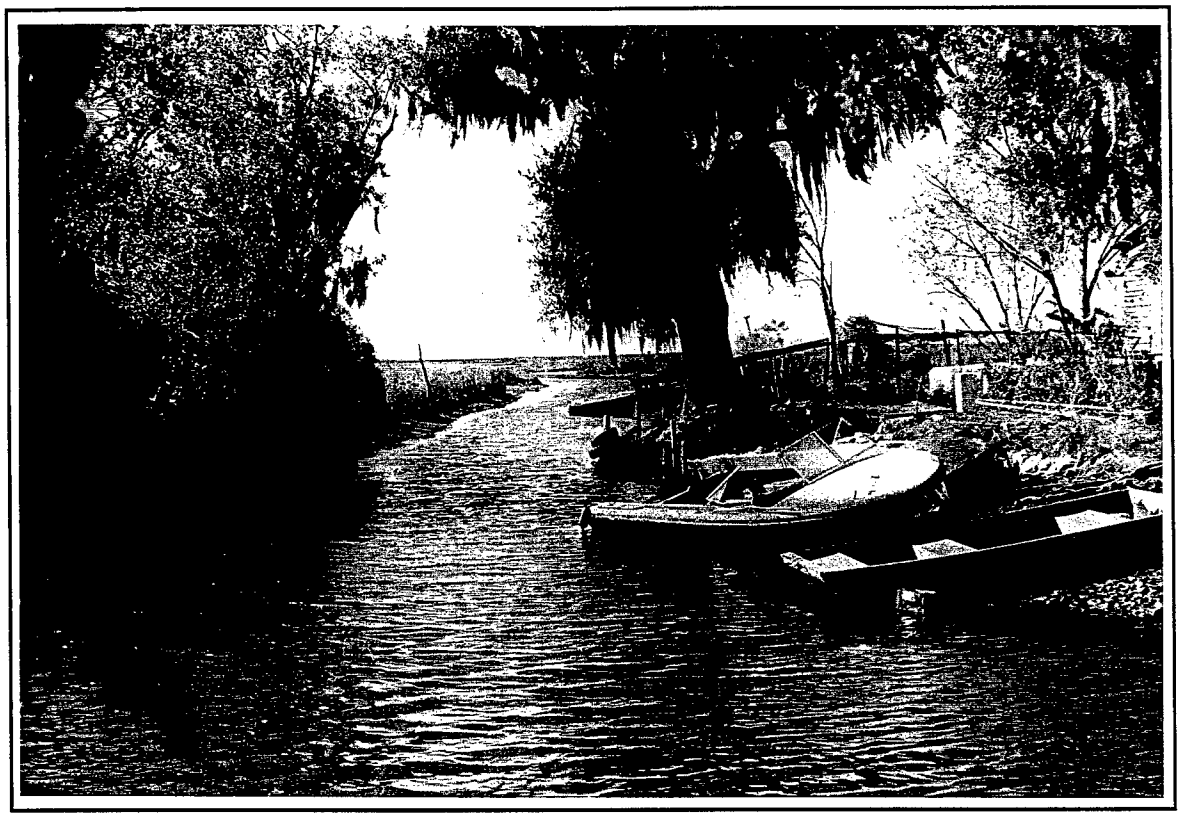


Figure 3-32. The Canal St. Jean Charles appears on maps from the early 1900s and it continues to serve the members of this relatively isolated fishing and trapping community. Date: December 30, 1997.

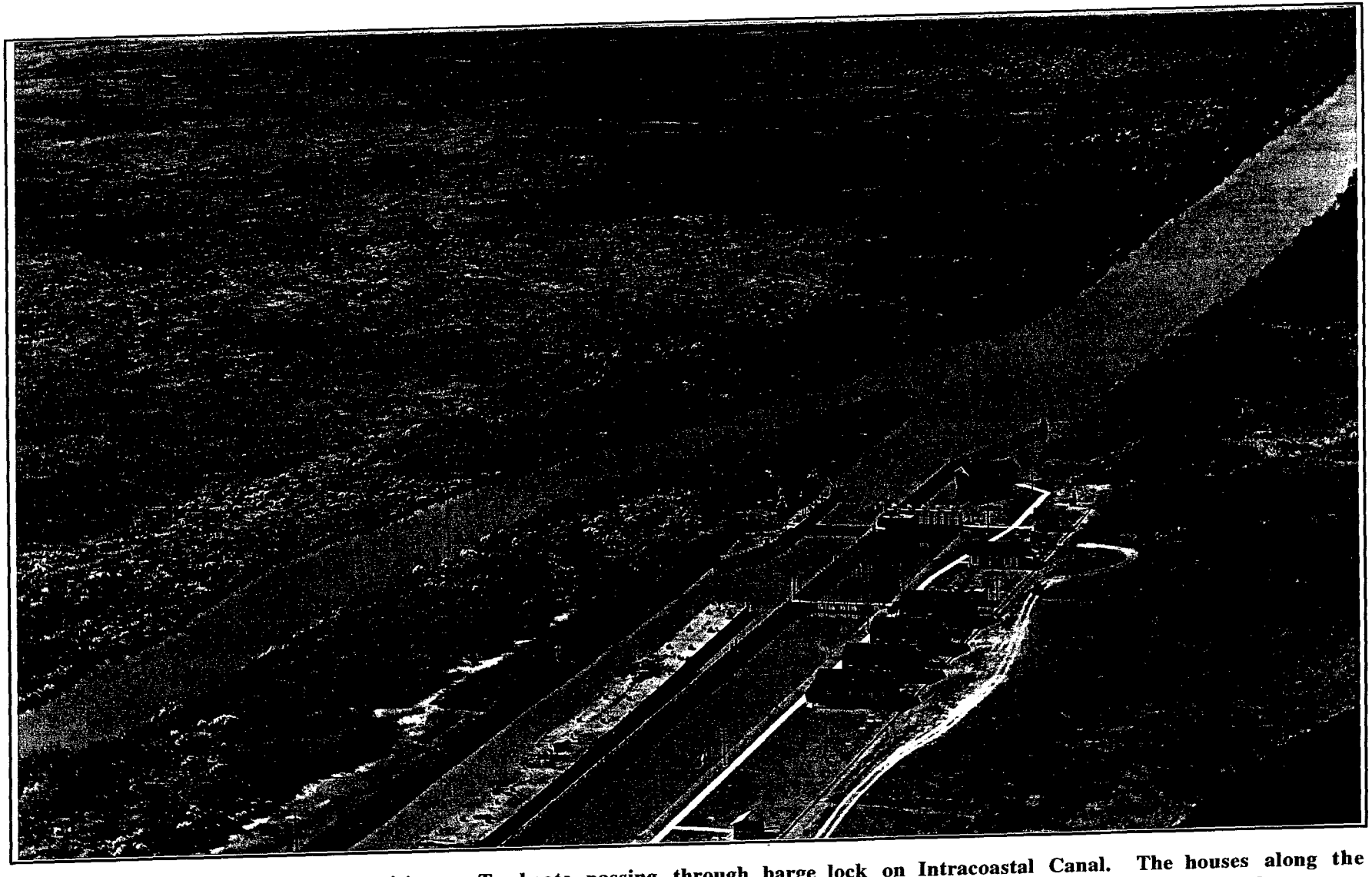


Figure 3-33. Intracoastal City, Louisiana. Towboats passing through barge lock on Intracoastal Canal. The houses along the bank are for employees who work on the barge locks. Communications are maintained by radio. [Today a new lock has been built, but the remnants of the structures shown in this photograph are still visible elements on the landscape.] University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62241. Photographer: Rotkin, November, 1948.

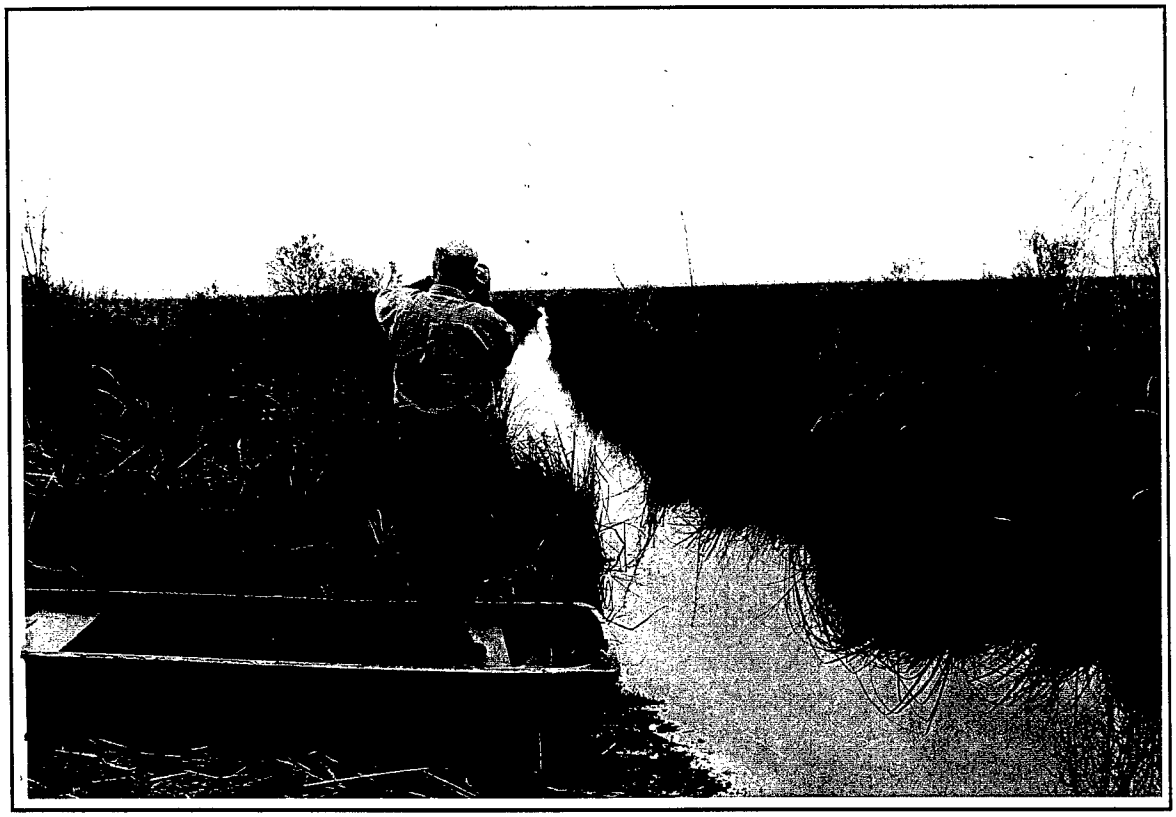


Figure 3-34. To gain access to trapping and hunting leases, trappers dug small pirogue trails called *trainasse*, like this one near the Leland Bowman Lock, in Vermilion Parish. Date: December 9, 1997.

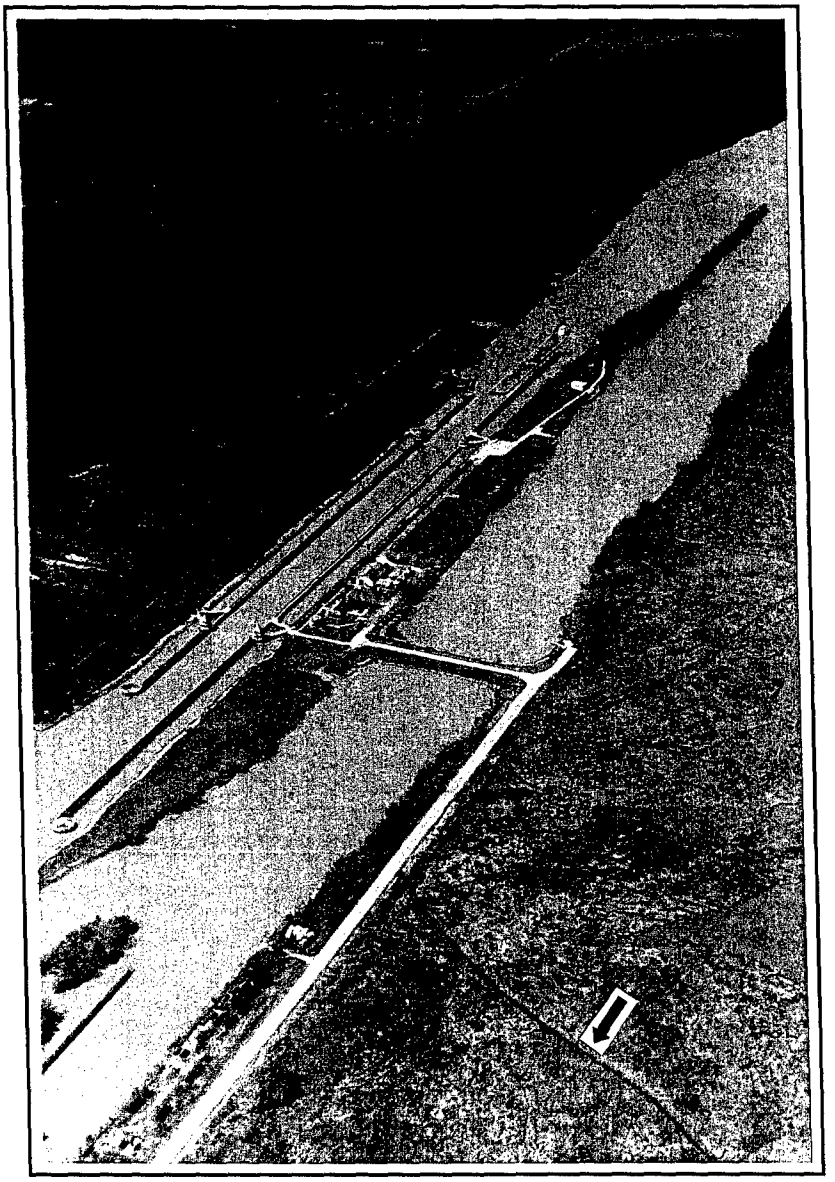


Figure 3-35. Trainasse (at lower right) in marsh adjacent to Leland Bowman Lock near Intracoastal City. Date: March 11, 1998.



Figure 3-36. Oil well location slip which has been newly dredged in marshes northeast of Pecan Island. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62198. Photographer: Rotkin, November, 1948.



Figure 3-37. Canals are an integral part of the onshore history of oil and gas exploration in Louisiana's alluvial wetlands. This network of channels at the west end of Vermilion Bay is one example. The drilling activity in the upper left corner is an indicator of the renewed interest in this particular field. Date: March 11, 1998.

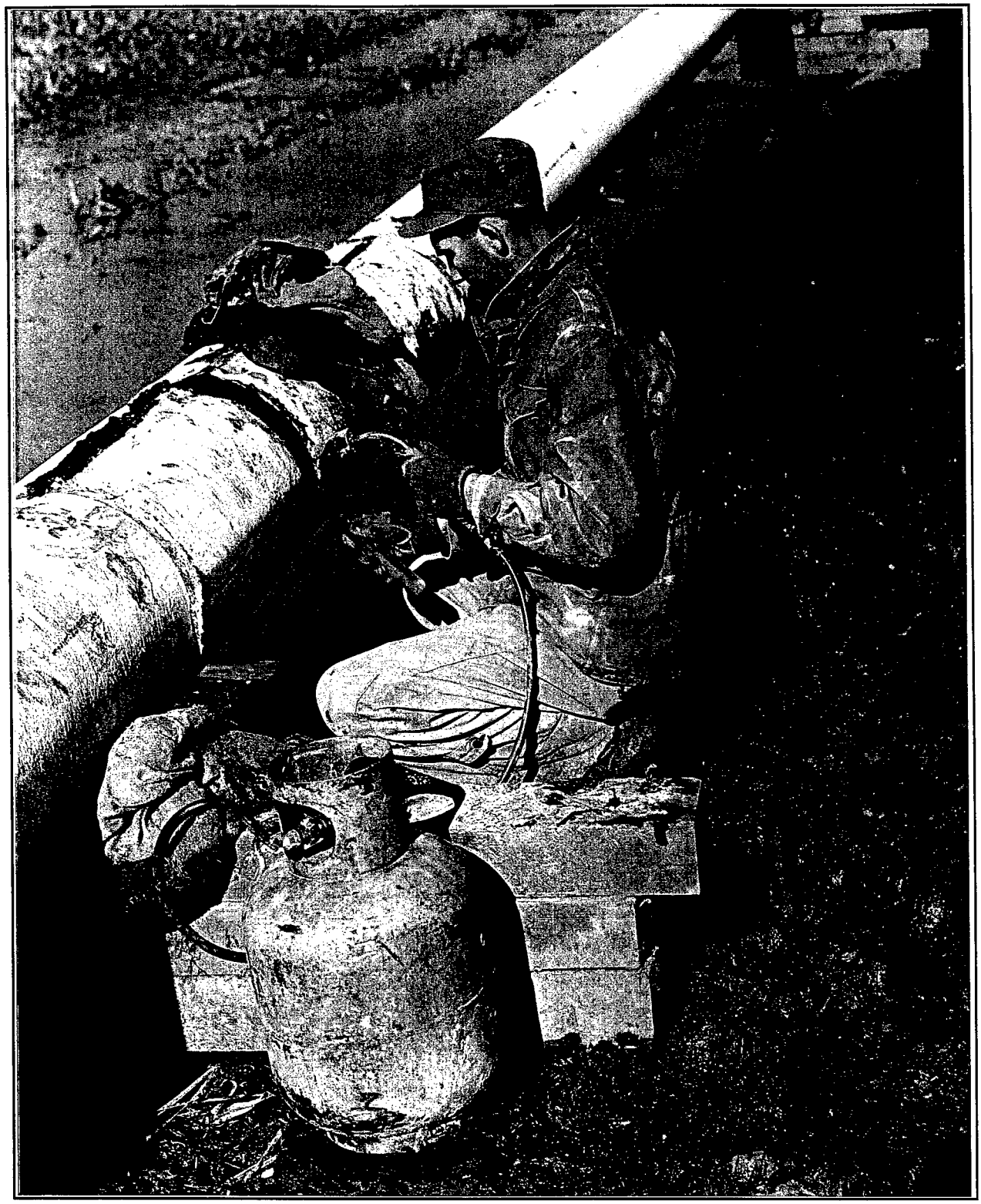


Figure 3-38. Workman applies somastic compound by hand to pipeline built through [Vermilion Parish in] Louisiana. Compound protects pipe from action of swamp waters. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 31840. Photographer: Corsini, December, 1945.

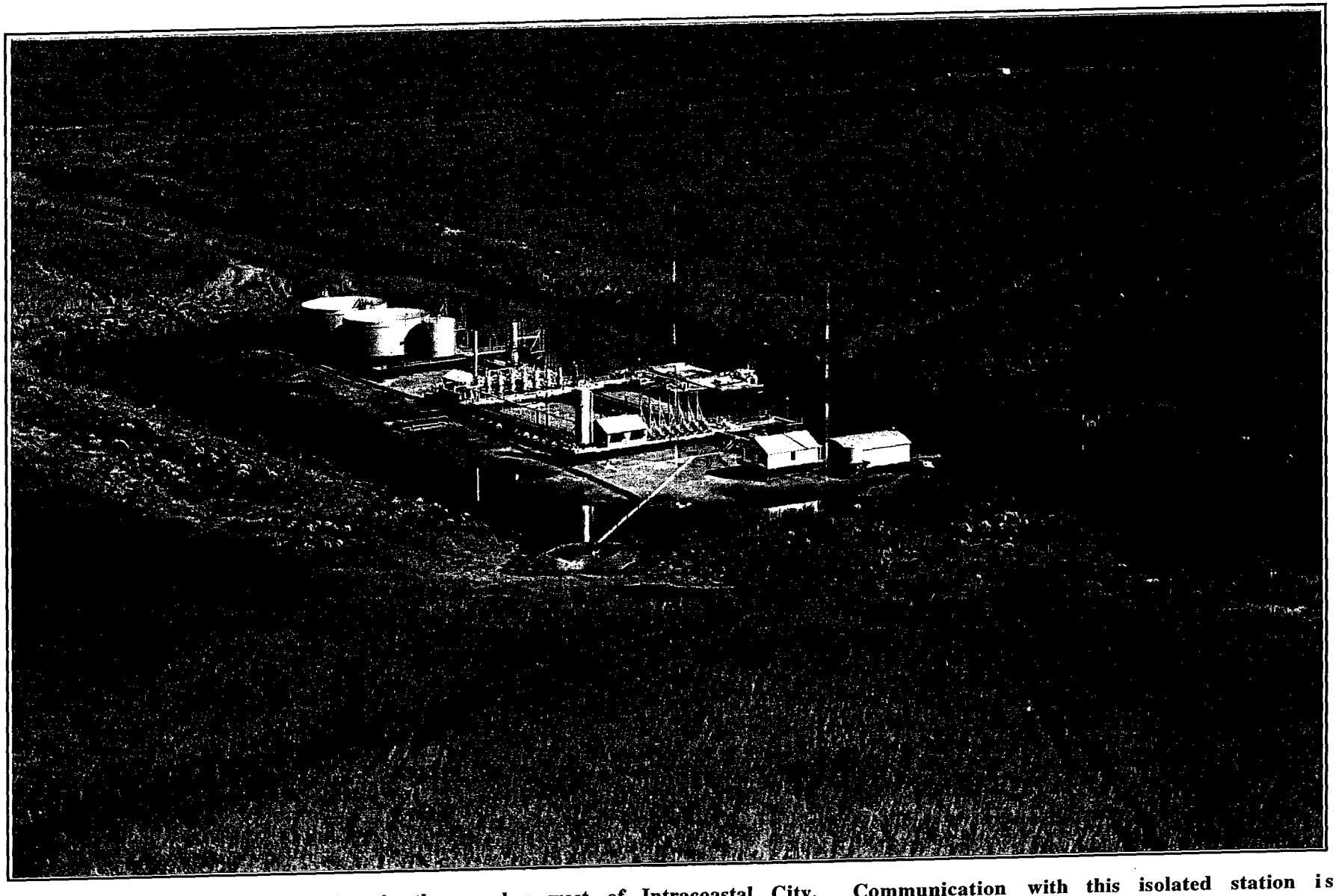


Figure 3-39. Oil collecting station in the marshes west of Intracoastal City. Communication with this isolated station is maintained by radio. [Note how the site is elevated above the marsh surface]. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62216. Photographer: Rotkin, November, 1948.

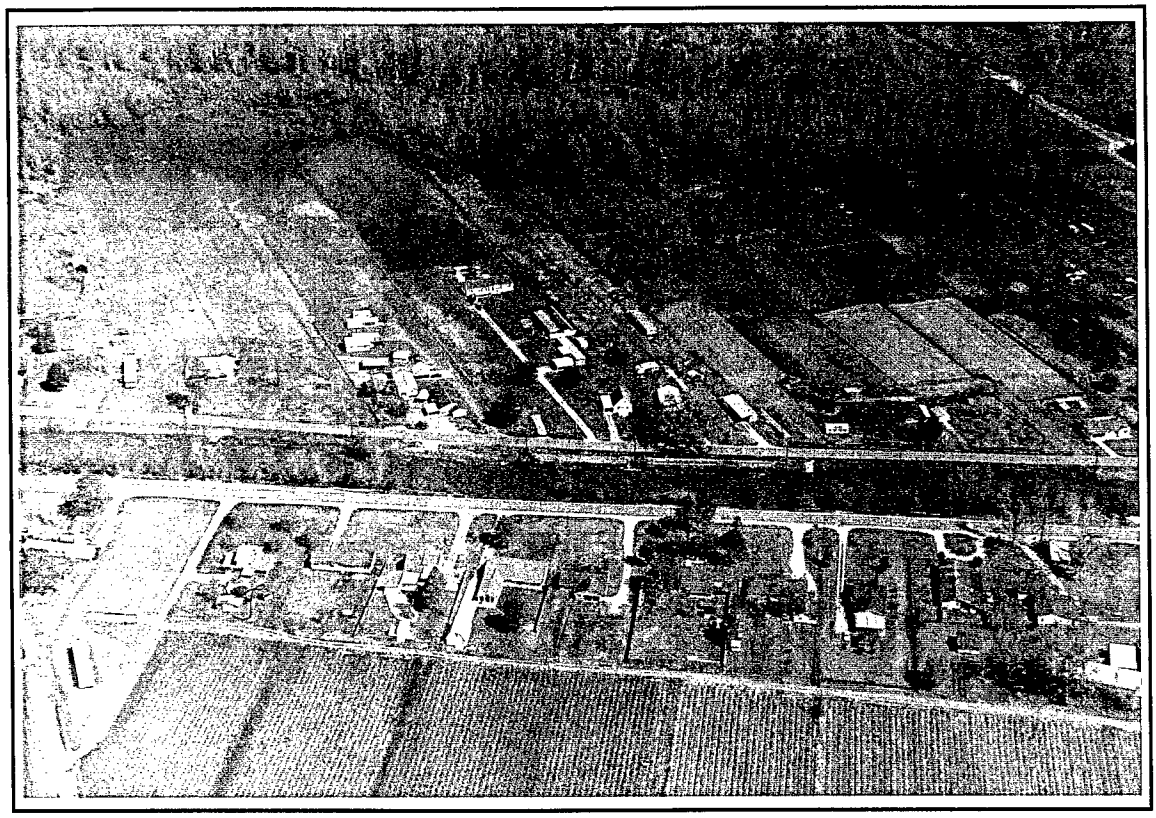


Figure 3-40. Aerial view of the linear settlements strung out along Bayou Black west of Houma, showing how all homes had access to the Bayou. Date: March 11, 1998.

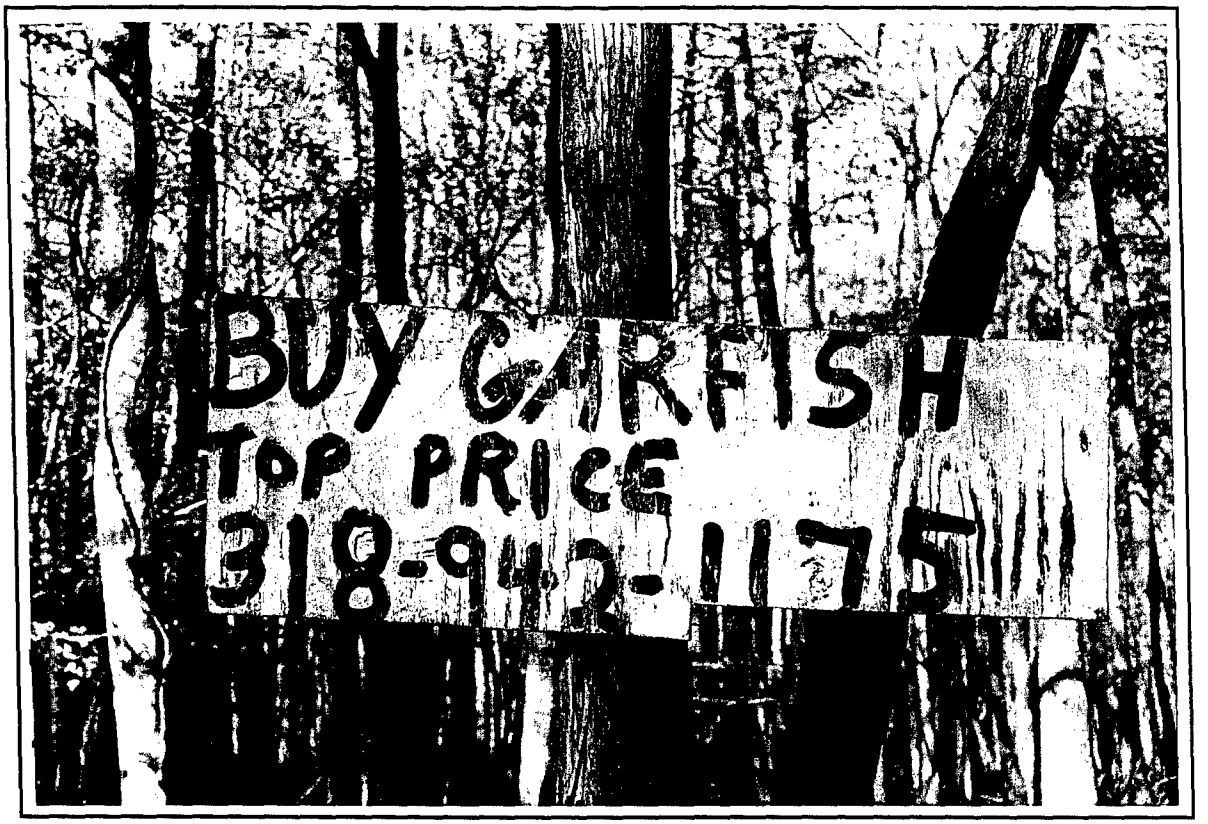


Figure 3-41. This "Buy Garfish" sign nailed to a tree in the swamp adjacent to Highway 82 in Vermilion Parish is an indicator of the importance of this fishery, since the buyer is willing to pay "top price" for this fish. Date: December 10, 1997.

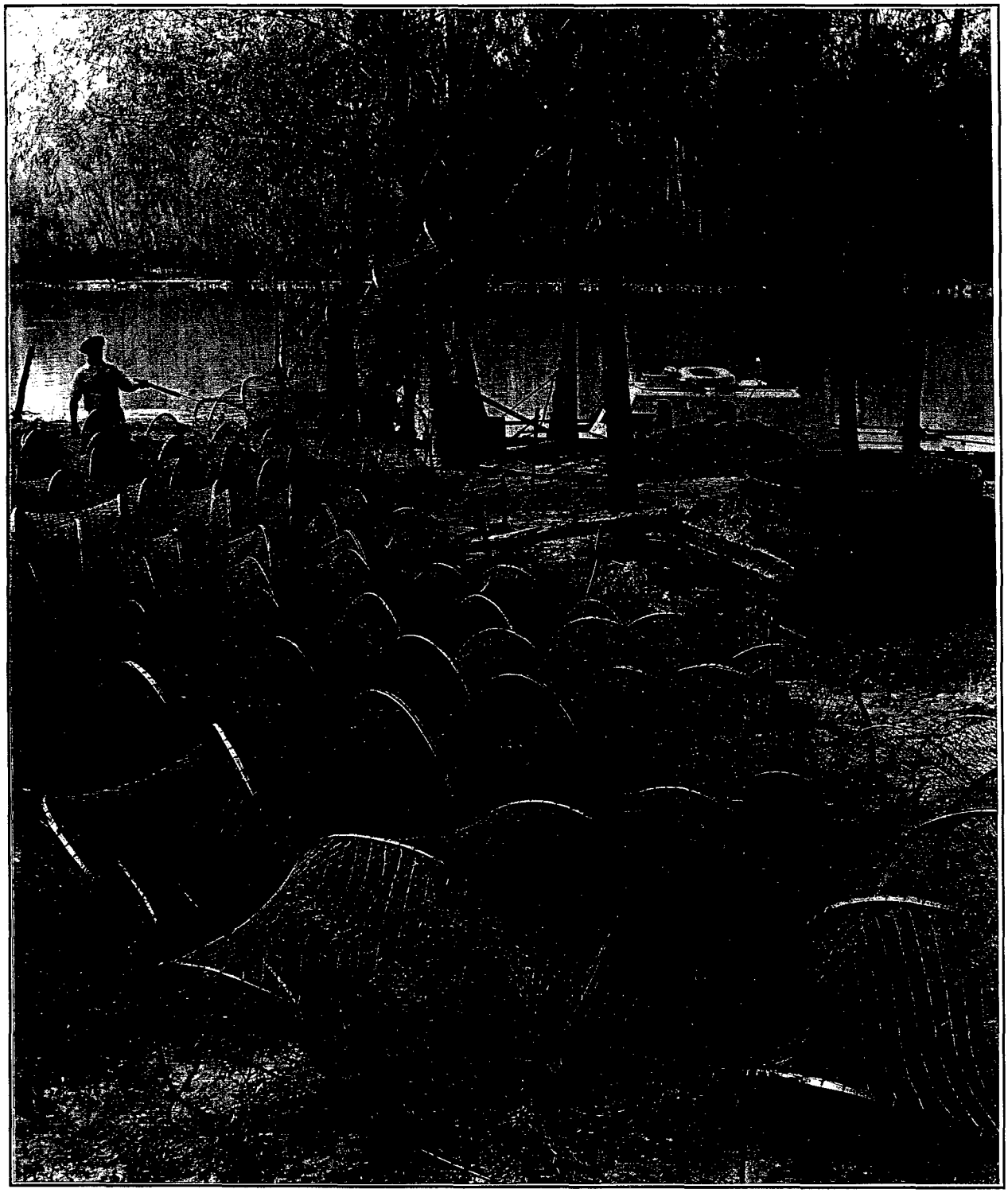


Figure 3-42. Tarring fishing nets being spread out to dry by fisherman living along Bayou Sorrel, Iberville Parish, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 67909. Photographer: Lee, November, 1950.

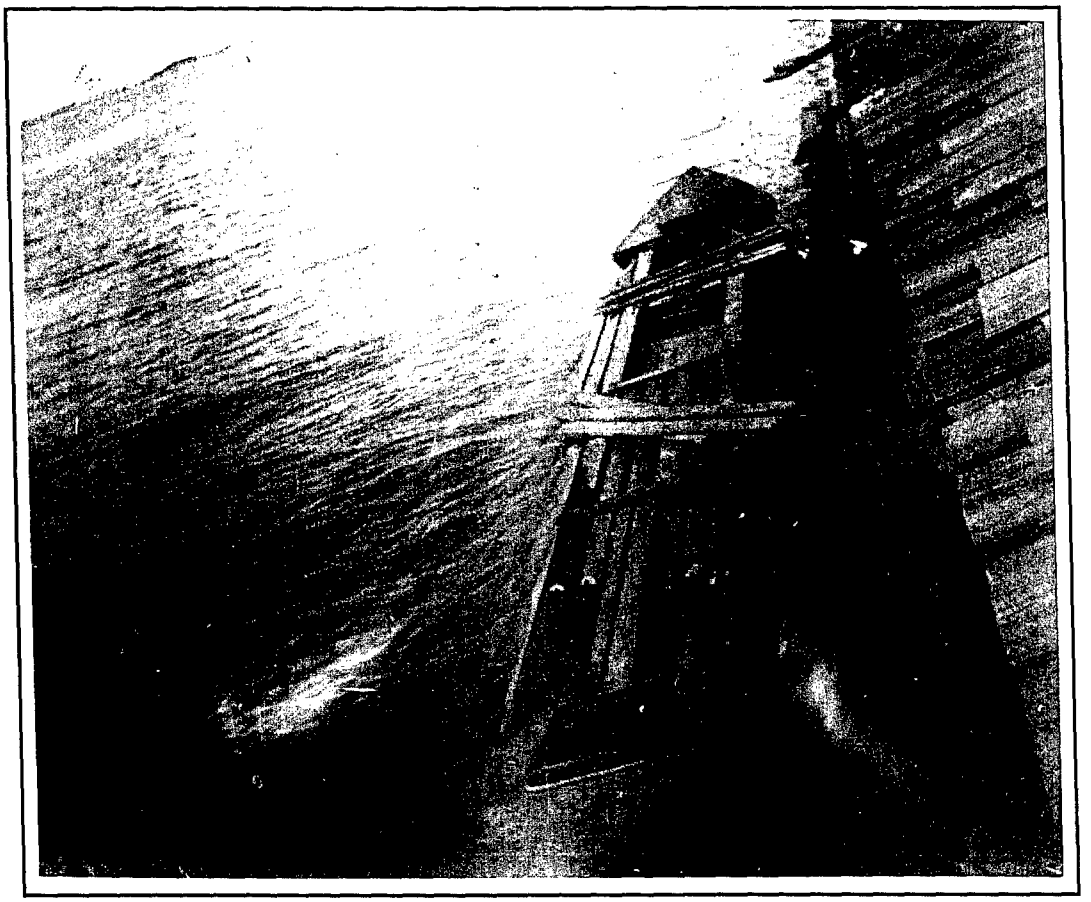


Figure 3-43. View of a fish car commonly used to transport fish to market prior to the introduction of refrigeration. This car was used in the fish trade between Grand Isle and Morgan City and is a rare example of this type of transportation technique (source: National Archives, Negative No. 22-FCD-10).

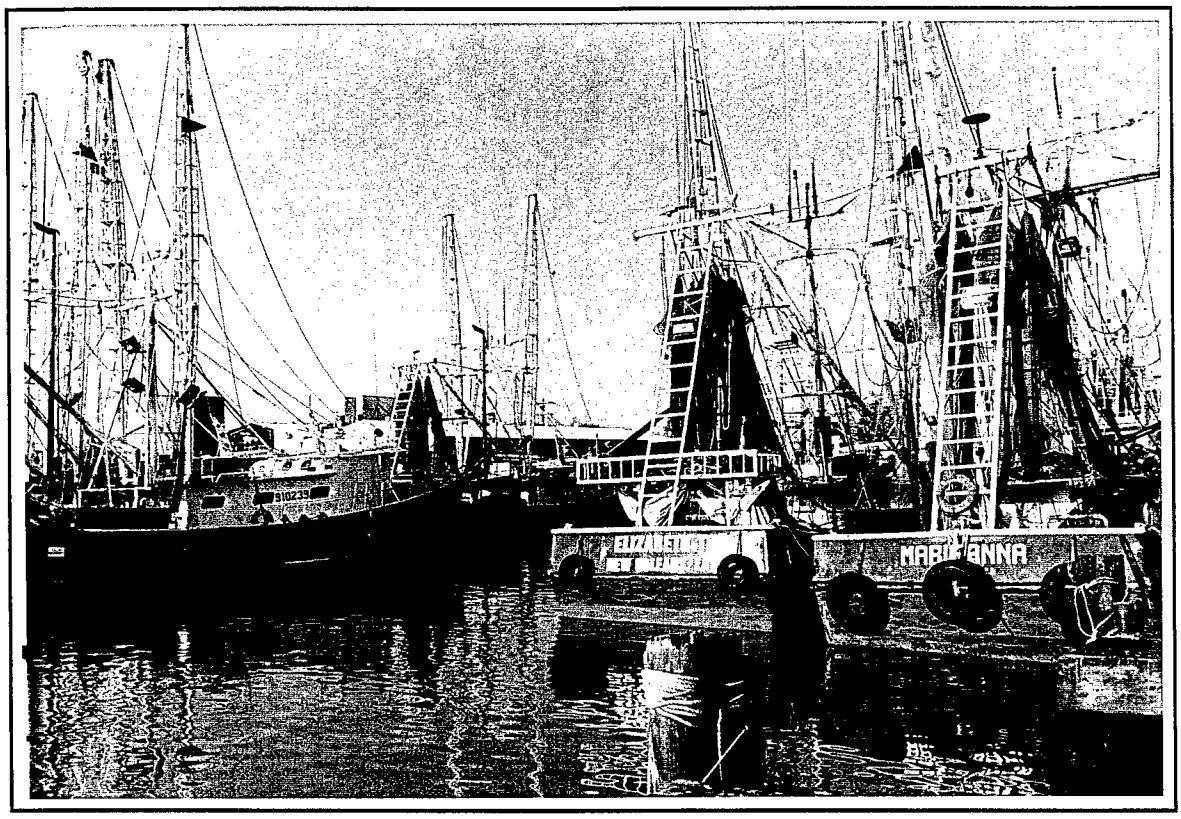


Figure 3-44. Steel-hulled shrimp boats at one of the seafood processing facility docks in Intracoastal City. Date: December 10, 1997.



Figure 3-45. **Although overshadowed by other fisheries, part of Louisiana's tuna fleet operates from docks along Bayou Grand Caillou within the community of Lower Dulac in Terrebonne Parish. Date: December 22, 1997.**



Figure 3-46. Part of a days catch by a mullet fisherman operating out of Chauvin in Terrebonne Parish. Date: December 22, 1997.

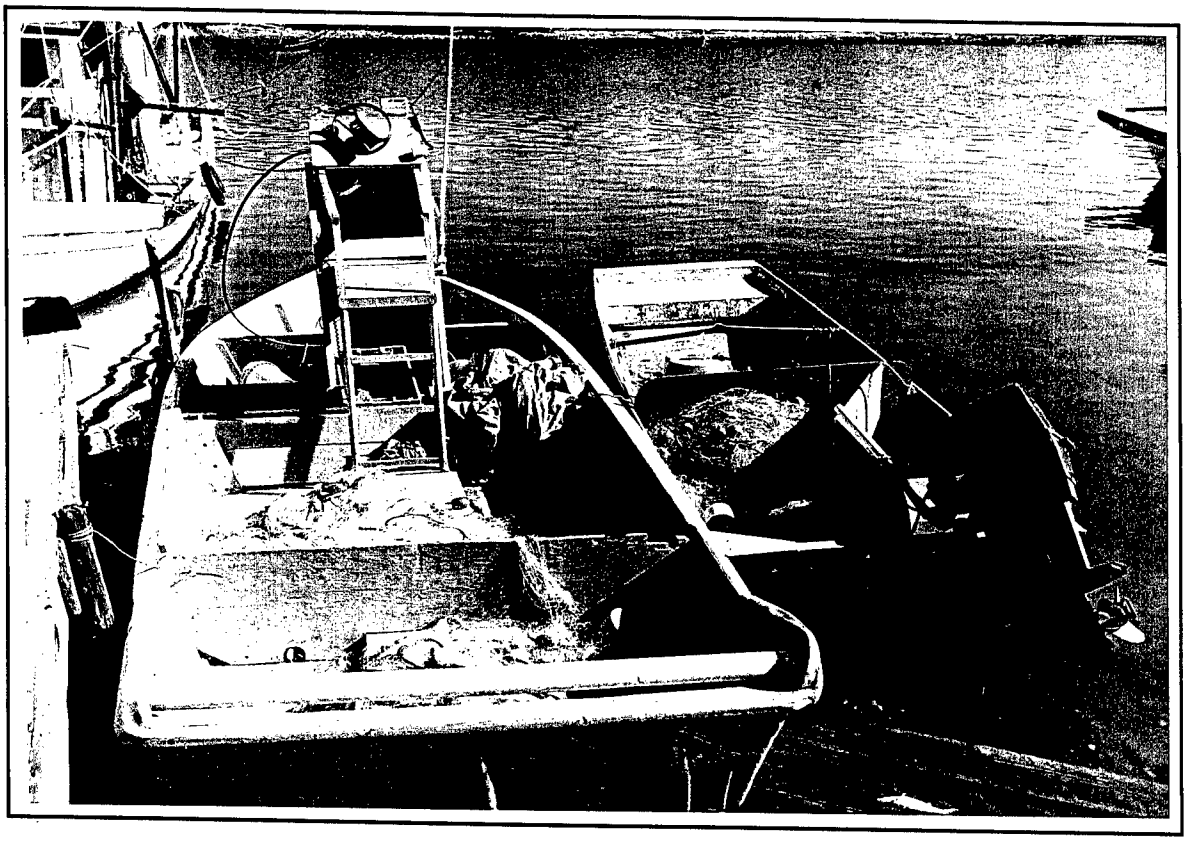


Figure 3-47. A new fishery in south Louisiana is mullet. Mullet are prized for their roe, which is exported to Asia. This mullet boat, with its distinctive hull design and motor placement, works out of Bayou Petit Caillou near Chauvin in Terrebonne Parish Date: December 18, 1997.

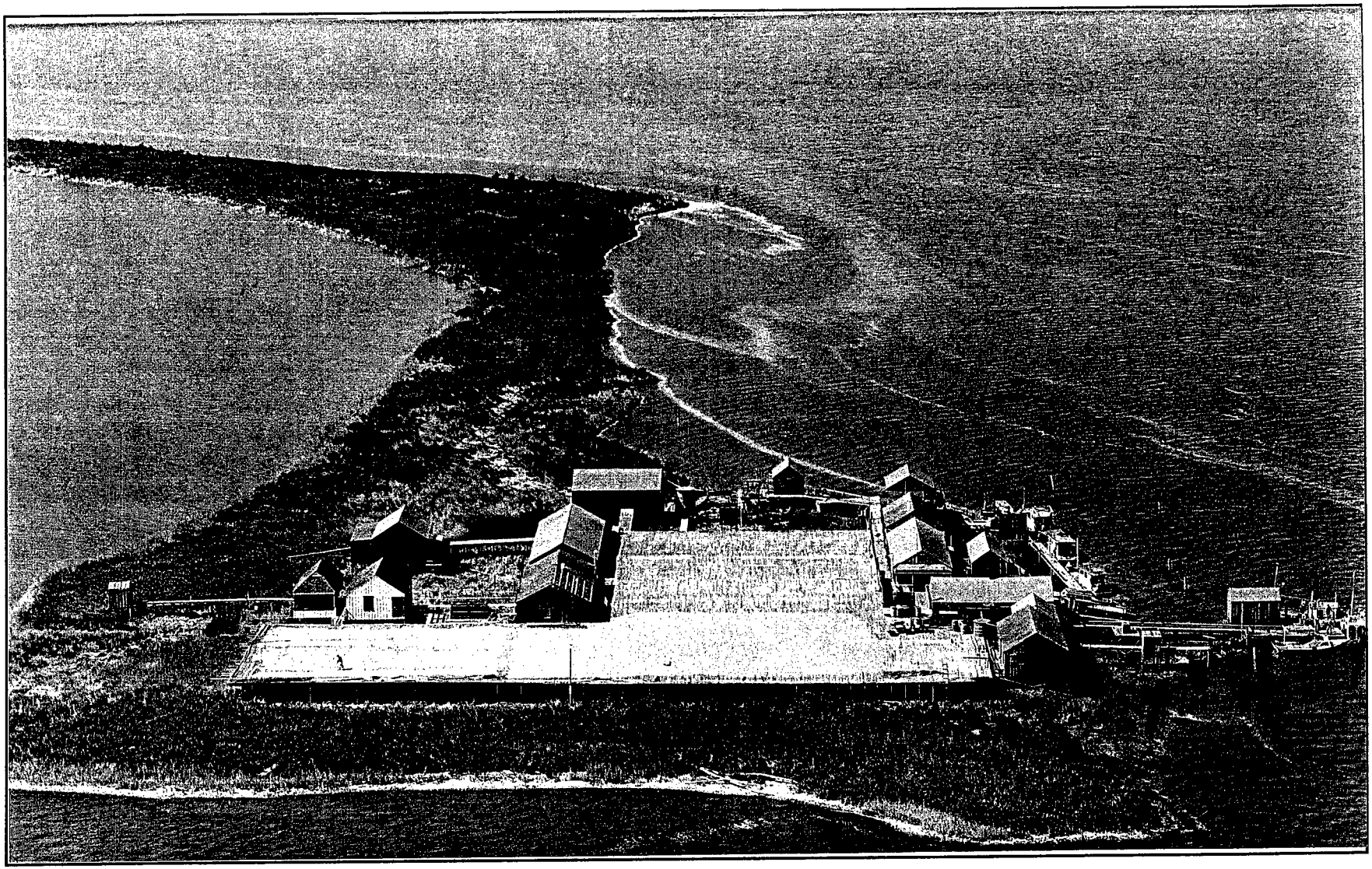


Figure 3-48. Shrimp fisherman's houses and shrimp-drying platform on high ground in Barataria Bay. [At the zenith of the shrimp-drying period, more than 75 of these platforms were scattered through south Louisiana's marshes]. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 61687. Photographer: Rotkin, October, 1948.



Figure 3-49. On this shrimp drying platform south of Houma, men and women "danced the shrimp" to remove the shell during the drying process. The shells were sold as "bran" and used as an additive to chicken feed. Date: ca. 1920. (source: Randolph Bazet Collection, Houma Louisiana).

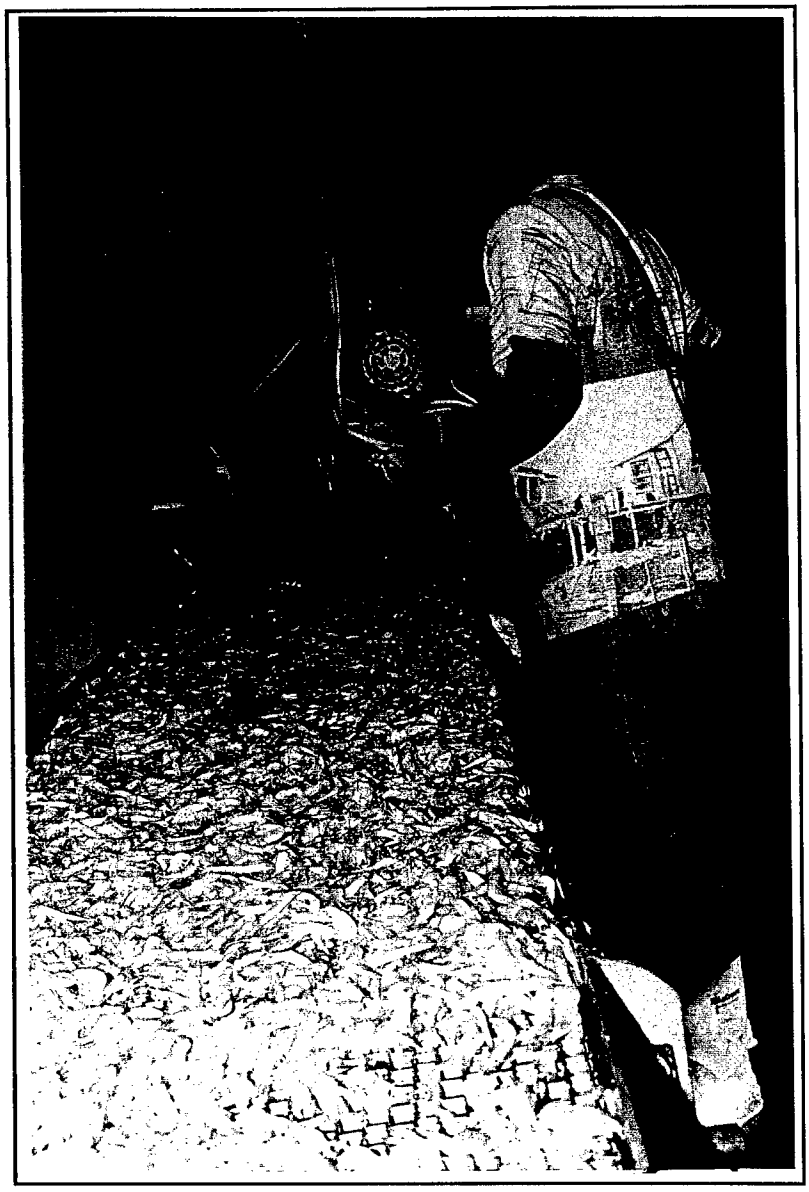


Figure 3-50. This conveyor is transferring shrimp from a shrimp boat at a seafood processing house near Cocodrie in Terrebonne Parish. Date: December 18, 1997.

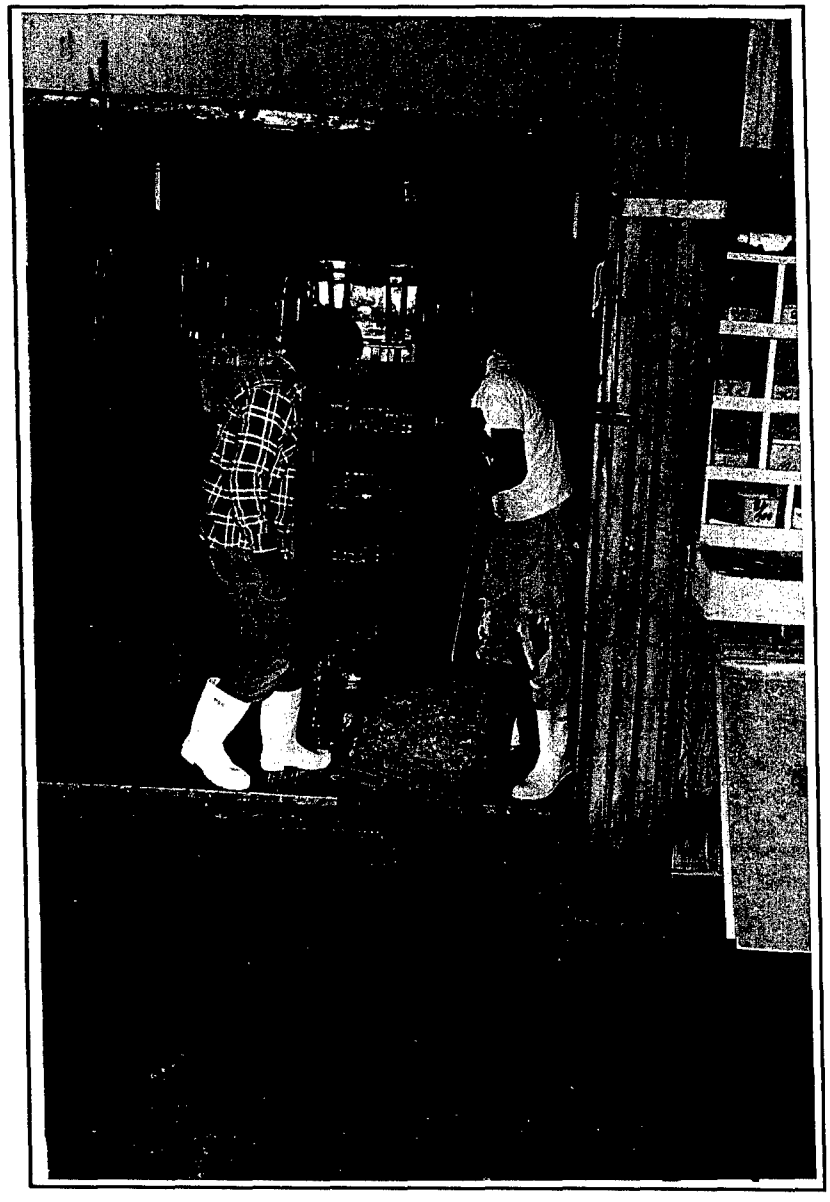


Figure 3-51. By dollar value, shrimp is the most important shellfish in Louisiana. Eighteen-wheelers carry the unprocessed shrimp to packing houses and to markets throughout the country. This truck is being loaded at a seafood processing house near Cocodrie in Terrebonne Parish. Date: December 18, 1997.



Figure 3-52. Tonging for oysters in the oyster beds of the Golden Meadow fisheries. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 47024. Photographer: Roberts, February, 1947.



Figure 3-53. Before mechanization, a pair of tongs was used to harvest Louisiana's oyster beds. Tongs resembled two long-handled rakes tied so their teeth were facing each other. Tonging was a long and tedious process, with the harvest often being off-loaded to steamboats to be taken to market, ca. 1938 (source: Fonville Winans, Louisiana State Library, Louisiana Photography Archives).

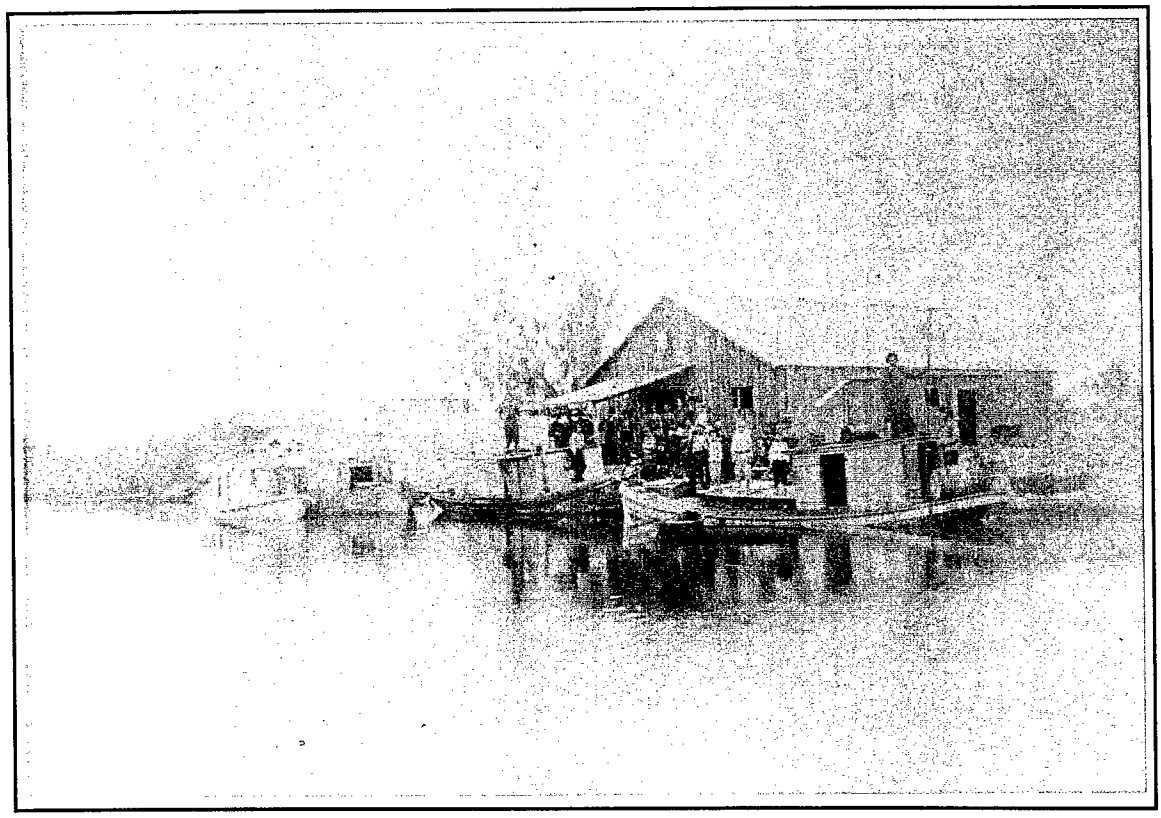


Figure 3-54. To facilitate processing, oyster shops were often built on isolated sites near productive oyster leases. This shop was located in the Terrebonne-Timbalier estuarine complex, south of Houma, ca. 1920. During this period, one processing plant was floated into the region on a barge and could, therefore, be moved at will (source: Randolph Bazet Collection, Houma, Louisiana).

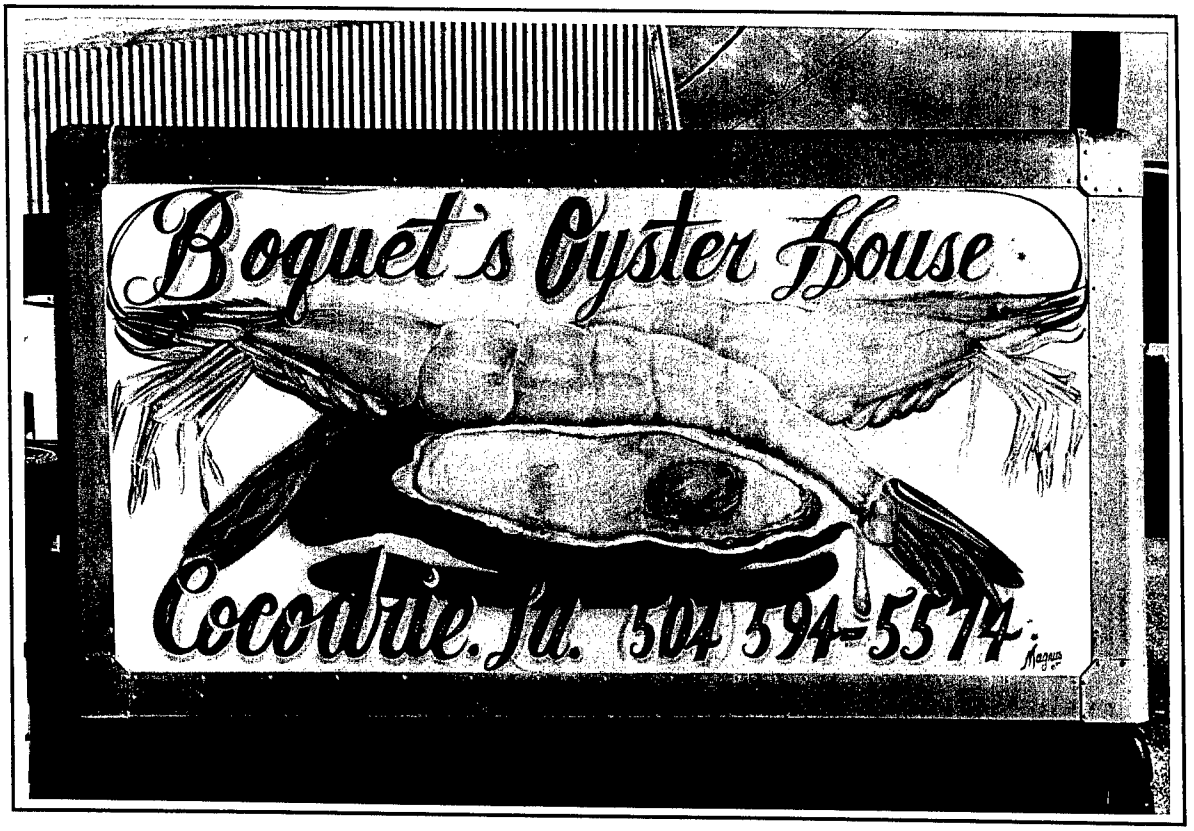


Figure 3-55. The region's fishing tradition is evident by this sign on a truck near Chauvin in Terrebonne Parish. Date: December 18, 1997.



Figure 3-56. Since the early 1900s oysters have been an important part of the Terrebonne/Lafourche parish economies. This oyster shucking house near Chauvin in Terrebonne Parish continues an industry that is nearly 100 years old. Date: December 18, 1997.

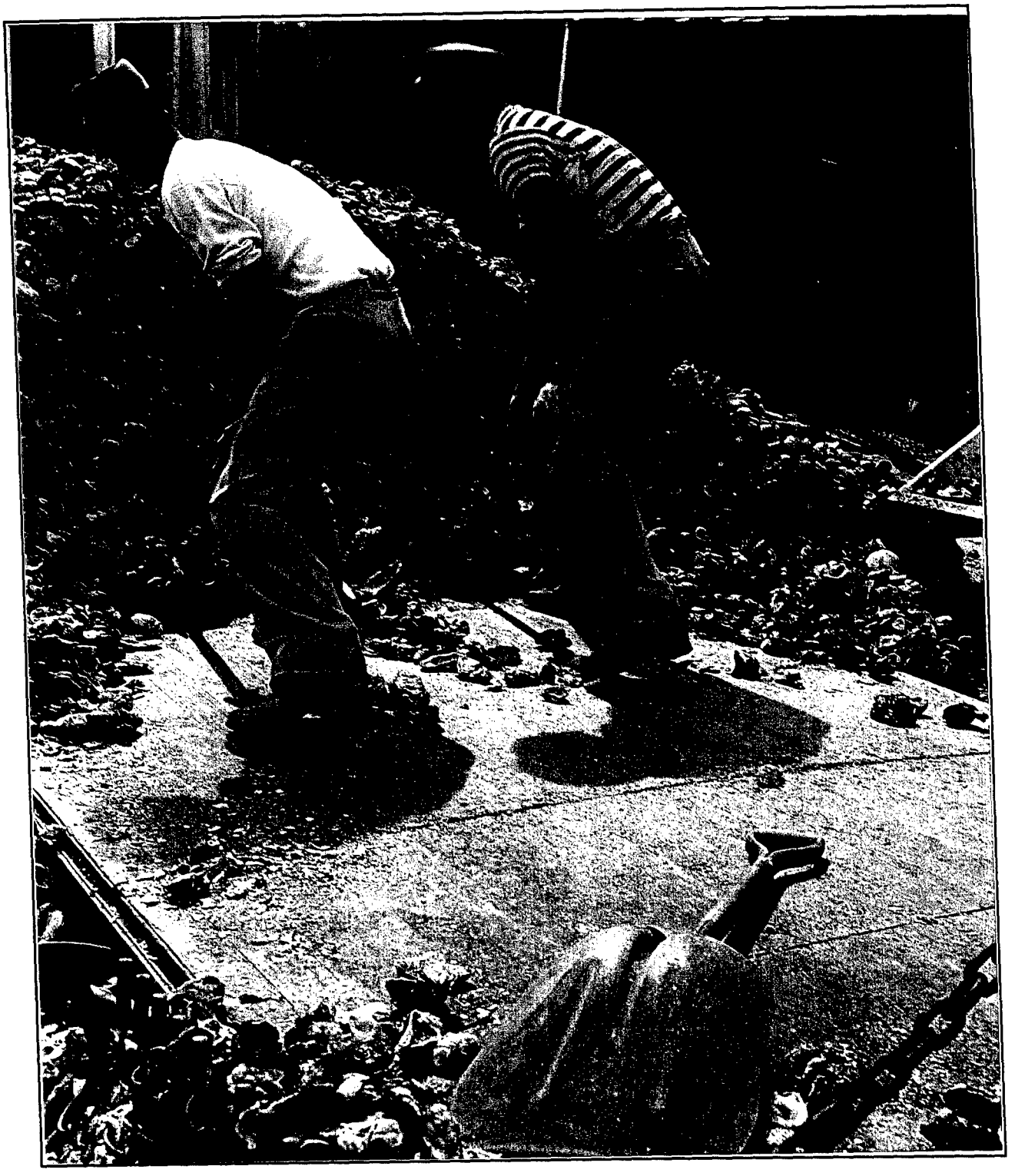


Figure 3-57. Unloading a boat load of oysters onto conveyer which carries them into the oyster house. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 45984. Photographer: Roberts, February, 1947.

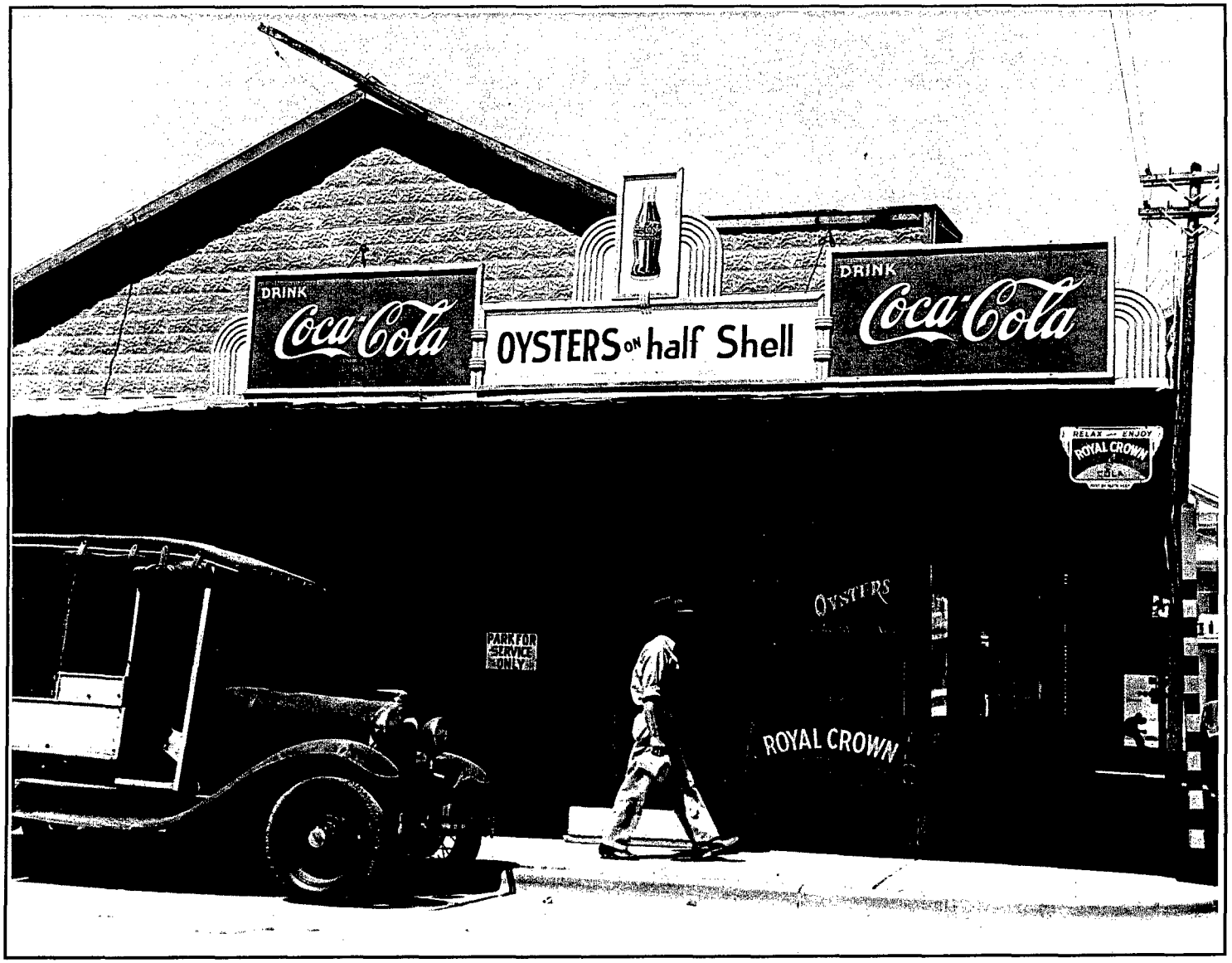


Figure 3-58. Main street in Houma, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 47883. Photographer: Webb, May, 1947.

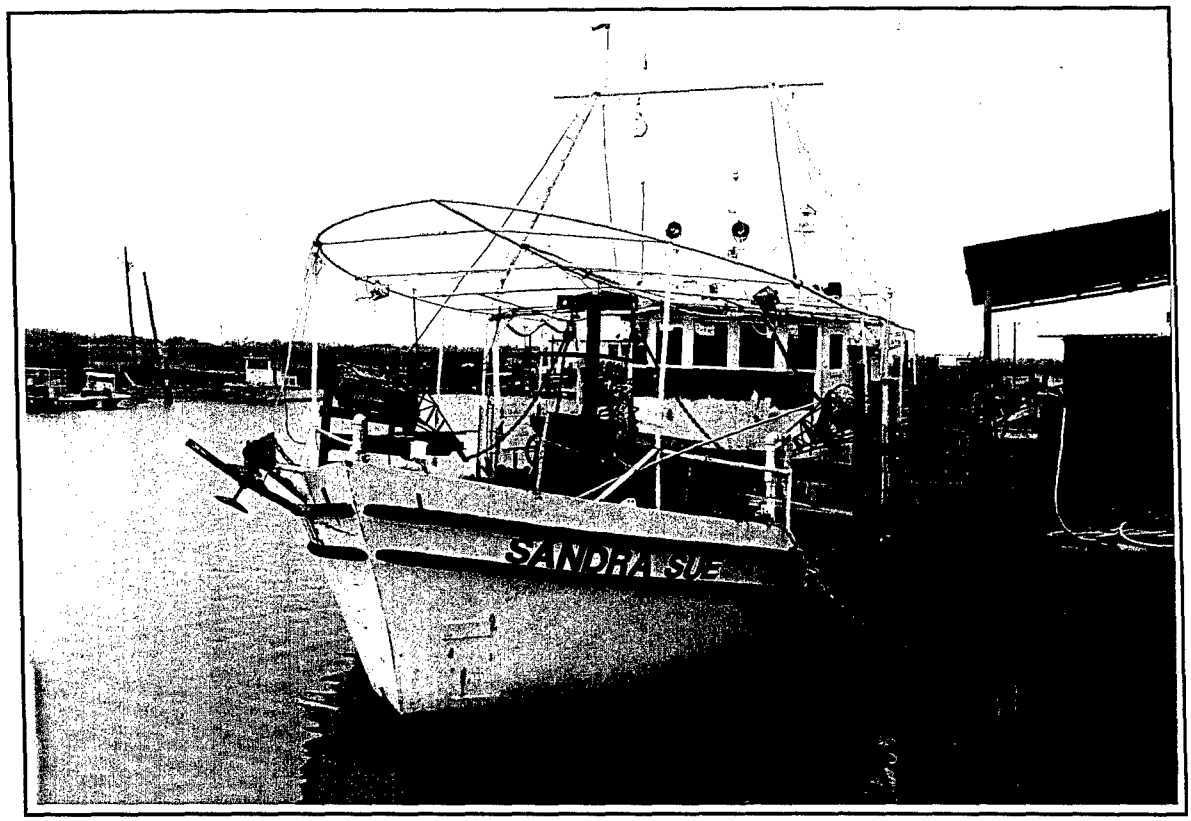


Figure 3-59. An oyster boat tied to the dock at the Port of West St. Mary. This boat works on leases at Southwest Pass near Marsh Island. Date: December 11, 1997.

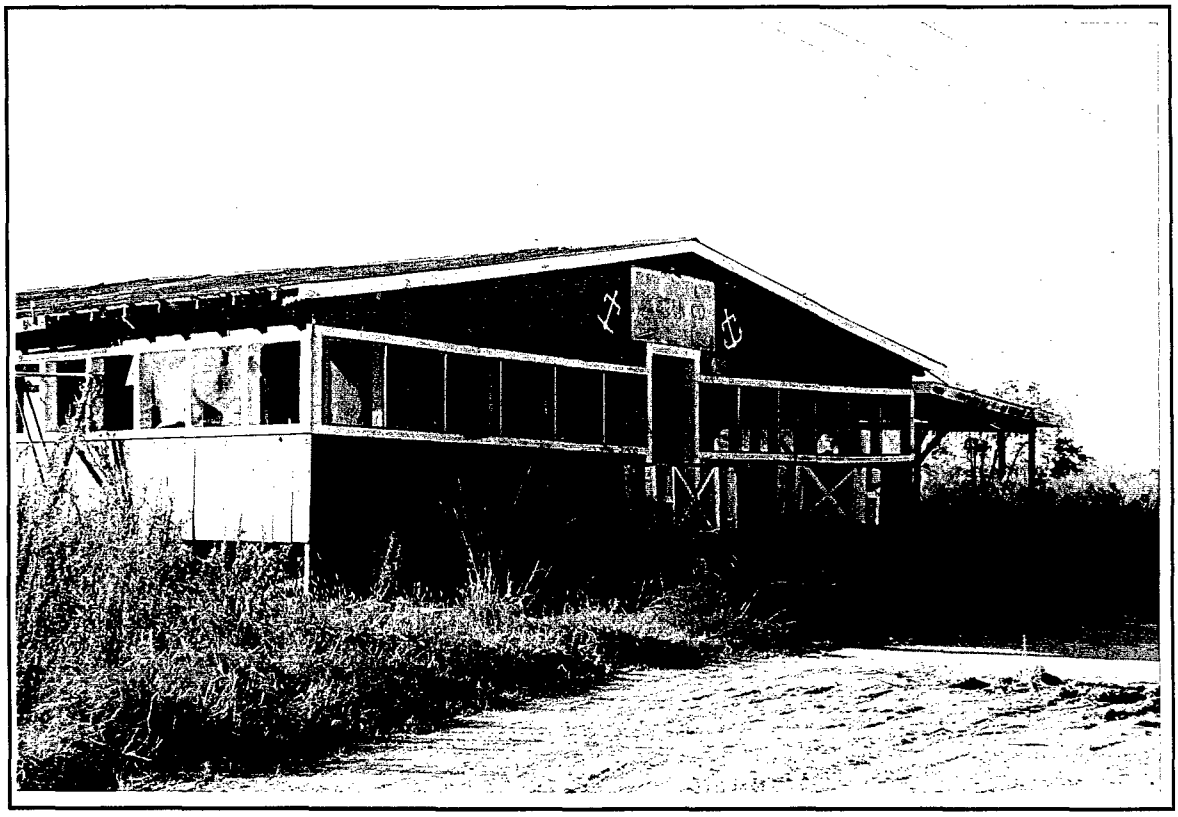


Figure 3-60. Abandoned Bay Junop Oyster Co. building along lower Bayou du Large. This building served as an office and dormitory for oystermen during the early twentieth century. Date: December 31, 1997.

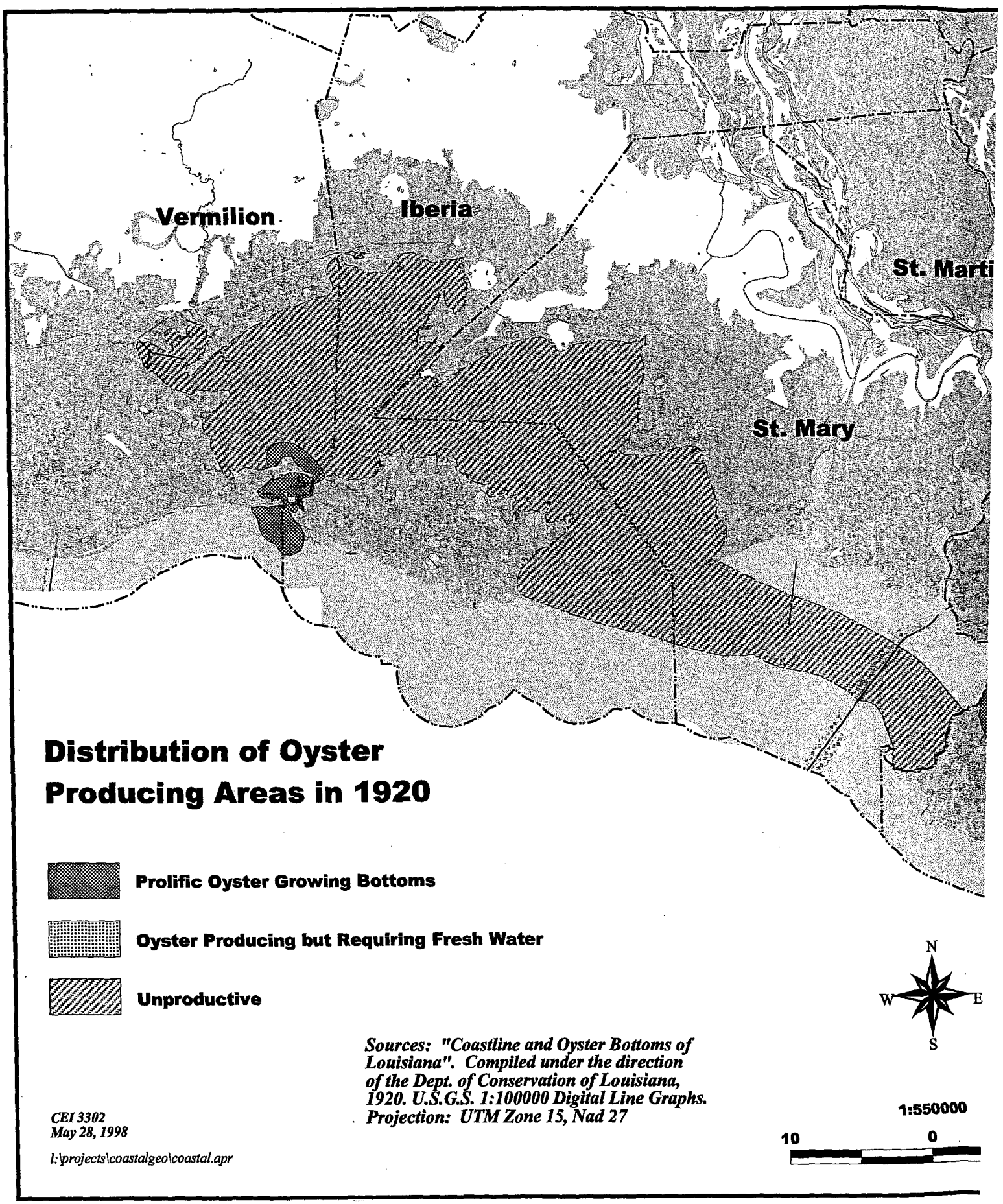
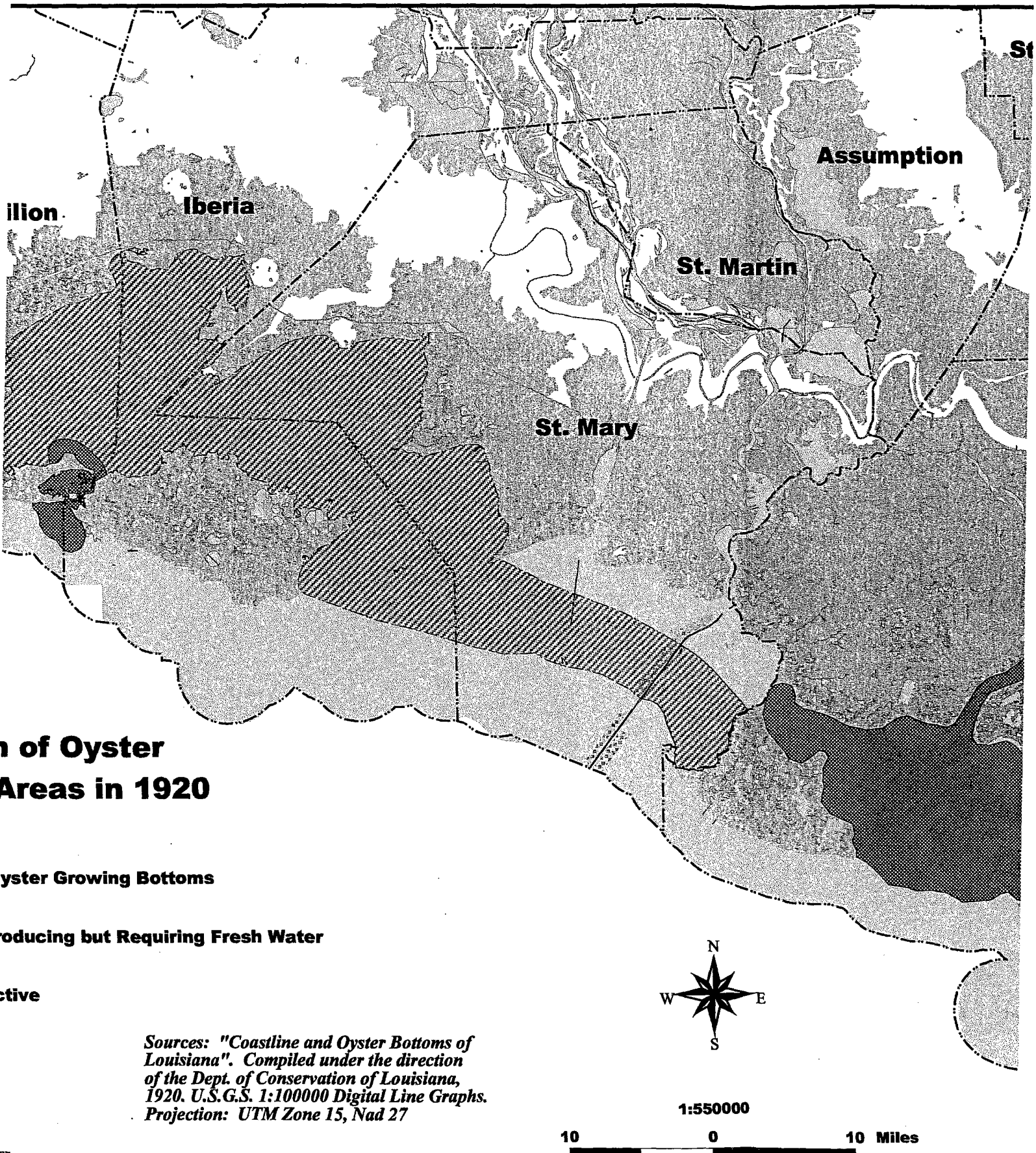
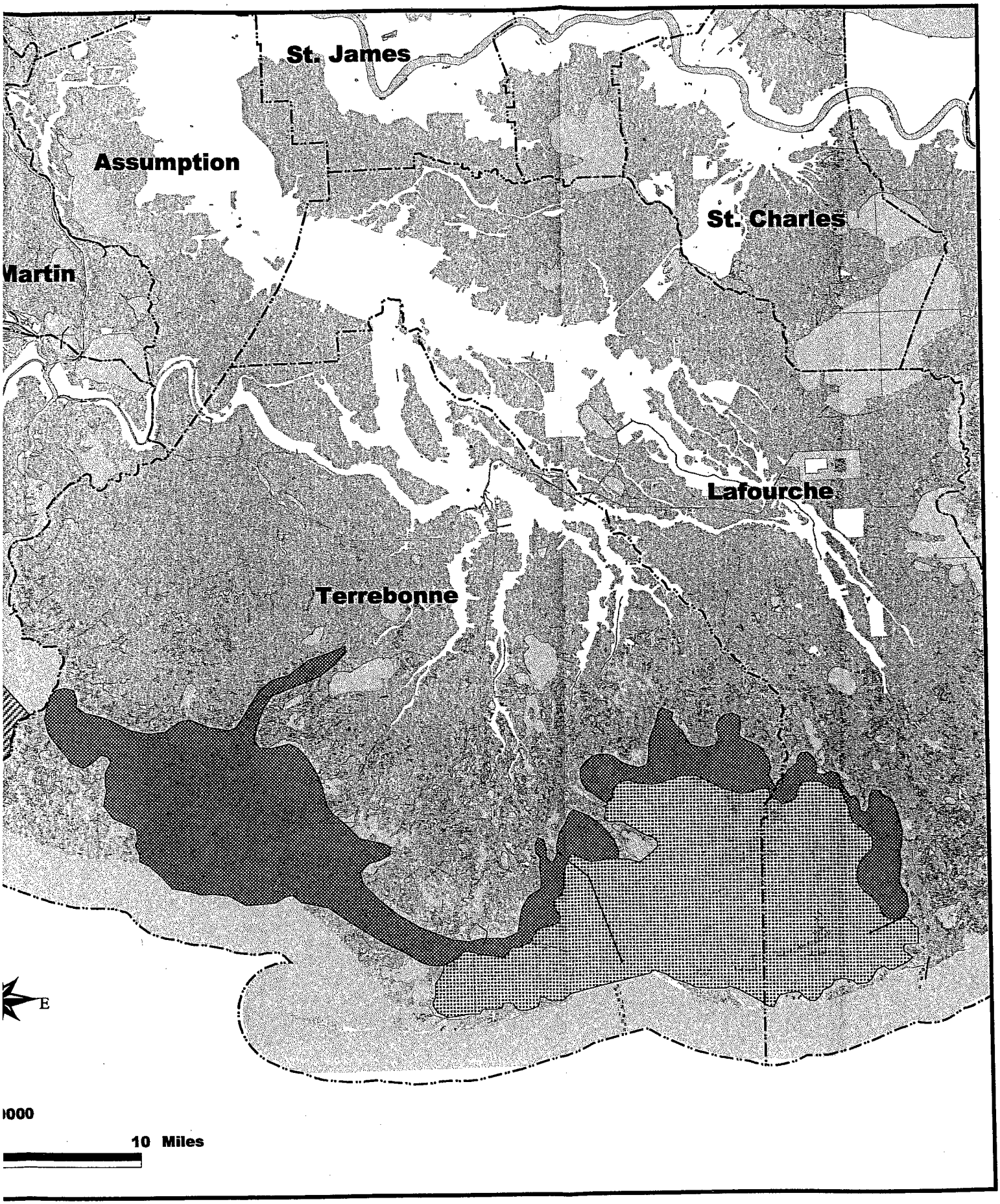


Figure 3-61. Distribution of oyster producing areas in 1920.



on of oyster producing areas in 1920.


St. James
Assumption
St. Charles
Martin
Lafourche
Terrebonne
E
)000
10 Miles

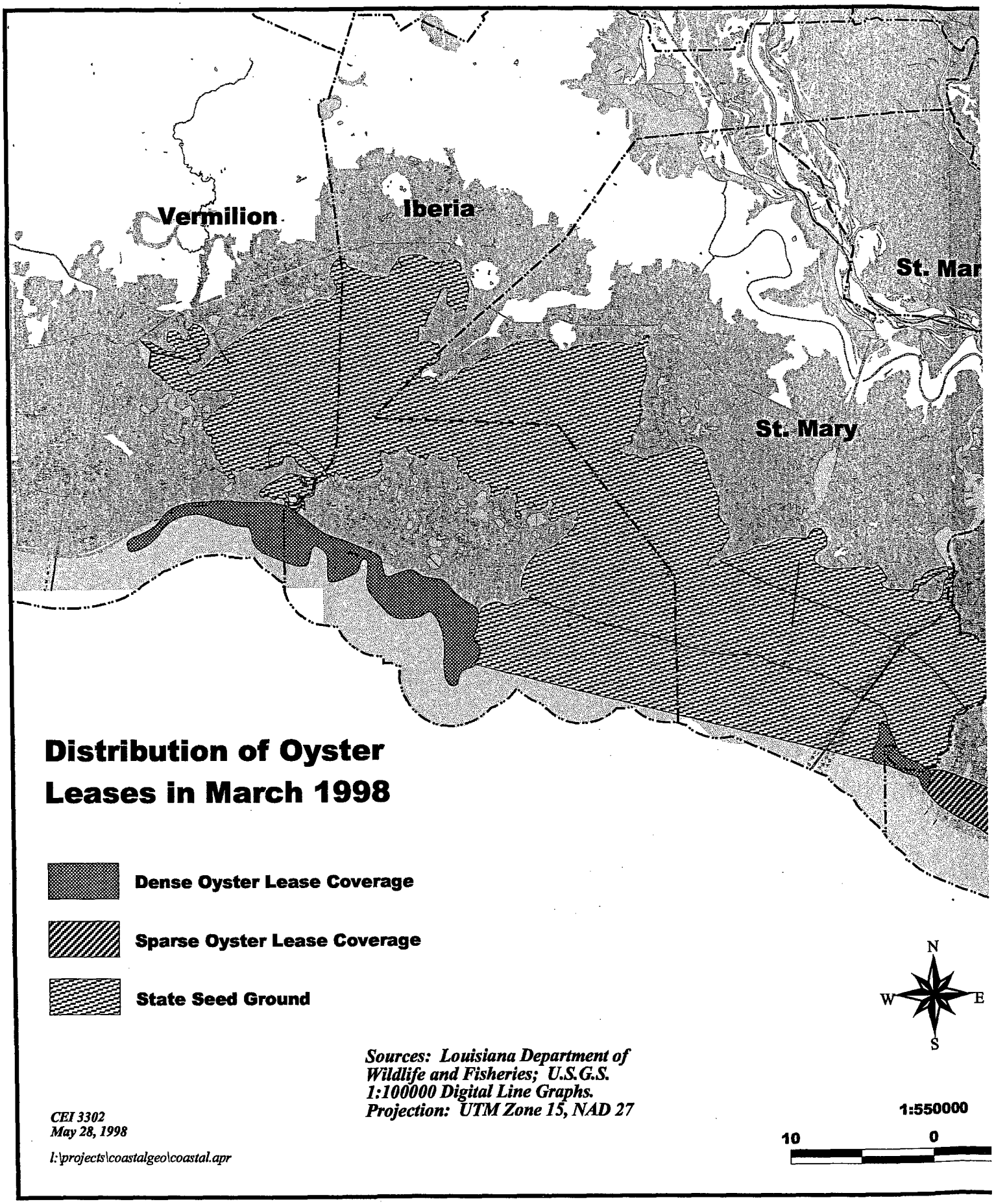
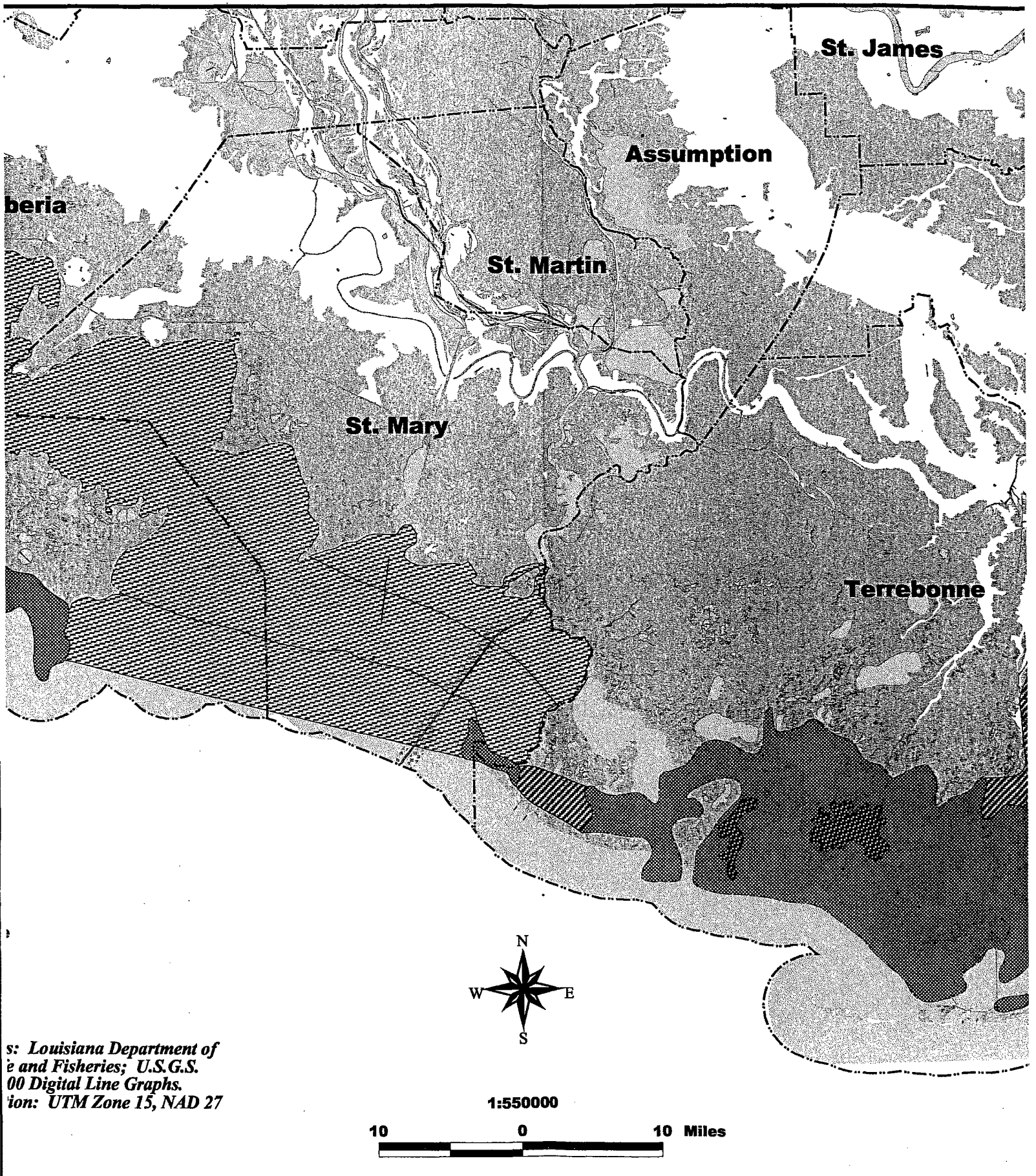
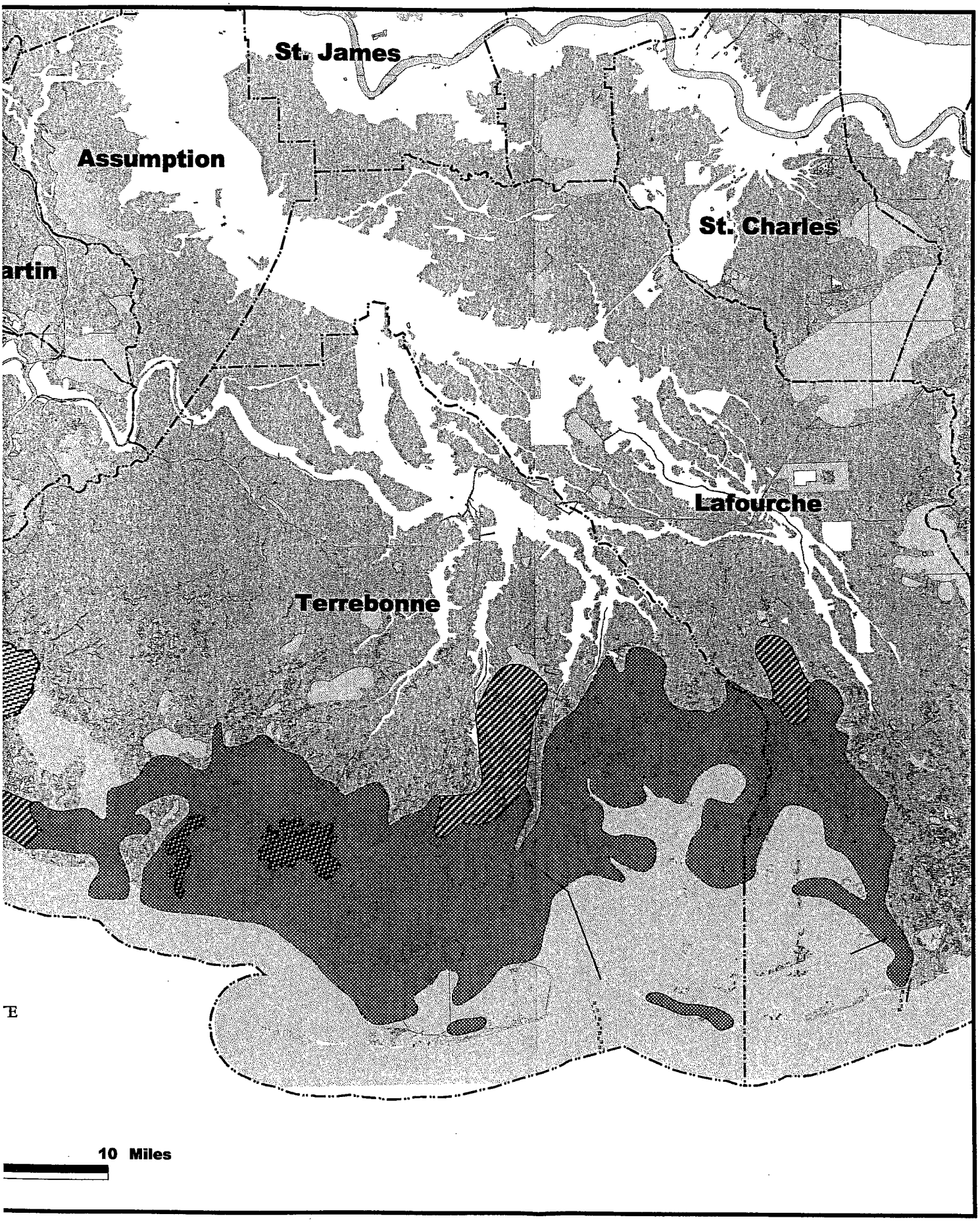


Figure 3-62. Distribution of oyster leases in March 1998.



s: Louisiana Department of
e and Fisheries; U.S.G.S.
00 Digital Line Graphs.
ion: UTM Zone 15, NAD 27

March 1998.


St. James
Assumption
St. Charles
artin
Lafourche
Terrebonne
E
10 Miles

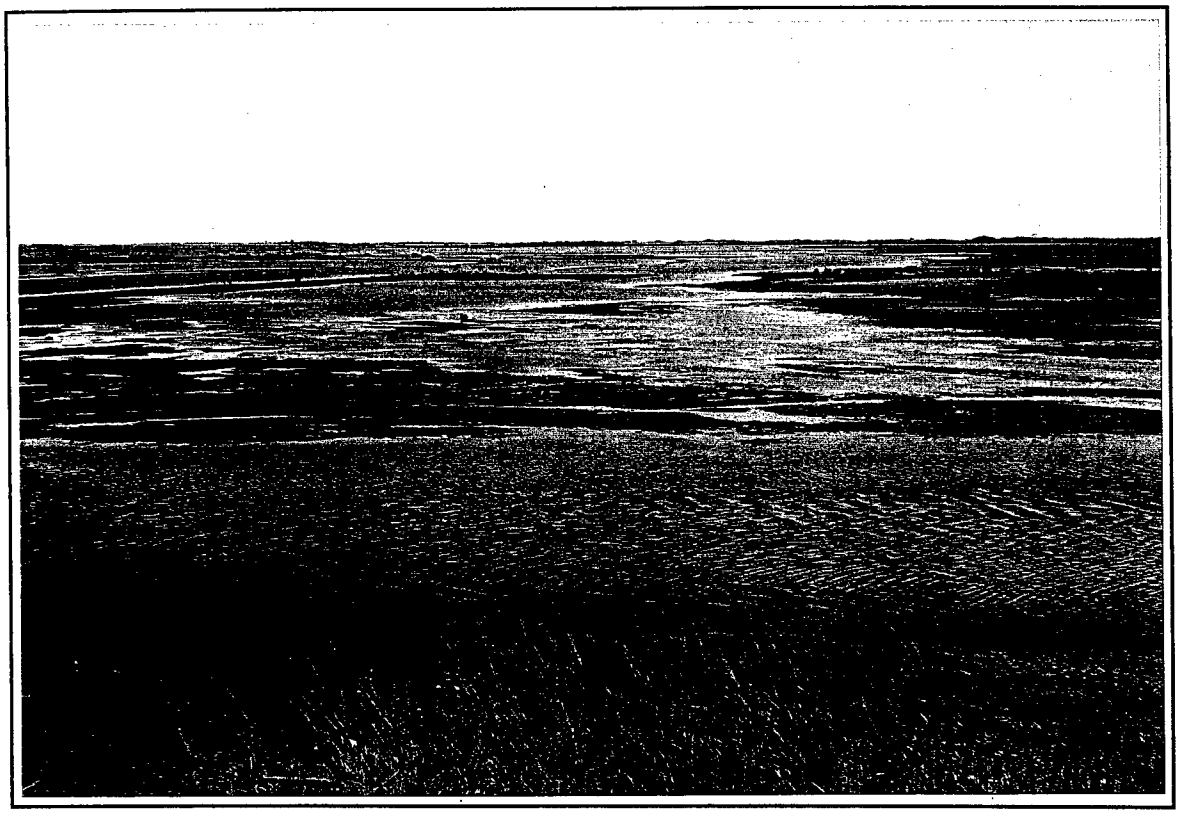


Figure 3-63. Deteriorated marsh along Isle de Jean Charles road, Terrebonne Parish. Date: December 30, 1997.

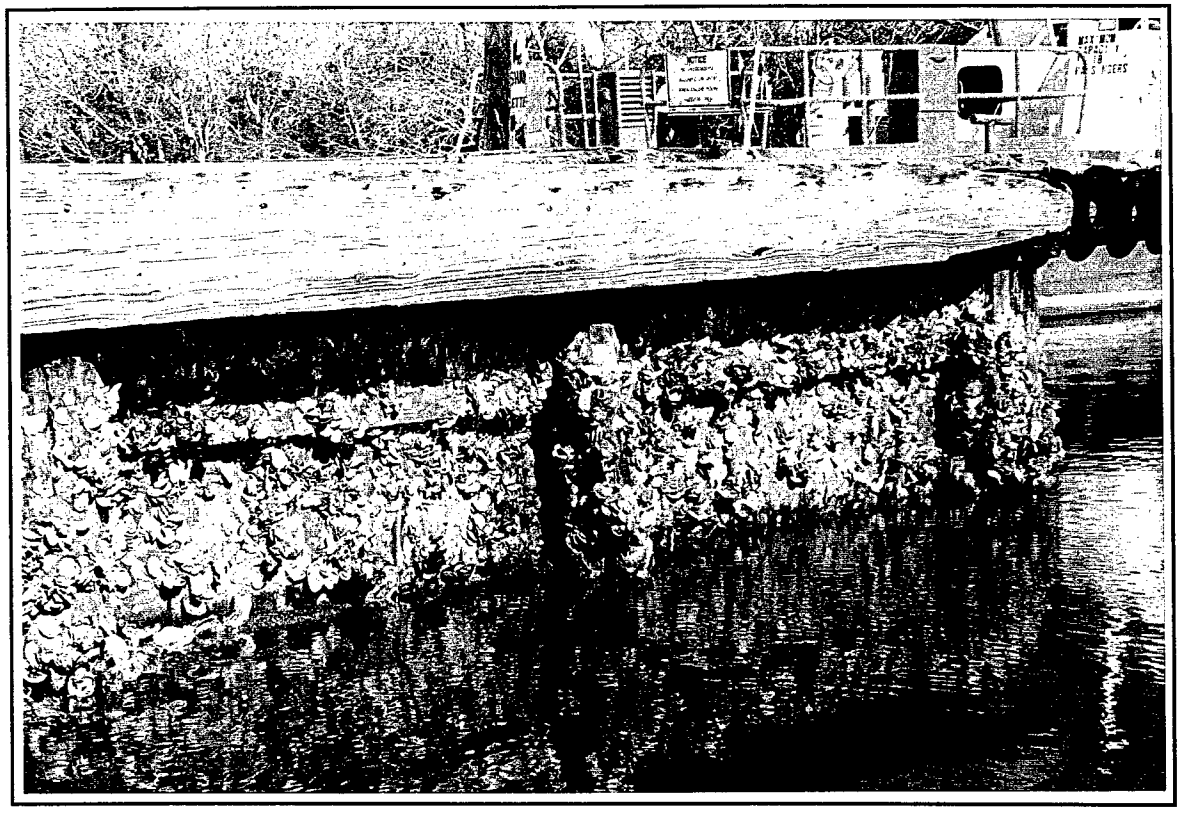


Figure 3-64. Oysters growing on the bulkhead of the public landing at Isle de Jean Charles in Terrebonne Parish. Date: December 30, 1997.



Figure 3-65. This February 1978 aerial view of Diamond Reef, south of Marsh Island, shows the extent of this exposed feature (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).

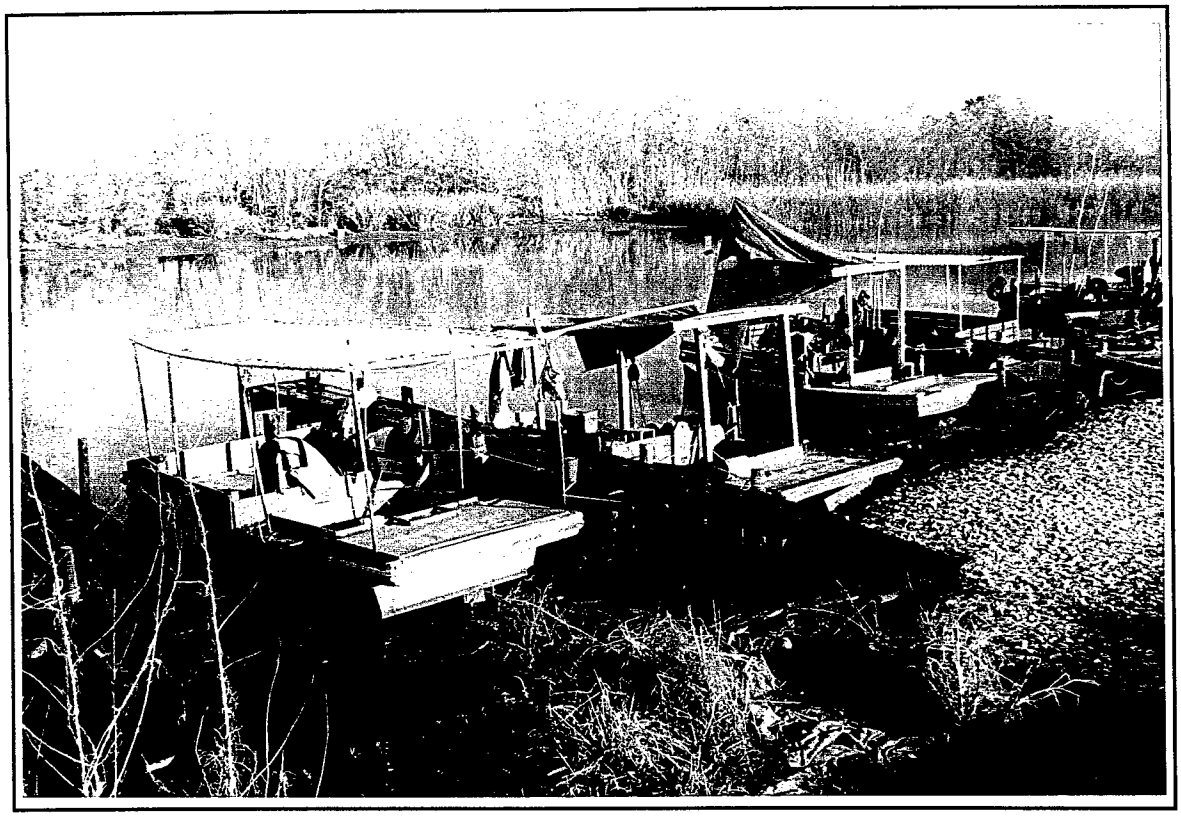


Figure 3-66. Oysters are dredged using both large luggers and small boats like these, docked along lower Bayou du Large in Terrebonne Parish. Date: December 31, 1997.

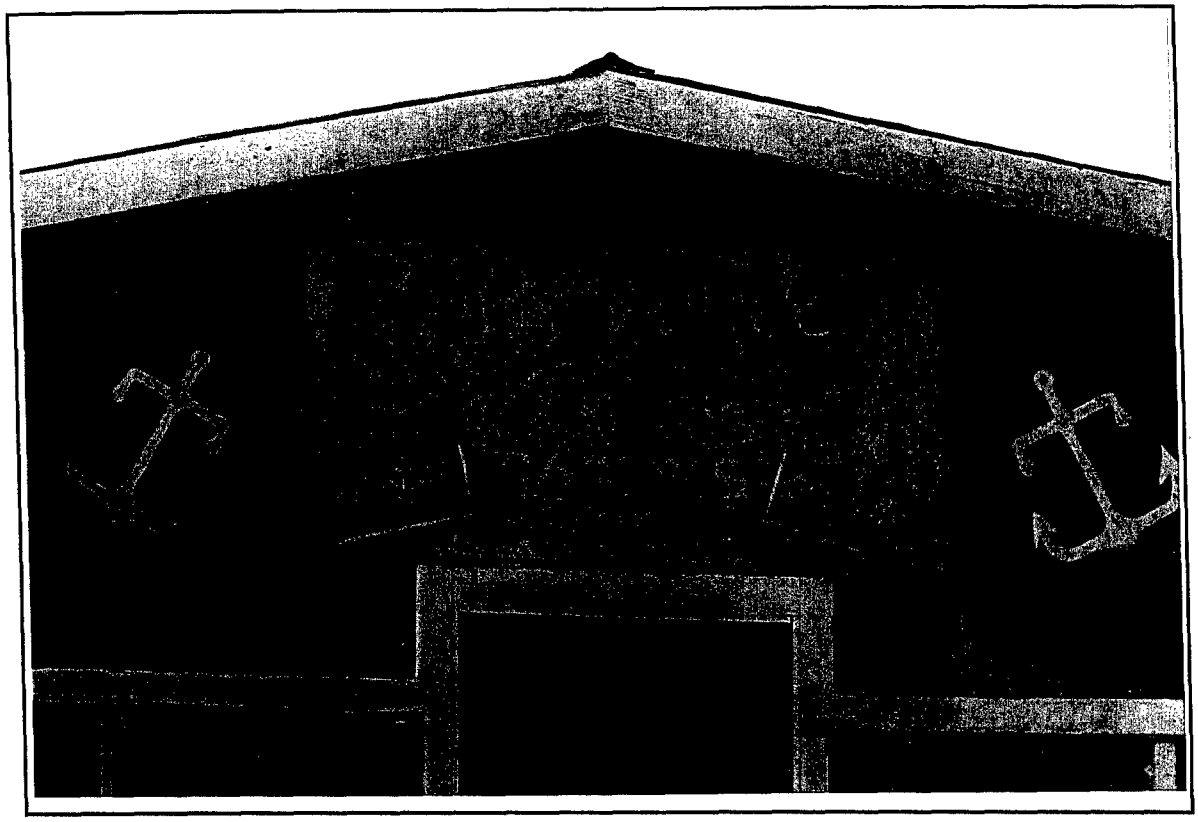


Figure 3-67. Although most of Louisiana's oyster activity is in the region east of Point Au Fer, these oyster luggers, docked at Cypremort Point, are a reminder of the oyster habitats associated with the Vermilion Bay estuarine complex. Date: December 10, 1997.



Figure 3-68. Although most of Louisiana's oyster activity is in the region east of Point Au Fer, these oyster luggers, docked at Cypremort Point, are a reminder of the oyster habitats associated with the Vermilion Bay estuarine complex. Date: December 10, 1997.

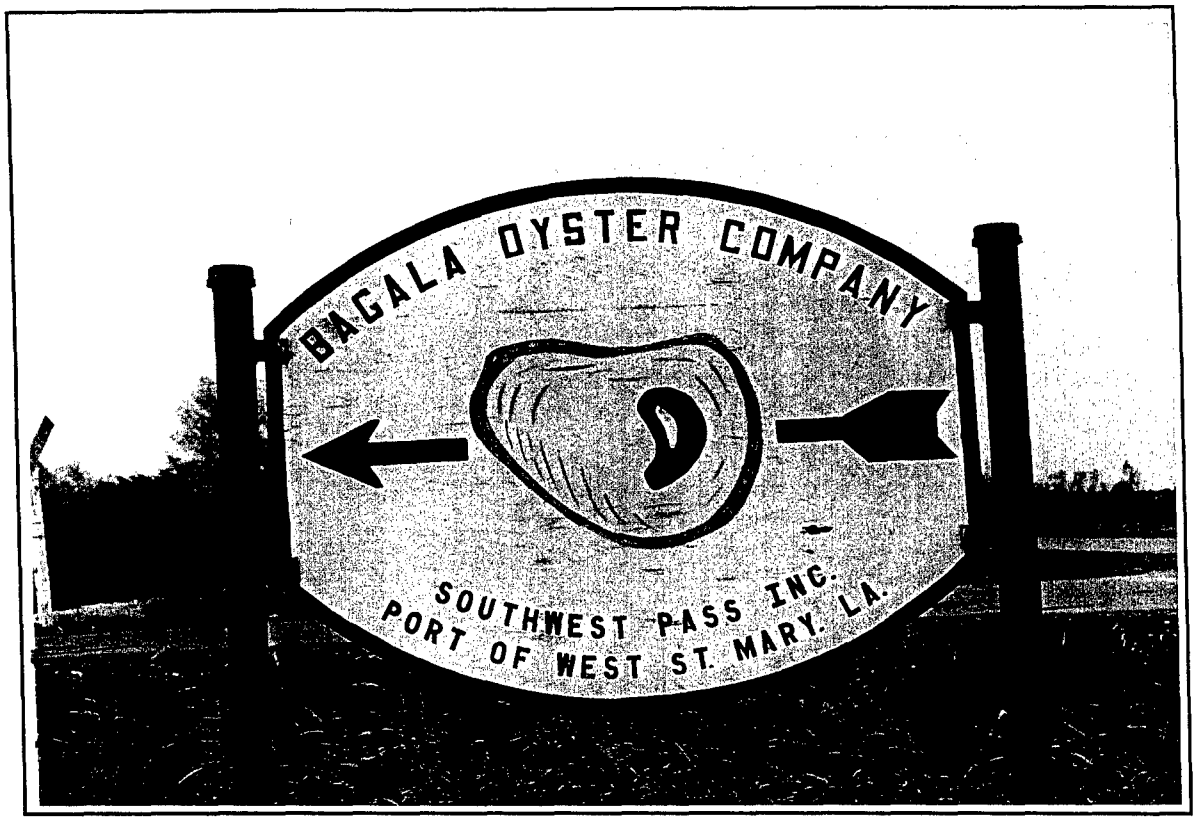


Figure 3-69. Sign for a seafood establishment at the Port of West St. Mary. It is one of the few oyster-processing facilities west of Houma. Date: December 11, 1997.

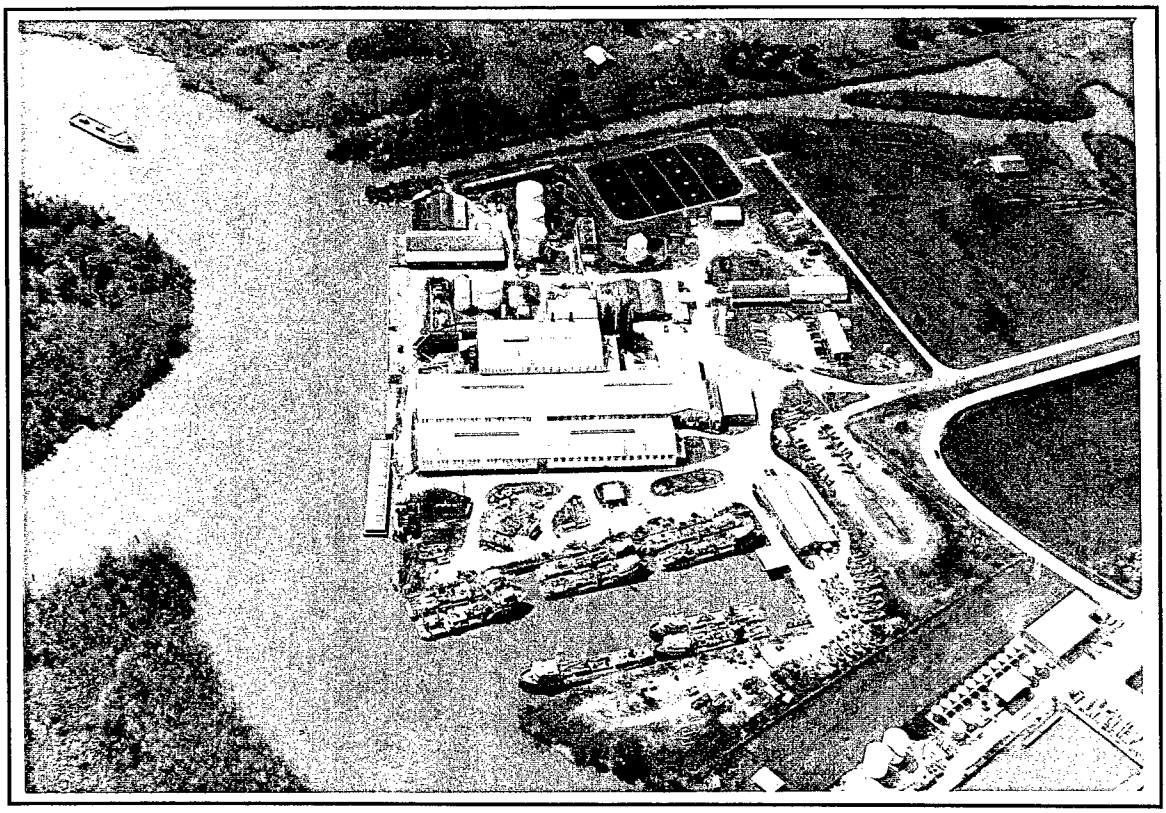


Figure 3-70. Aerial view of a menhaden processing plant along the Vermilion River at Intracoastal City in Vermilion Parish. Date: March 11, 1998.

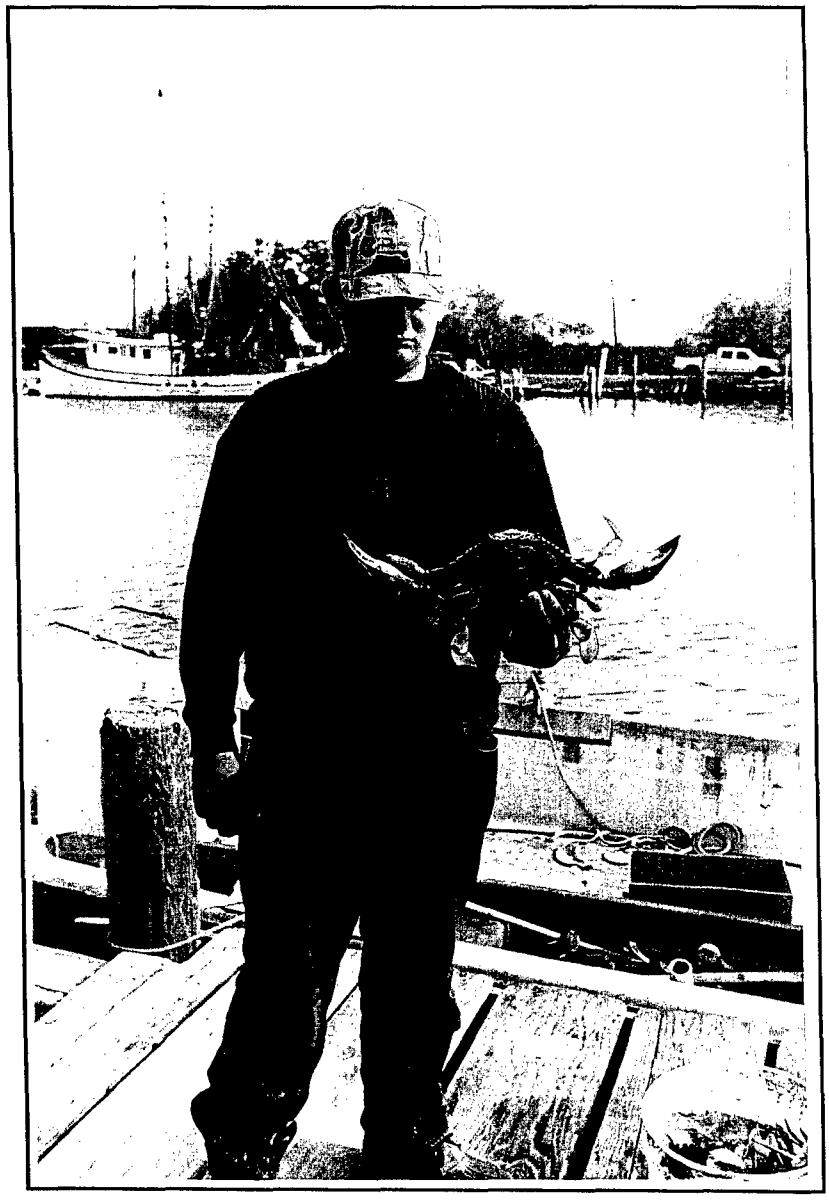


Figure 3-71. Crabber with an example of the type of crabs being delivered to processing plants along Bayou Grand Caillou. Date: December 22, 1997.



Figure 3-72. Fisheries resources have been an important part of the coastal economy. In the 1930s blue crabs were scooped up from baited lines and placed in wooden baskets for market (source: Fonville Winans, Louisiana State Library, Louisiana Photography Archives).

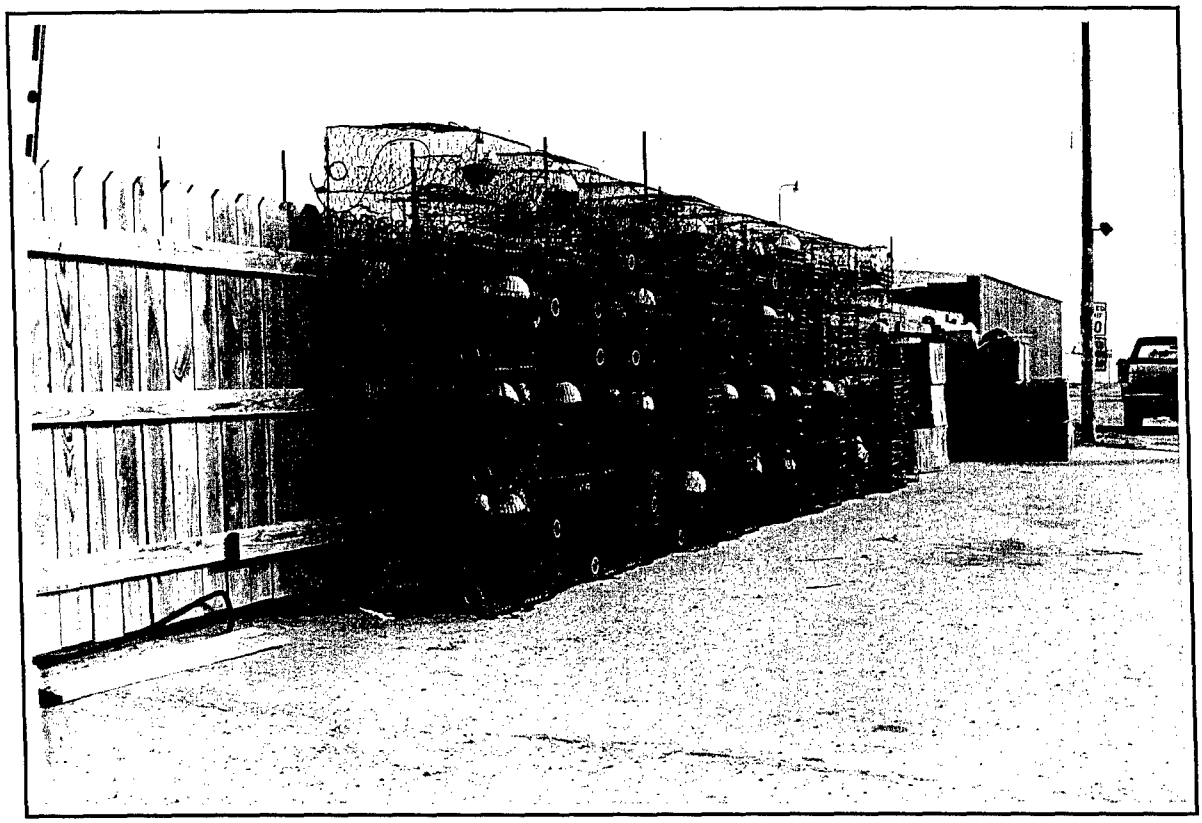


Figure 3-73. A stack of crab traps adjacent to a seafood house at Cypremort Point, St. Mary Parish. The small rings on the traps allow small crabs to escape. Date: December 10, 1997.



Figure 3-74. Boxes and boxes of catfish heads are sold to crabbers as bait for their traps. This example was found at a seafood processing facility on Bayou du Large in Terrebonne Parish. Date: December 31, 1997.

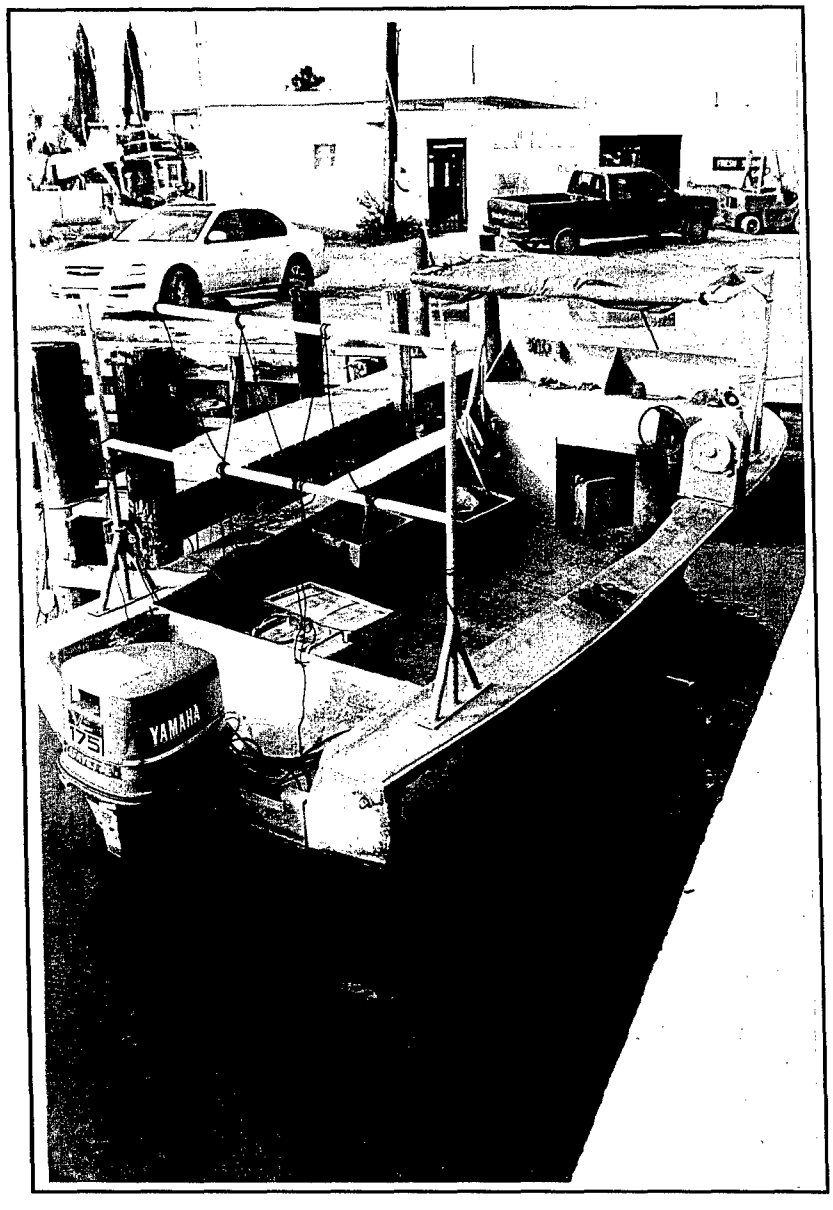


Figure 3-75. This typical crab boat is used to harvest crabs from the Vermilion Bay estuarine complex and is based in Cypremort Point in St. Mary Parish. Date: December 10, 1997.

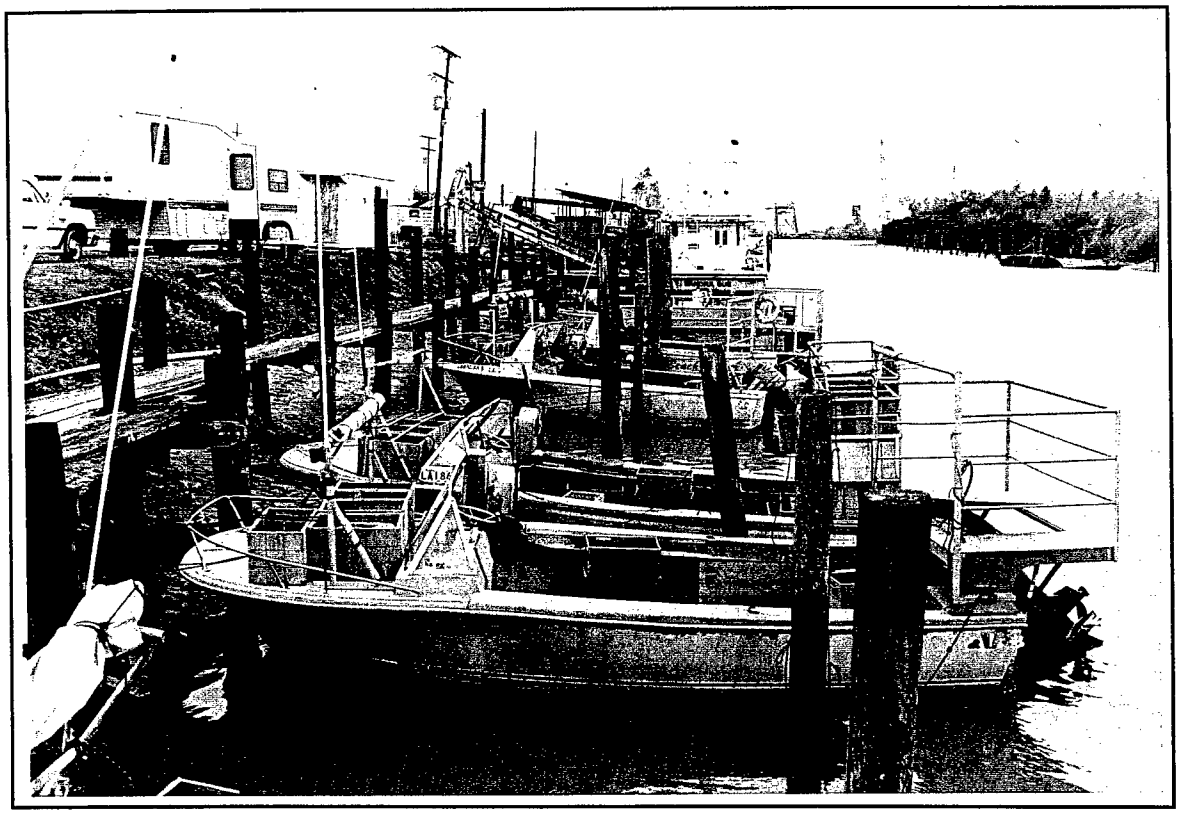


Figure 3-76. The distinctive design of these boats is a clue to their crab harvesting function. The large platforms over the stern are used to store the crab boxes as they are filled. Date: December 11, 1997.

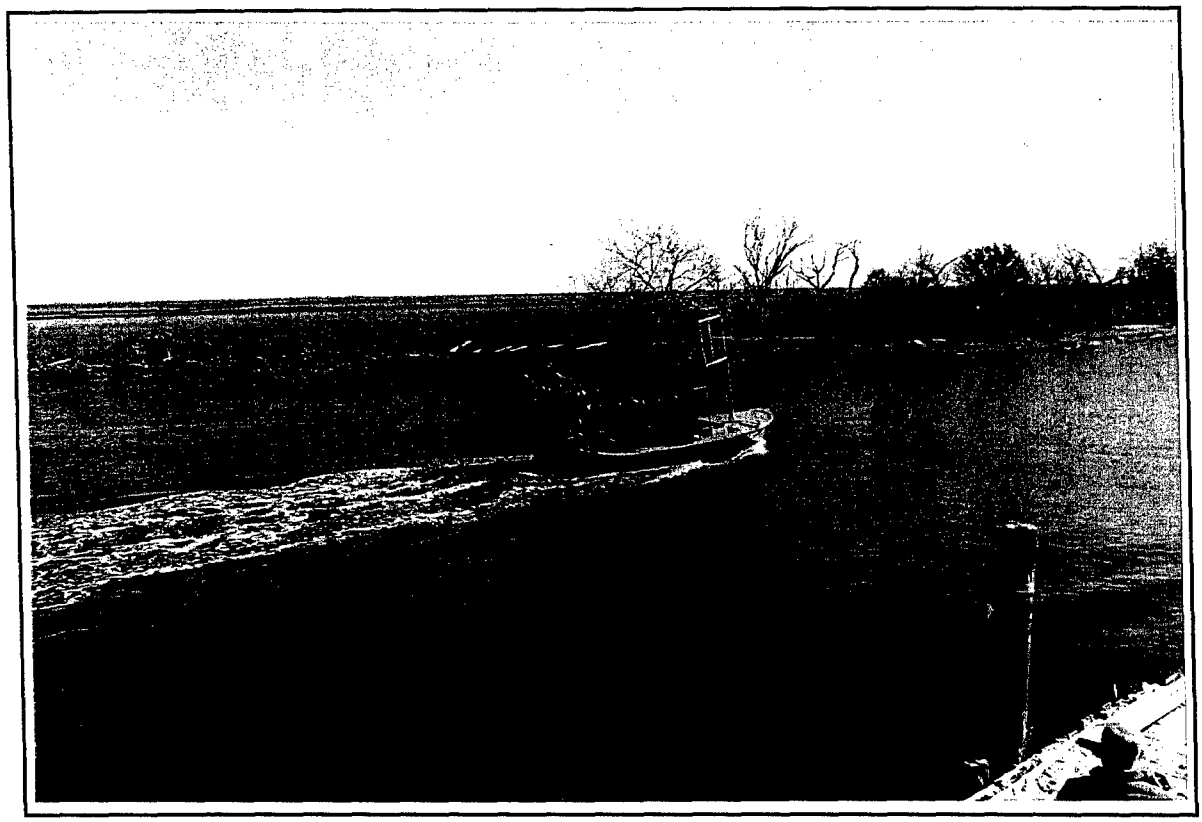


Figure 3-77. A crab fisherman moving his traps along Bayou Pointe au Chien near Pointe au Chien Marina in Terrebonne Parish. Date: December 30, 1997.



Figure 3-78. A box of live crabs waiting shipment to market from a crab house at Cypremort Point in St. Mary Parish. Date: December 10, 1997.

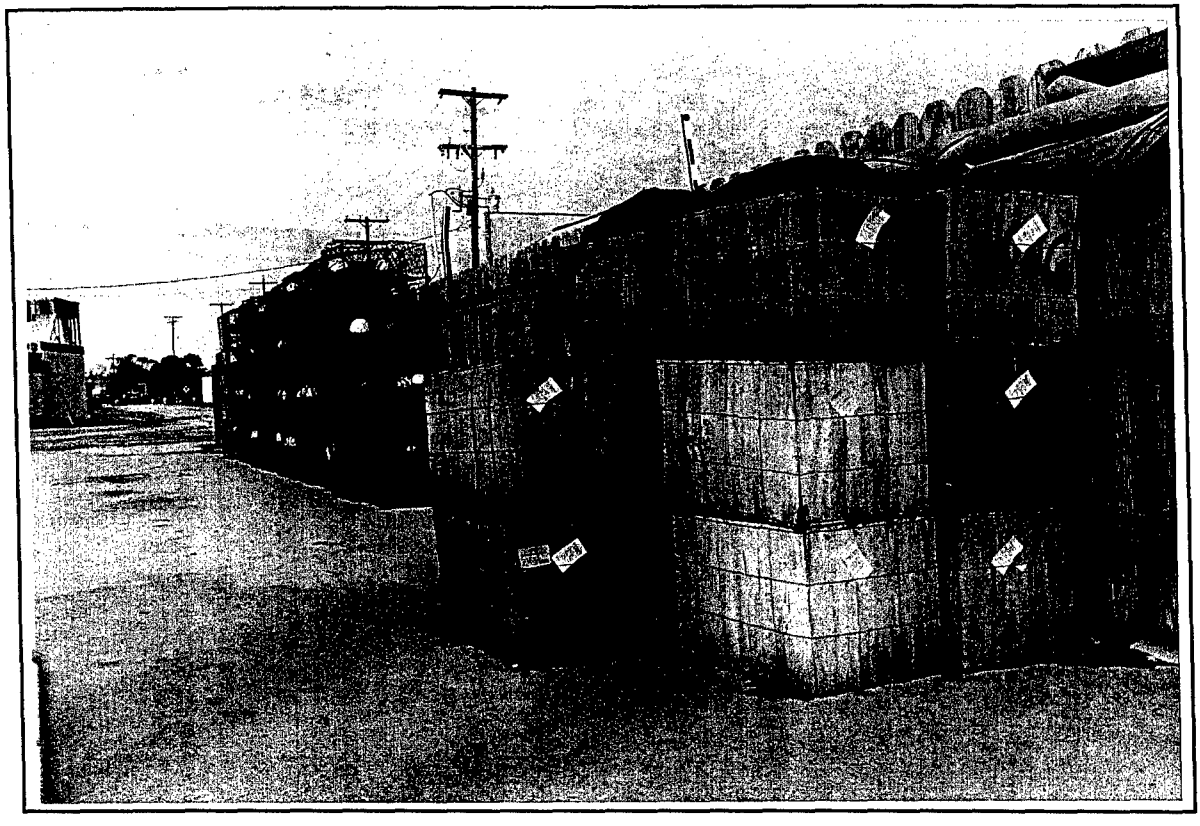


Figure 3-79. Boxes of crabs waiting shipment to market in the foreground with the associated traps in the background, at Cypremort Point in St. Mary Parish. Date: December 10, 1997.

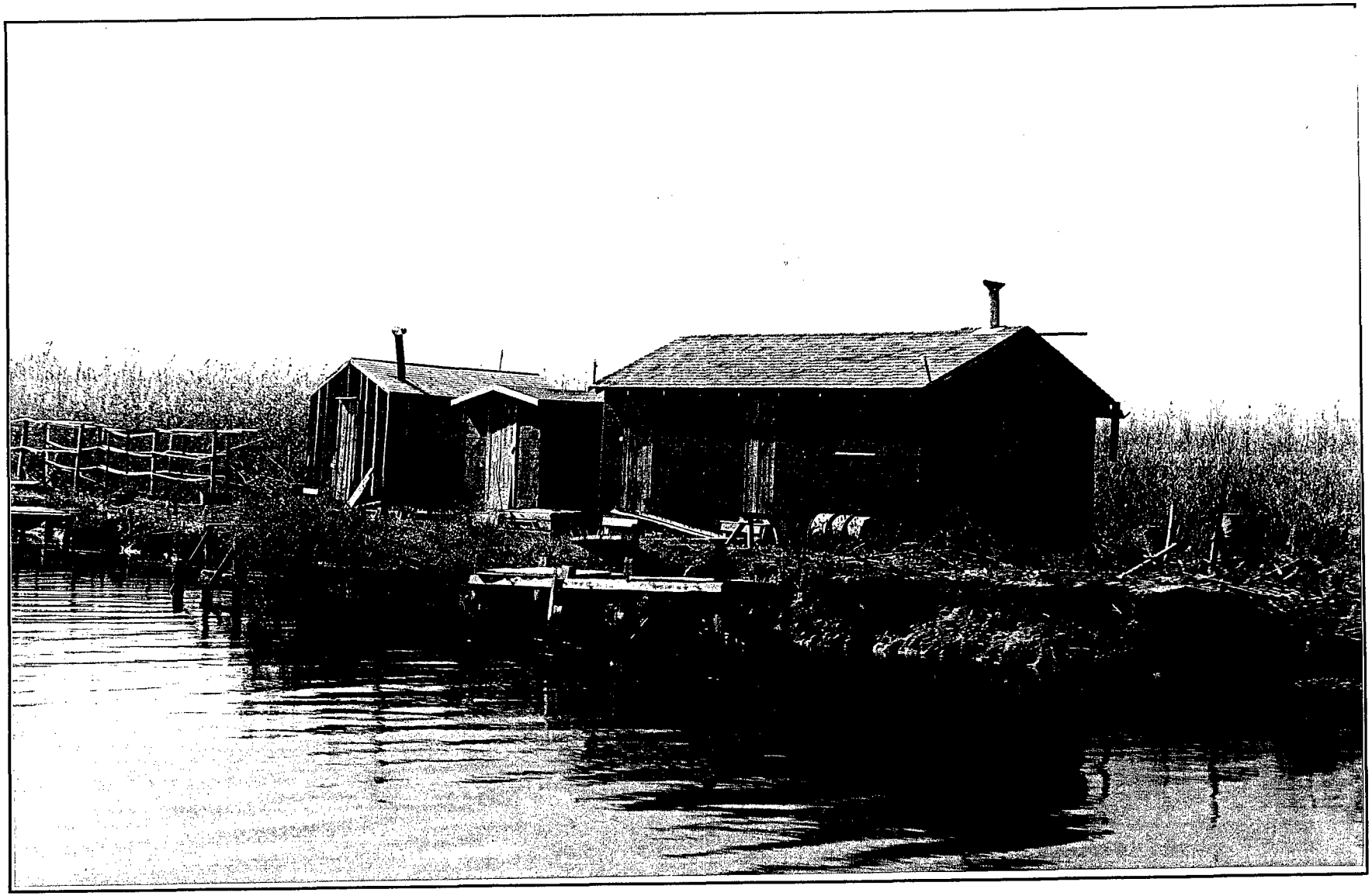


Figure 3-80. A typical trapper's camp on Belle Isle Bayou. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 54976. Photographer: Webb, January 1948.

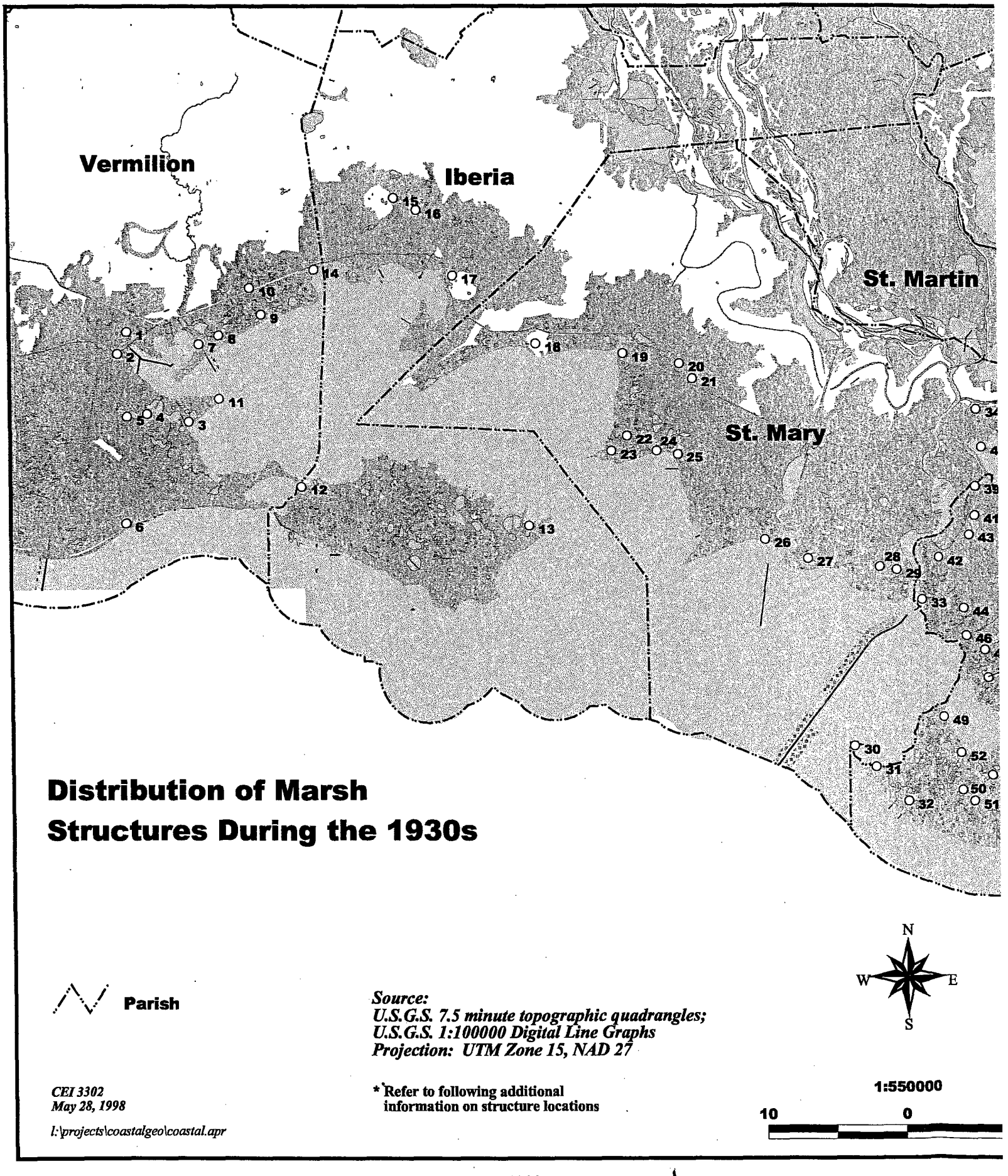
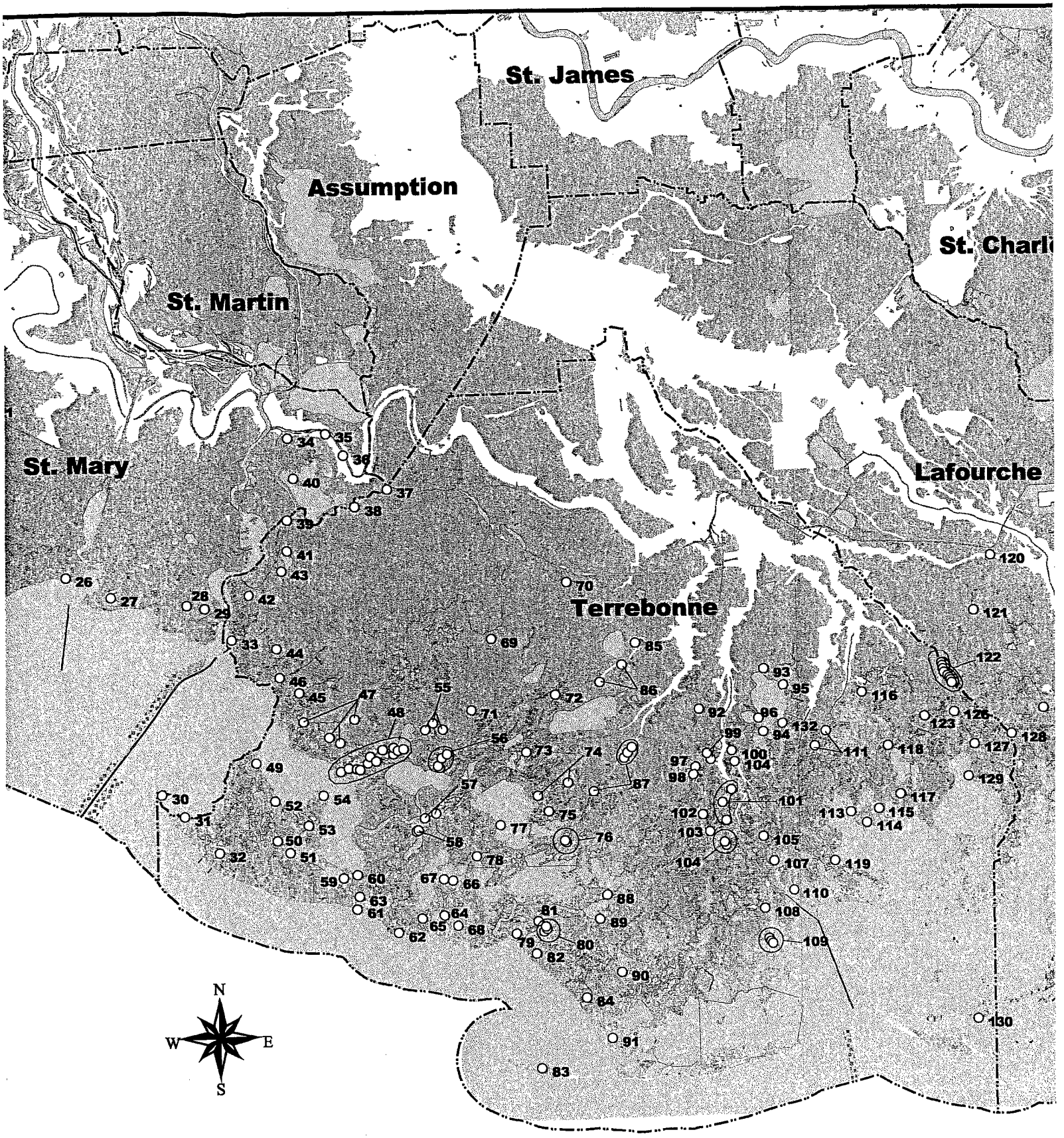
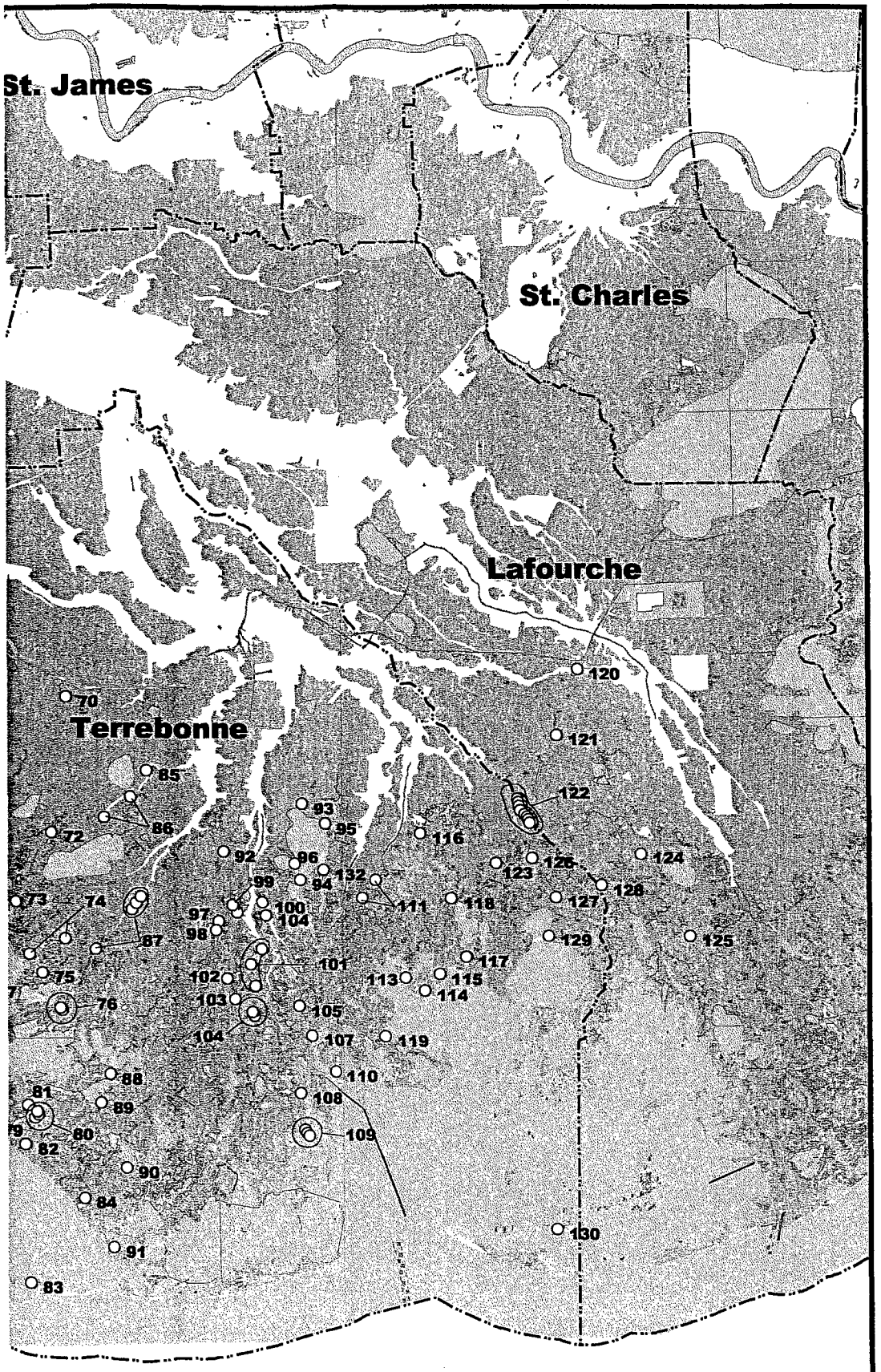


Figure 3-81. Distribution of marsh structures during the 1930s.


St. James
Assumption
St. Martin
St. Mary
Lafourche
Terrebonne
N
W
E
S
1:550000
10 0 10 Miles


St. James
St. Charles
Lafourche
Terrebonne
70
72
73
74
75
76
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
107
108
109
110
111
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
132

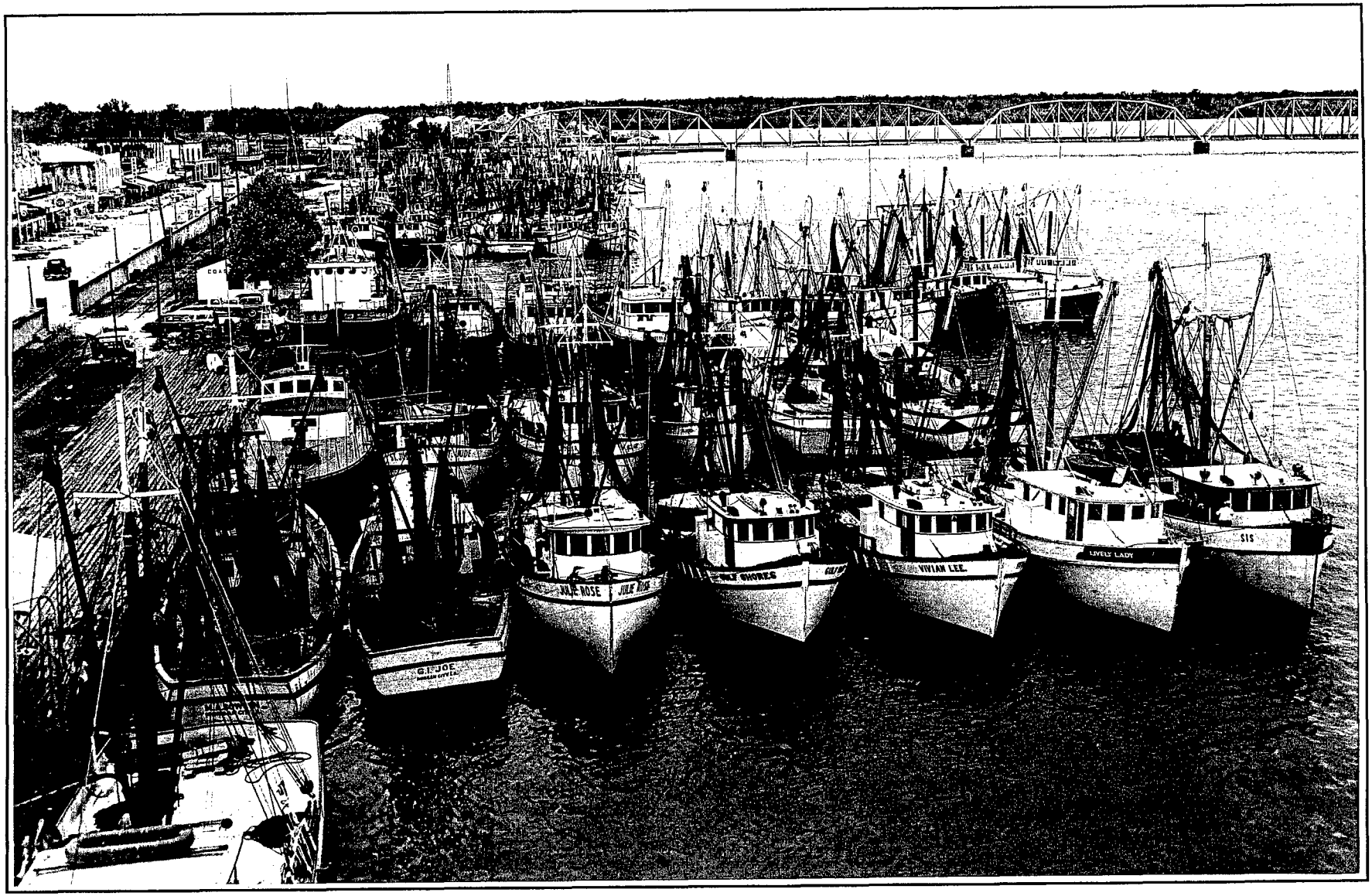


Figure 3-82. The shrimping fleet docked at the Morgan City waterfront during the May 1959 season. The small seawall protecting Front Street from possible Atchafalaya River flooding is considerably larger today (source: Morgan City Library Historic Archives, Jessie Grace Collection, Image No. 2166, 5/11/59).

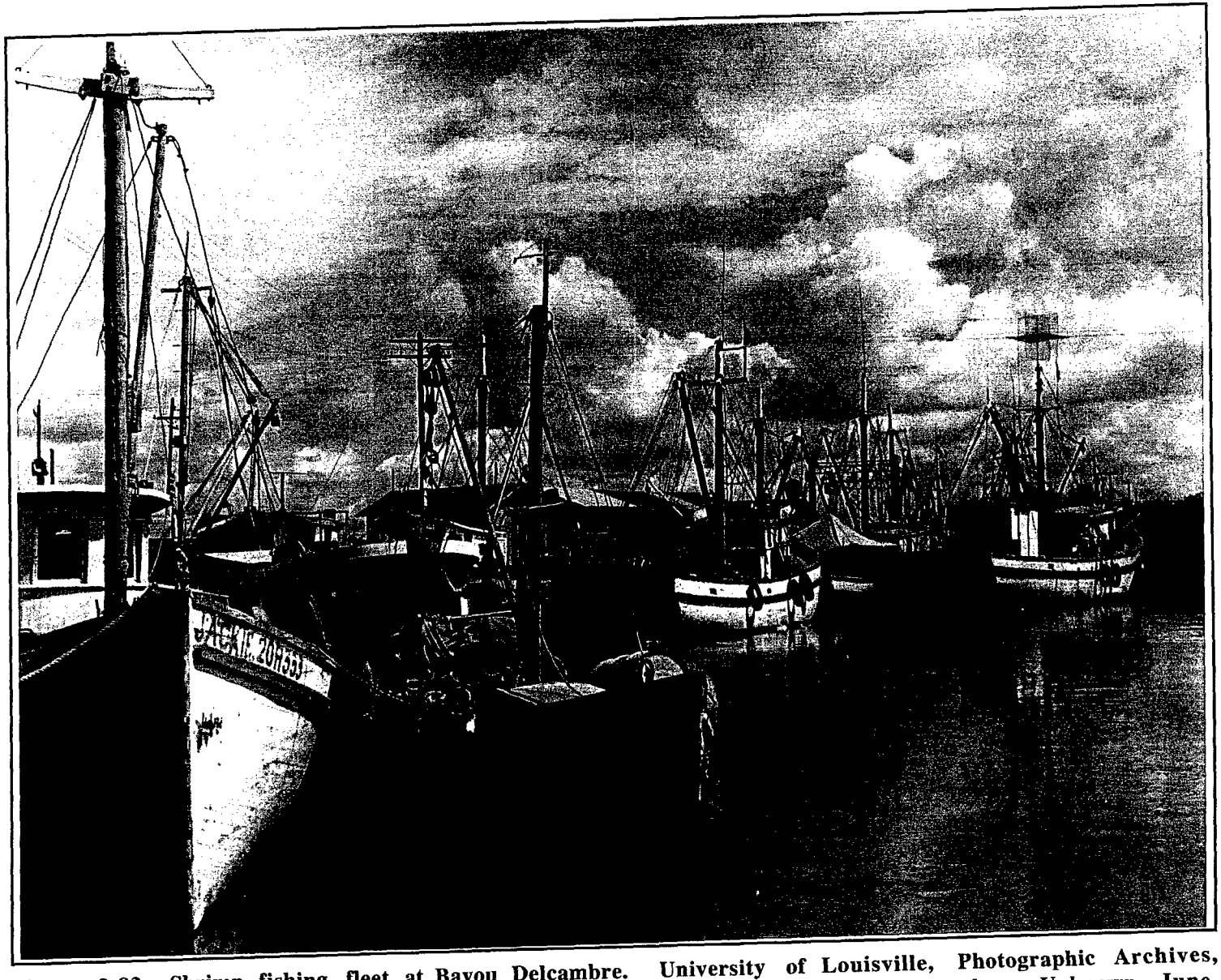


Figure 3-83. Shrimp fishing fleet at Bayou Delcambre. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 49777. Photographer: Unknown, June, 1947.

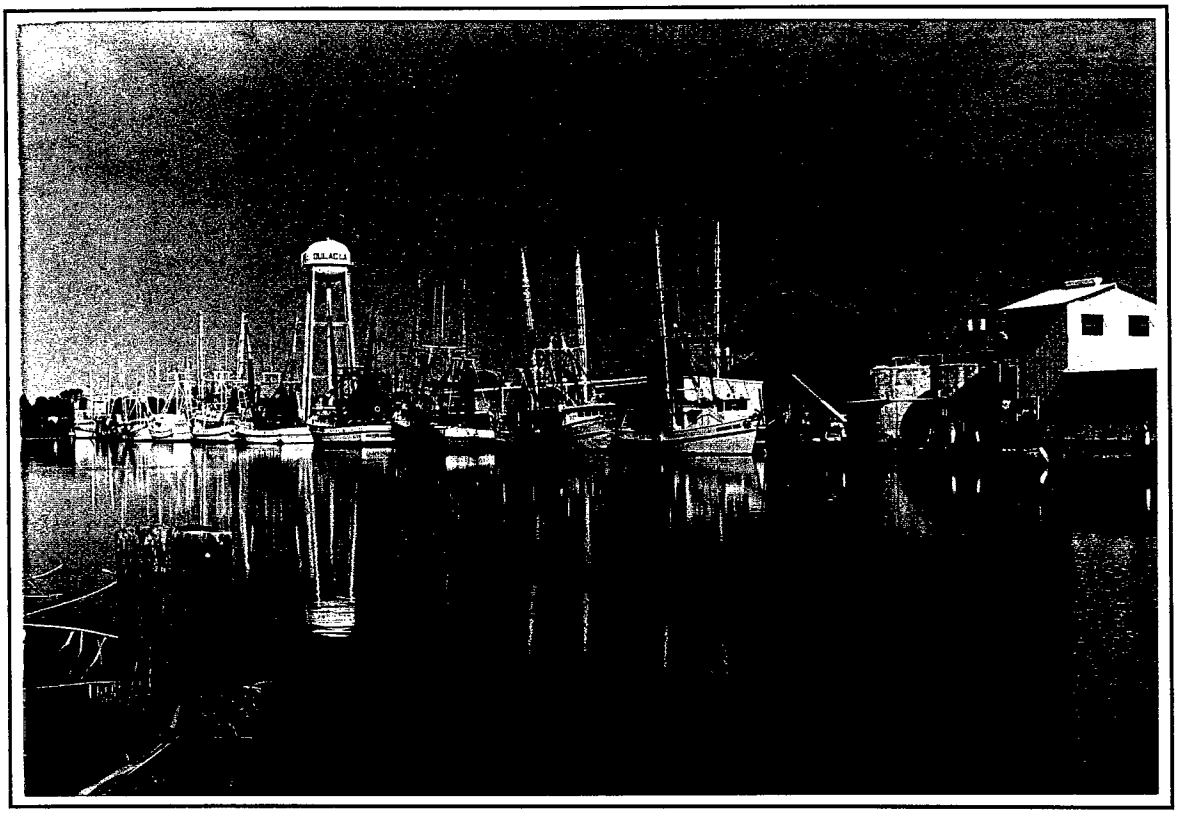


Figure 3-84. The boat-oriented community of Dulac is a typical south Louisiana bayou settlement. Dulac is located on Bayou Grand Caillou in Terrebonne Parish. Date: December 22, 1997.

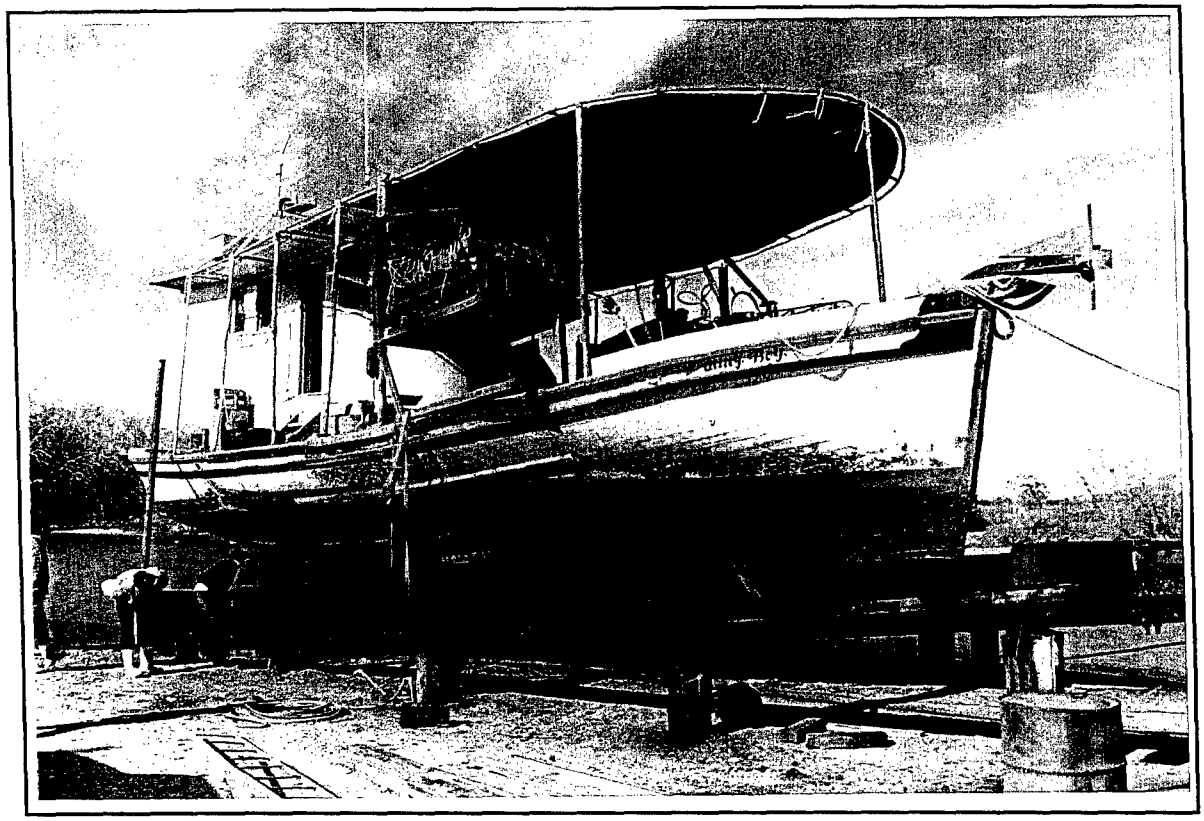


Figure 3-85. The oyster lugger "Danny Boy" being hauled up on dry dock at a Bayou du Large marine service facility in Terrebonne Parish. Date: December 31, 1997.



Figure 3-86. Dwight Naquin skinning a nutria in his processing shed along Bayou Pointe au Chien in Terrebonne Parish. Date: December 17, 1997.



Figure 3-87. Trappers have used marsh fires for nearly 100 years to improve their trapping leases. This fire was east of the Atchafalaya River in Terrebonne Parish. Date: March 11, 1998.

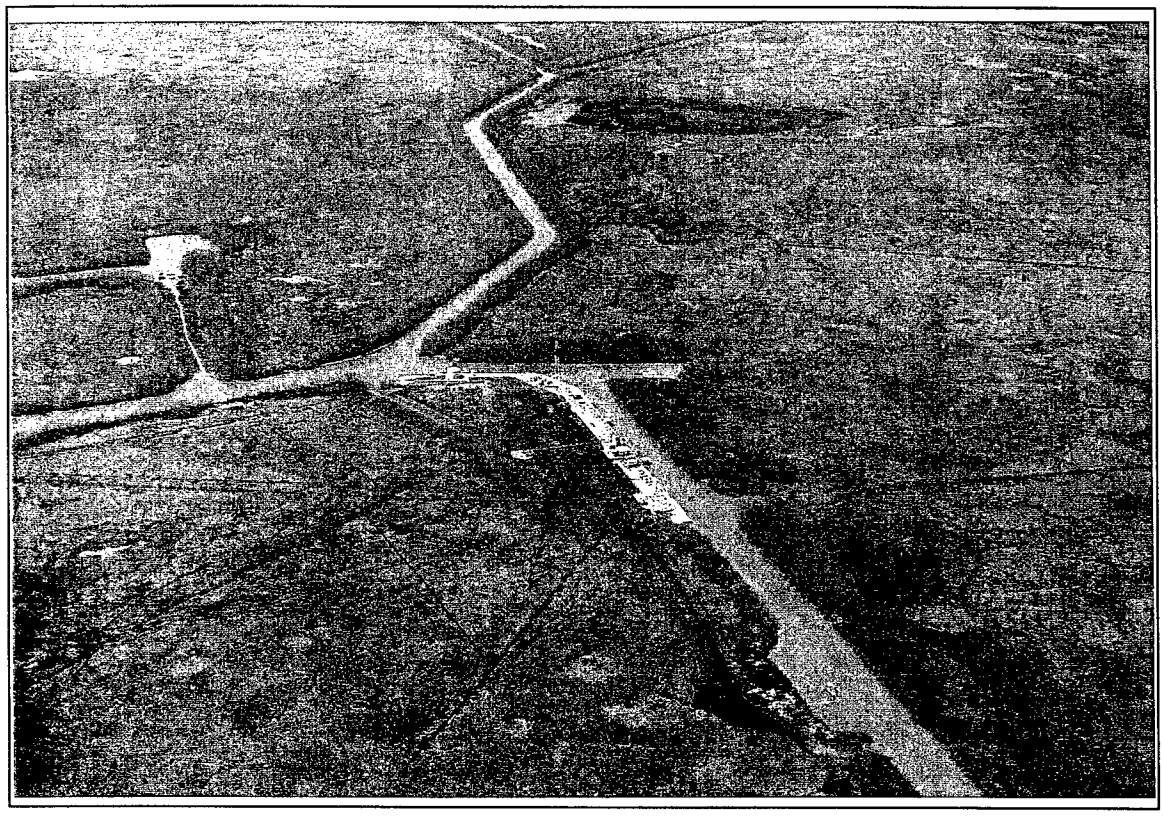


Figure 3-88. Oil well canal and trainasse in Vermilion Parish. Date: March 11, 1998.



Figure 3-89. This 15 $^{1}/_{2}$ ft long alligator was caught along Ivanhoe Canal near Cote Blanche Island, St. Mary Parish, in 1958 (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).

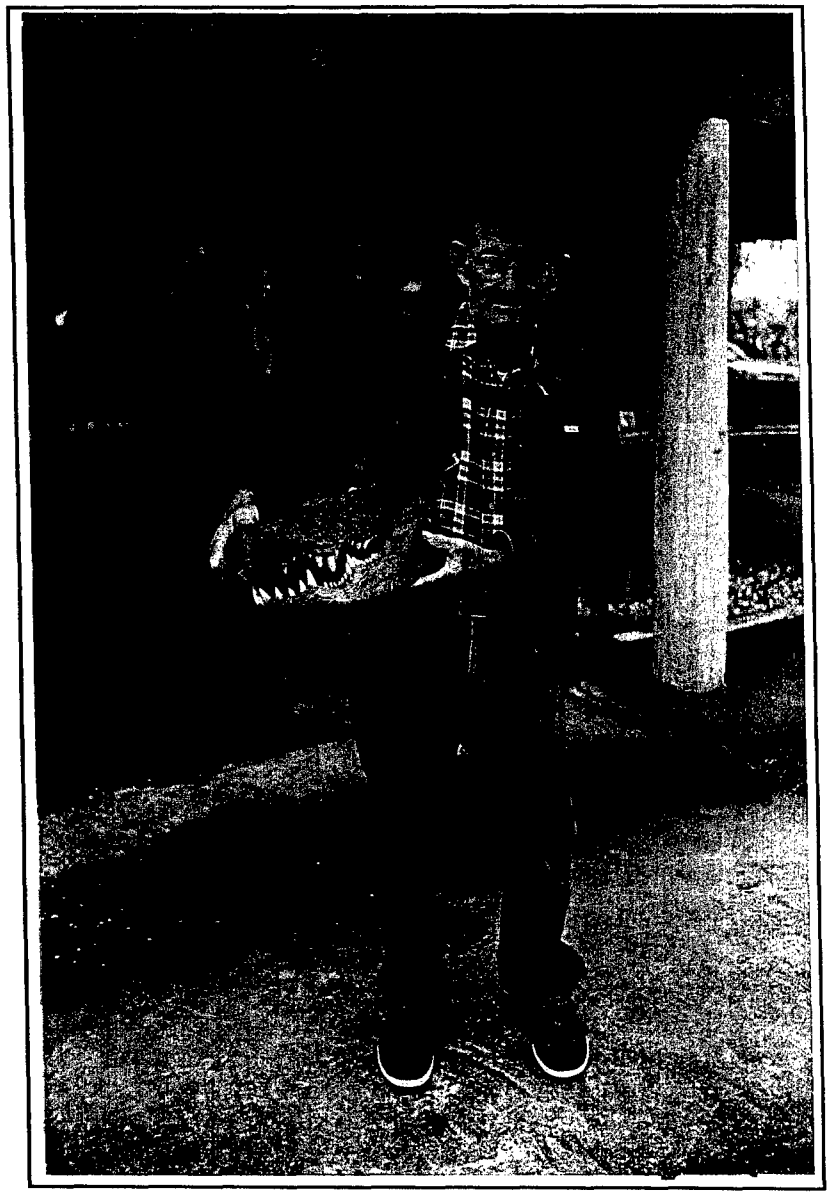


Figure 3-90. An example of the size of alligators trapped during the September harvest. Date: December 17, 1997.

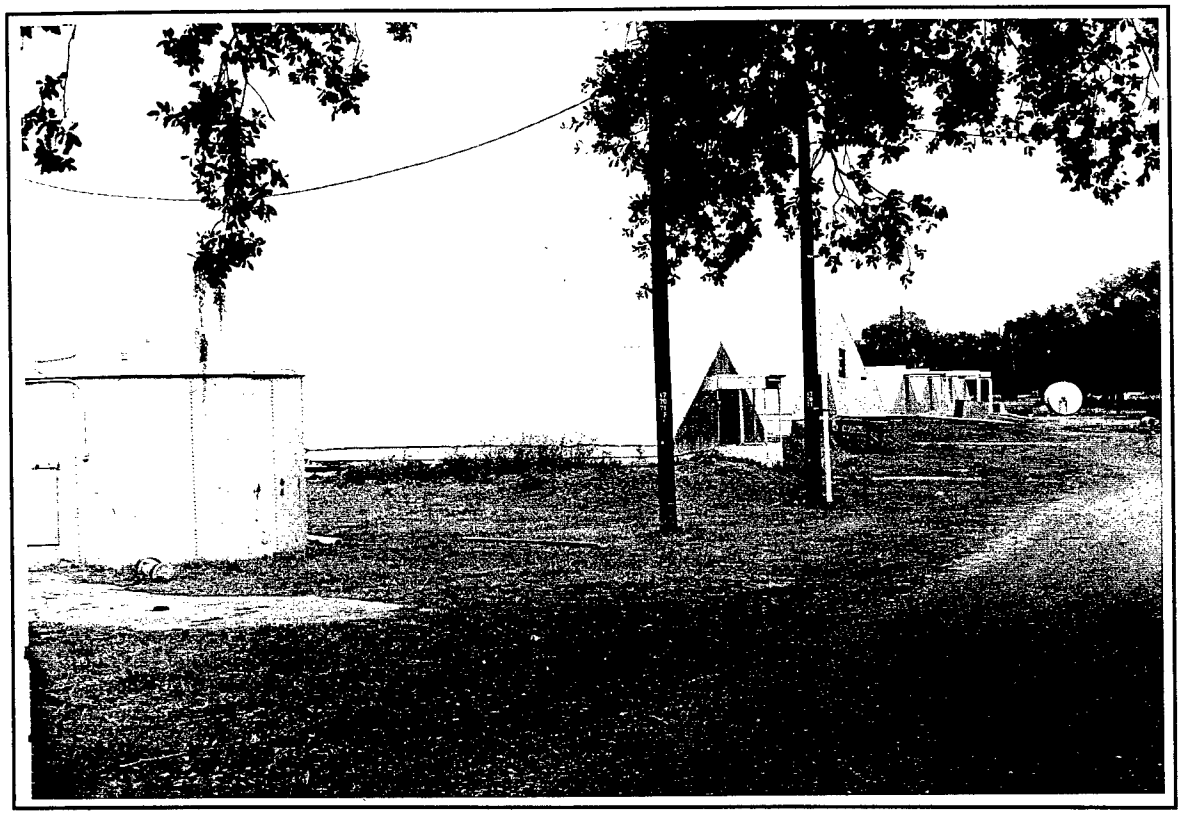


Figure 3-91. This alligator farm along Highway 82 north of the Gulf Intracoastal Waterway is one example of an industry that includes more than 100 commercial operators. Date: December 9, 1997.



Figure 3-92. A trainasse machine digs marsh ditches with two rotating blades that spin in opposite directions. As these blades rotate, they plow a furrow through the "soft" marsh of the delta plain. Date: December 17, 1997.

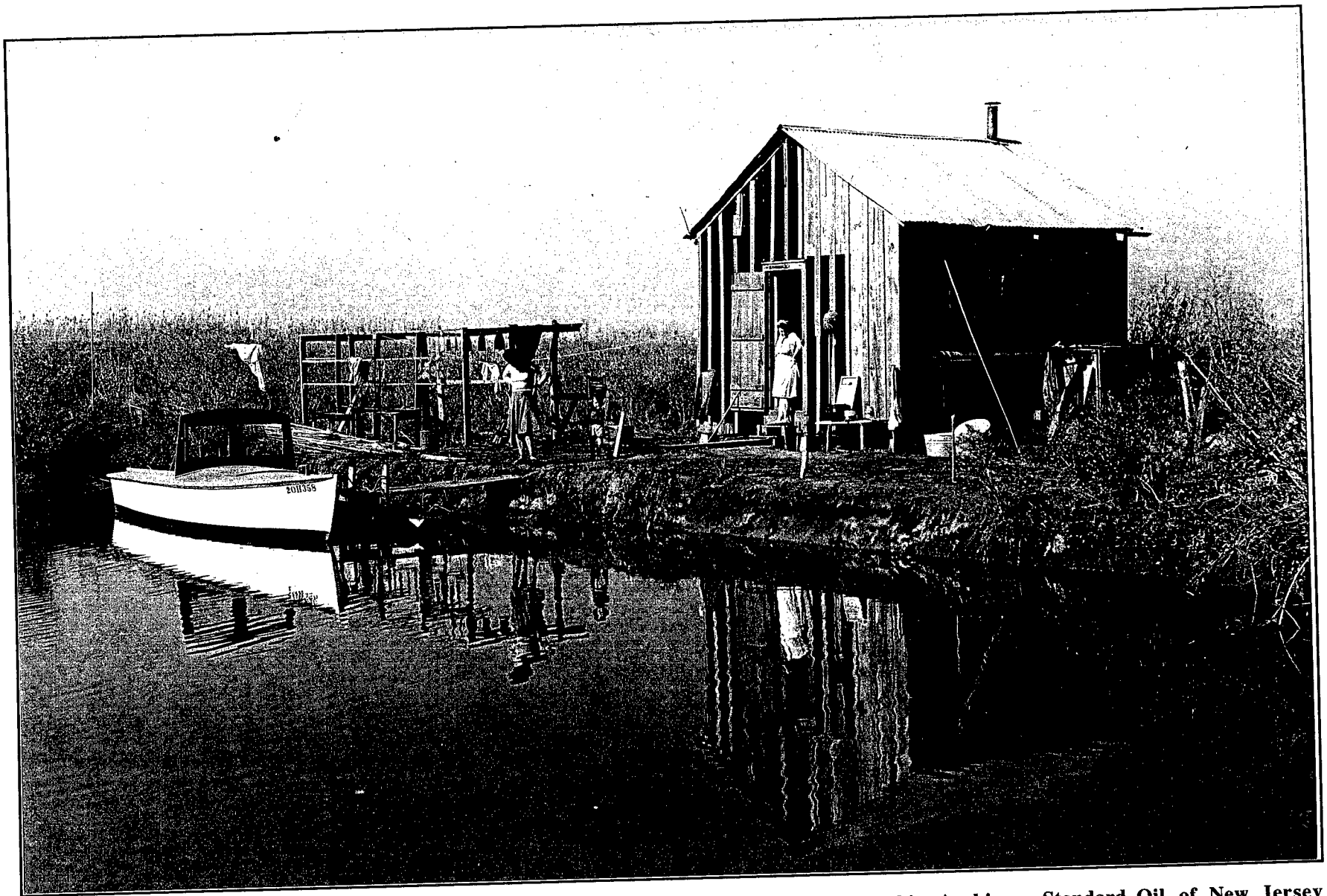


Figure 3-93. Trapper's camp on Bayou Belle Isle. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 54968. Photographer: Webb, January, 1948.

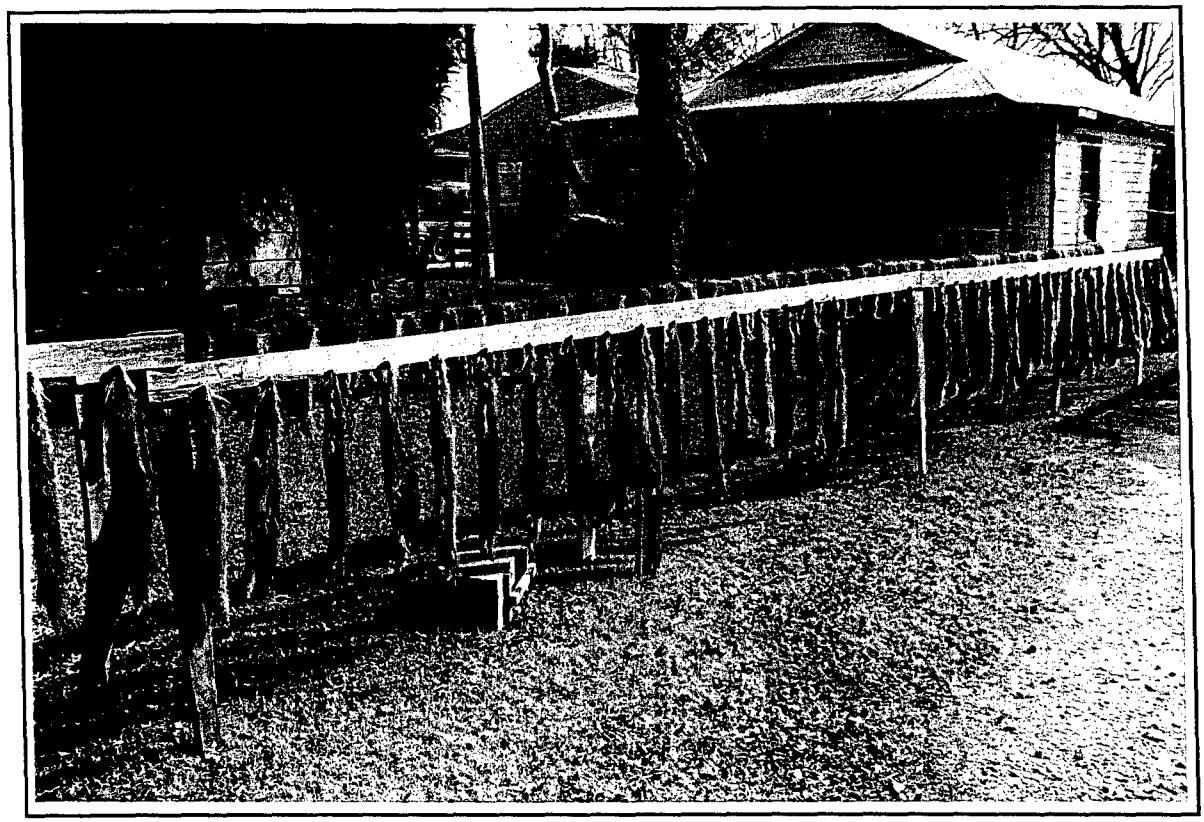


Figure 3-94. Nutria skins drying at a fur collection facility on Bayou du Large in Terrebonne Parish. Date: December 31, 1997.

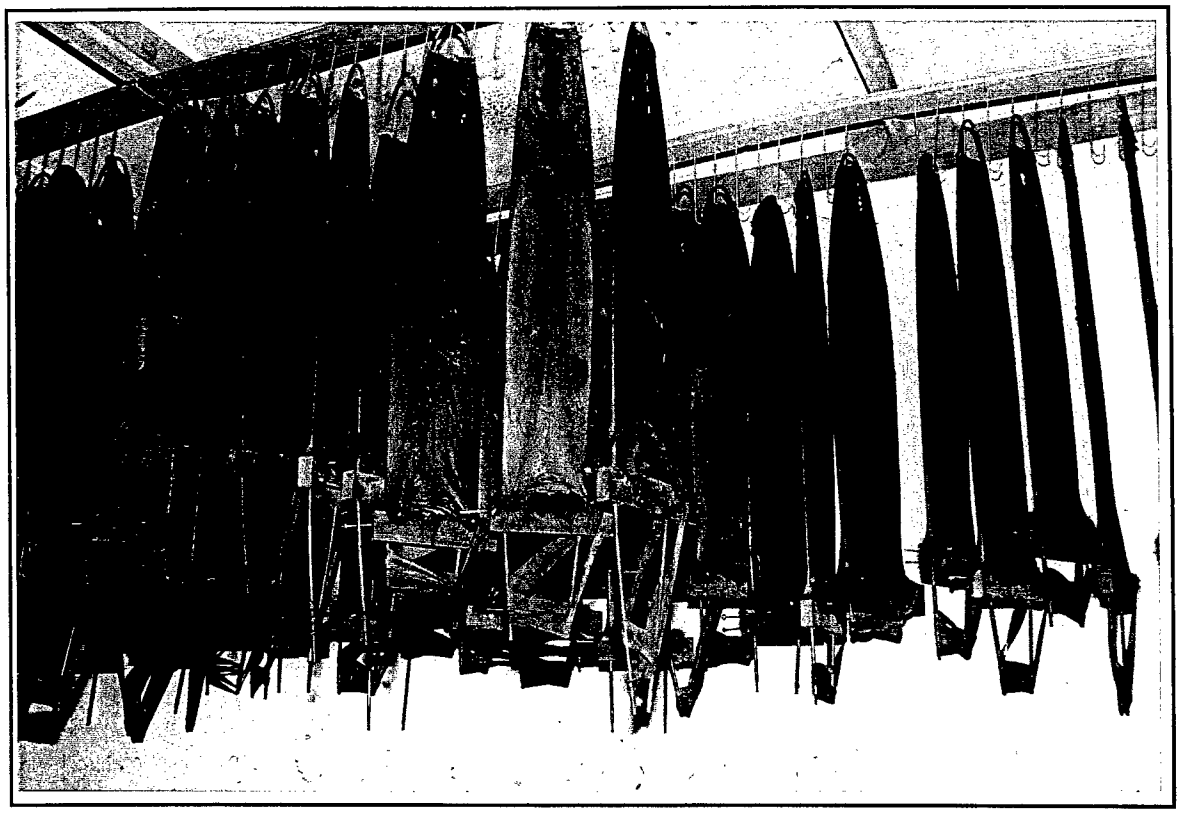


Figure 3-95. Nutria skins on metal frames in a drying shed on Bayou du Large in Terrebonne Parish. Date: December 31, 1997.

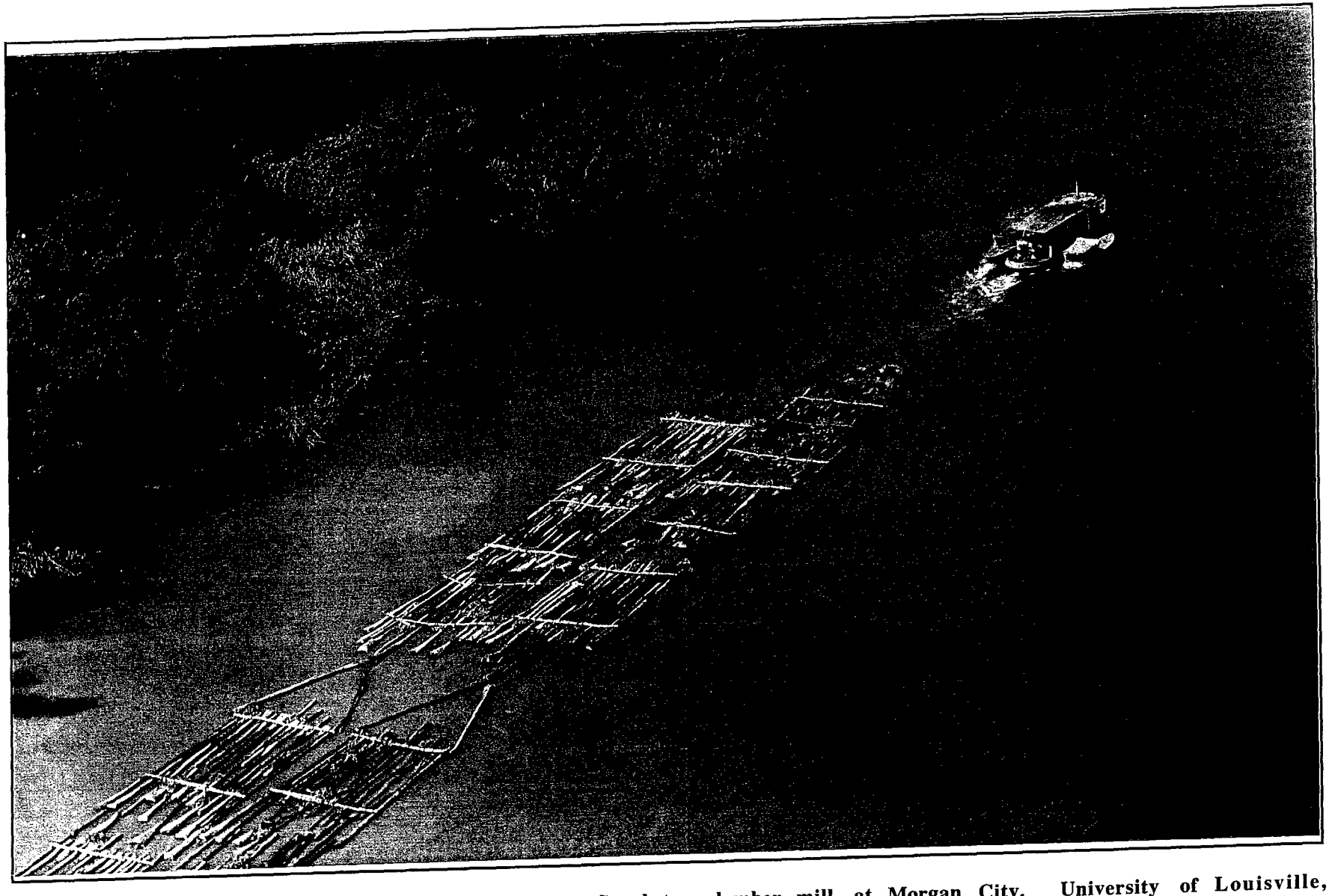


Figure 3-96. Log raft being towed on the Intracoastal Canal to a lumber mill at Morgan City. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 61754. Photographer: Rotkin, October, 1948.

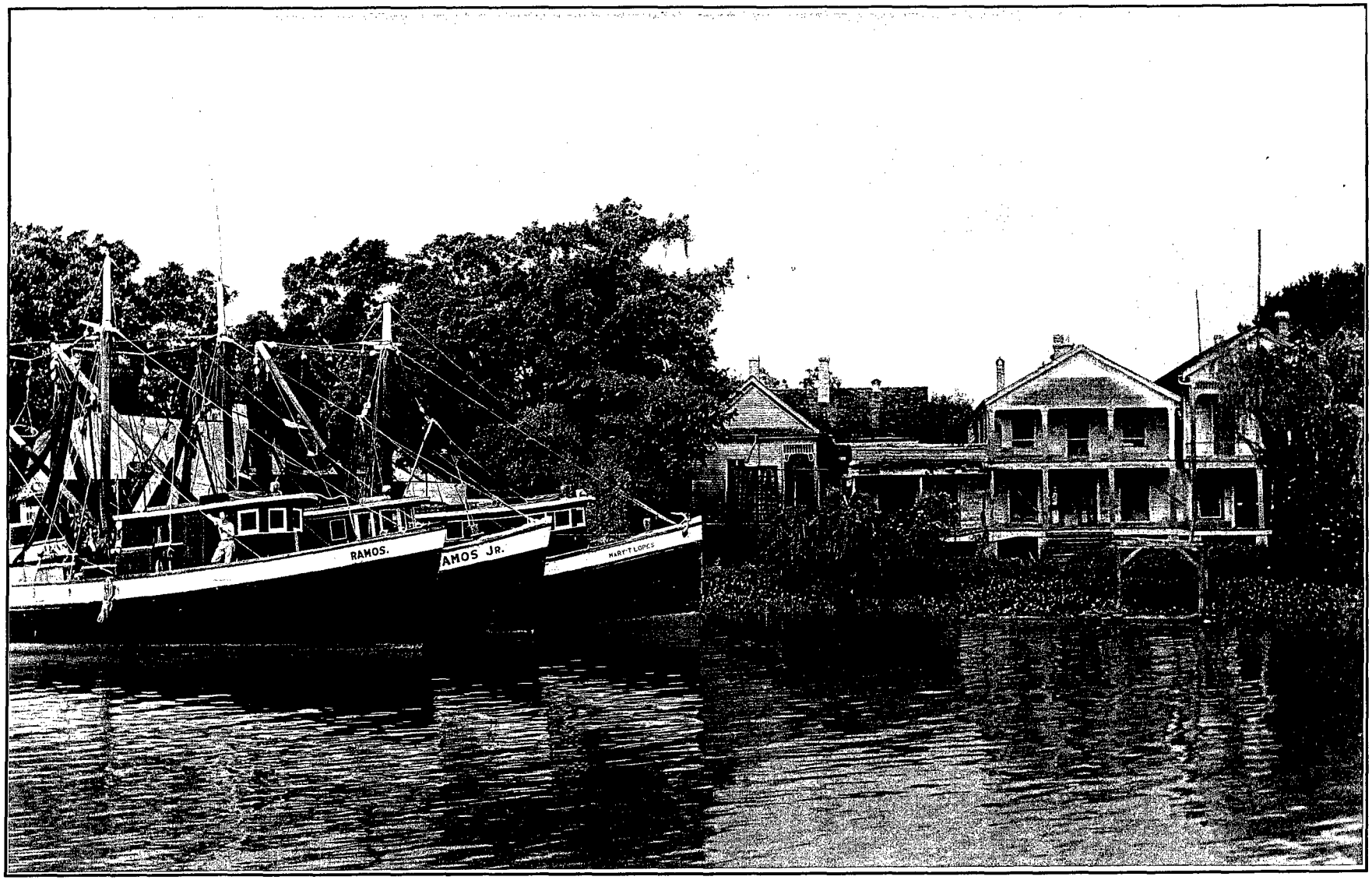


Figure 3-97. A part of the town of Patterson, located on the lower reach of Bayou Teche, with the shrimping fleet in the foreground. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 25930. Photographer: Rosskam, June, 1945.

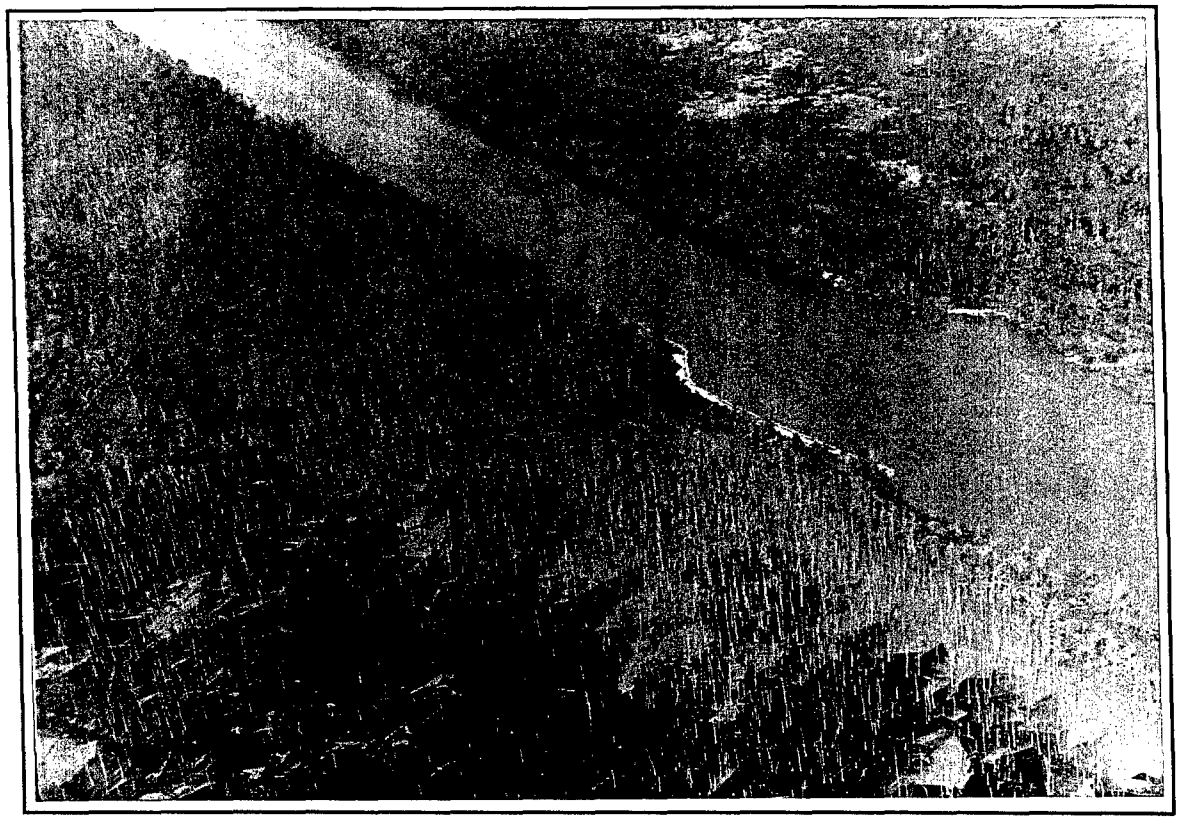


Figure 3-98. This example of a dying cypress swamp is along the Houma Navigation Canal just north of Falgout Canal in Terrebonne Parish. The demise of the swamp is probably the result of saltwater intrusion. Date: March 11, 1998.

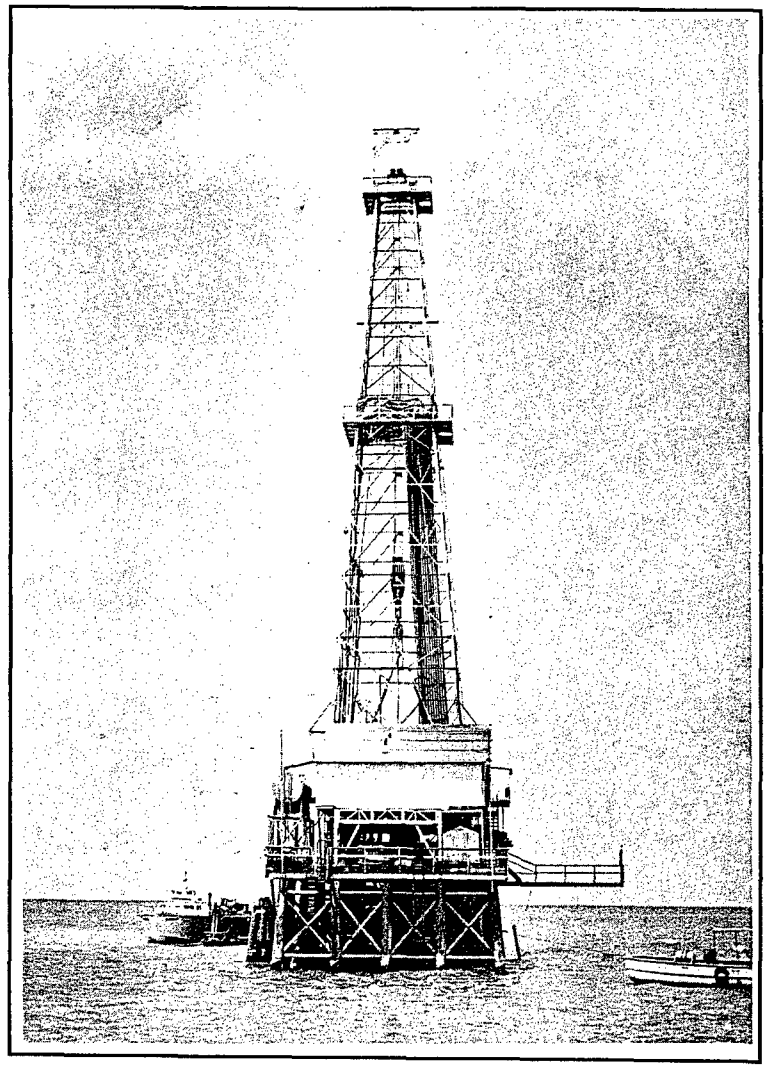


Figure 3-99. More than 50 years ago, the first commercial oil well out-of-sight-of-land was completed in the Gulf of Mexico. On November 14, 1947 a drilling crew working on Kerr-McGee's Rig 16 made their now famous discovery in Ship Shoal Block 32, approximately 45 miles from Morgan City (source: Morgan City Library Historic Archives).



Figure 3-100. Detonating a charge in association with a seismic survey in the marshes near Golden Meadow, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 67498. Photographer: Lee, May, 1950.



Figure 3-101. Seismographic operations in the Gulf of Mexico. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50207. Photographer: Lee, August, 1947.

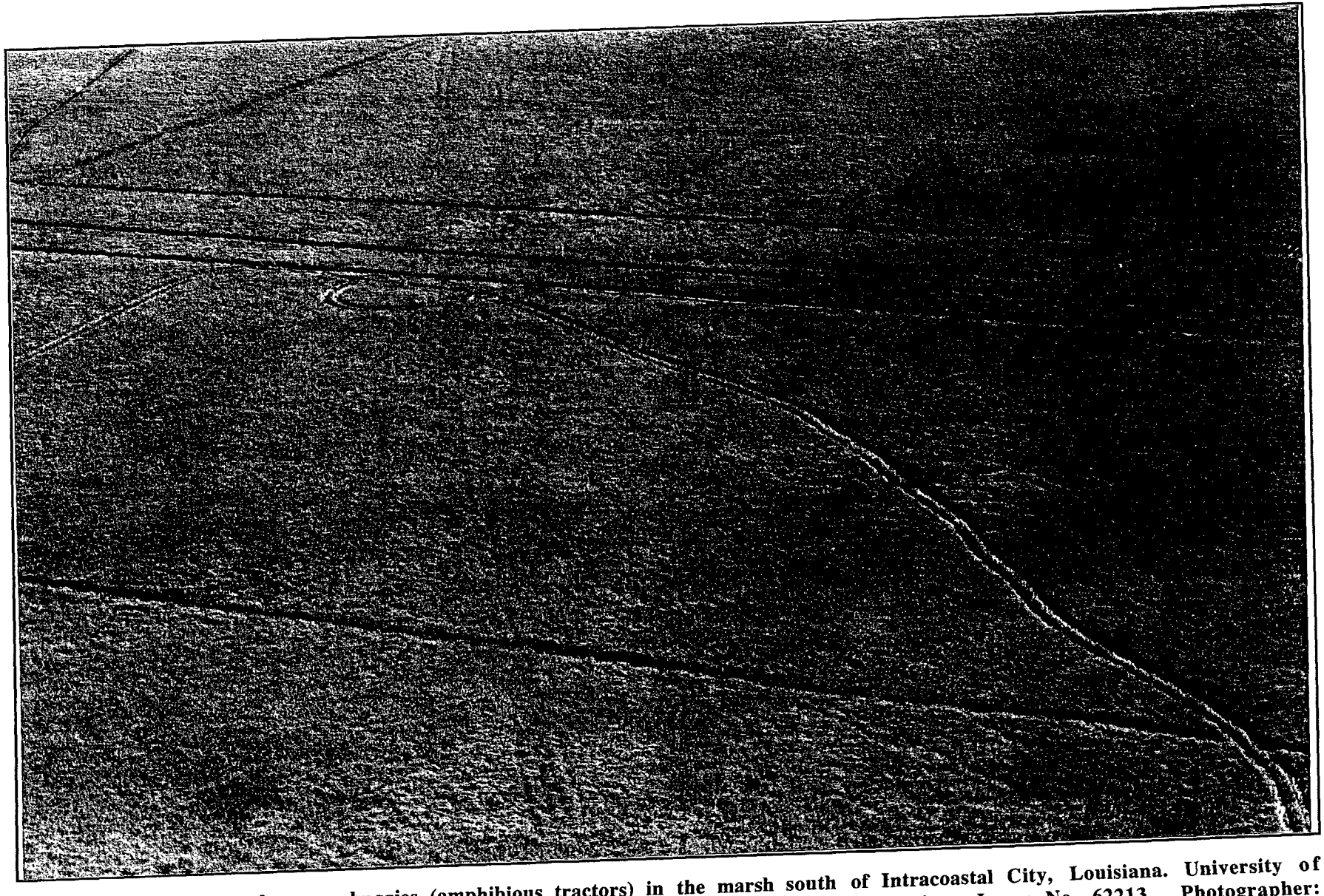


Figure 3-102. Tracks of swamp buggies (amphibious tractors) in the marsh south of Intracoastal City, Louisiana. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62213. Photographer: Rotkin, November, 1948.

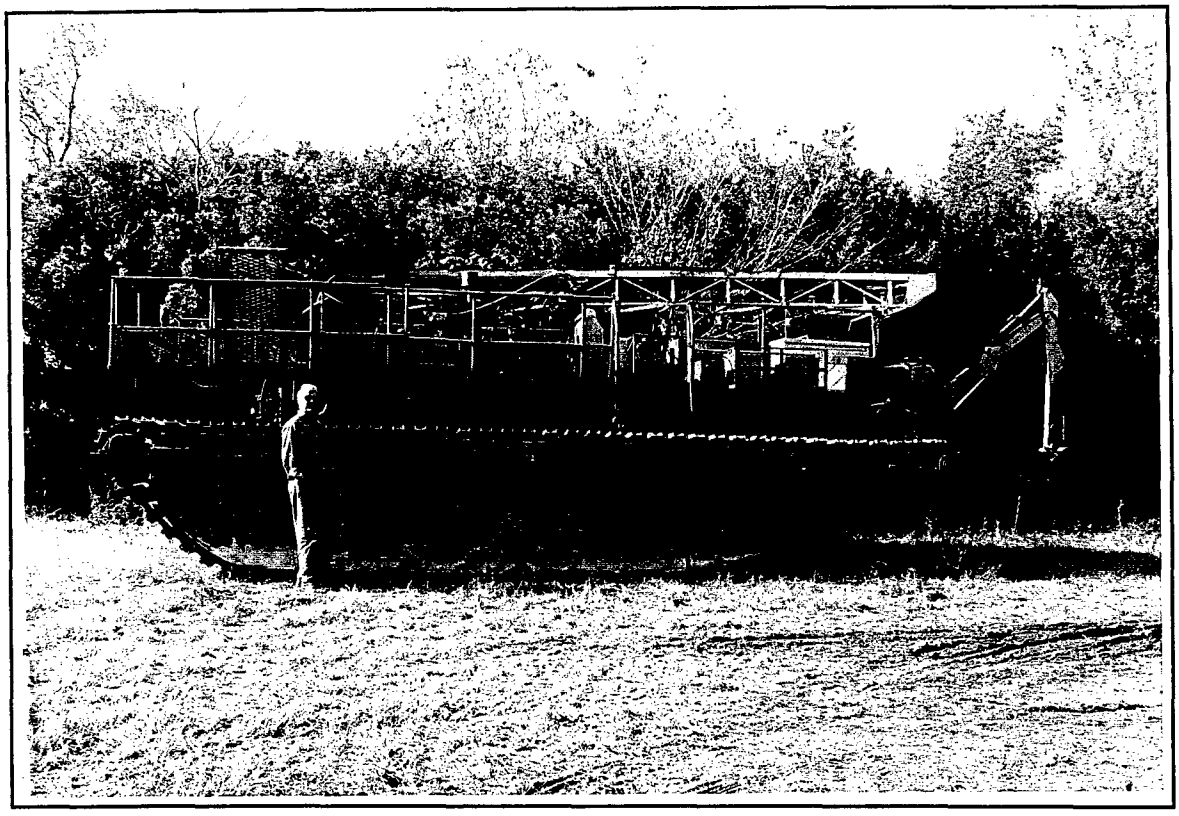


Figure 3-103. This geophysical-survey marsh buggy is used to help develop 3-D seismic profiles of the subsurface marsh geologic structure. This vehicle was parked along Highway 319 at the Gulf Intracoastal Waterway near Louisa in St. Mary Parish. Date: December 10, 1997.



Figure 3-104. Geophysical survey team operating on an airboat during a recent 3-D seismic survey. Date: 1997

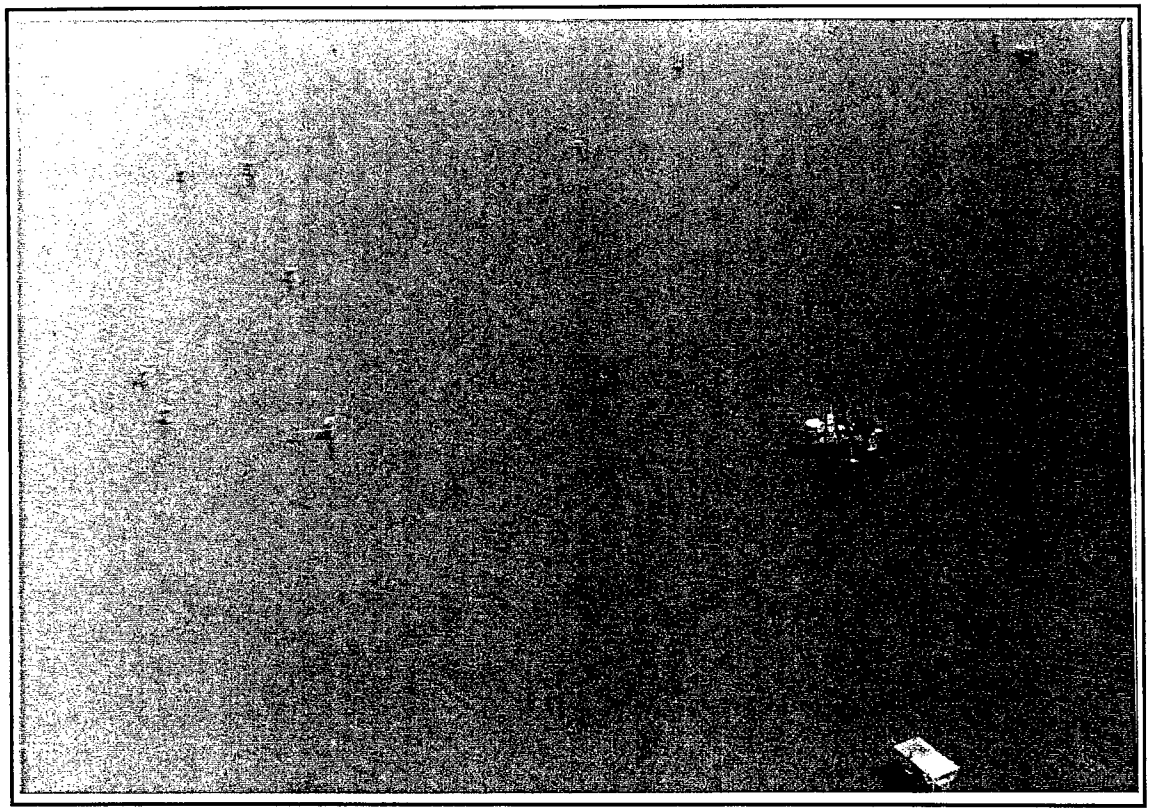


Figure 3-105. **This aerial view of a cluster of oil and gas well locations in the Gulf of Mexico near the mouth of Freshwater Bayou Canal shows a small portion of the structures anchored to the Gulf's floor. Date: March 11, 1998.**

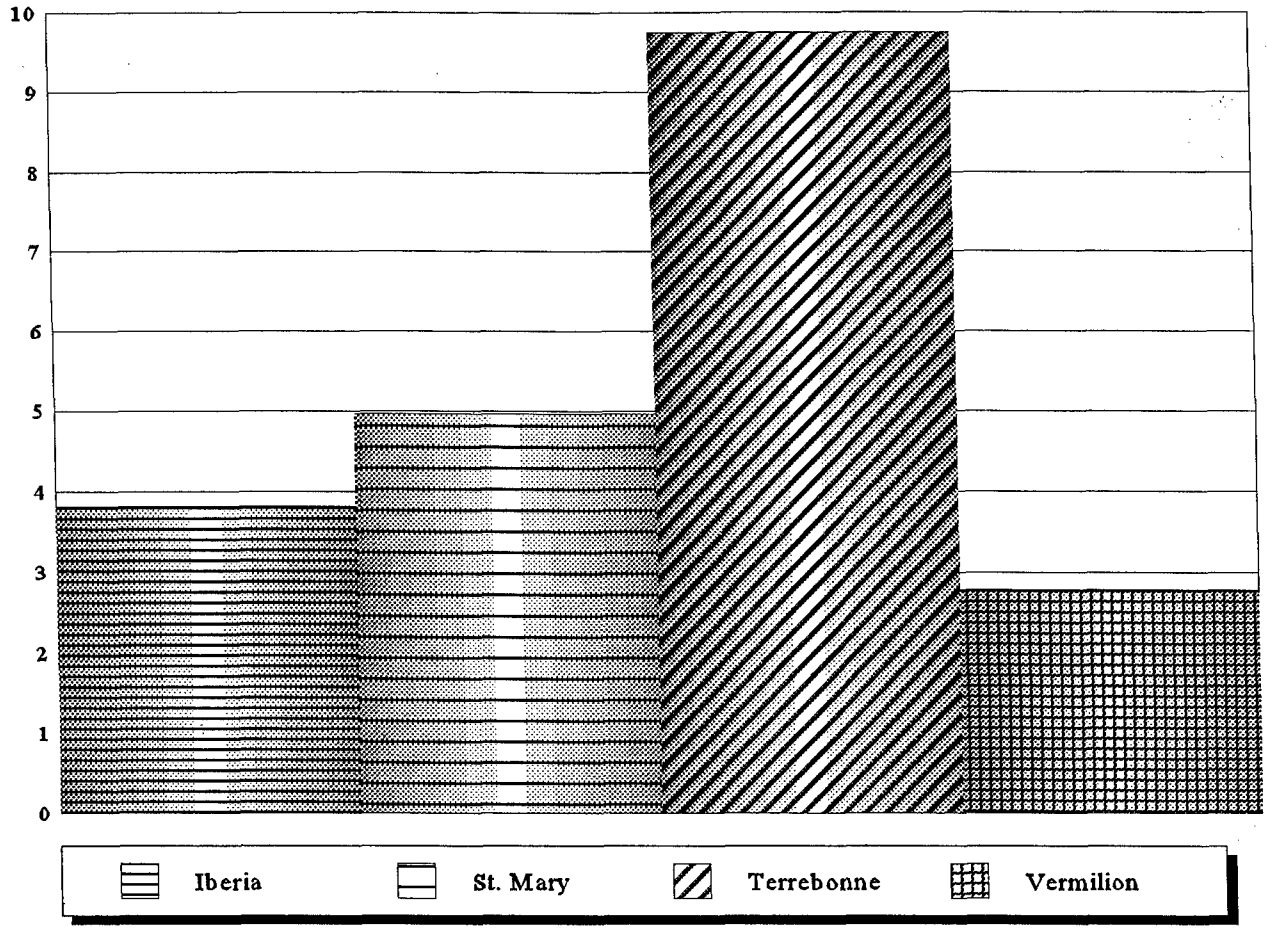


Figure 3-106. Graph showing crude oil and condensate production in 1993.

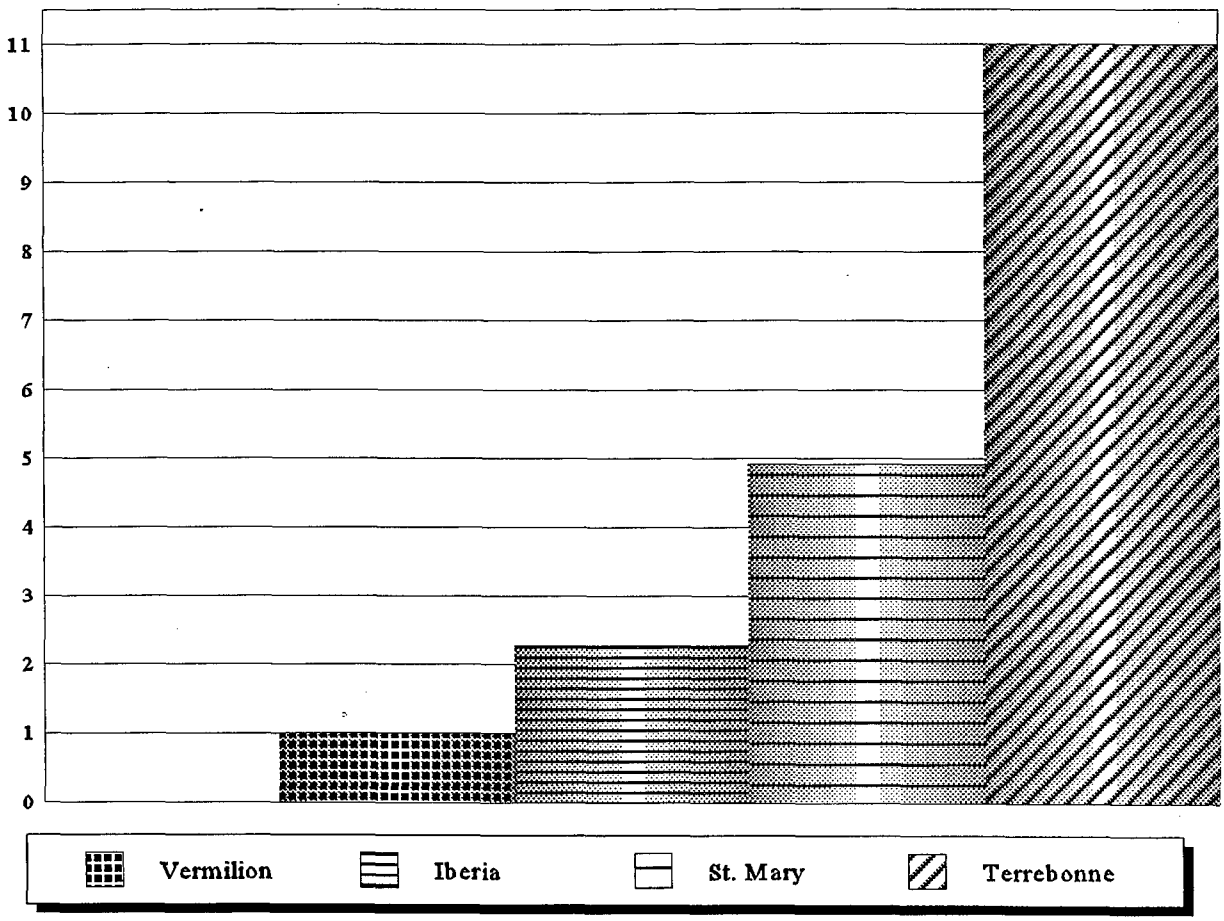


Figure 3-107. Graph showing percent dry and casinghead gas production in 1993.

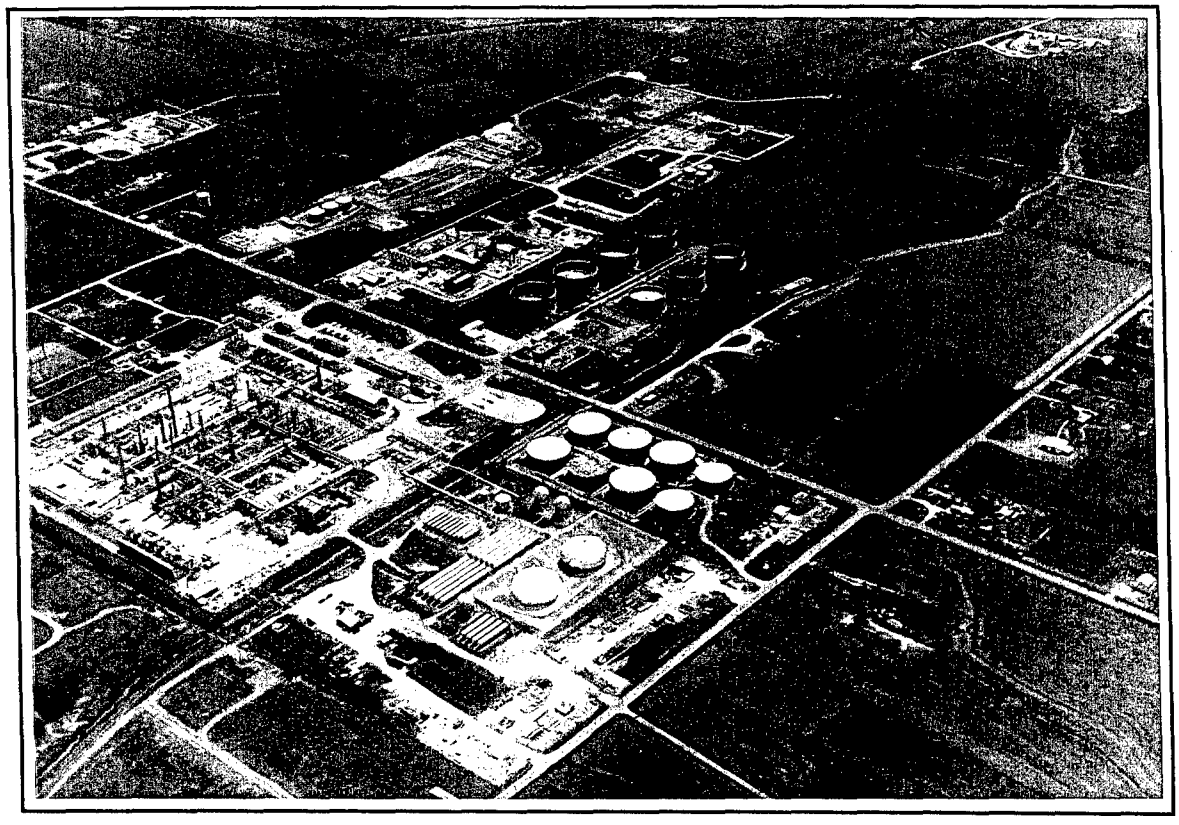


Figure 3-108. The "Henry Hub" is an important gas processing facility south of Erath in Vermilion Parish. Date: March 11, 1998.

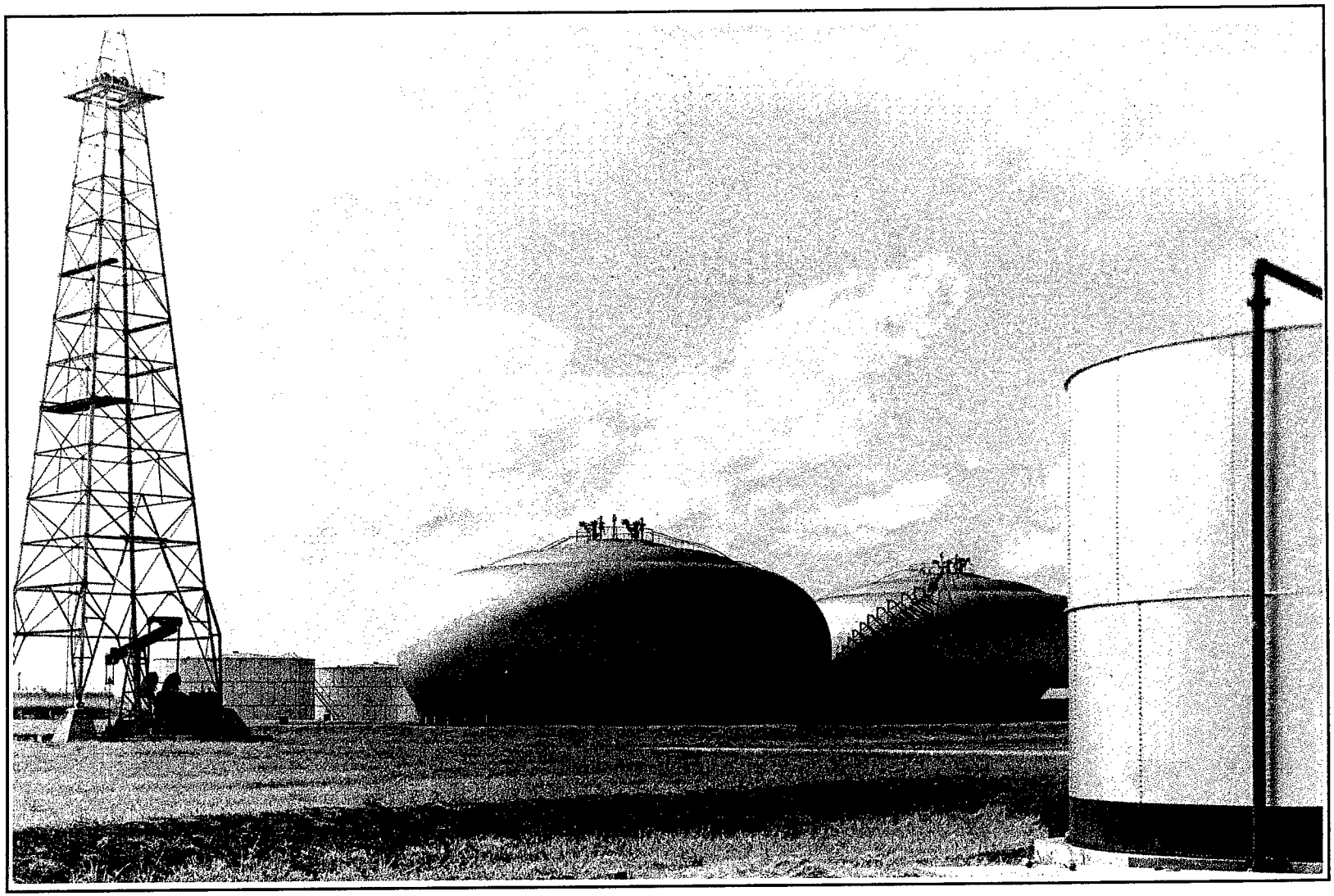


Figure 3-109. Pumping rig and storage tanks at the recycling plant at Erath, Louisiana. There were six companies operating this plant. [This is now part of the "Henry Hub" where natural gas prices are fixed for the New York Commodity Exchange. The facility is located at the small community of Henry in Vermilion Parish.] University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 50477. Photographer: Webb, August, 1947.

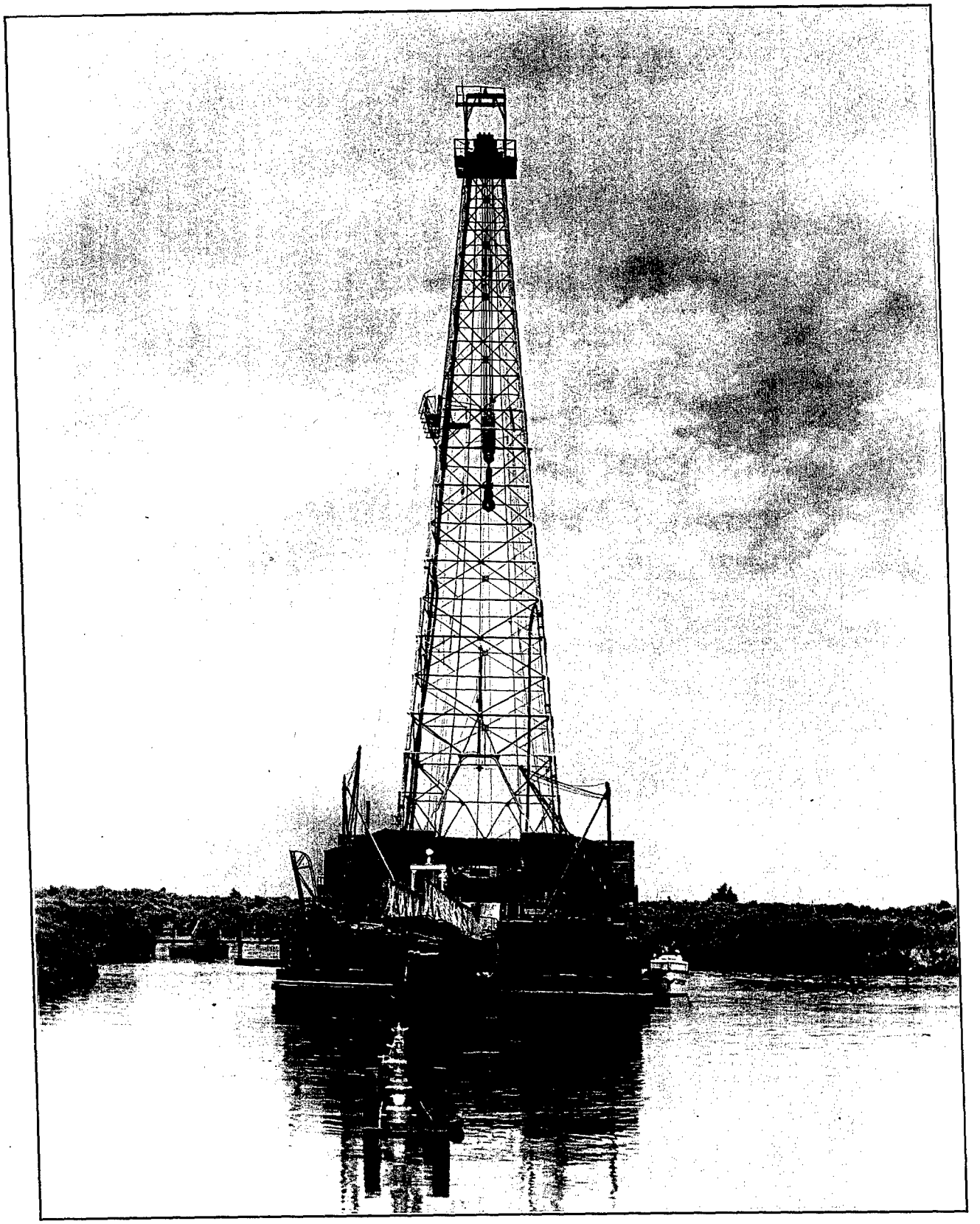


Figure 3-110. The Aztec Oil and Gas Company's Rathborne #1 drilling in south Louisiana's swamps (Image No. 6279-4 from the Jessie Grace Collection, 10/27/63, Morgan City Library Historic Archives).

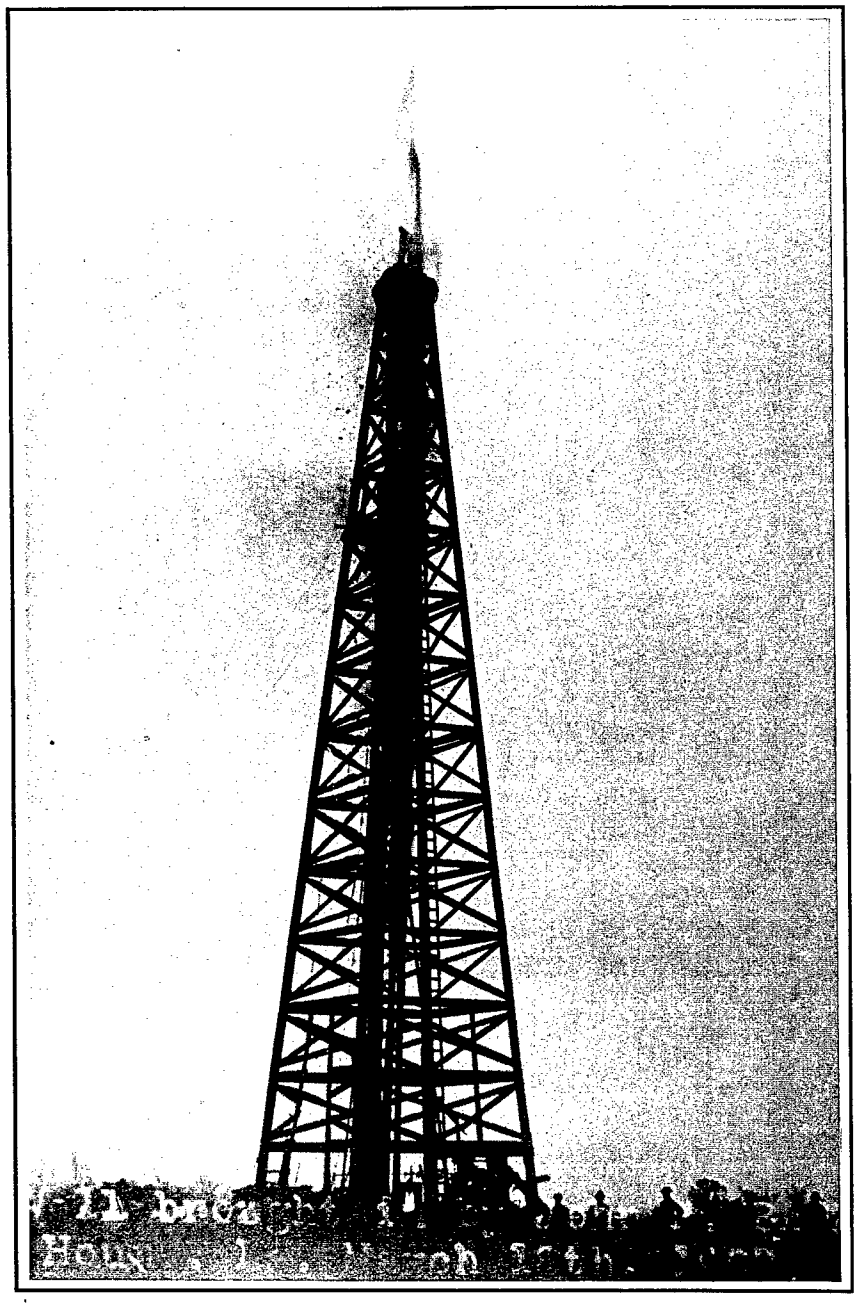


Figure 3-111. The first oil well was completed in Houma on March 18, 1927 (source: the Bernard Davis collection, Houma, Louisiana).

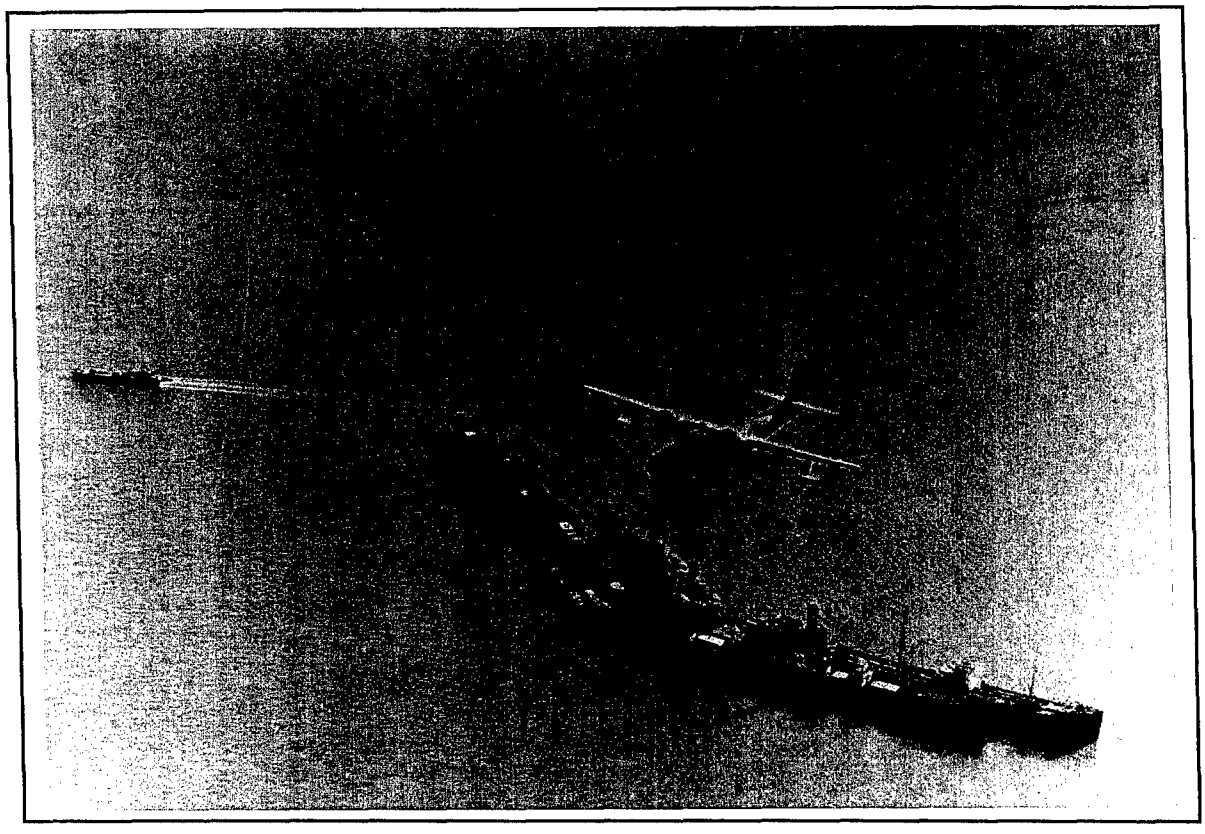


Figure 3-112. Once the Texas company (Texaco) had discovered oil at its Lake Barre field in 1929, there was an immediate storage problem. Field storage was in a grounded oil tanker, which was also the case in the company's Caillou Island field. From these storage tankers oil was offloaded to barges and moved to "Port Texaco" – three obsolete oil tankers, grounded in Cat Island Pass, and connected to an old steel schooner that was used as a loading dock. From "Port Texaco" oil was lightered to vessels offshore (source: Bernard Davis Collection, Houma, Louisiana).

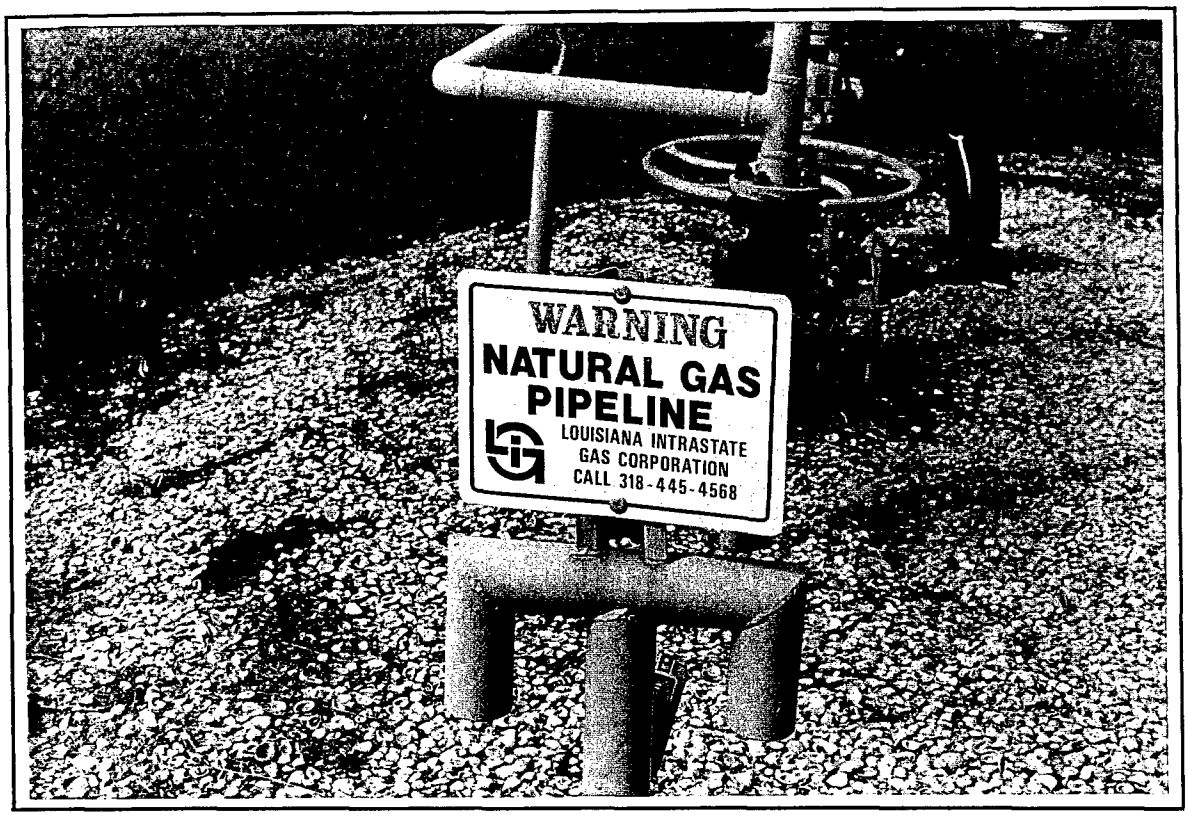


Figure 3-113. Since the 1930s, pipelines have evolved into an important component in the marketing strategy of oil and gas and their associated products. These linear routes are now an integral part of Louisiana's landscape. There are so many pipelines crossing the terrain, they often go unnoticed, but are critical in the modern distribution of mineral fluids. Date: July 15, 1997.

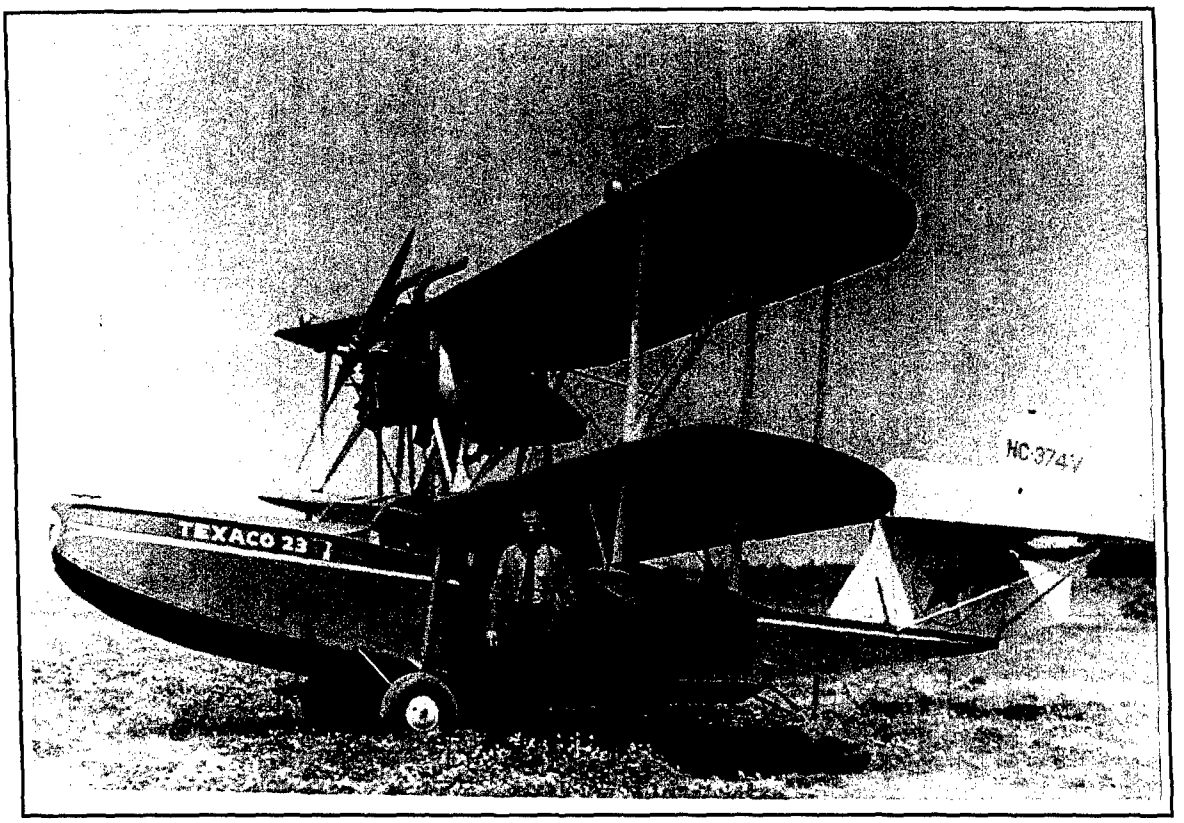


Figure 3-114. After purchasing a fleet of sea planes used to carry mail from ships anchored in the Mississippi delta to New Orleans, Texaco became a pioneer in using aircraft to support their marsh operations, ca. 1930. This form of transport is now a vital part of the state's on and offshore logistic support services (source: Bernard Davis Collection, Houma, Louisiana).

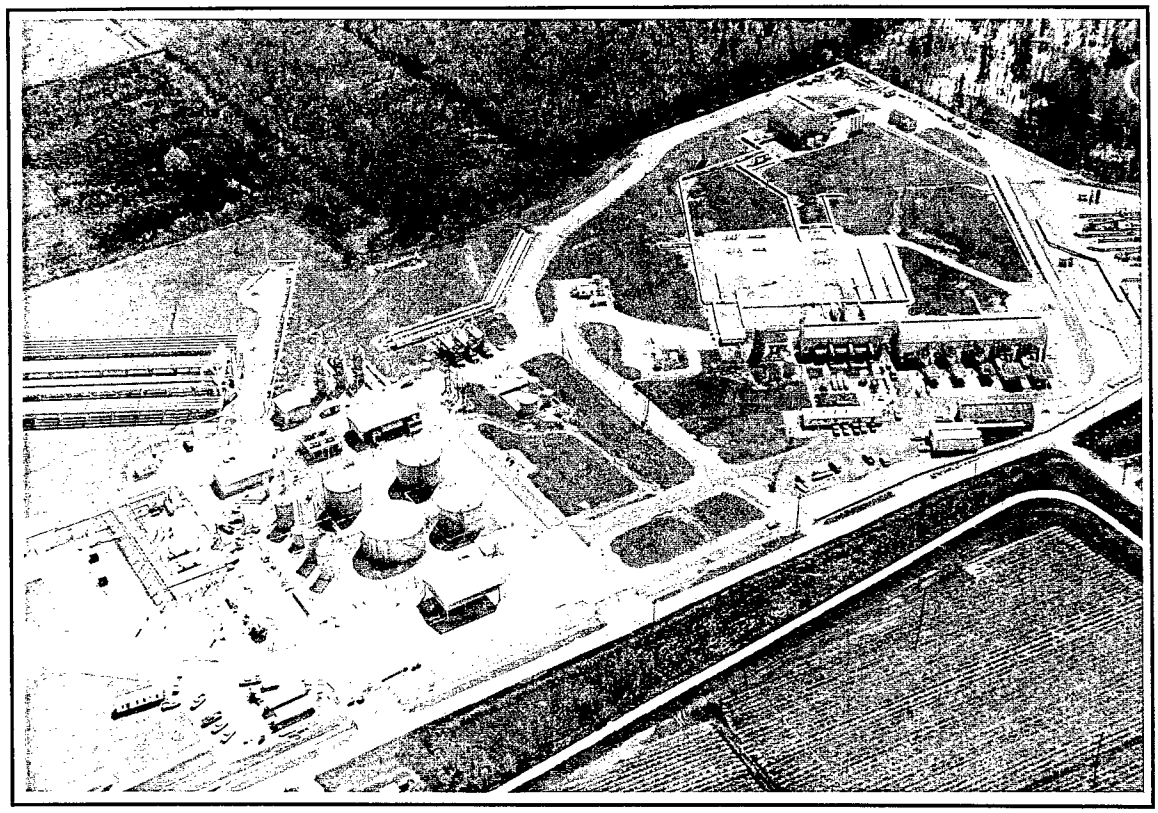


Figure 3-115. Aerial view of a small oil and gas processing plant along Bayou Black northwest of Houma. Date: March 11, 1998.

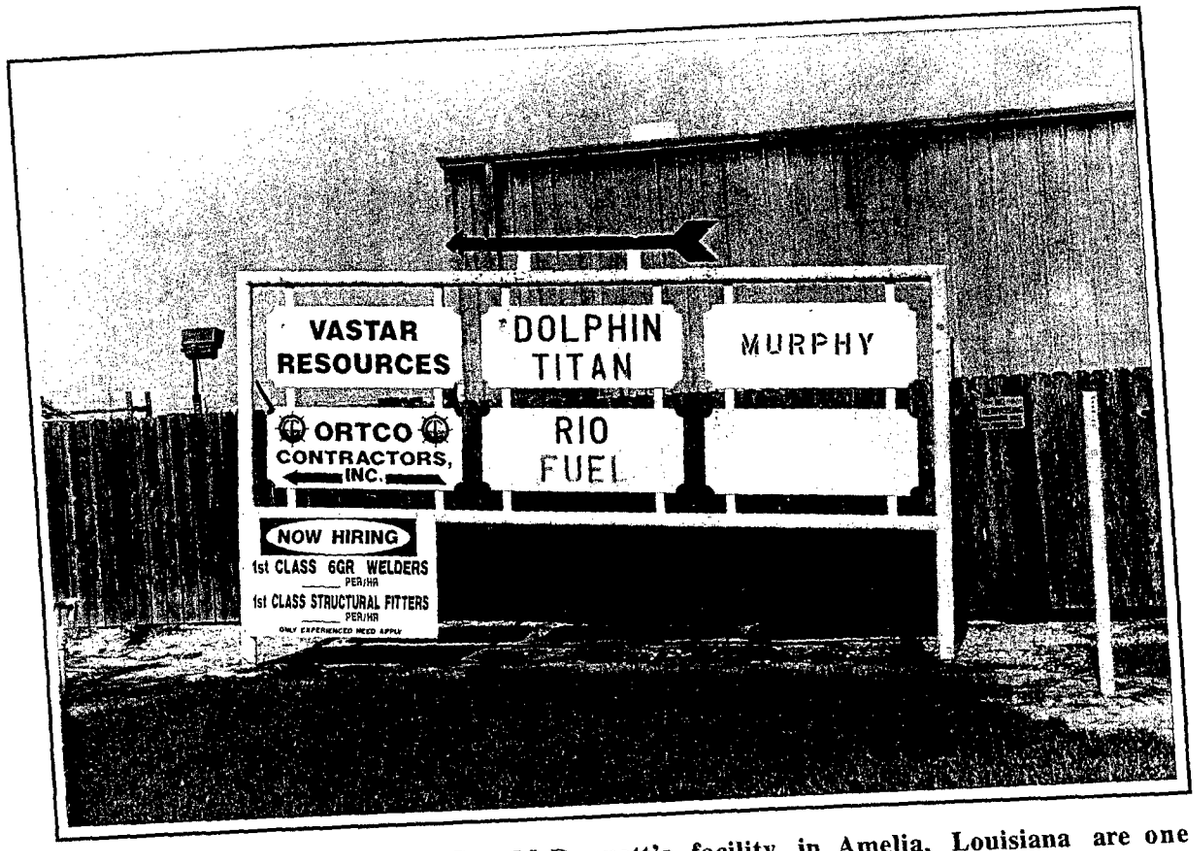


Figure 3-116. Signs near J. Ray McDermott's facility in Amelia, Louisiana are one indicator of the health of the local economy. This is evident by the advertisement that one firm is hiring welders and structural fitters. Date: July 15, 1997.

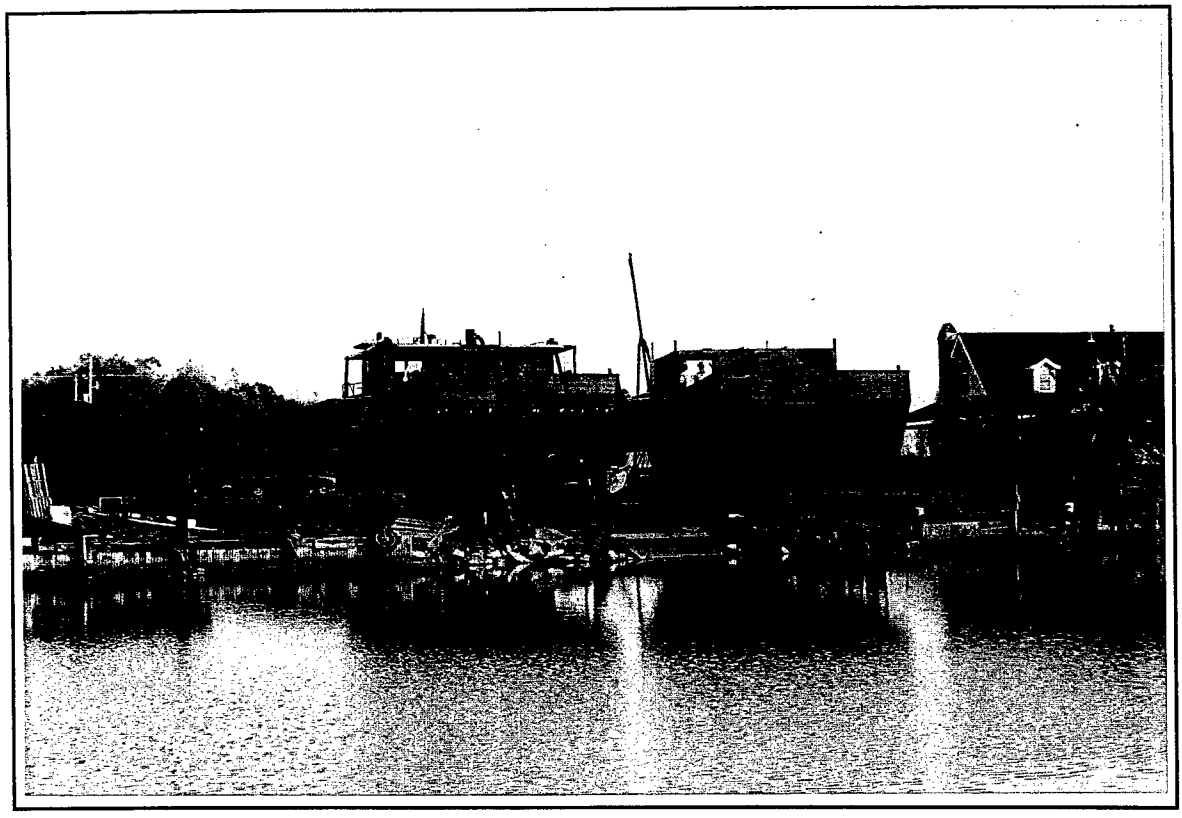


Figure 3-117. Small ship-building facilities are a part of south Louisiana's commercial landscape. These vessels are being built at one of the yards along Bayou Petit Caillou in Chauvin in Terrebonne Parish. Date: December 22, 1997.



Figure 3-118. This sign lists only a fraction of the offshore oil and gas service companies operating in the Intracoastal City. Date: December 10, 1997.

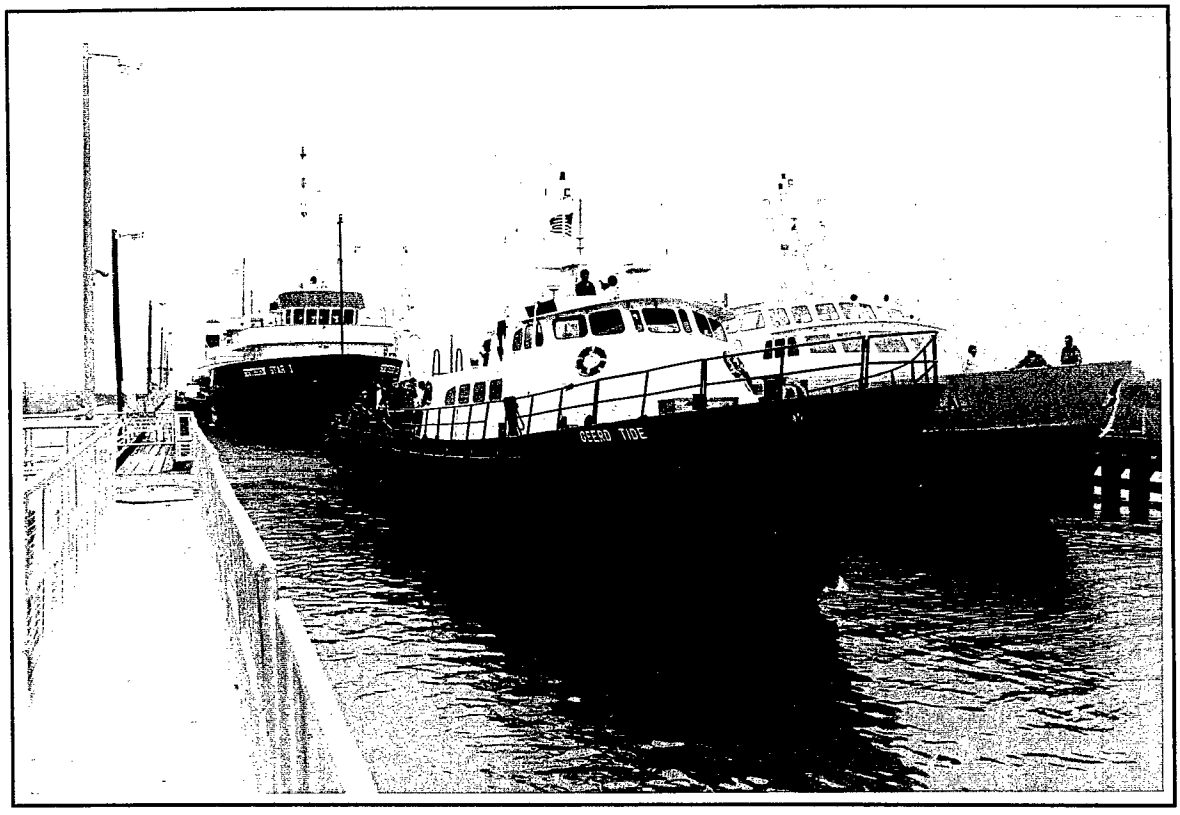


Figure 3-119. These supply boats transport supplies and crew between Intracoastal City and offshore oil and gas platforms south of Marsh Island. Date: December 9, 1997.

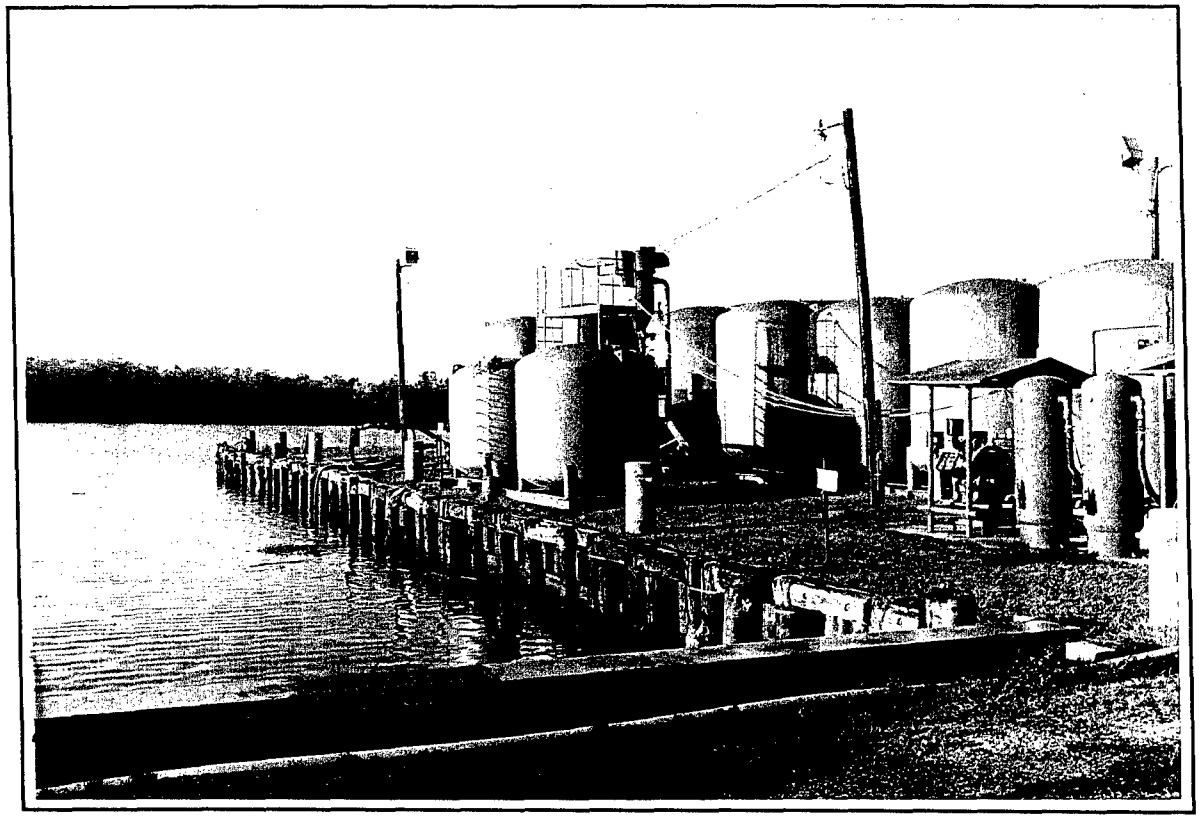


Figure 3-120. These mud tanks at Intracoastal City are one example of some of the expendables associated with the offshore oil and gas business. Date: December 10, 1997.

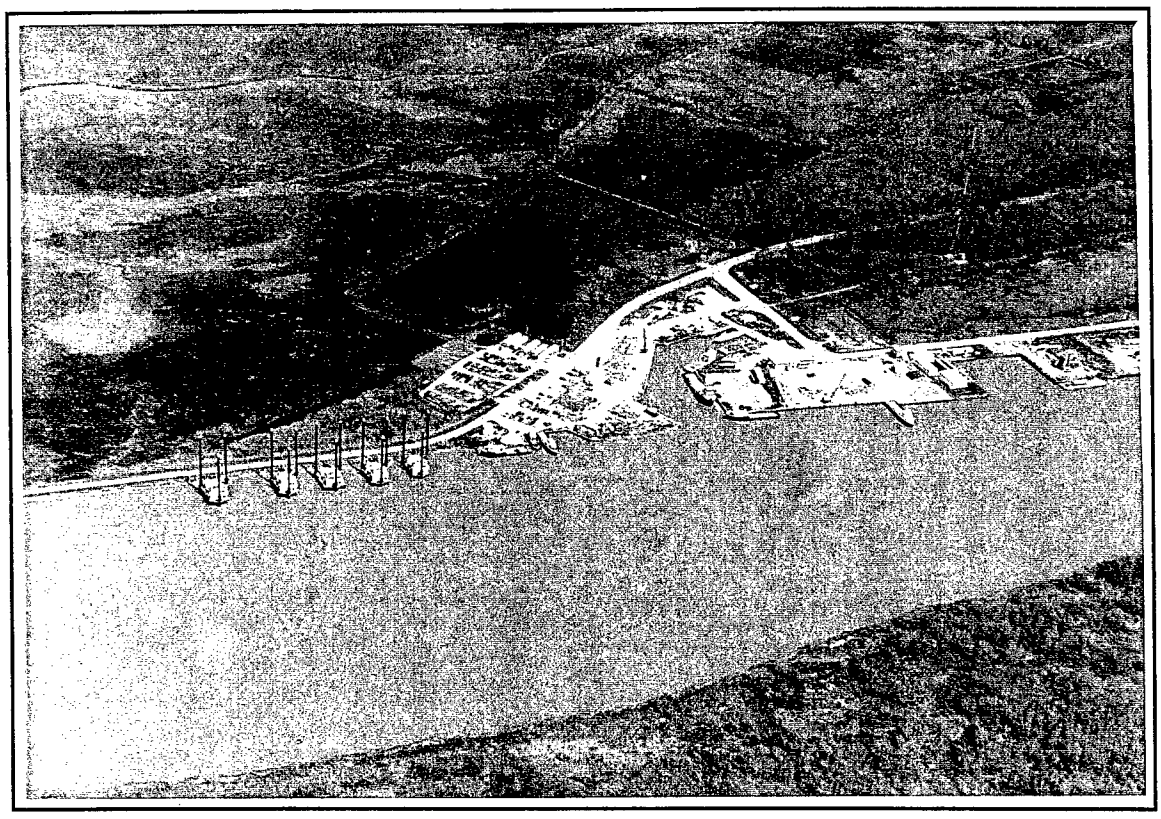


Figure 3-121. A small part of the logistic support center for the offshore oil and gas industry that has developed at Intracoastal City. Date: March 11, 1998.

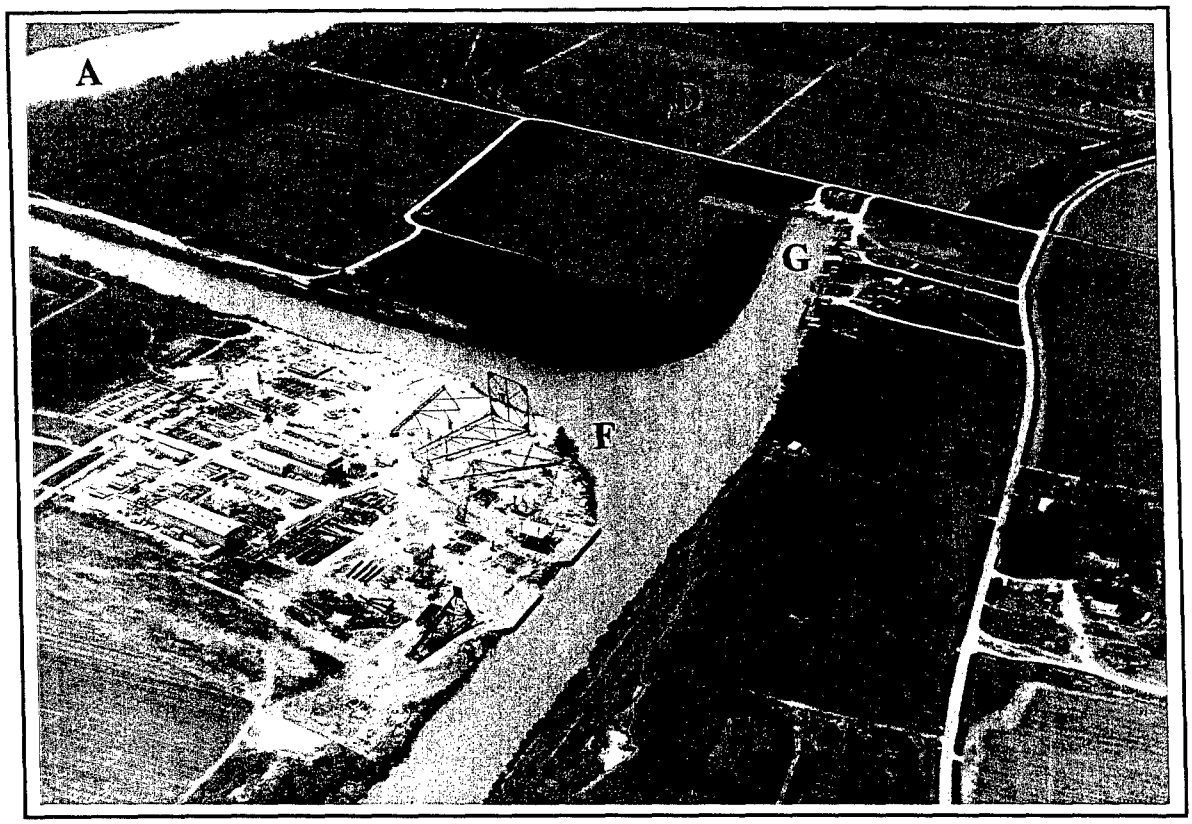


Figure 3-122. **The Port of West St. Mary near Louisa, in St. Mary Parish, is an emerging industrial center. This site was selected for development because of access to the Gulf Intracoastal Waterway (A) and high natural levee soils, provided by an old river channel (B-C), barely discernible to the left of the highway that follows the old channel. Also note the sugar cane fields (D), the residence/maintenance building complex of a sugar cane farmer (E), the developing oil and gas services facilities (F), and the fishing port with its seafood processing facilities (G). Date: March 11, 1998.**

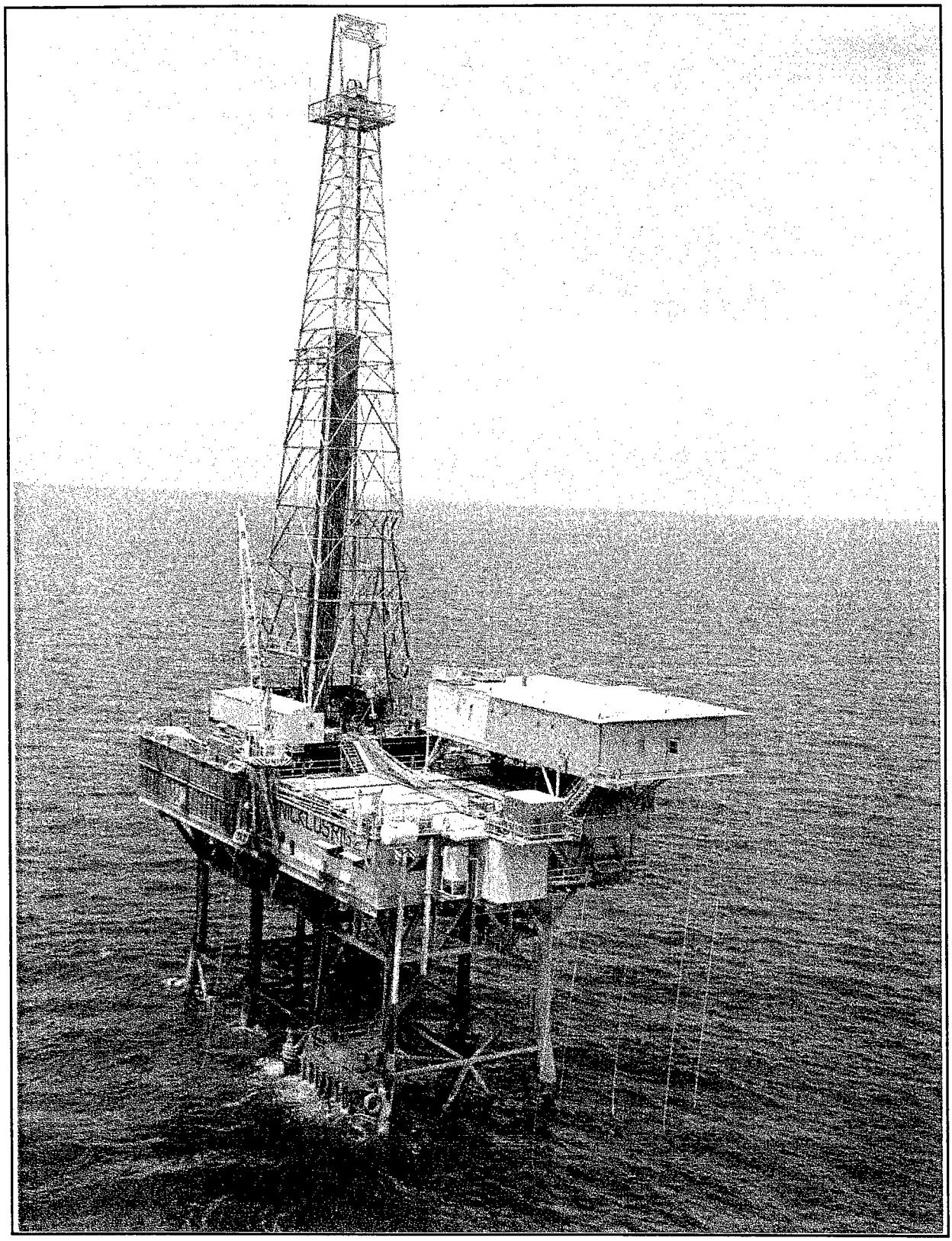


Figure 3-123. During the 1960s drilling companies were active off Louisiana's coast looking for marketable hydrocarbons. (source: Morgan City Library Historic Archives, Jessie Grace Collection, Image No. 6744, 5/29/64).

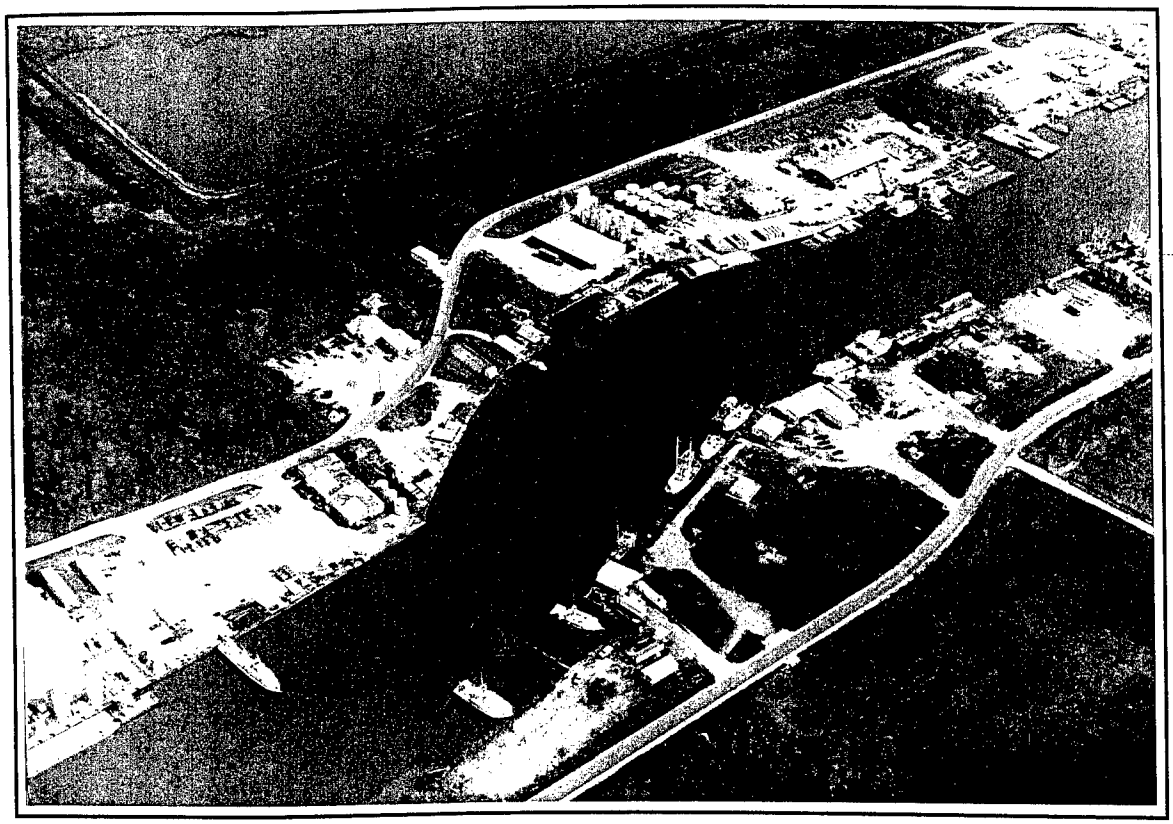


Figure 3-124. Along Bayou Grand Caillou at Lower Dulac in Terrebonne Parish, tuna boats (A), shrimp boats (B), and offshore service bases (C) are aligned along the available wharf space. Date: March 11, 1998.

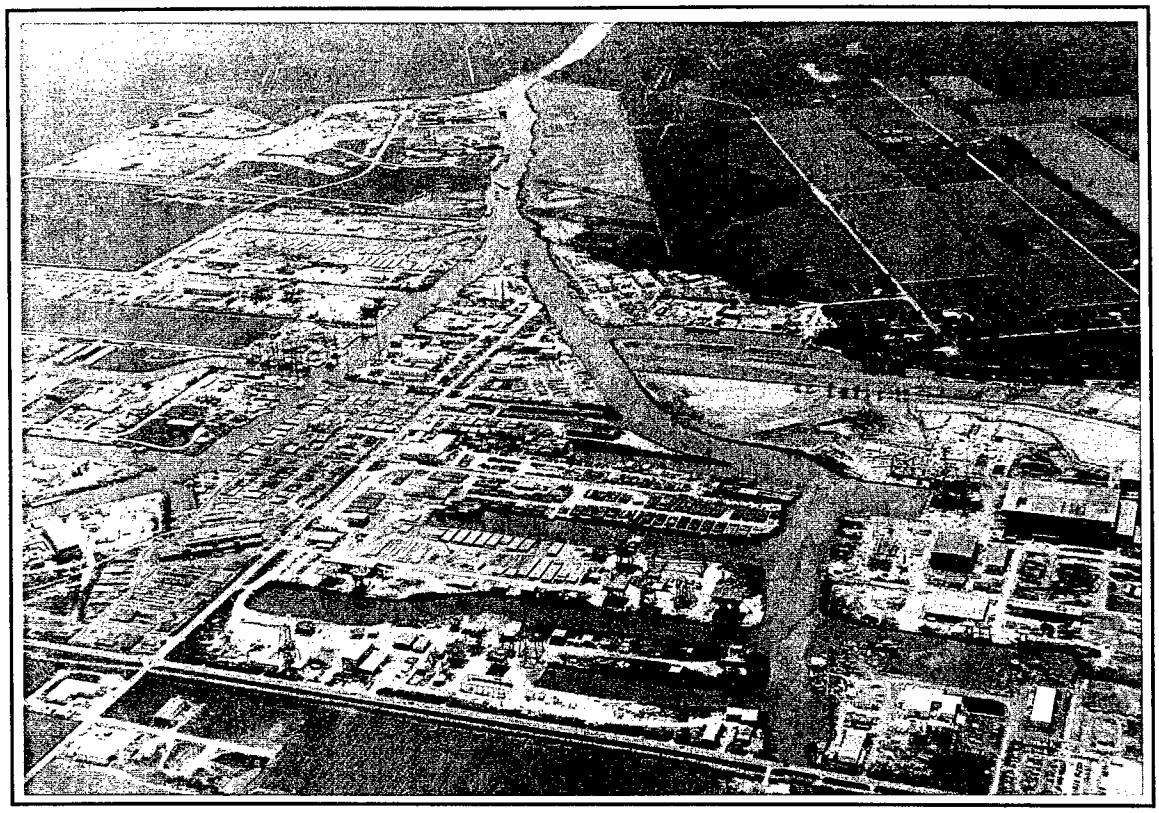


Figure 3-125. Like Amelia, the industrial complex within the Port of Iberia has evolved around the multifaceted and diverse needs of the offshore oil and gas business. Date: March 11, 1998.

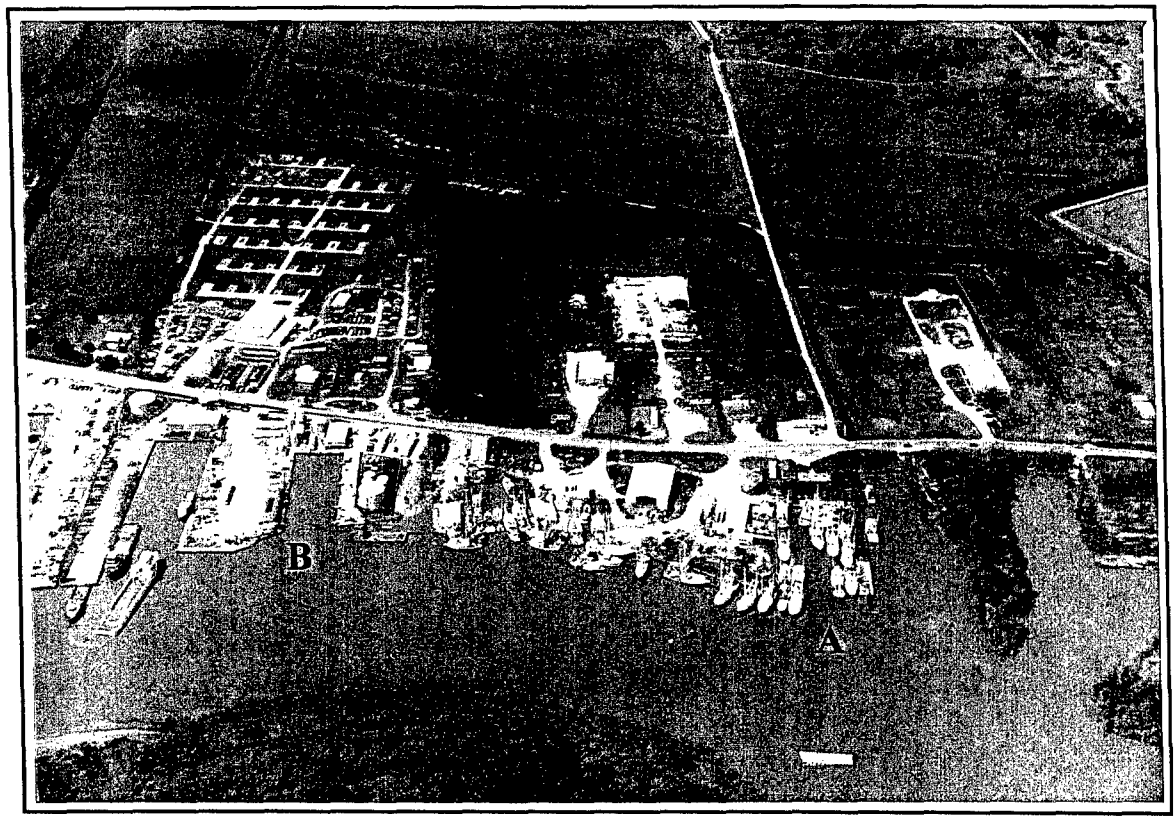


Figure 3-126. Aerial view of Intracoastal City in Vermilion Parish with shrimp boats (A), offshore service industries (B) and a heliport (C) clearly shown. Date: March 11, 1998.

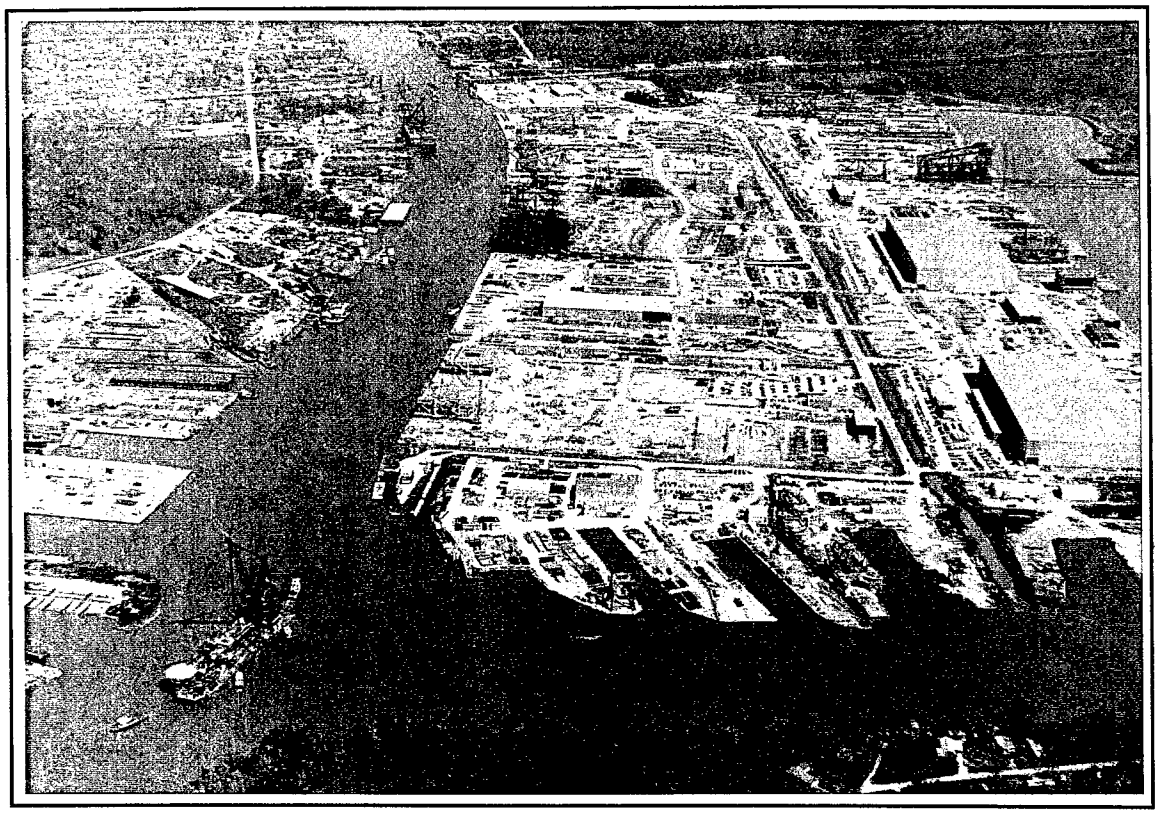


Figure 3-127. Aerial view of the Amelia industrial complex associated with meeting the fabrication needs of the offshore oil and gas industry. Date: March 11, 1998.



Figure 3-128a. Aerial view of the Amelia industrial complex associated with meeting the fabrication needs of the offshore oil and gas industry. Date: March 11, 1998.

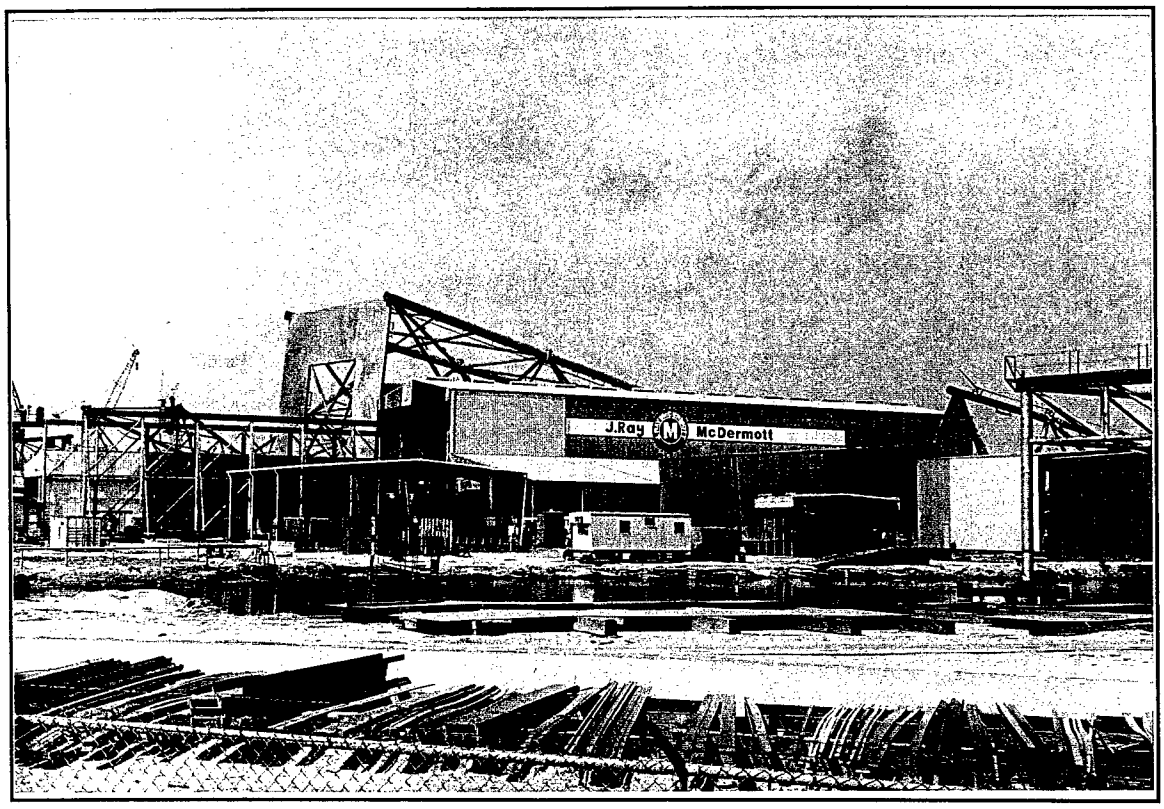


Figure 3-128b. The fabrication facilities in the Amelia/Morgan City area have evolved since the 1950s into an innovator in the design and construction of offshore exploration and production platforms. Date: July 15, 1997.

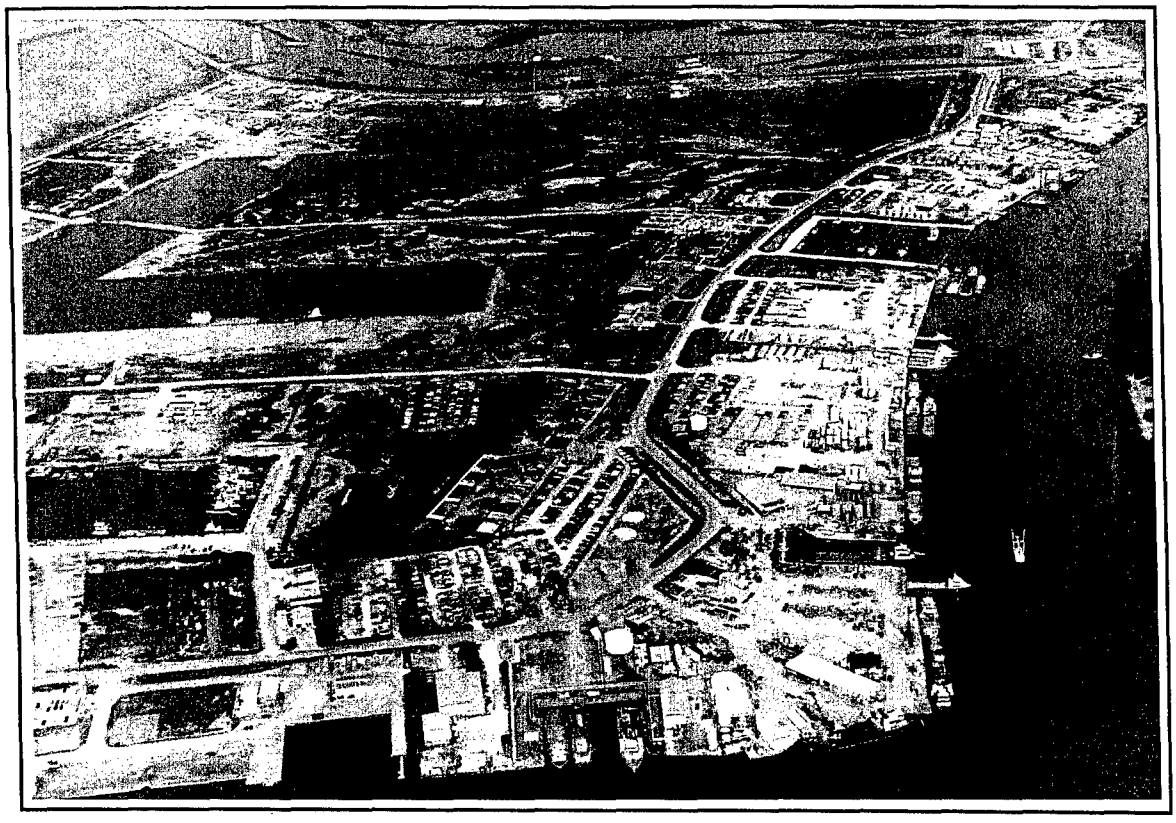


Figure 3-129. Port Fourchon has developed into one of the most important ports in Louisiana. In less than three years it has evolved into the central hub for deep water drilling and production activity. Date: March 11, 1998.



Figure 3-130. Bayou Lafourche has been characterized as "The Longest Main Street in the World" and the local tourist office has taken advantage of this slogan in some of its promotions. Date: January 6, 1998.

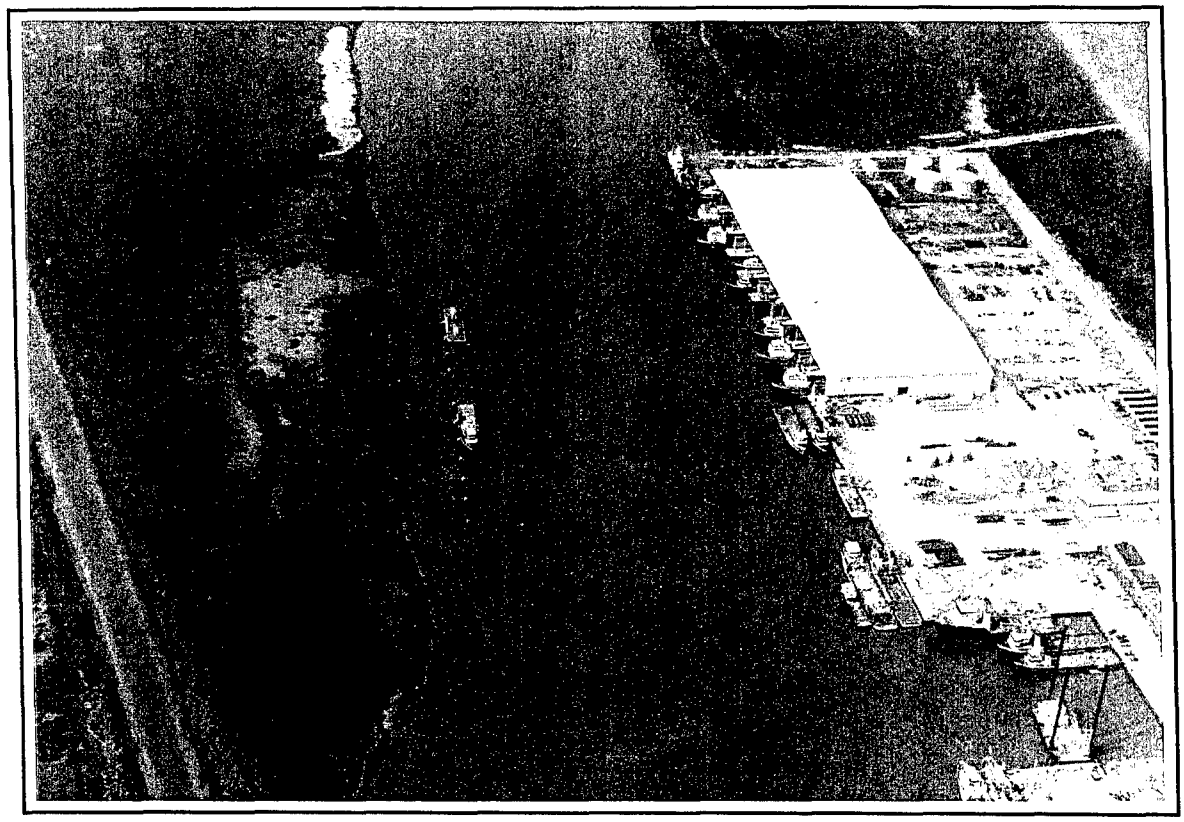


Figure 3-131. C-Port at Port Fourchon is a state-of-the-art loading facility designed to meet the logistic support needs of the exploration and production structures working in the deep waters off Louisiana's coast. Date: March 11, 1998.

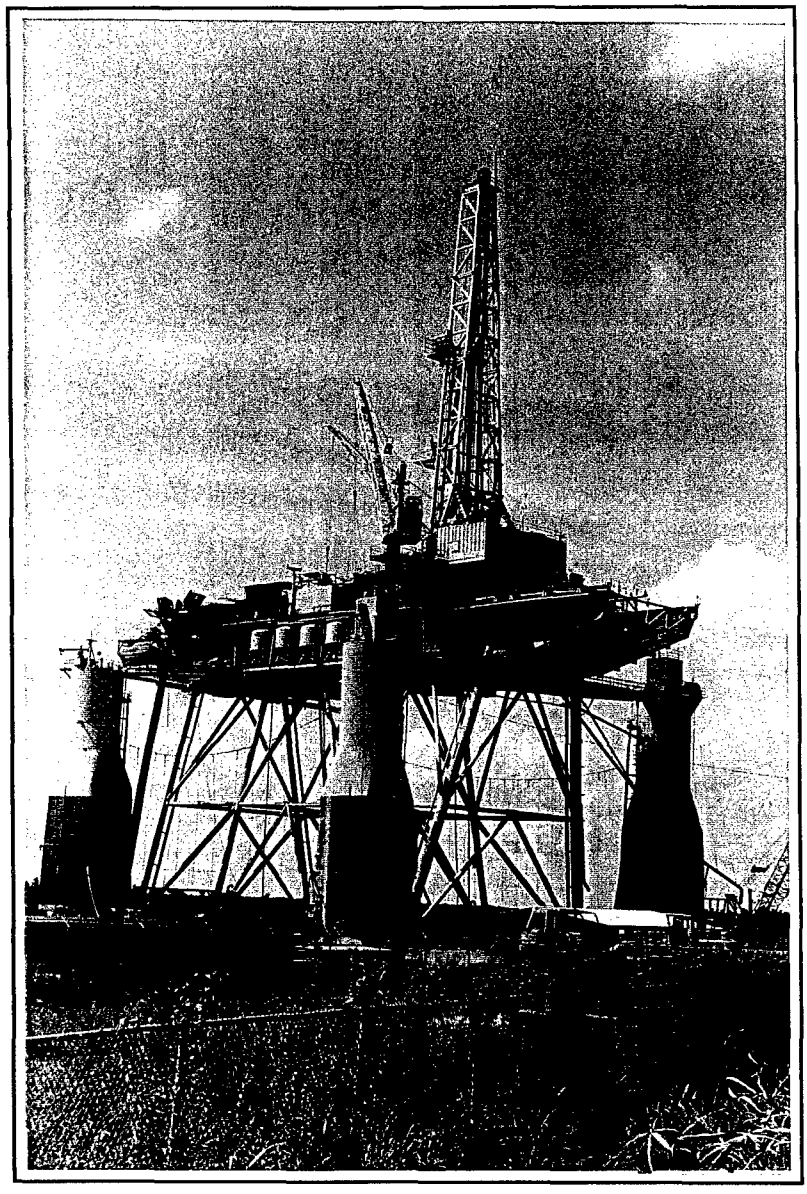


Figure 3-132. An example of a deep-water drilling rig under construction near Morgan City. Date: July 15, 1997.

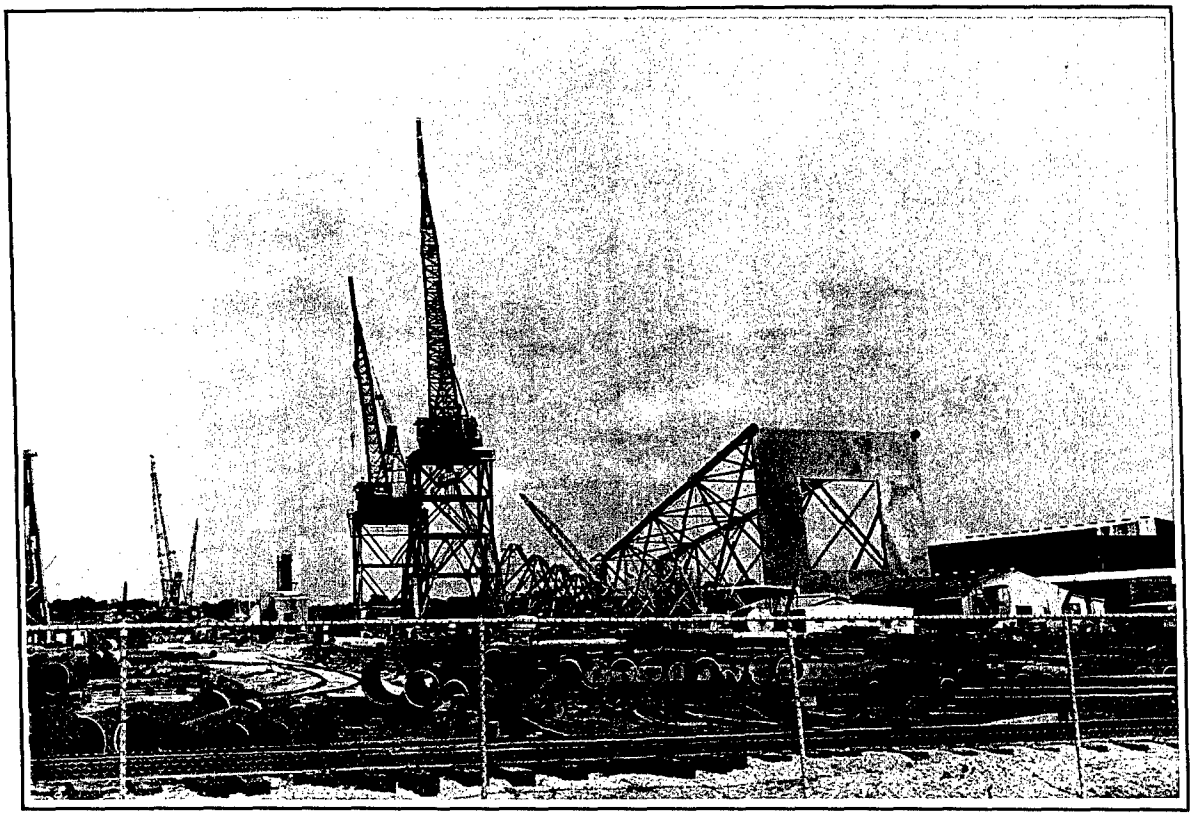


Figure 3-133. With the rebirth of the Gulf of Mexico as a major source of marketable hydrocarbons, fabricators are trying to handle a backlog of business. This fabrication yard is in Amelia, St. Mary Parish. Date: July 15, 1997.

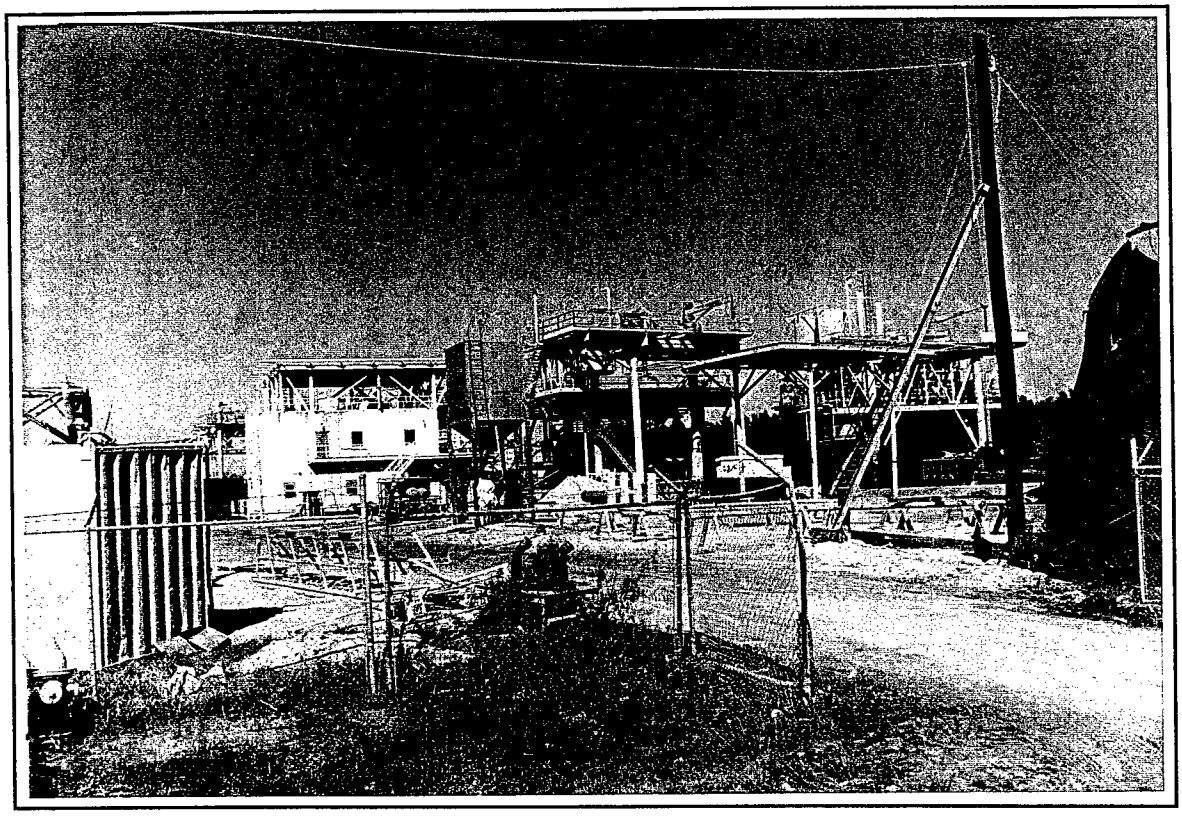


Figure 3-134. Offshore fabrication yard along the Houma Navigation Canal near Houma, Louisiana. Date: November 25, 1997.



Figure 3-135. **"Now Hiring" signs like this one near Morgan City, can be found throughout south Louisiana, as fabricators try to meet the demands of the oil and gas industry. Date: July 15, 1997.**

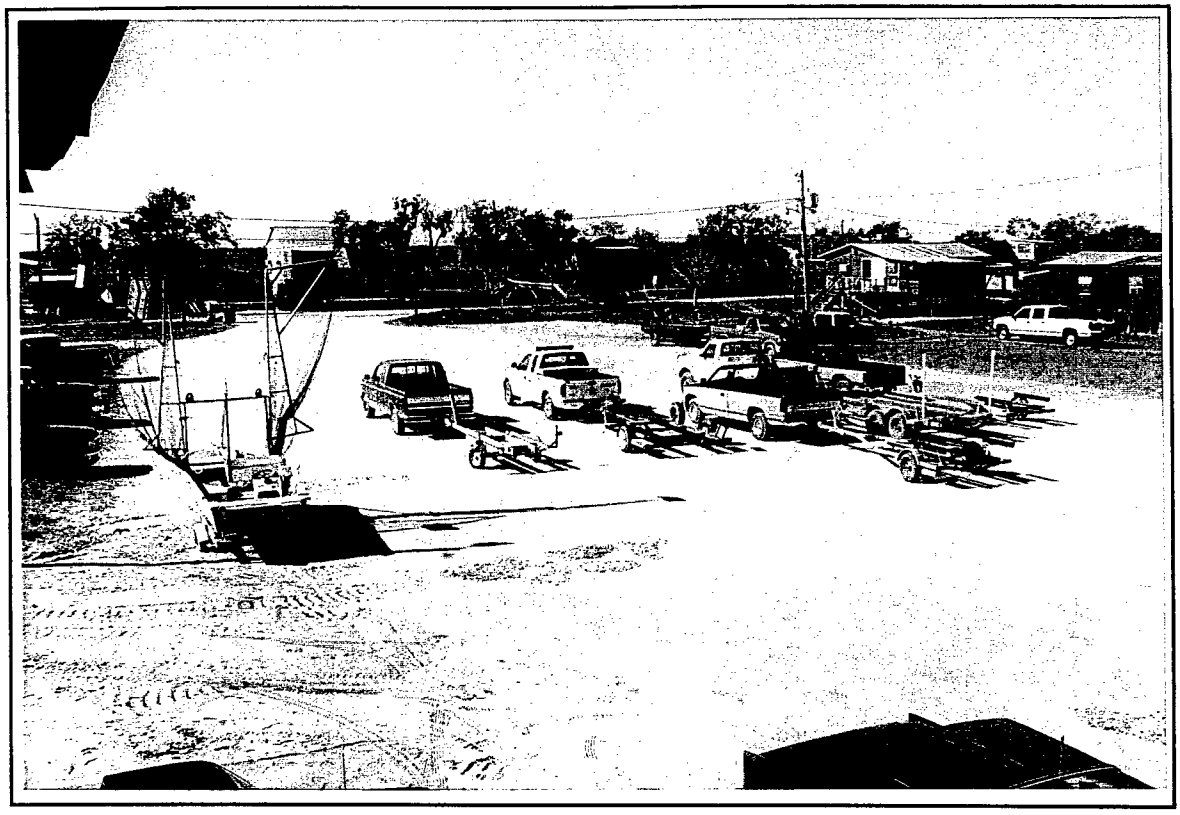


Figure 3-136. There are numerous public boat landings throughout south Louisiana, such as this site at Isle de Jean Charles in Terrebonne Parish. Date: December 30, 1997.

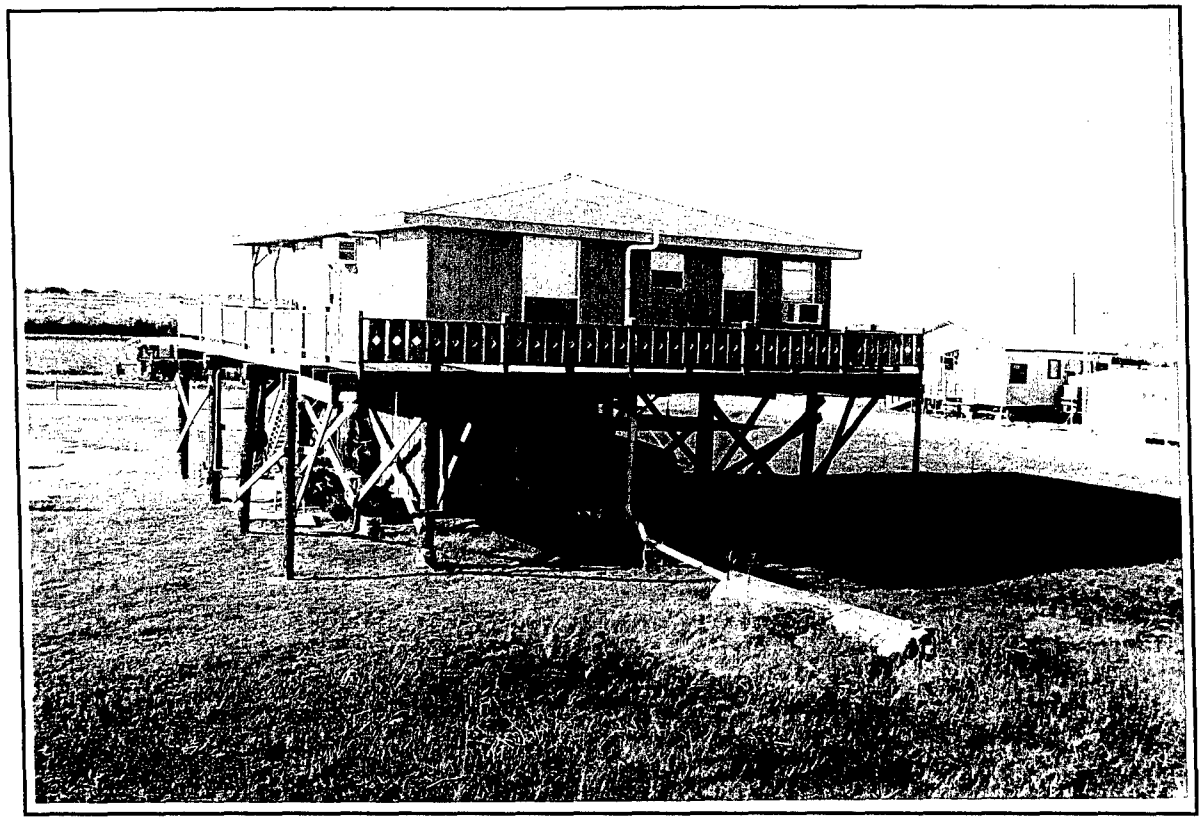


Figure 3-137. An example of a new raised camp on lower Bayou Terrebonne. Date: December 30, 1997.

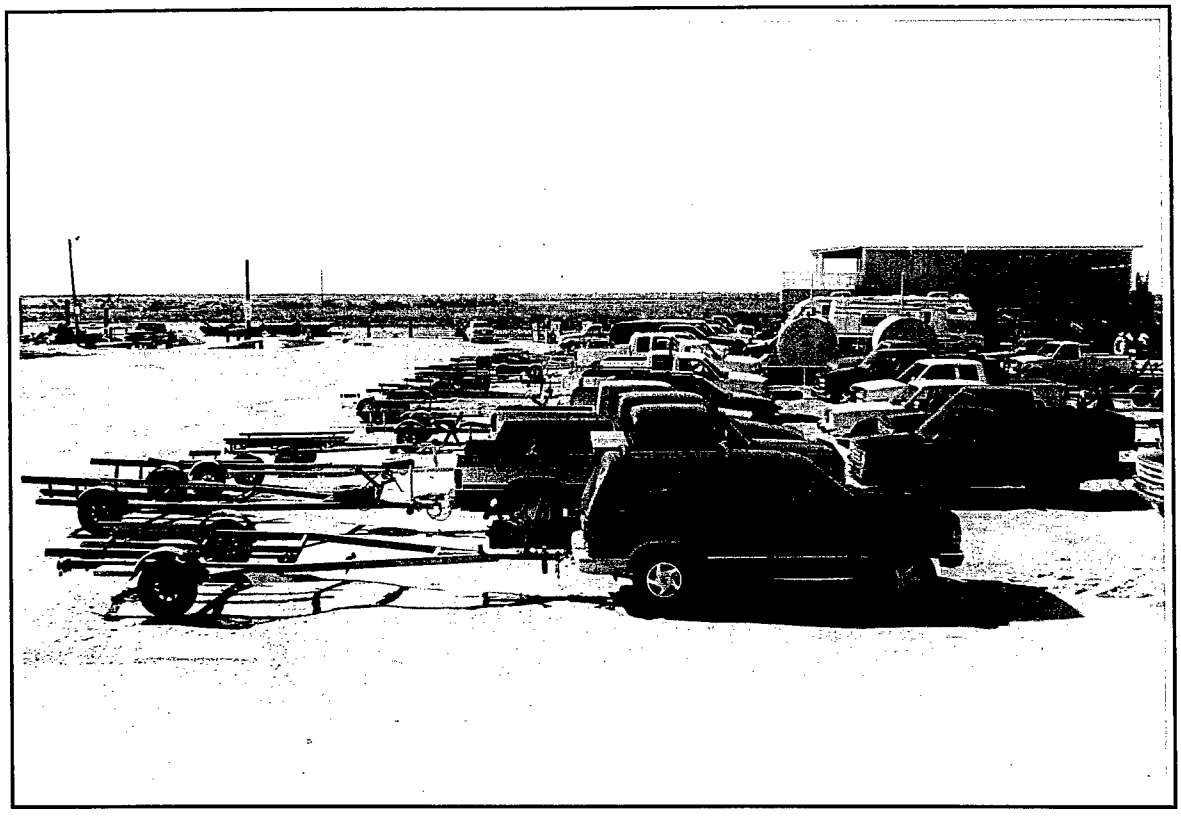


Figure 3-138. Nearly anytime of year south Louisiana's boat launches are full of cars, trucks and sport utility vehicles and their empty boat trailers, such as this site at the Pointe au Chien Marina. Date: December 30, 1997.

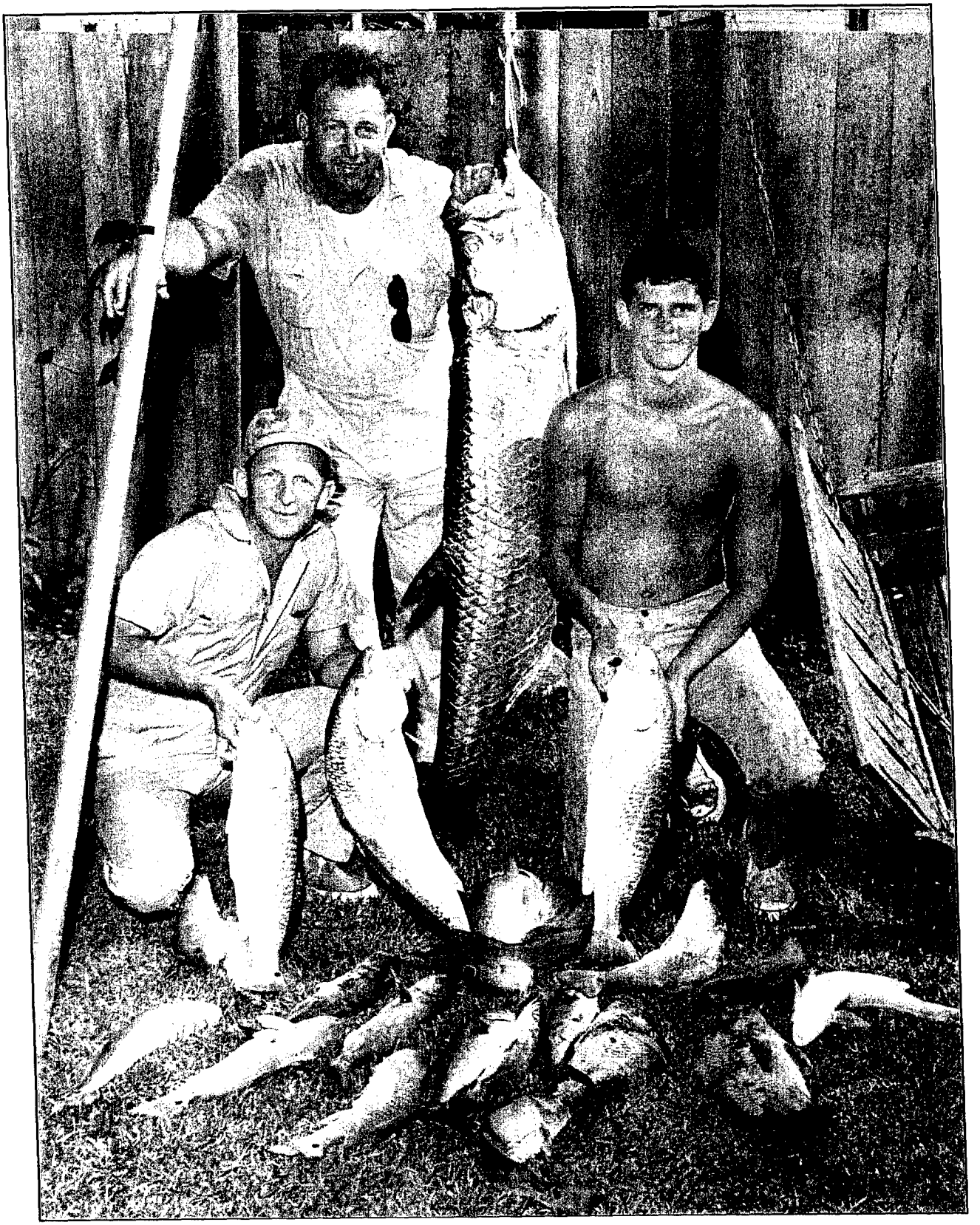


Figure 3-139. Louisiana's oyster reefs serve as important fisheries habitats, as witnessed by the variety of game fish caught in 1968 at Outside Reef (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).

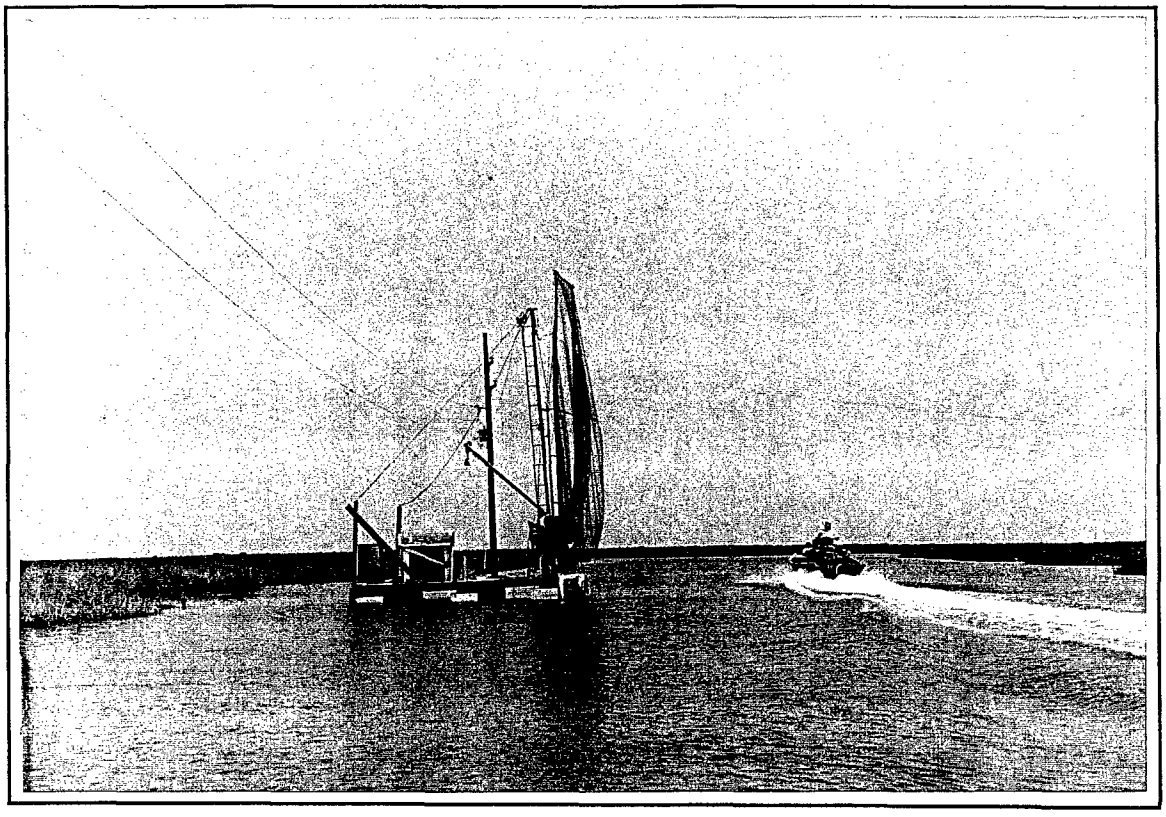


Figure 3-140. A *poupier* mounted on a floating platform near lower Bayou Lafourche in Lafourche Parish. Date: August 30, 1997.

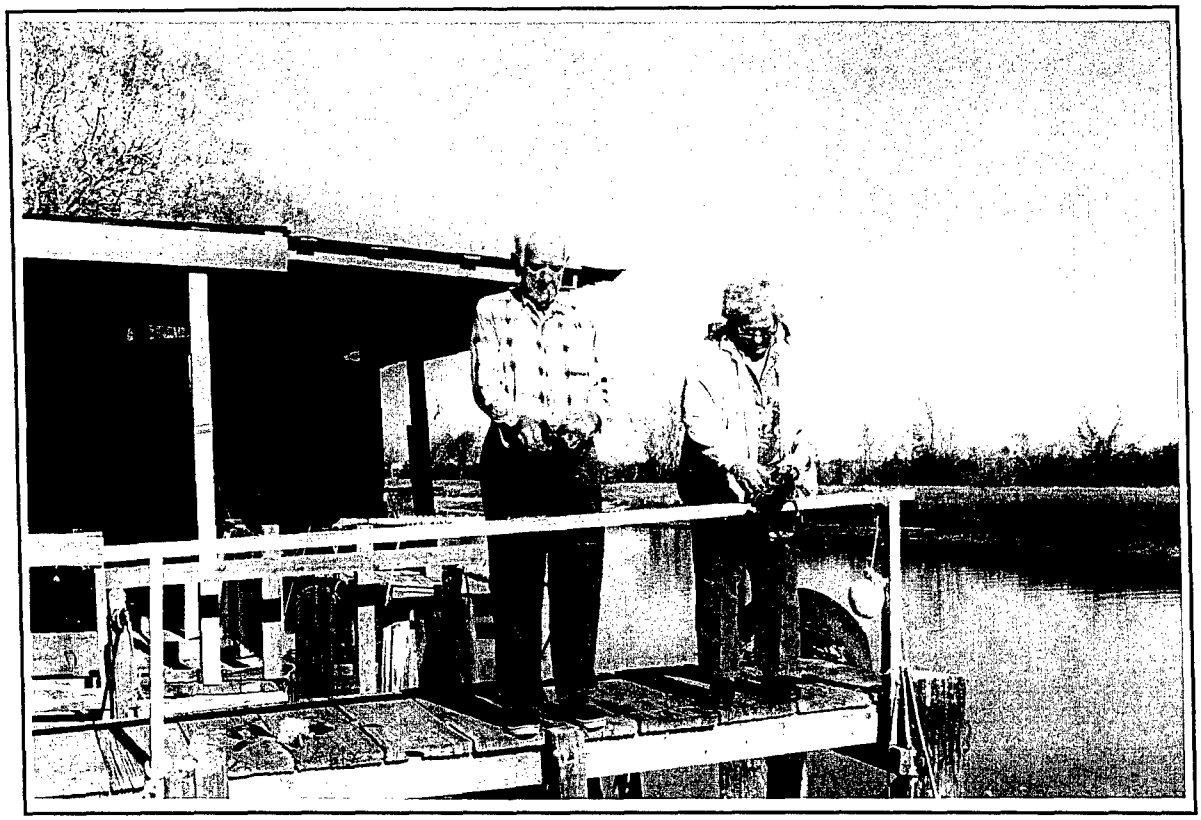


Figure 3-141. Cleaning ducks at Guidry's Bait Shop along Bayou Pointe au Chien. Date: December 30, 1997.



Figure 3-142. This "We clean ducks" sign is unique to south Louisiana and indicates the importance and size of the region's duck hunting harvest. Date: December 9, 1997.

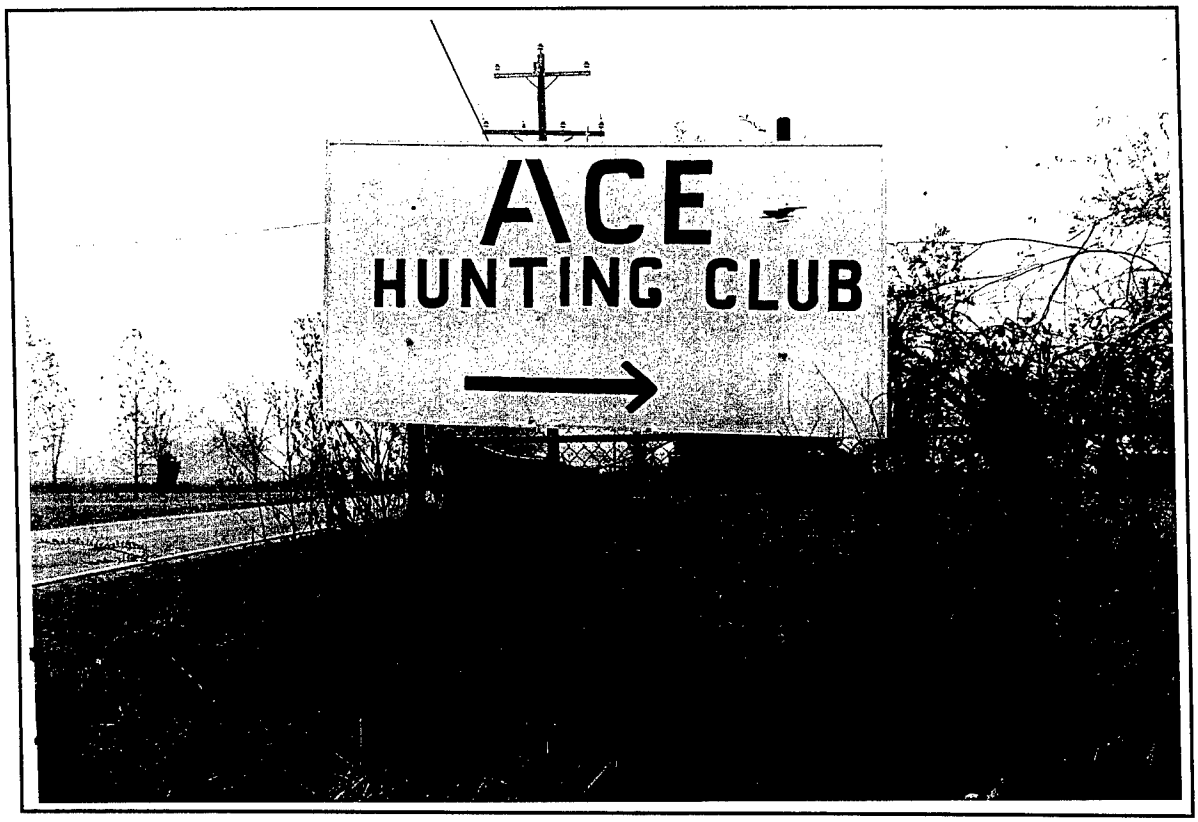


Figure 3-143. Hunting clubs are an important part of the hunting culture of south Louisiana. Date: December 9, 1997.

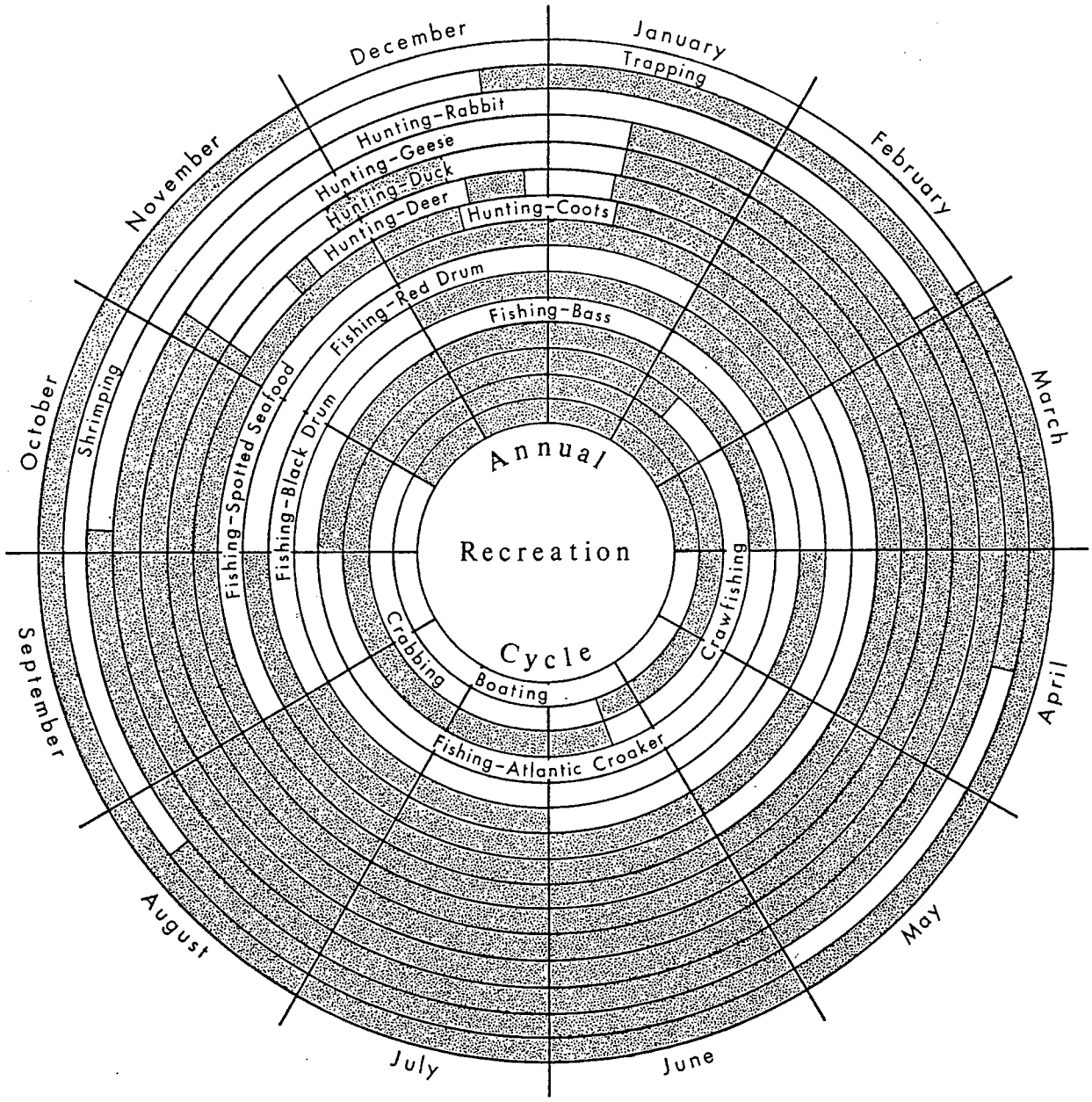


Figure 3-144. Annual recreational cycle based on the period of greatest activity (source: Davis and Detro 1975:95).

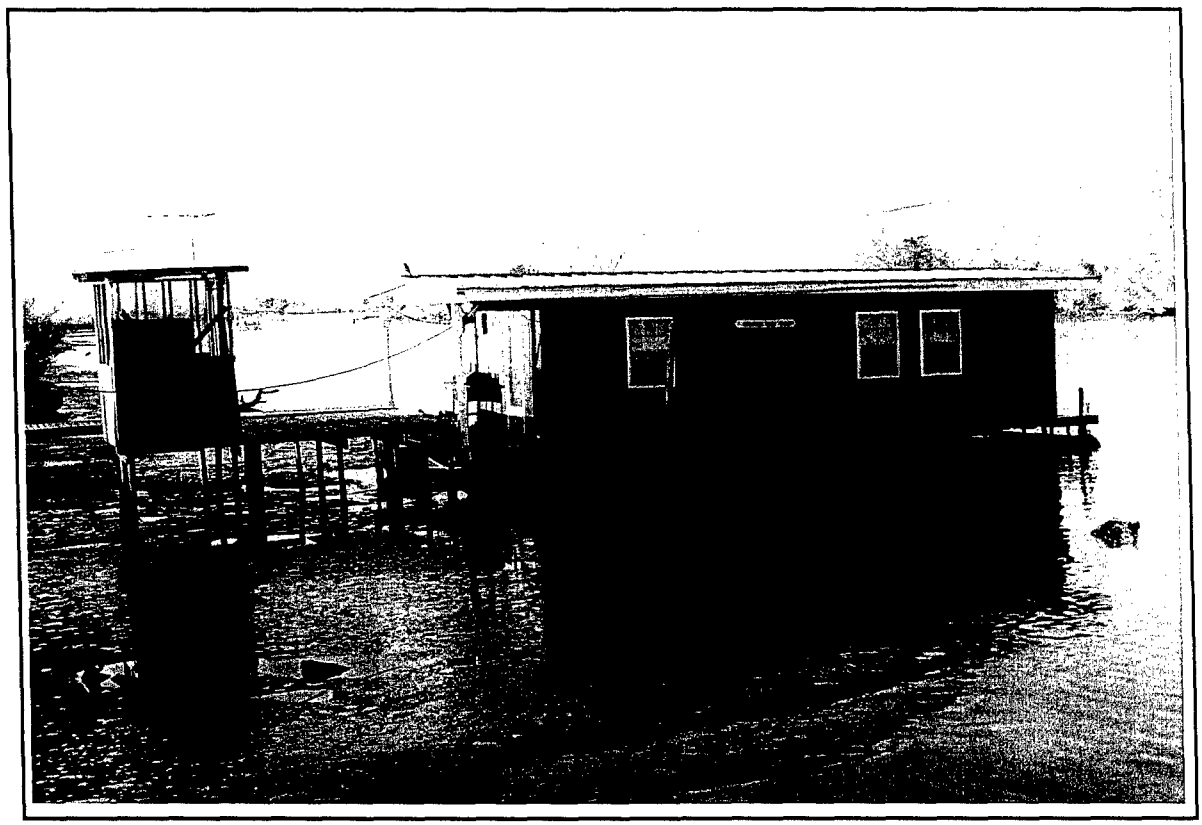


Figure 3-145. An example of a small floating camp along lower Bayou du Large. Floating camps can be towed to hunting leases or productive fishing areas. Date: December 31, 1997.

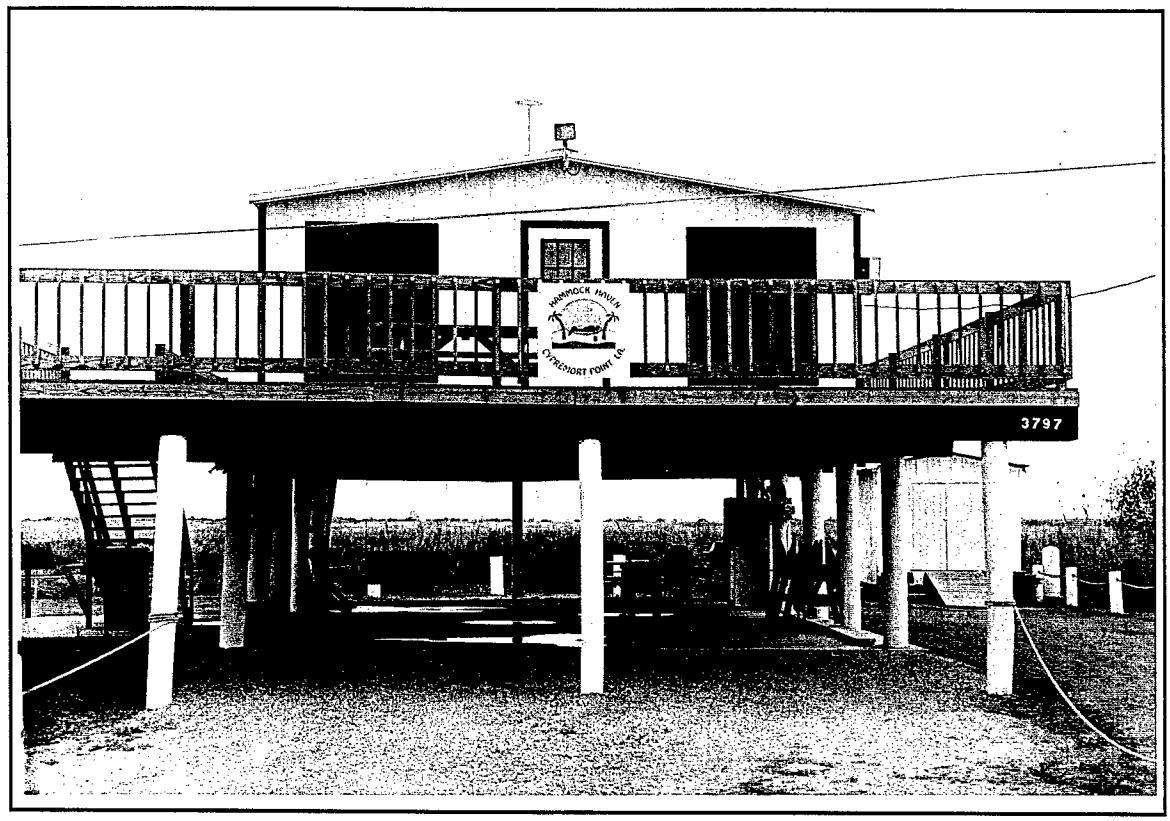


Figure 3-146. Originally, most of south Louisiana's camps (seasonally occupied recreational dwellings) were built on the ground. However, experience and new lending regulations now make it prudent to build above the marsh surface. Date: December 10, 1997.

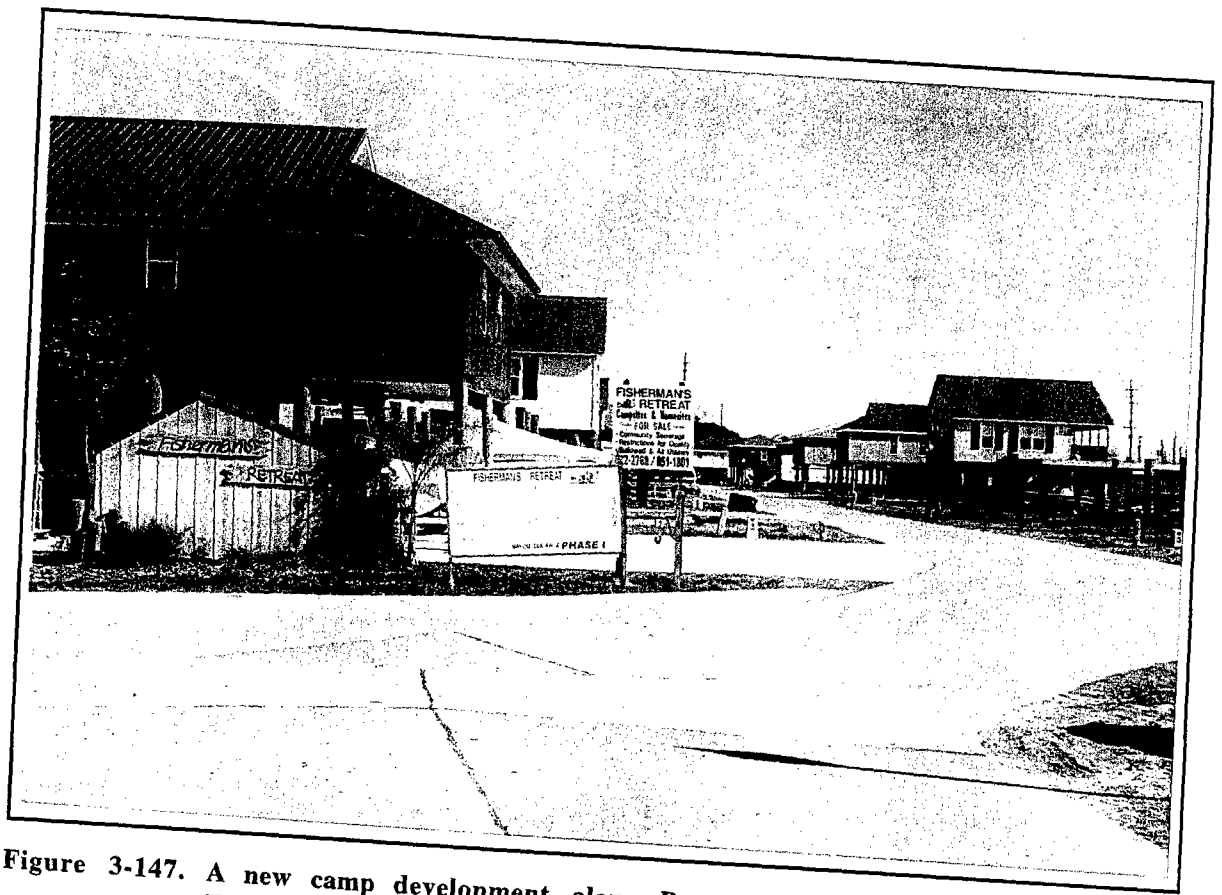


Figure 3-147. A new camp development along Bayou du Large at Falgout Canal in Terrebonne Parish. Like an urban subdivision, all utilities at this site are underground. Date: December 31, 1997.

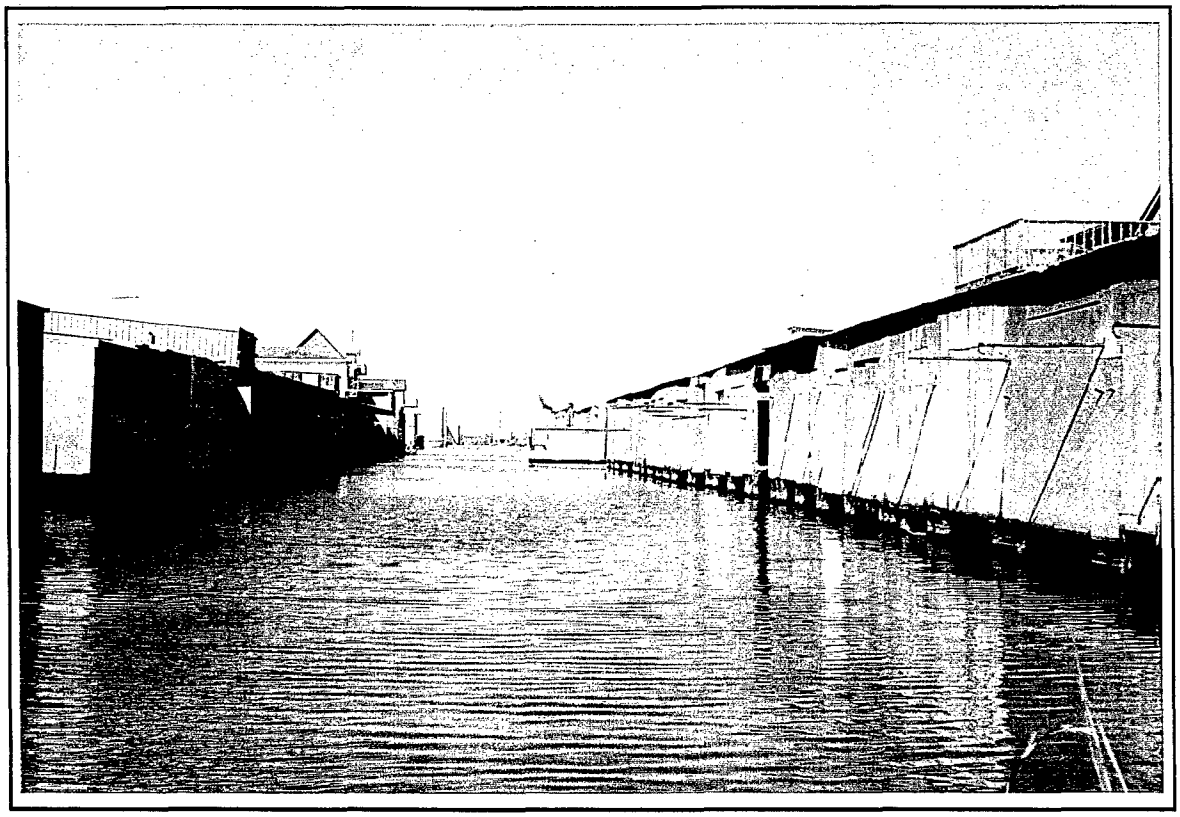


Figure 3-148. A double row of boat sheds used by sportsmen and commercial businesses to store their boats at a marina along Bayou du Large in Terrebonne Parish. Date: December 31, 1997.



Figure 3-149. Some marinas build multipurpose boat storage/accommodations to meet the needs of their customers. At this site along Bayou Petit Caillou, boats are stored below the rental room. Date: December 18, 1997.

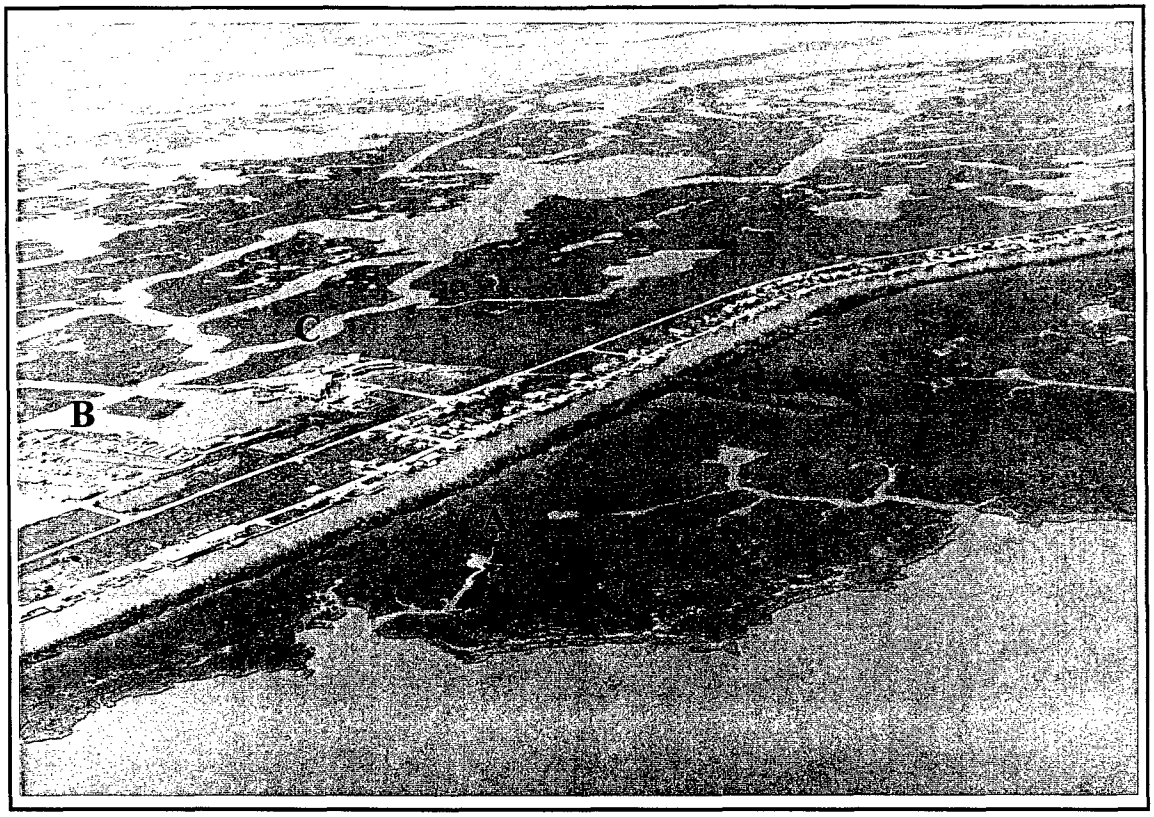


Figure 3-150. **The narrow natural levee associated with the lower reach of Bayou Petit Caillou in Terrebonne Parish is shown, with the undeveloped east bank of the bayou (A), a large marina (B), and the headquarters of the laboratory of the Louisiana Universities Marine Consortium (C) clearly visible. Date: March 11, 1998.**



Figure 3-151. A dense cluster of camps has developed along Bayou Decade in an area accessible only by boat. Date: March 11, 1998.

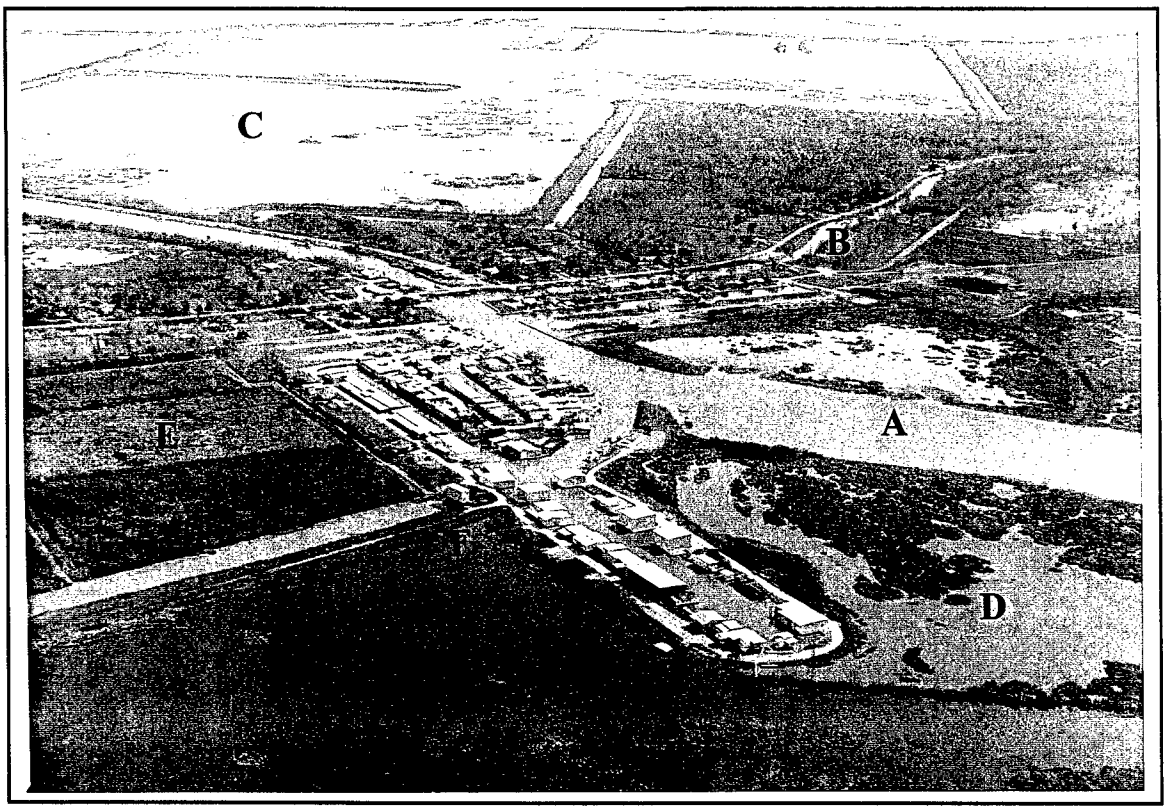


Figure 3-152. This aerial view is centered on Falgout Canal where it intersects Bayou du Large. The canal (A), bayou (B), subsiding/eroding marsh (C & D), area under pump drainage (E), and a drainage pump (F) represent elements found on almost any bayou in south Louisiana. Date: March 11, 1998.

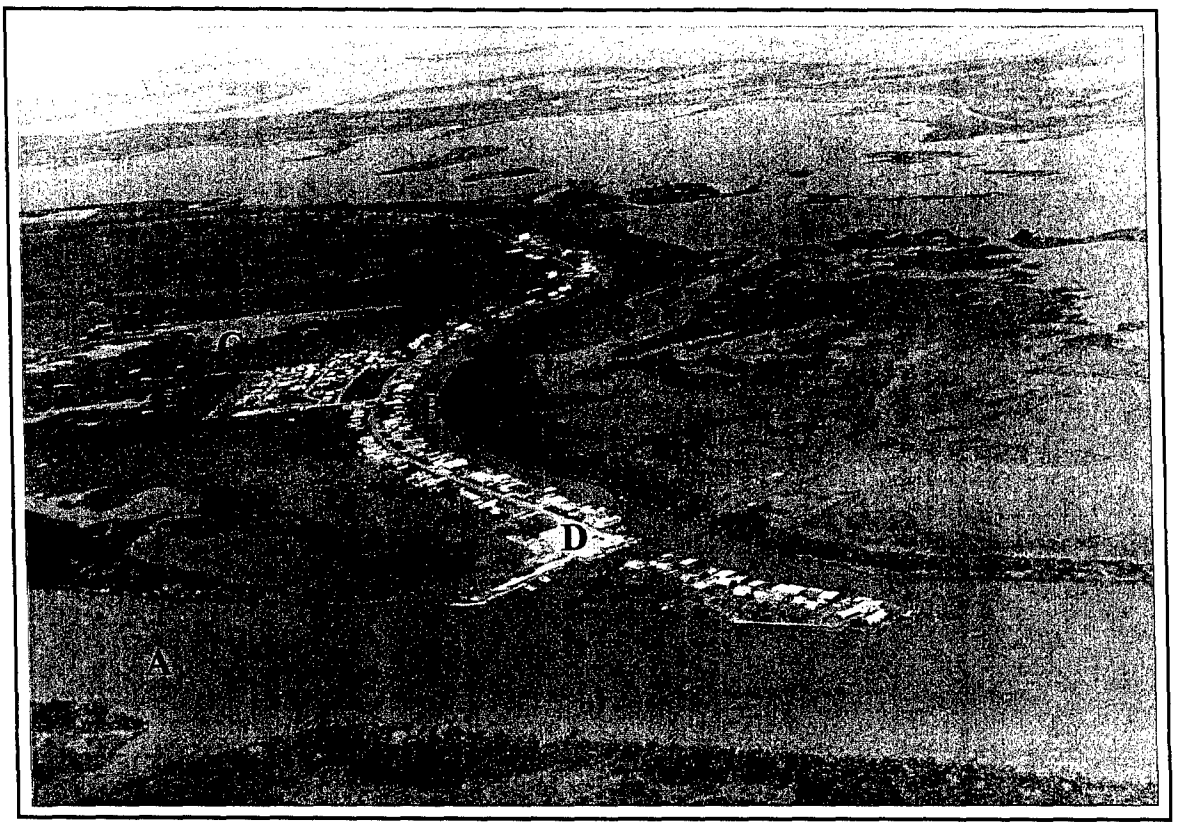


Figure 3-153. Aerial view of the intersection of the Houma Navigation Canal (A) and Four Point Bayou (B) in Terrebonne Parish, with a marina (C) and boat landing (D) shown as well. Date: March 11, 1998.

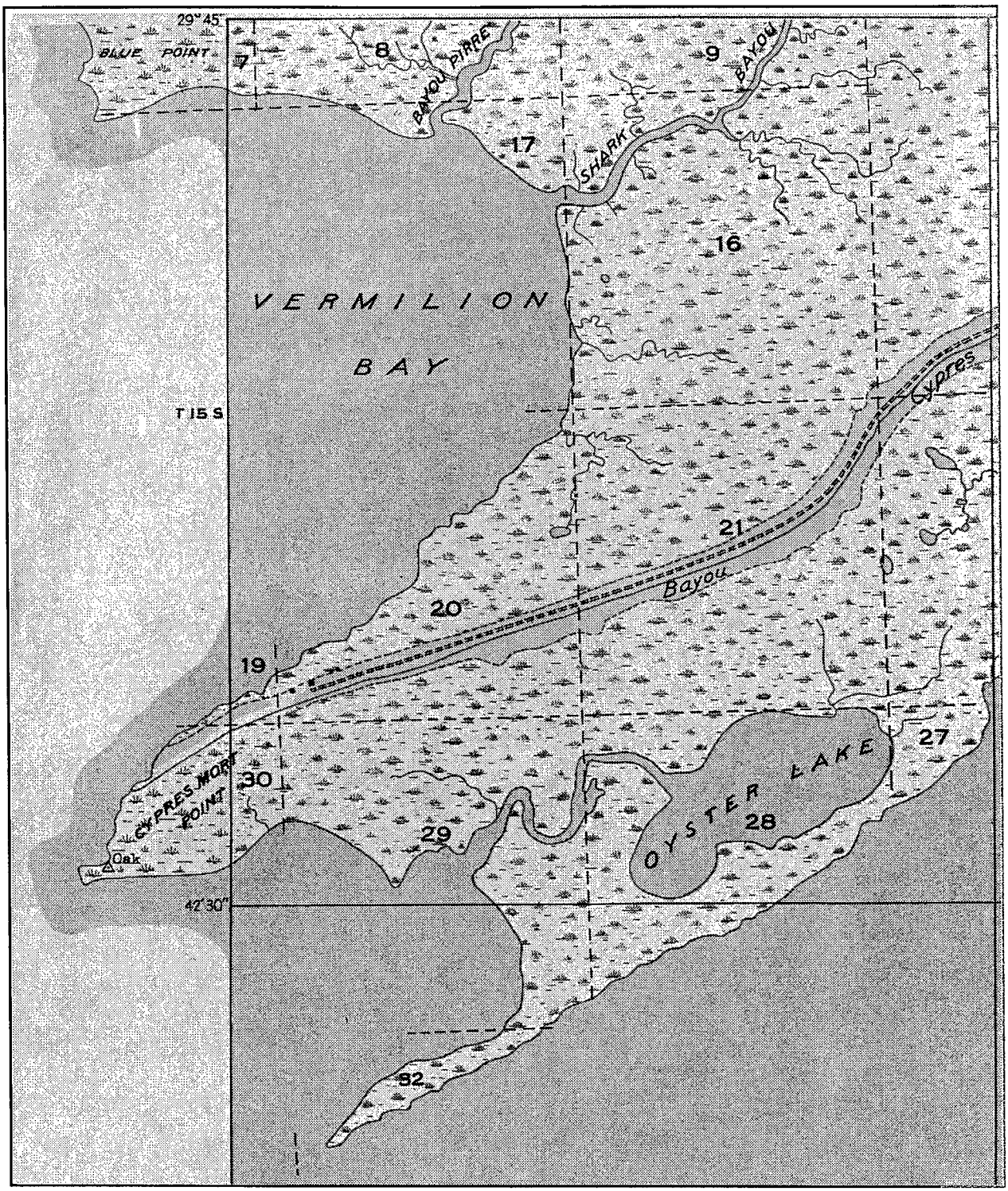


Figure 3-154. Map of Cypremort Point, St. Mary Parish in 1932 (source: USGS Cypres Mort Point, Louisiana, 7.5-minute quadrangle).

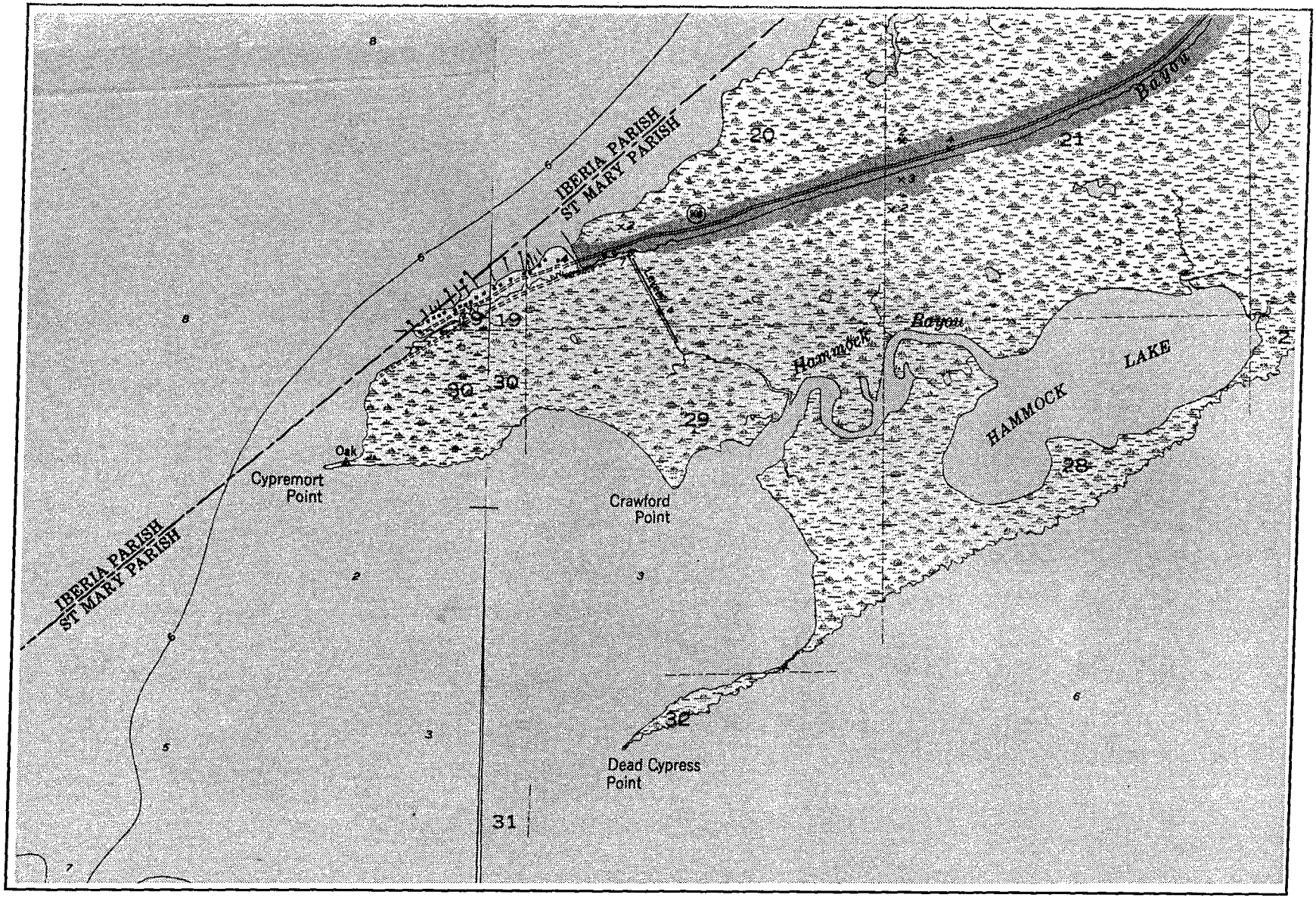


Figure 3-155. Map of Cypremort Point, St. Mary Parish, showing camp locations in 1948 (source: USGS Hammock Lake, Louisiana, and Cypremort Point, Louisiana, 7.5-minute quadrangles).

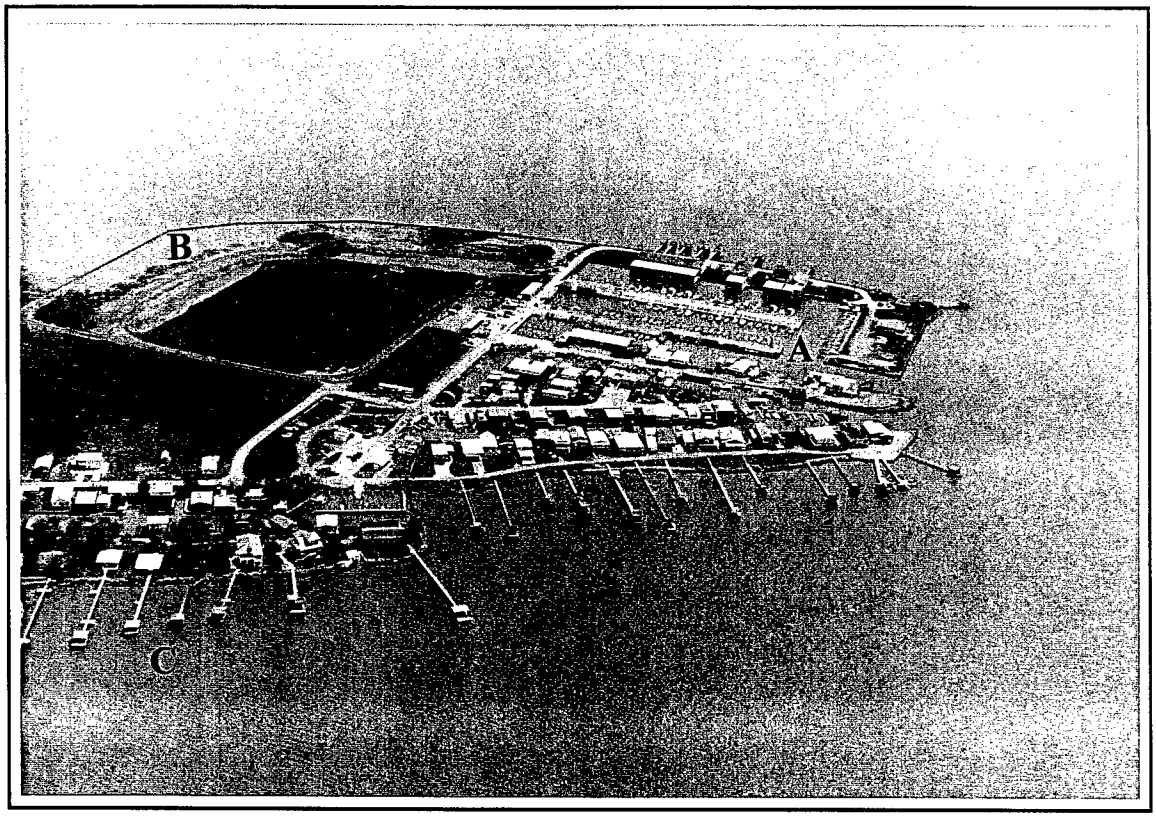


Figure 3-156. Aerial view of the recreation and commercial complex that has developed at Cypremort Point in St. Mary Parish. Note the location of the marina (A), the new development (B), and the long fishing piers tied to camps facing Vermilion Bay (C). Date: March 11, 1998.

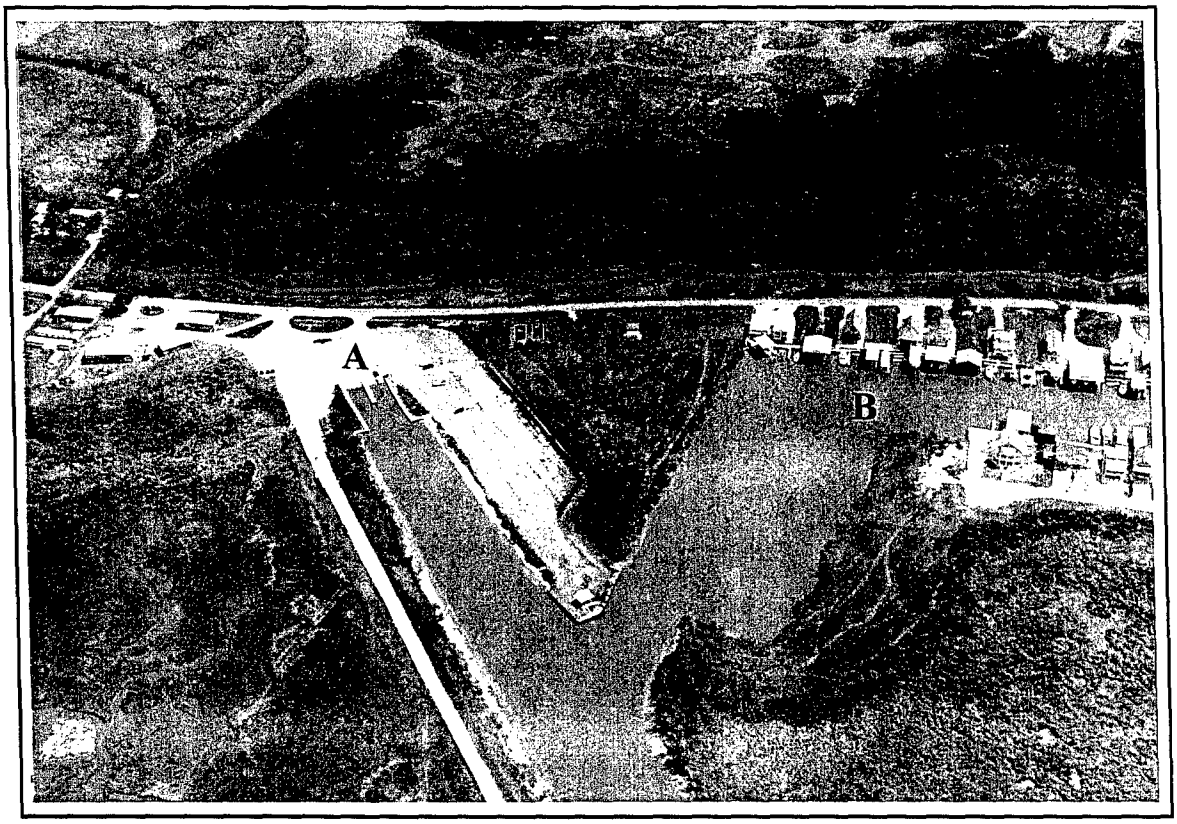


Figure 3-157. **The Cypremort Point State Park boat landing (A) and new camp development (B) extend out into marsh flanking Bayou Cypremort (C). Date: March 11, 1998.**



Figure 3-158. This sign, on the Bayou Sale road in St. Mary Parish, is an indicator of one oil company's history, as shown by the change in operating names. Date: December 11, 1997.

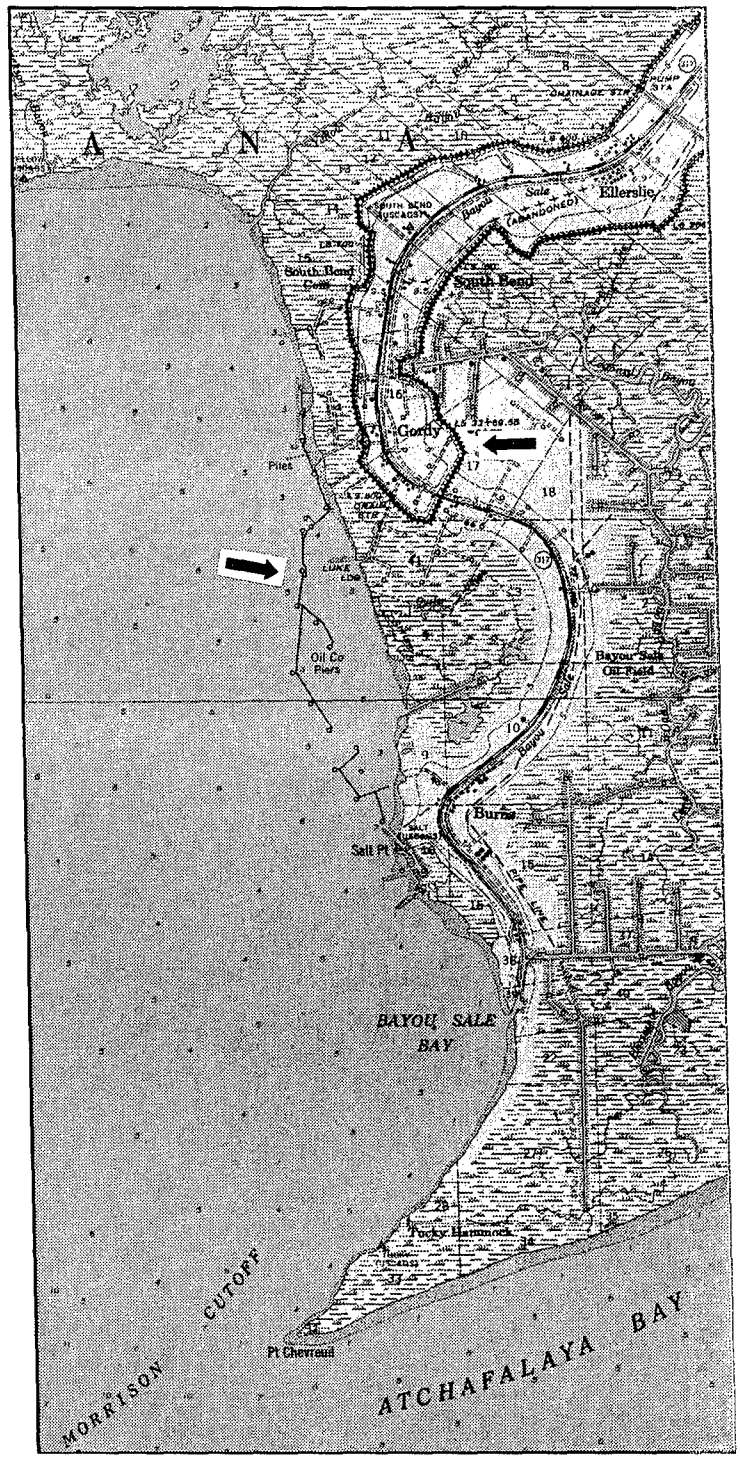


Figure 3-159. **Map of lower Bayou Sale, St. Mary Parish in 1957. Note the offshore structures connected to oil well locations and the levee that extends south just below the Gordy. The community of Ellerslie is a small oil and gas "boom town" (source: USGS Bayou Sale, Louisiana, 15-minute quadrangle).**

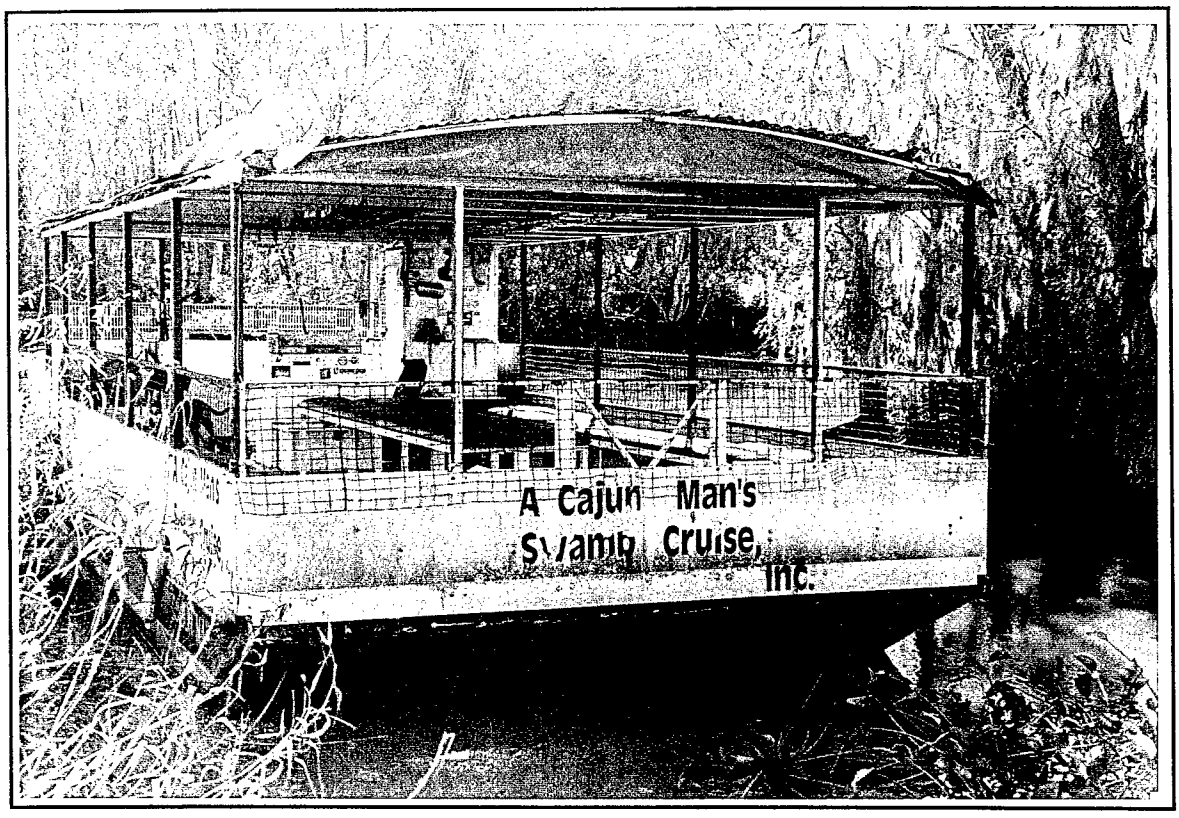


Figure 3-160. Ecotourism supports a number of local entrepreneurs, such as this tour on Bayou Black west of Houma. Date: December 31, 1997.

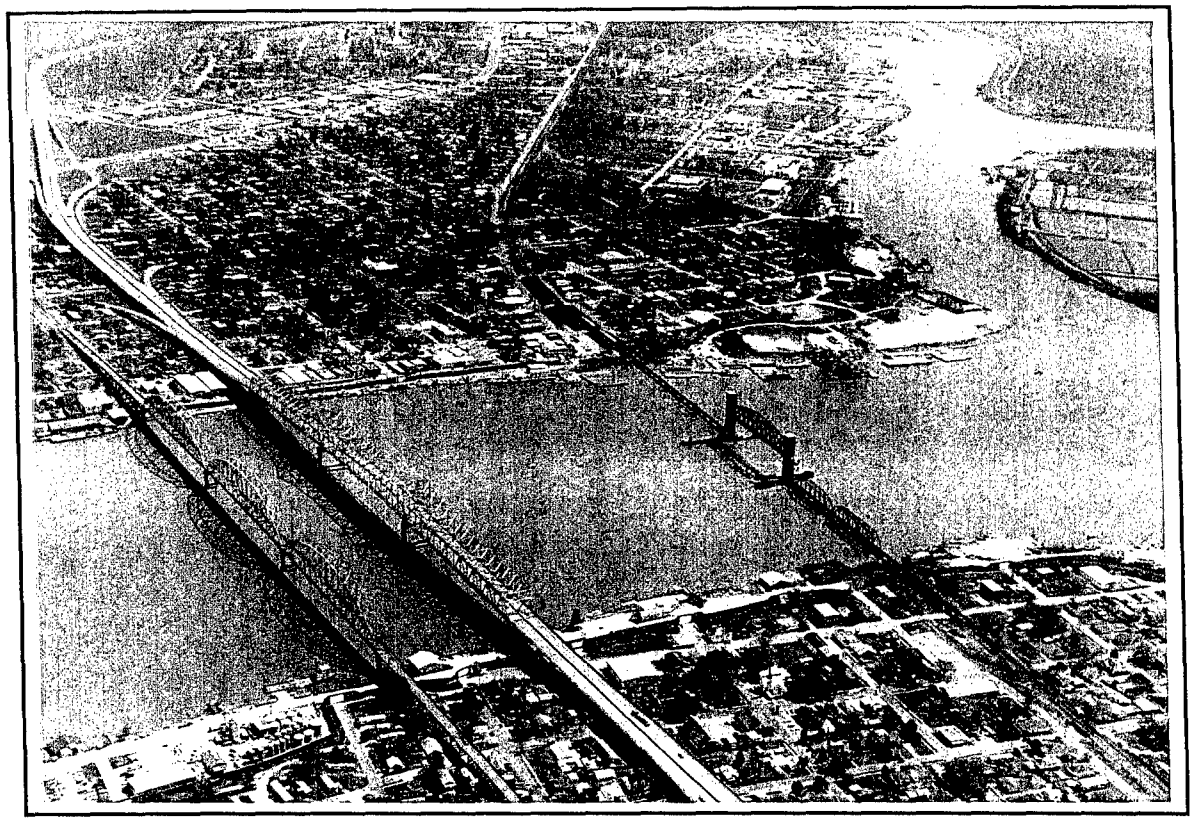


Figure 3-161. Aerial view of the Atchafalaya River at Morgan City and the three bridges that cross the river at this point. Date: March 11, 1998.

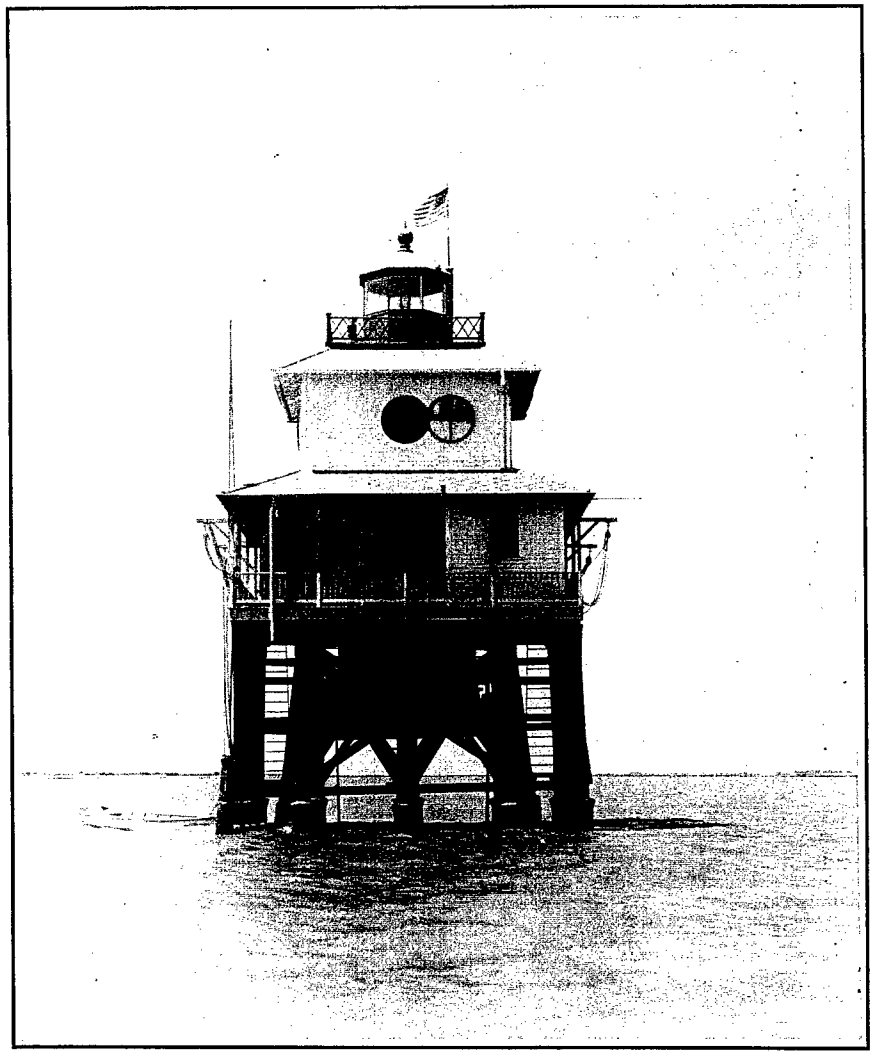


Figure 3-162. Point-Au-Fer lighthouse was located at the mouth of Atchafalaya Bay. Between 1916 and 1945 it helped to guide boats following the navigation channel through the Point au Fer oyster reefs. Between 1945 and 1976 it served as a rescue station for the U.S. Coast Guard (source: National Archives, Negative No. 26-S-686. Date: ca. 1945).

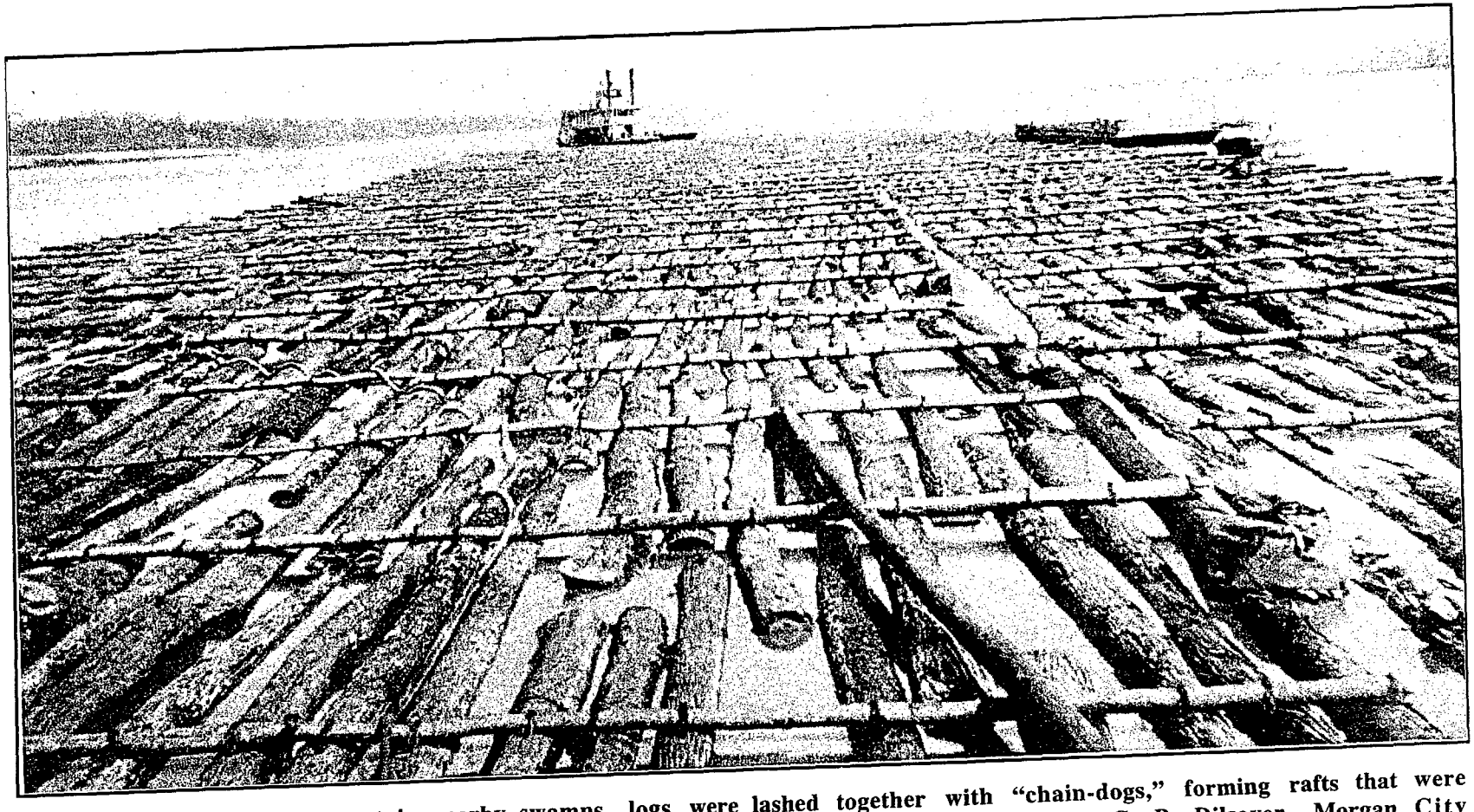


Figure 3-163. After being cut in nearby swamps, logs were lashed together with "chain-dogs," forming rafts that were then pulled by a steamboat to lumber mills for processing (source: Mrs. C. B. Dilsaver, Morgan City Library Historic Archives).



Figure 3-164. A portion of the Magnolia Petroleum Company's (now Mobile) offshore operation at Block 126. (Image No. 451-15 from the Jessie Grace Collection, no date, Morgan City Library Historic Archives).

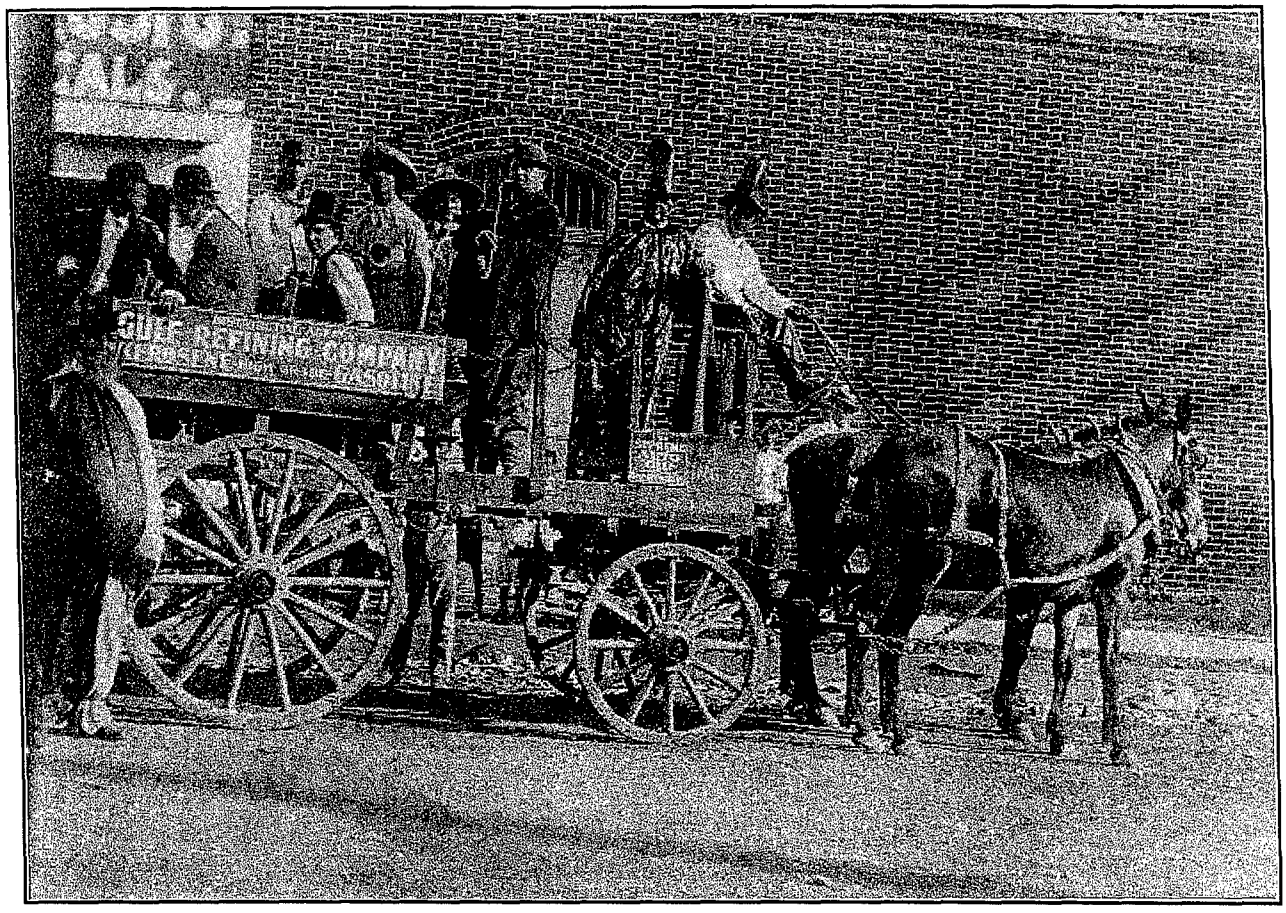


Figure 3-165. This Gulf Refining Company "float" was part of an early 1900s Mardi Gras parade (source: Morgan City Library Historic Archives).

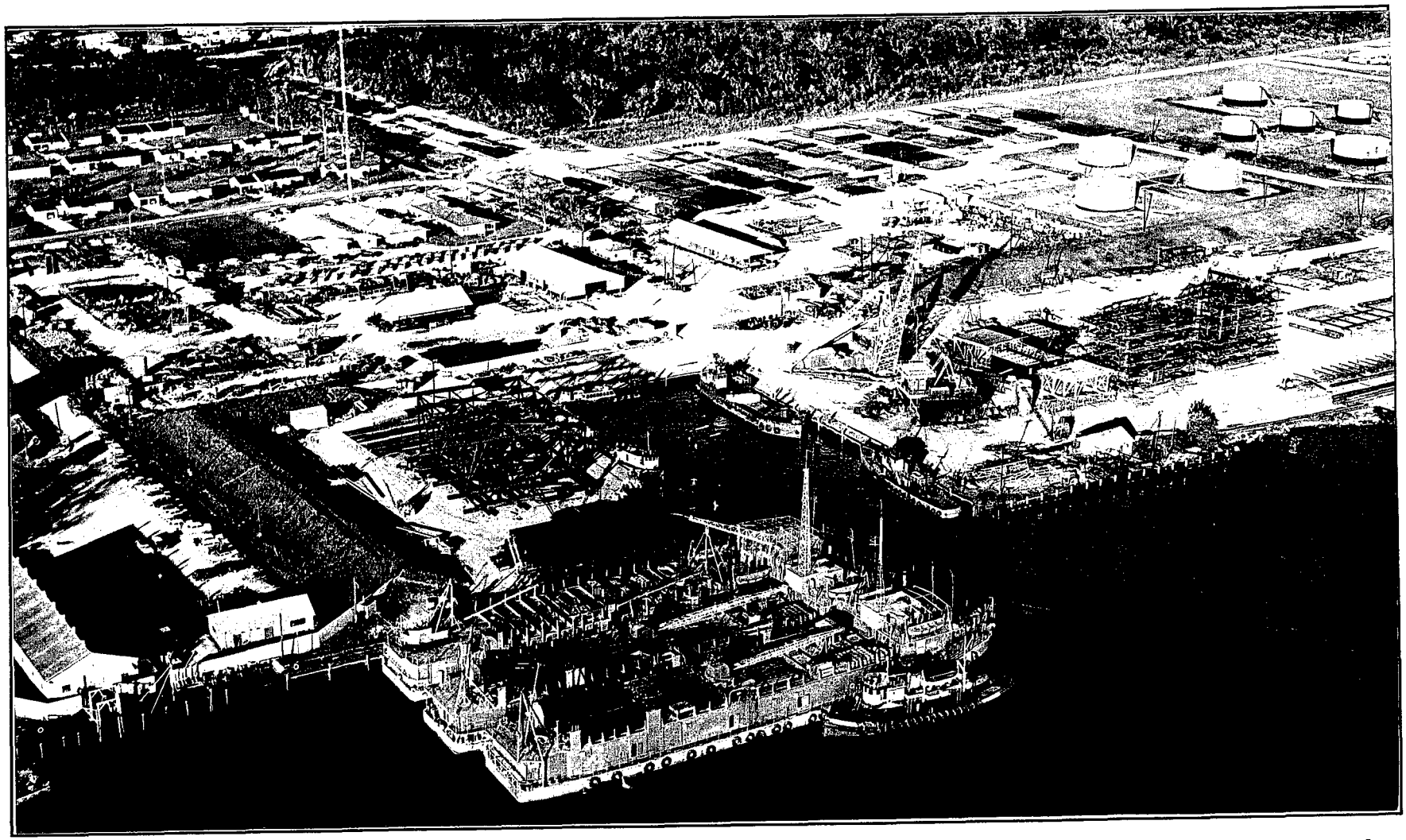


Figure 3-166. This photograph of the Magnolia Petroleum Company's (now Mobil) support center in Morgan City was taken less than 10 years after establishment of the world's first offshore oil well. The company housing complex in the upper left corner of the photograph, the flotilla of vessels required, and the size of the levee built by the company in conjunction with the city's seawall are further signs of the Company's commitment to the offshore oil province (source: Morgan City Library Historic Archives, Jessie Grace Collection, Image No. 373, 10/15/56).

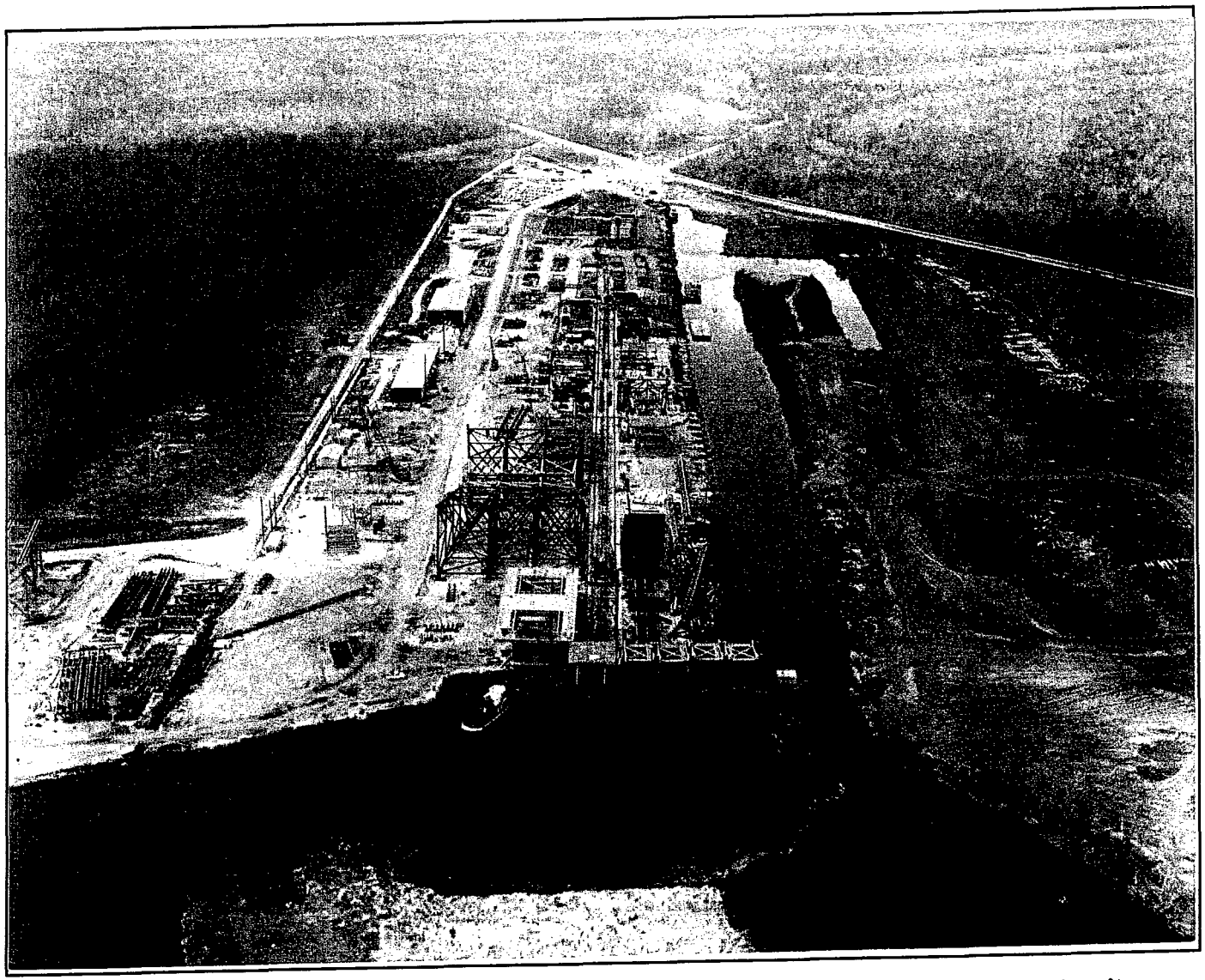


Figure 3-167. As the offshore industry matured, steel fabrication facilities, such as this site near Amelia, in St. Mary Parish, were expanding to meet their long and short term contractual obligations (source: Morgan City Library Historic Archives, Jessie Grace Collection, Image No. 7020, 10/29/64).



Figure 3-168. These Large drilling and exploration platforms being constructed at facilities along Bayou Black in Amelia, Louisiana are part of the economics of the offshore industry (source: Morgan City Library Historic Archives, Jessie Grace Collection, Image No. 9154, 9/21/67).



Figure 3-169. South Louisiana is a labyrinth of pipelines, such as this gas line crossing at the Charenton Navigation and Drainage Canal near Baldwin in St. Mary Parish. Date: December 11, 1997.

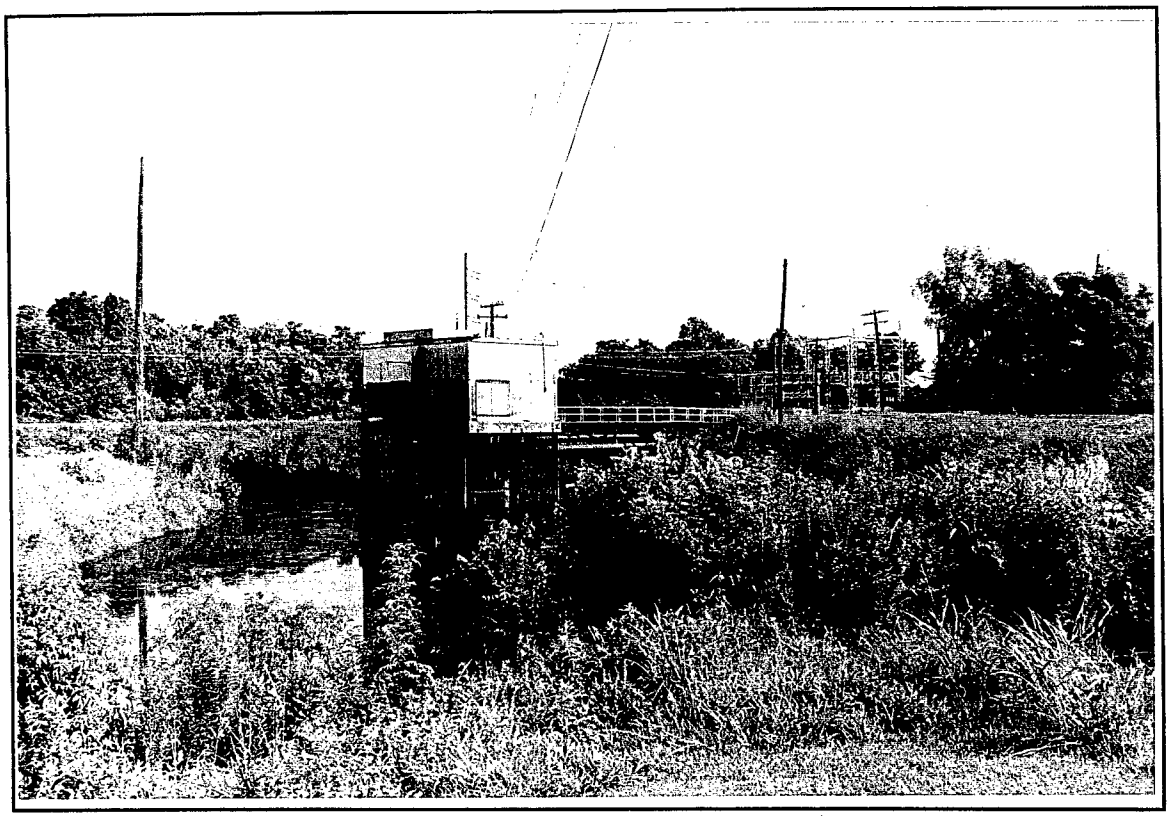


Figure 3-170. In order to live in parts of south Louisiana it is necessary to improve drainage with a system of pumps. This drainage pump along Highway 70 in Morgan City is one example. Date: July 15, 1997.

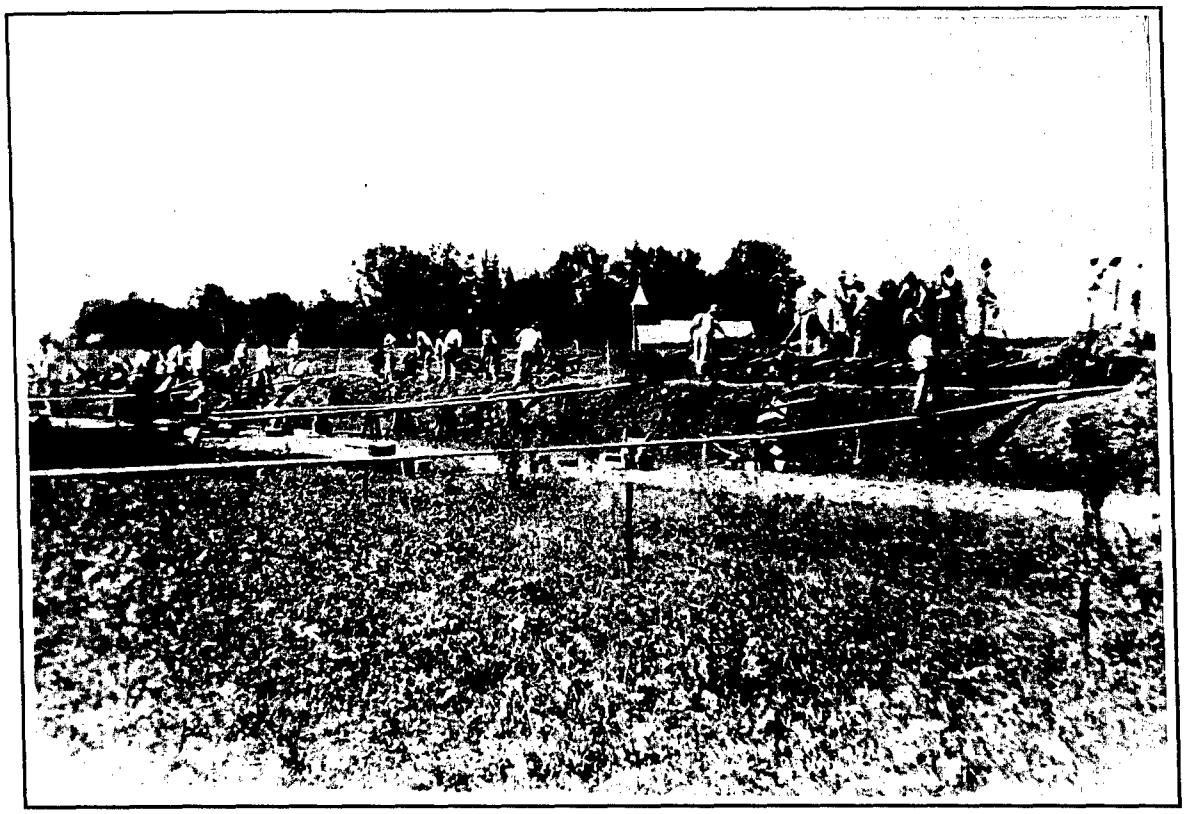


Figure 4-1. Shoal in Little Pass Timbalier between Timbalier Island and East Timbalier Island. Note waves breaking across underwater barrier ridge. Date: April 16, 1993.

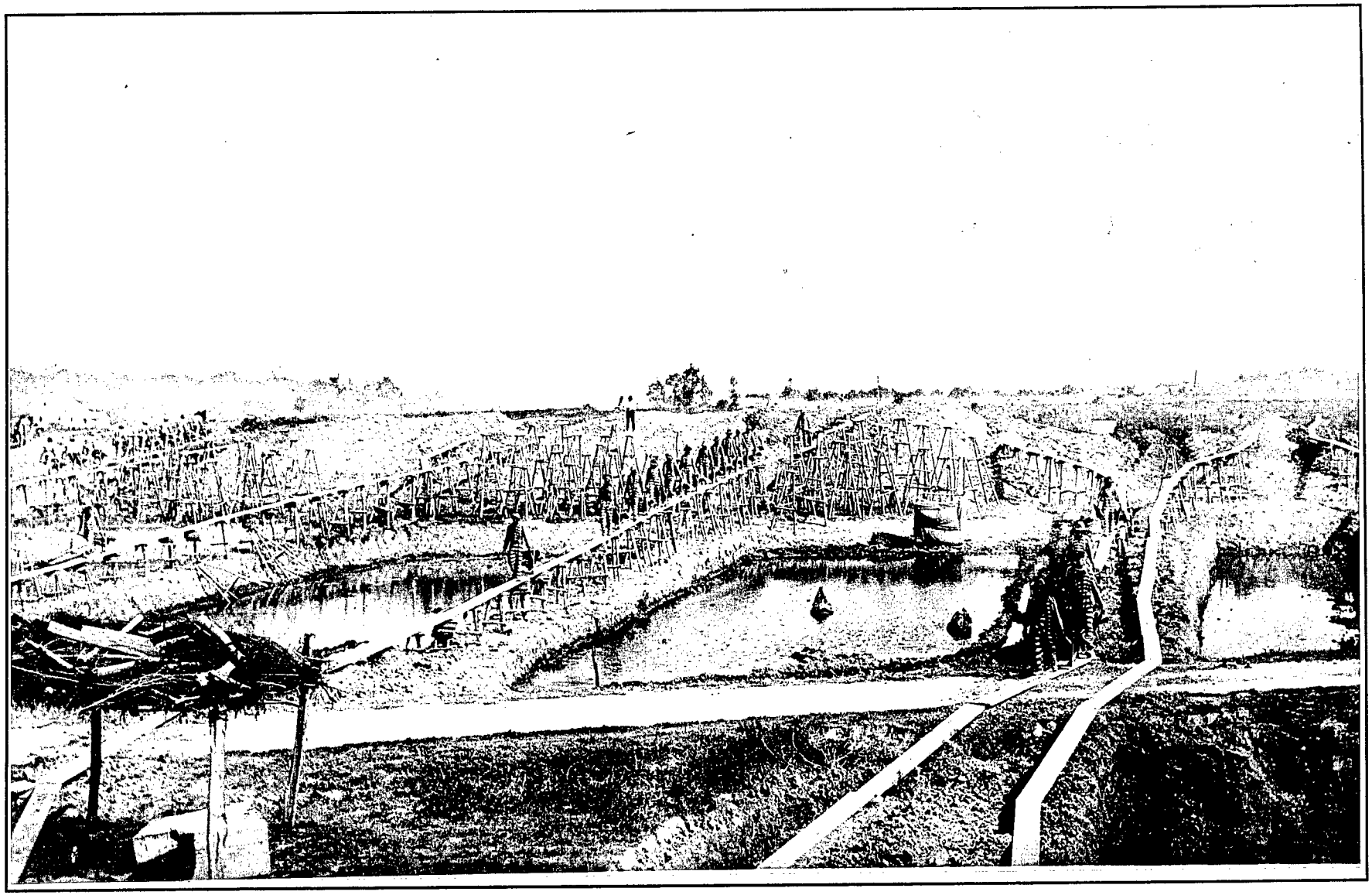


Figure 4-2. Using convict labor and scaffolding-supported ramps the Morganza Crevasse was closed. Date: ca. 1893 (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 8278-1).



Figure 4-3. Repairing a levee during the flood of 1927. May 21, 1927. (From New Orleans District, U.S. Army Corps of Engineers, Image No. 14243-9).

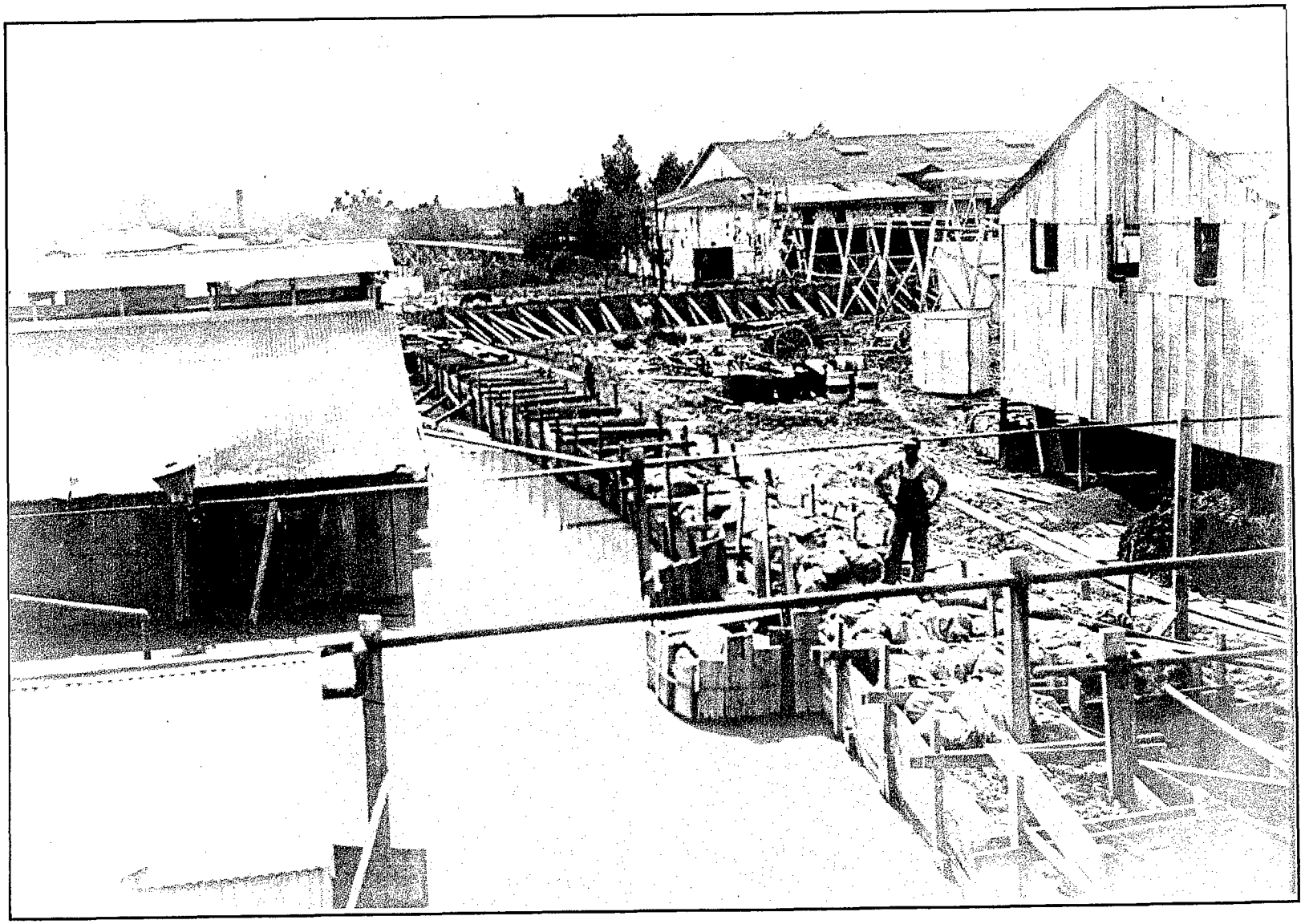


Figure 4-4. Although waters from the 1927 flood inundated a large portion of Morgan City, the Norman-Breaux Lumber Company's ring levee clearly protected the property from flooding (source: Mrs. C. B. Dilsaver, Morgan City Library Historic Archives).



Figure 4-5. When unusually high water occurred in 1973, 10 bays on the Morganza Control Structure were opened to relieve potential flooding problems down river (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 13635-5).

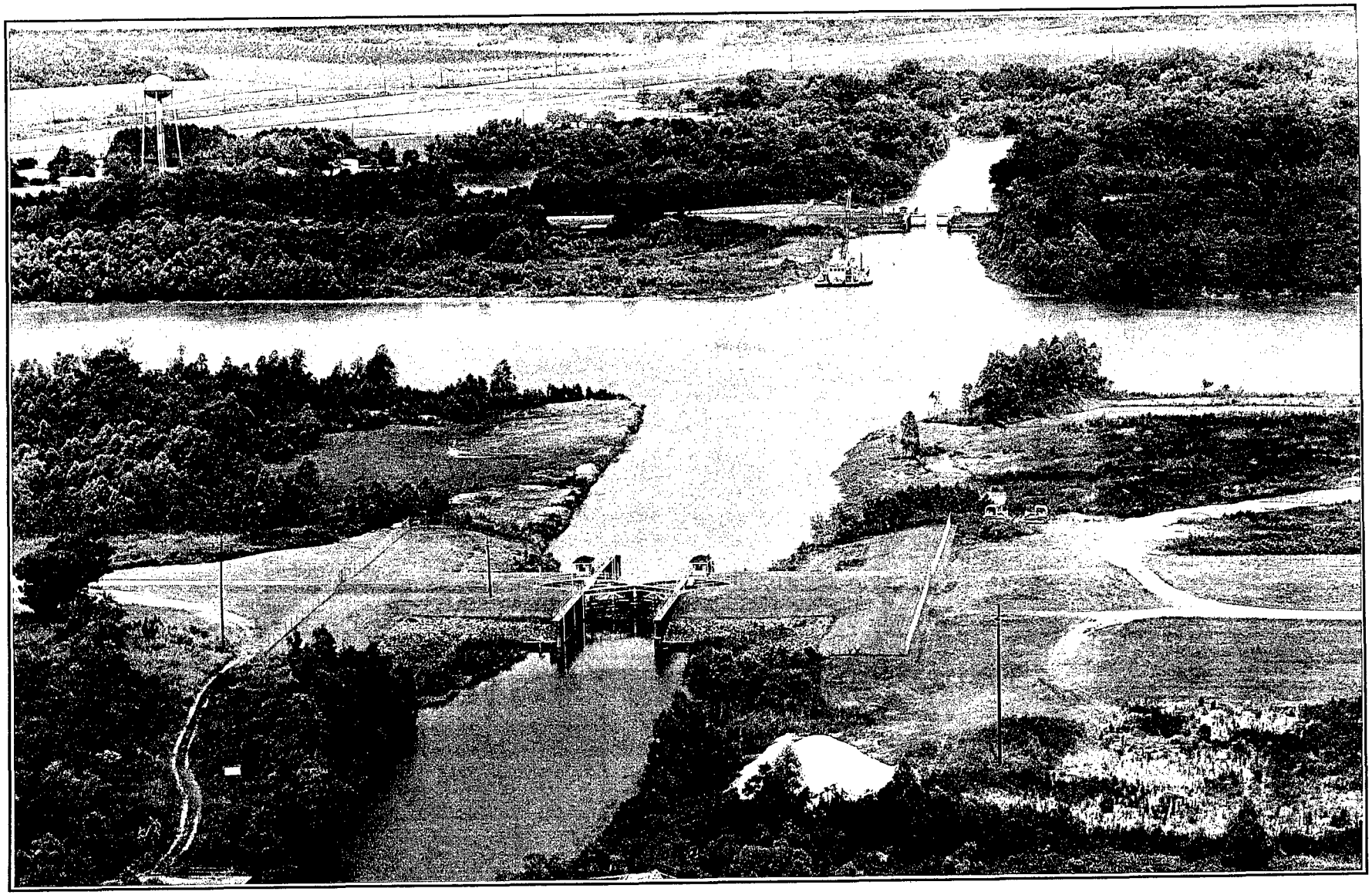


Figure 4-6. **Calumet floodgates were constructed to prevent high water on Wax Lake Outlet from entering Bayou Teche. The Wax Lake Outlet flows right to left in this photo. Date: June 26, 1980. (source: New Orleans District, U.S. Army Corps of Engineers).**



Figure 4-7. In 1988 the stone weir in this photo was constructed across Wax Lake Outlet. The weir was removed in 1995 (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 18873M-32).



Figure 4-8. During the high water period of 1973, the Morgan City flood wall protected much of the city. Those areas not protected were flooded. Date: April 22, 1973 (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 13576-8).

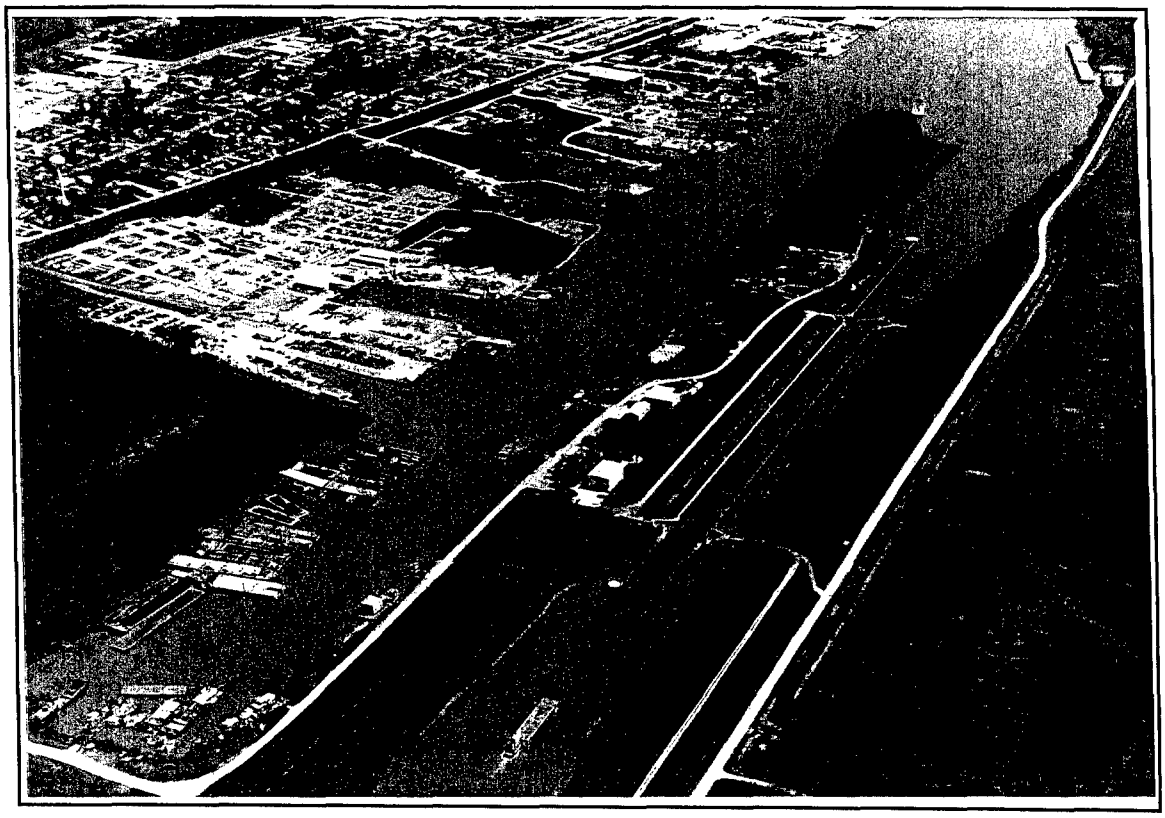


Figure 4-9. Aerial view of the Bayou Boeuf locks along the Gulf Intracoastal Waterway near Morgan City. Date: March 11, 1998.



Figure 4-10. This aerial view shows "The Jaws" facing south towards the Gulf in St. Mary Parish. This opening serves as a minor Gulf outlet for waters of the Atchafalaya River. Date: March 11, 1998.

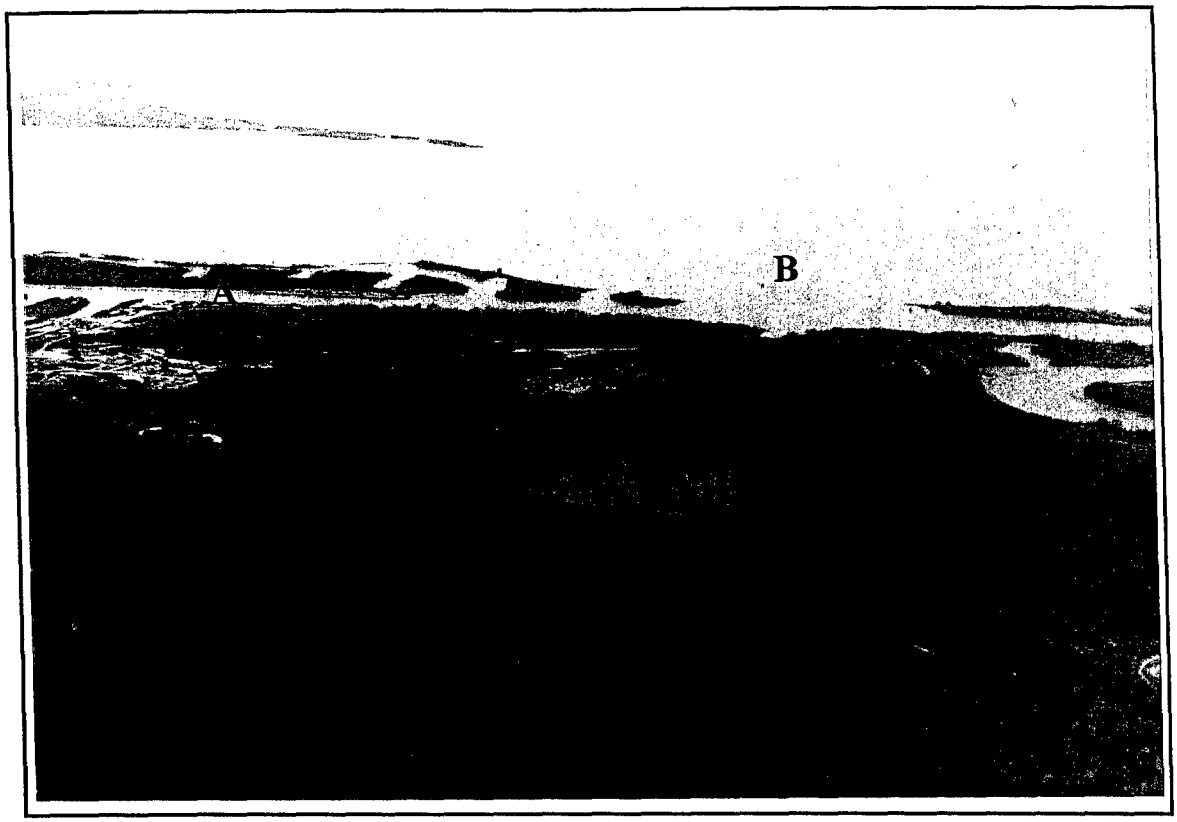


Figure 4-11. Near Weeks Island, erosion has created a breach between the Gulf Intracoastal Waterway (A) and Weeks Bay (B). Date: March 11, 1998.



Figure 4-12. The Corps of Engineers dredge Grosse Tete at work in south Louisiana (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 10762-10).



Figure 4-13. Aerial view of the lock on the Gulf Intracoastal Waterway near Intracoastal City, with a portion of the old Vermilion Lock visible in the lower right corner. Date: March 11, 1998.

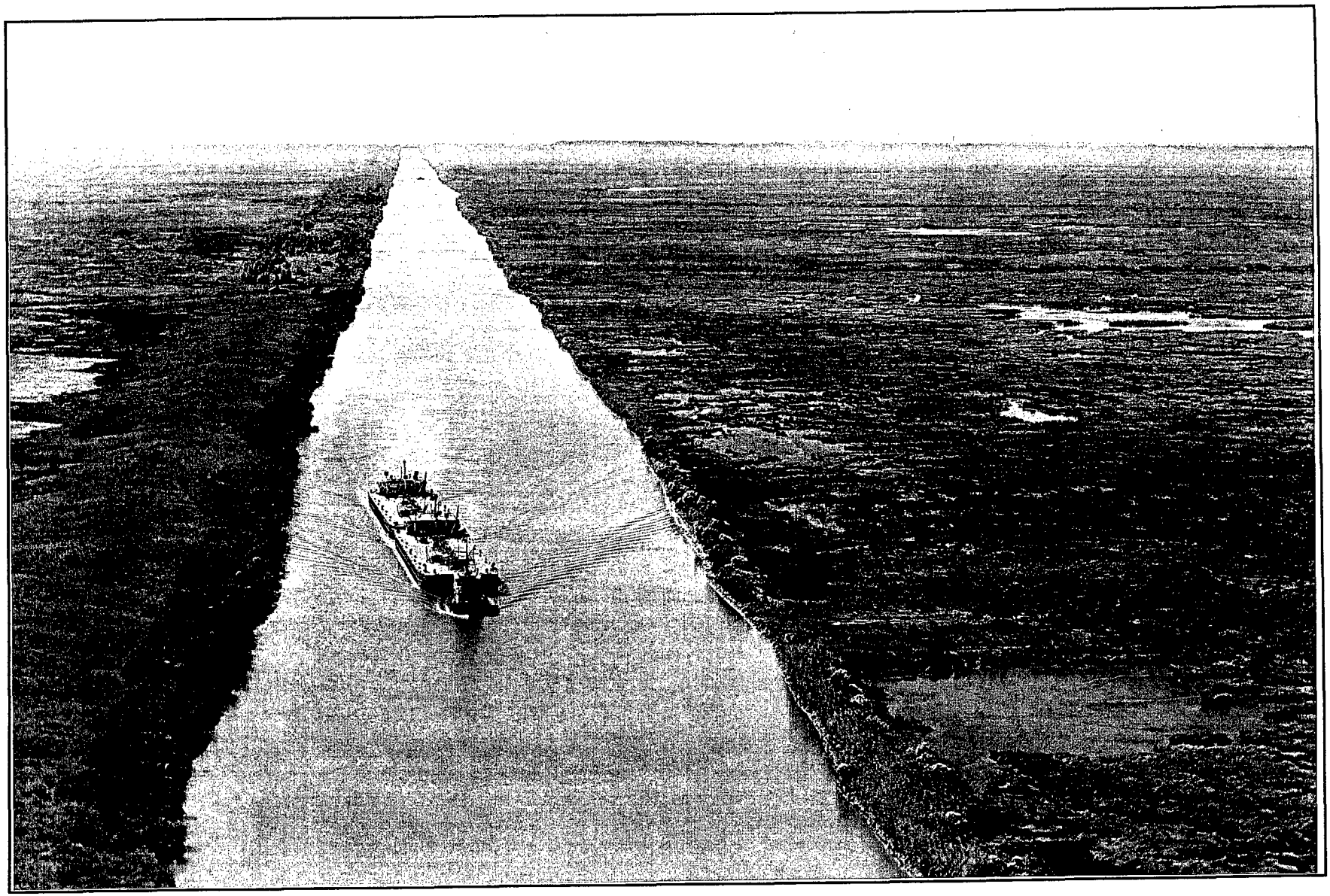


Figure 4-14. Small towboat on the Intracoastal Canal east of Intracoastal City. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 62238. Photographer: Rotkin, November 1948.

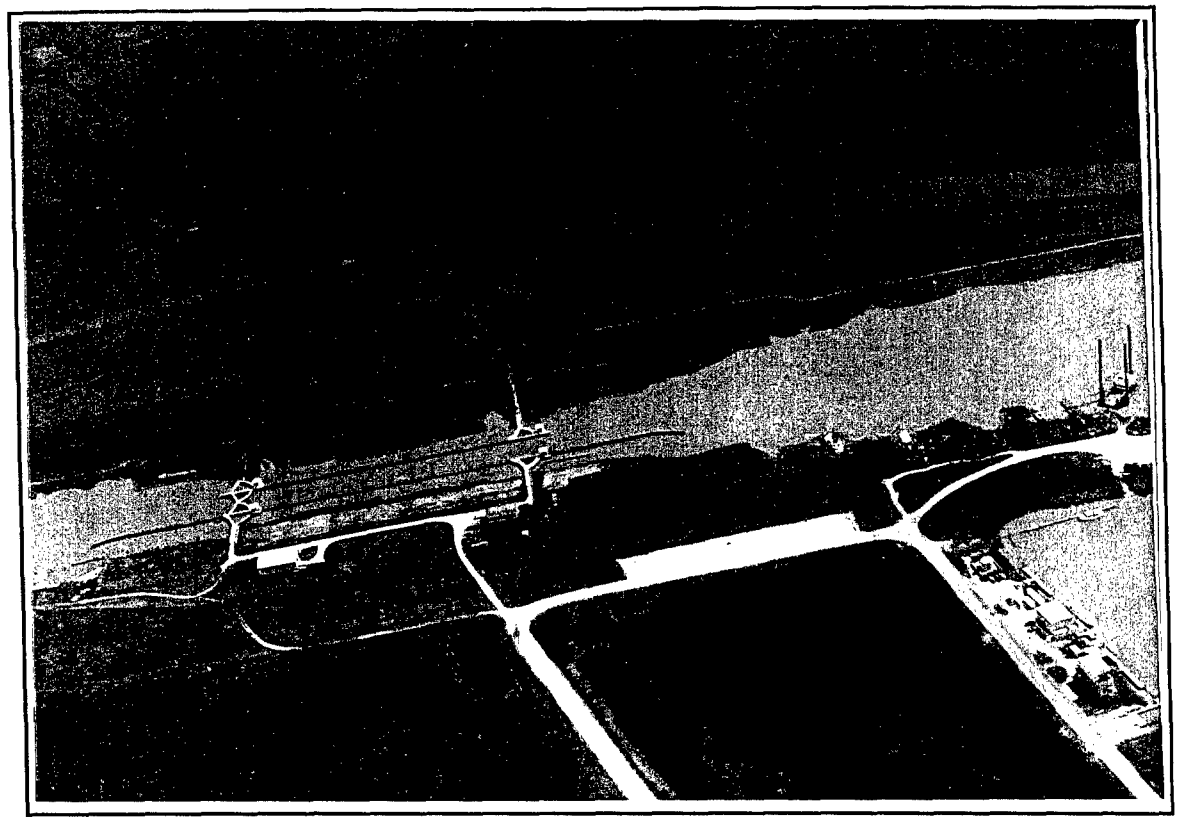


Figure 4-15. The locks on Freshwater Bayou Canal have promoted development of a small port for fishing and offshore service vessels, visible in the lower right corner of the photograph. Date: March 11, 1998.

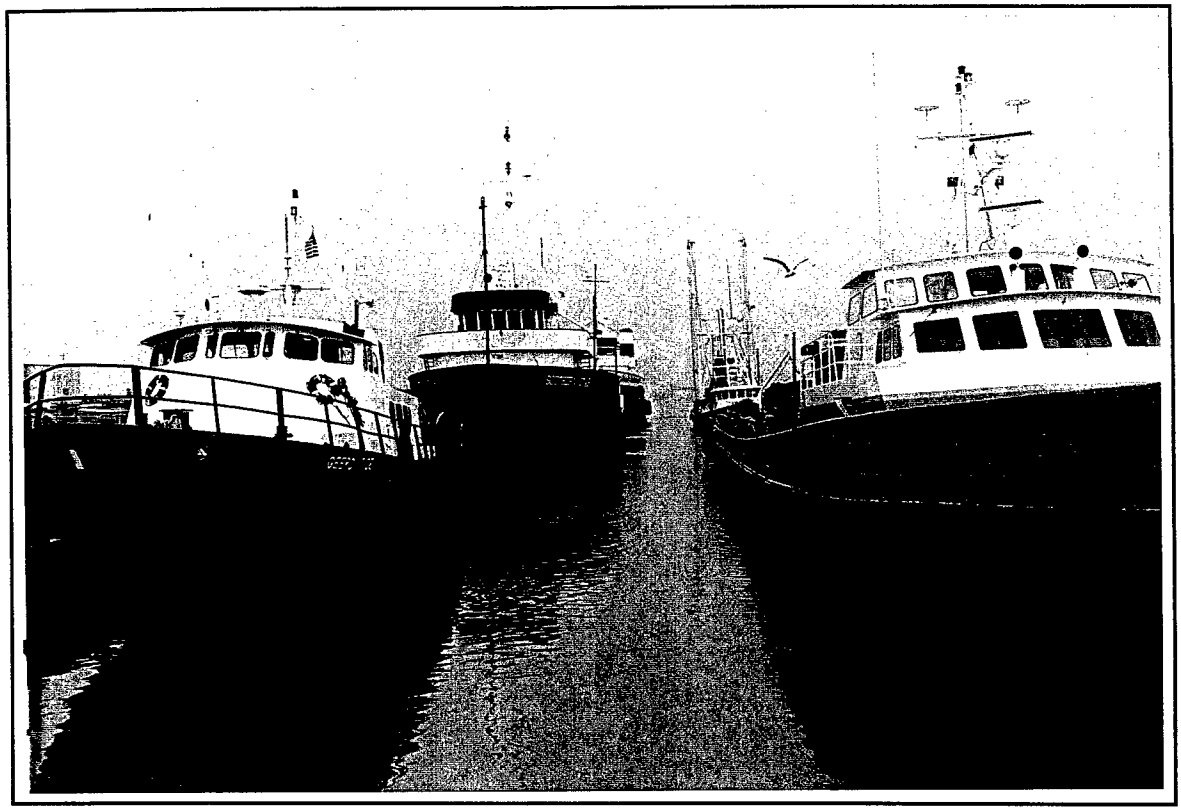


Figure 4-16. **Originally designed to control water levels in the Freshwater Bayou canal, the locks are now clogged with offshore service vessels that transport supplies from supply bases and yards in Intracoastal City, to offshore fields. Date: December 9, 1997.**

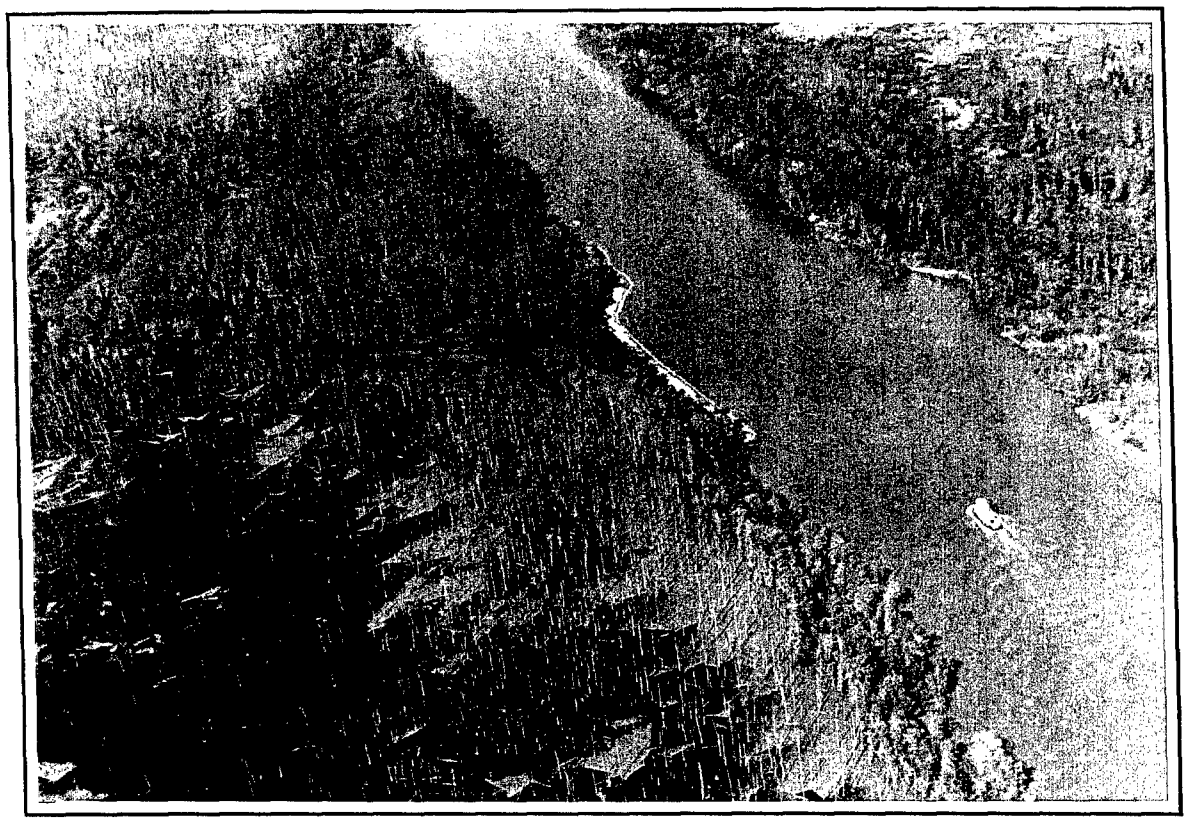


Figure 4-17. **Houma Navigation Canal and dead cypress swamp in bottom half of photo. Date: March 11, 1998.**

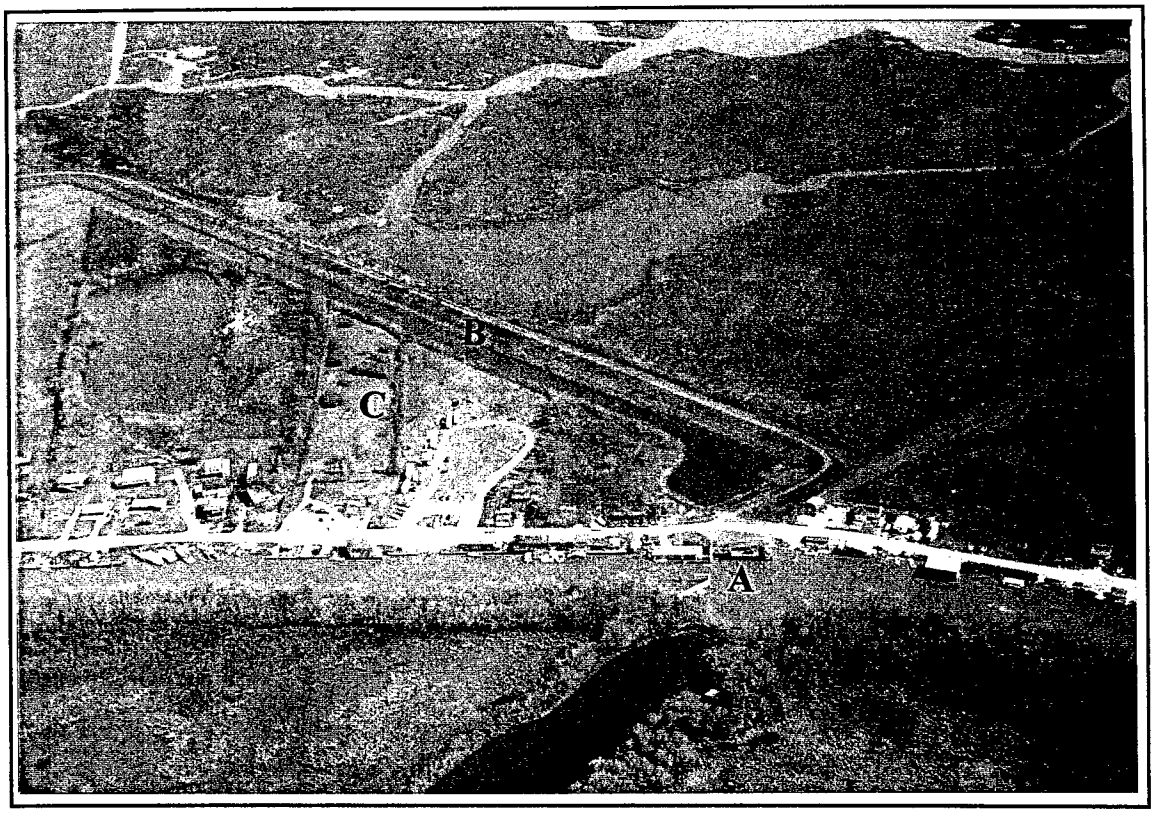


Figure 4-18. **Aerial view of Bayou du Large showing a flood control structure (A) on the bayou, the region's hurricane protection levee (B), and impoundment area (C). Date: March 11, 1998.**

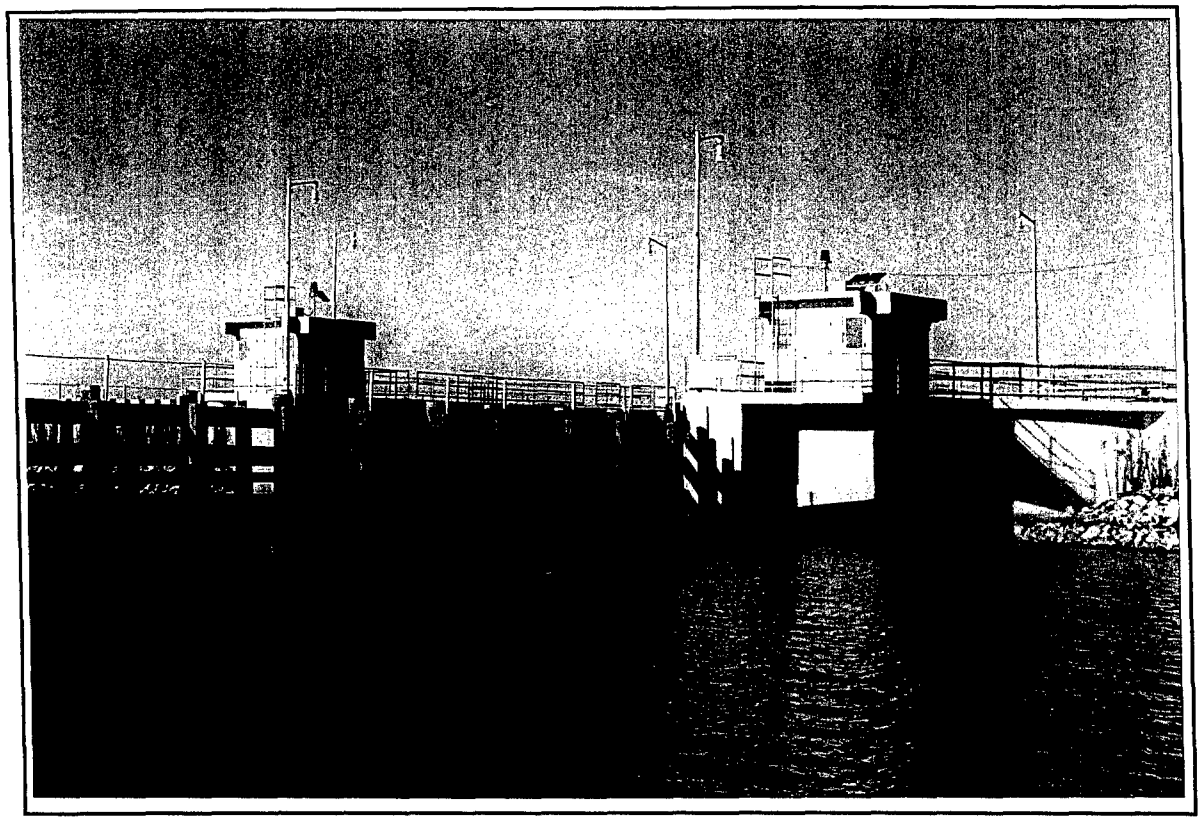


Figure 4-19. **Although common in a country like the Netherlands, these large floodgates on the bayous of Terrebonne Parish are not expected, but are a vital part of the local hurricane flood protection system. Date: December 30, 1997.**

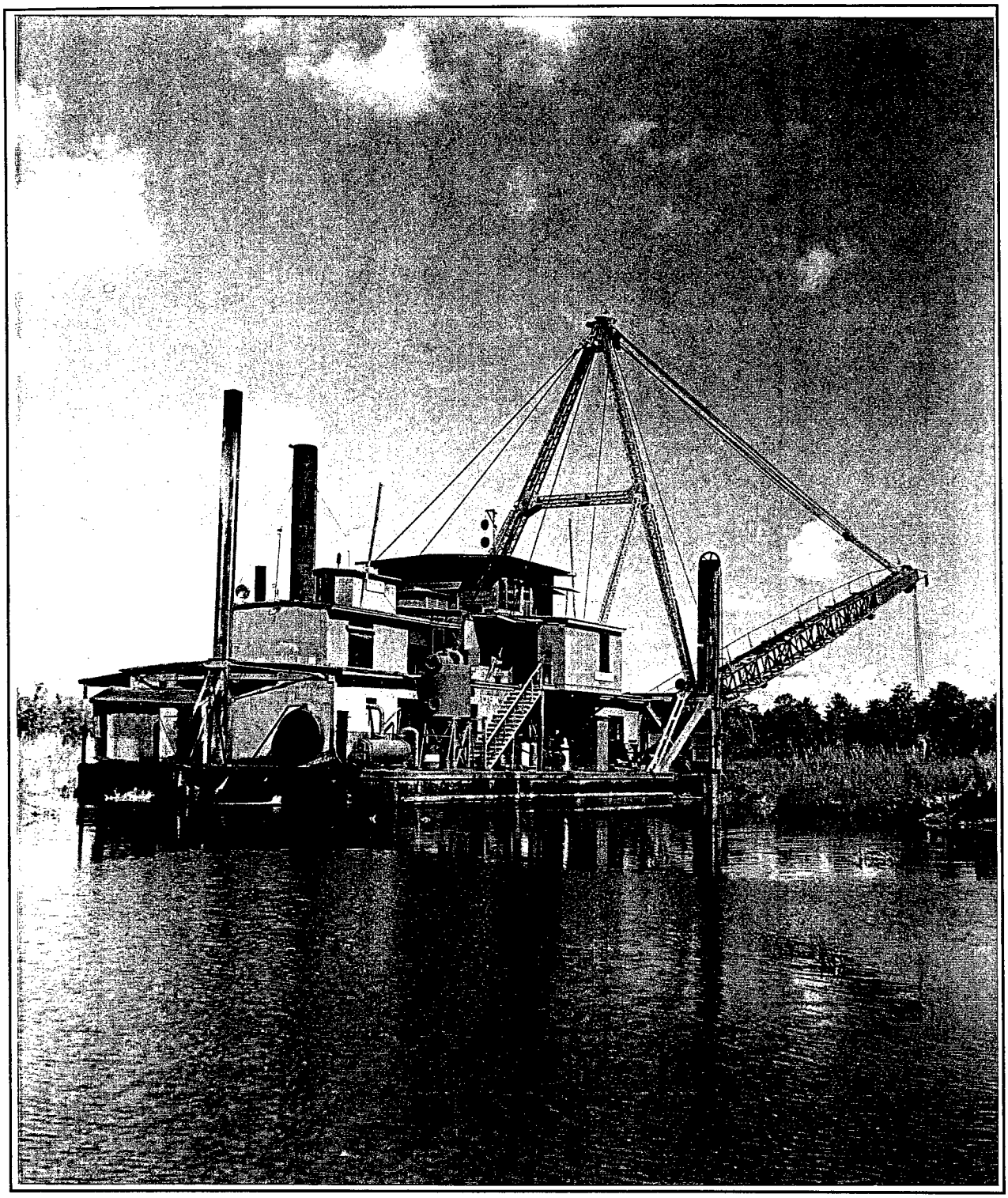


Figure 4-20. **A canal is dredged to a new drilling operation. In this part of the country it is simpler to drill wells with barge rig, bringing supplies in by barge via the Intracoastal Canal, rather than building roads and hauling heavy equipment over them. University of Louisville, Photographic Archives, Standard Oil of New Jersey Co. Collection, Image No. 15524. Photographer: Libsohn, September, 1944.**



Figure 4-21. A new well is being drilled in the Weeks Island oil field near the Gulf Intracoastal Waterway in Iberia Parish. Date: March 11, 1998.

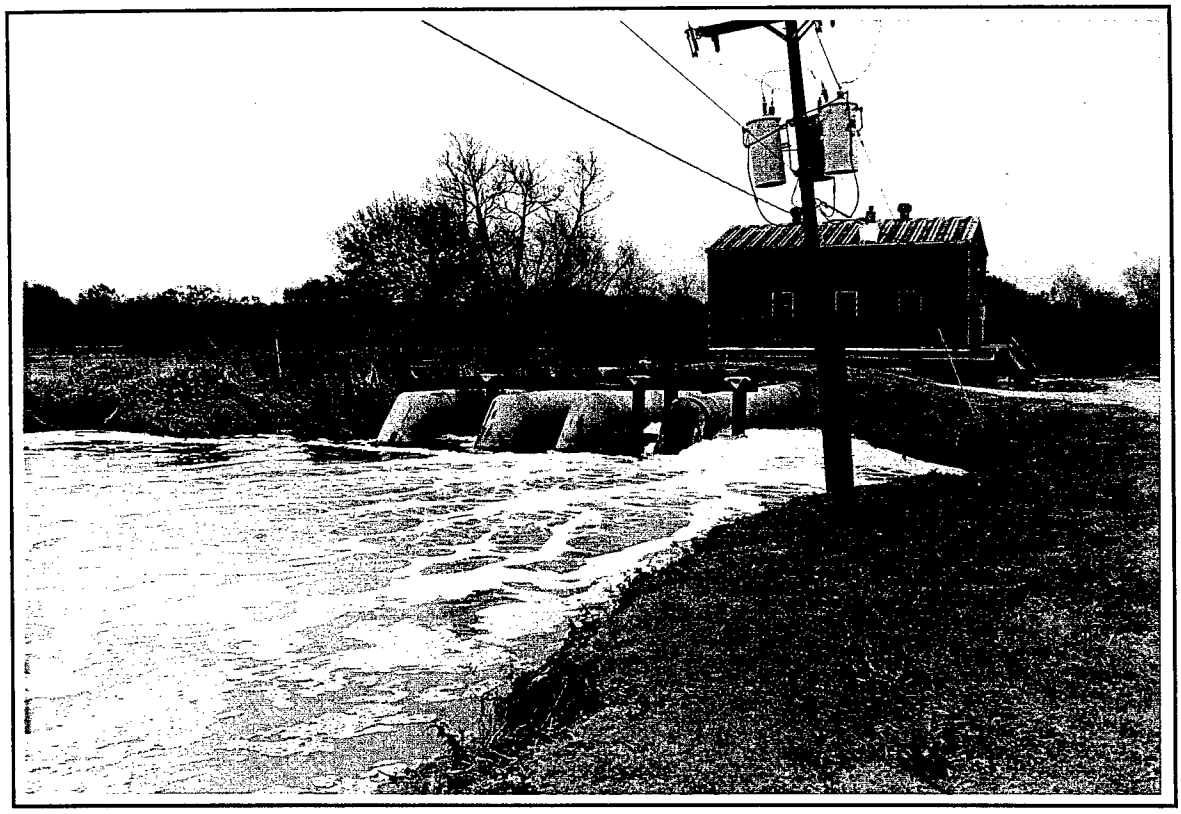


Figure 4-22. Part of Terrebonne Parish's drainage system is illustrated by these pumps just north of Montegut. The pumps operate mainly after local rainfall events. Date: January 6, 1998.

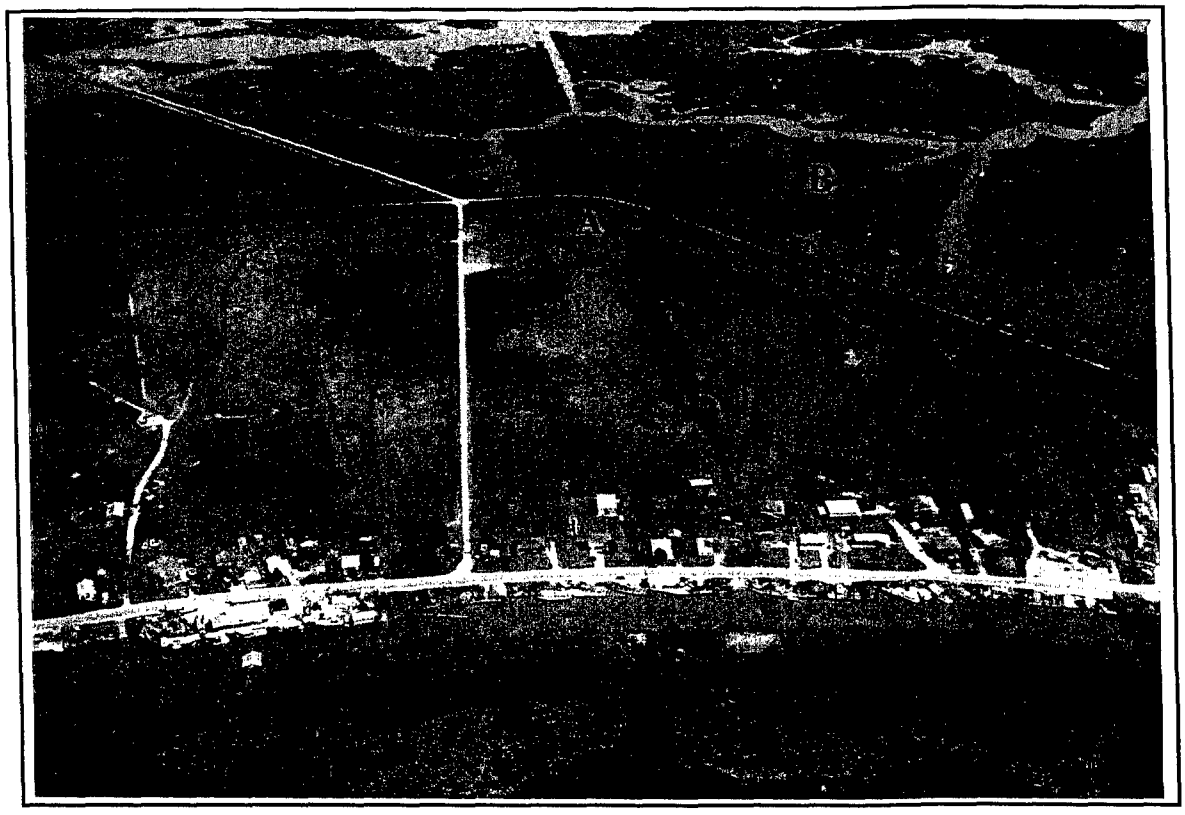


Figure 4-23. Aerial view of Bayou du Large showing area impounded by hurricane protection levee (A), marsh land (B), and the undeveloped west bank of the bayou (C). Date: March 11, 1998.

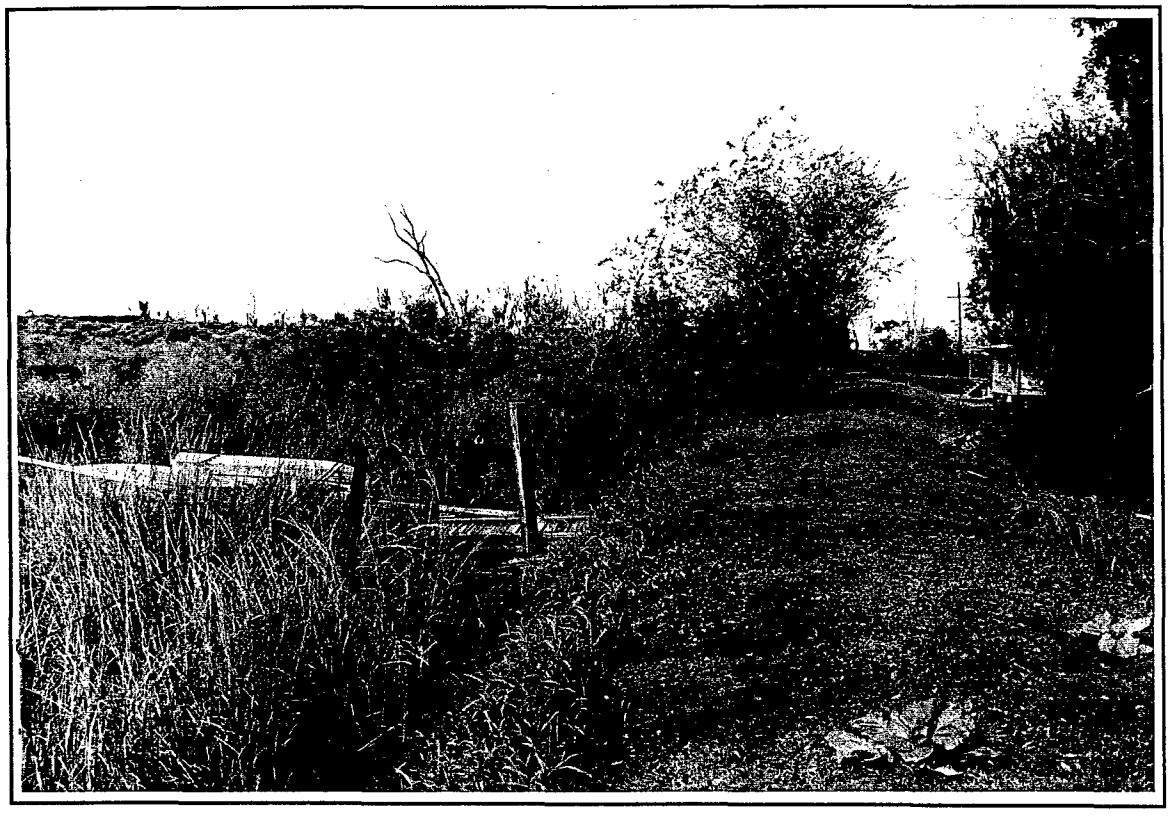


Figure 4-24. **An example of an impoundment levee that is part of the Terrebonne Parish engineered landscape. This levee is about three feet high and is part of a system that protects the west side of Bayou Pointe au Chien. The wooden walkway at the left leads to a dock used by fishermen and trappers. Date: December 17, 1997.**

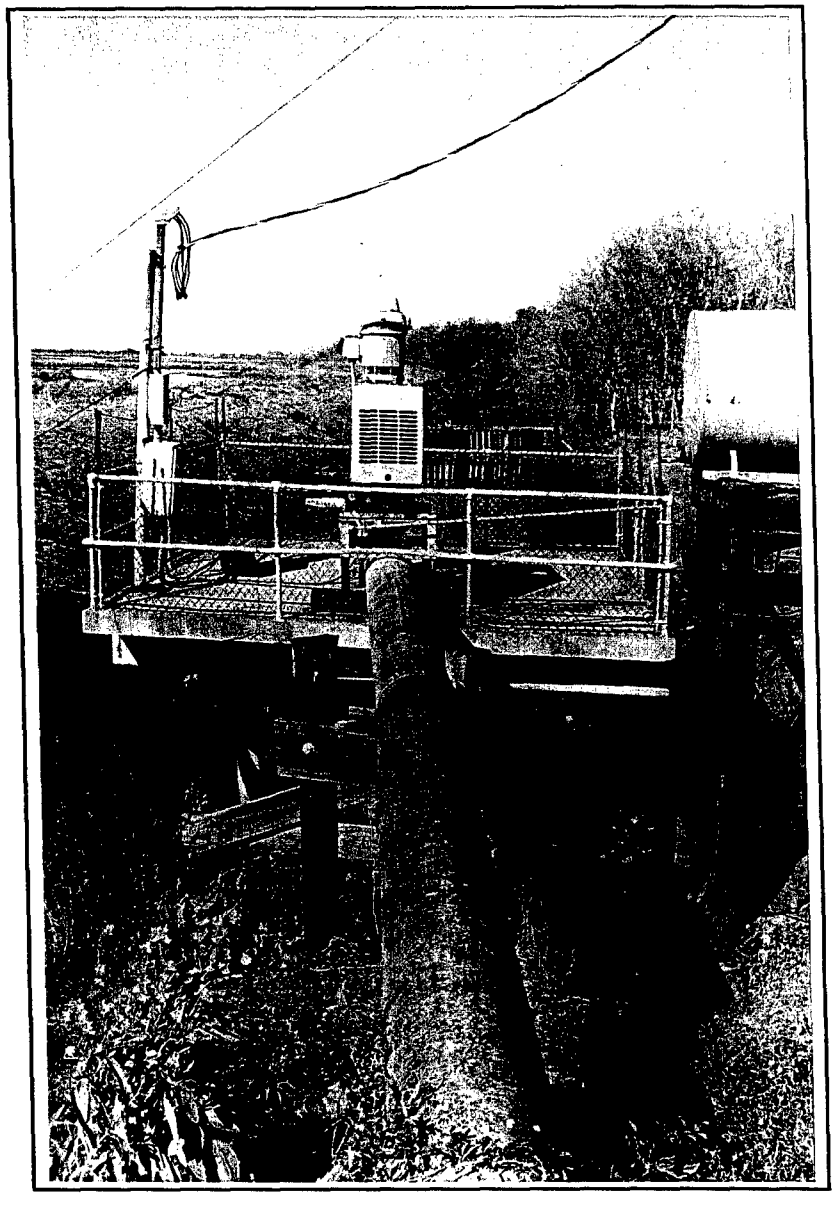


Figure 4-25. The southernmost impoundment drainage pump located near the Isle de Jean Charles road, along the west side of Bayou Pointe au Chien. Along lower Bayou Pointe au Chien there are at least 100 camps and homes that are outside this impoundment area. Date: December 30, 1997.

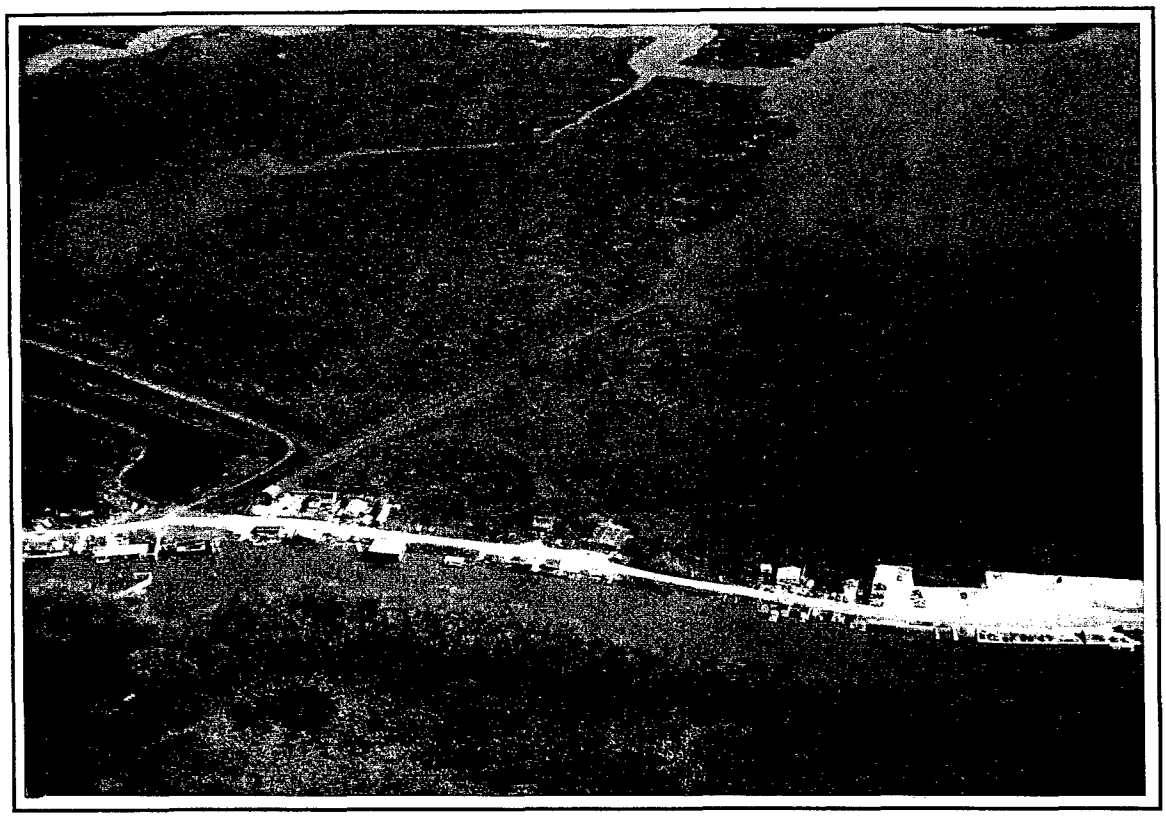


Figure 4-26. Lower Bayou du Large at end of artificial levee. Note natural levee along lower edge of photo, end of artificial levee at left, and decaying marsh at upper right. Date: March 11, 1998.



Figure 4-27. Along Bayou Pointe au Chien, vegetation protected by the drainage levee (A) is within part of a healthy ecosystem; however, outside the levee (B) the cypress swamp is dying. Date: March 11, 1998.

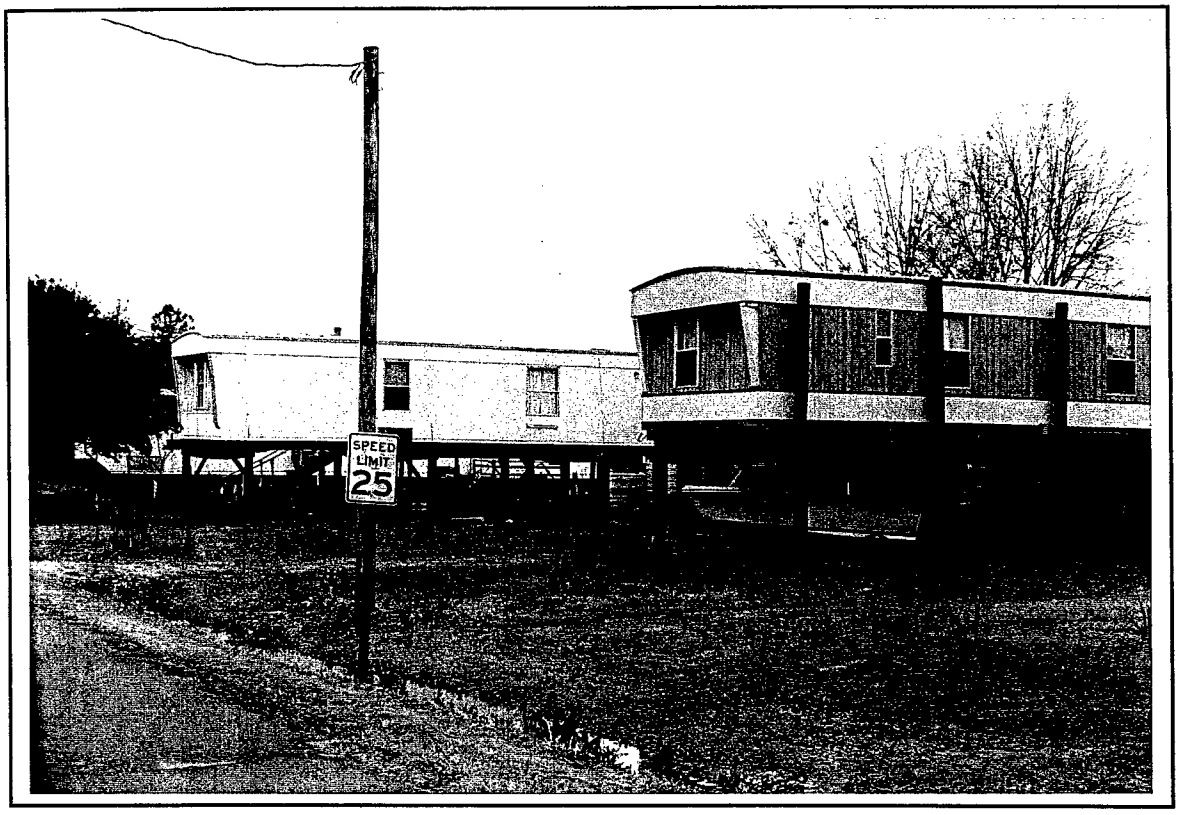


Figure 4-28. **In order to secure a home loan, many house trailers – depending on their location – must be elevated to protect them from potential flood waters. These trailers are in the community of Montegut, which is located within a Terrebonne Parish pump drainage district. Date: January 6, 1998.**

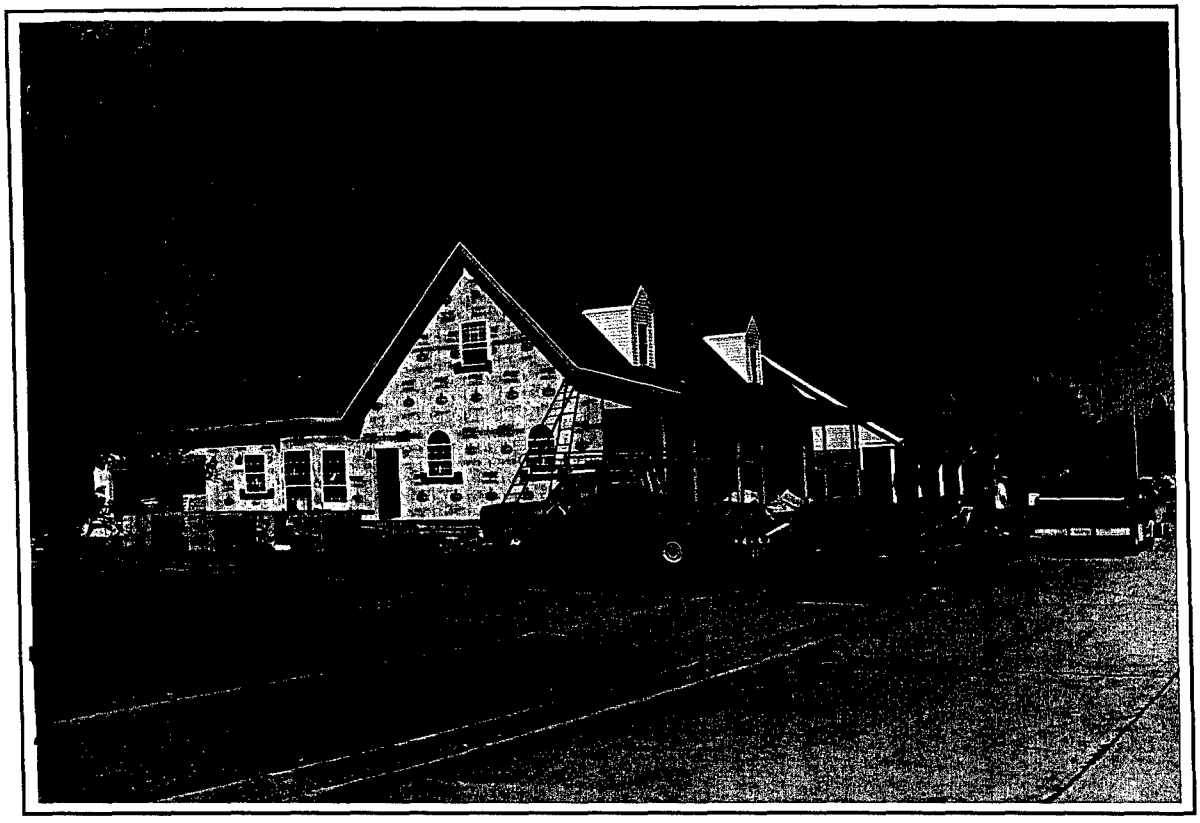


Figure 4-29. New house construction along Bayou Black in Houma. Date: November 25, 1997.

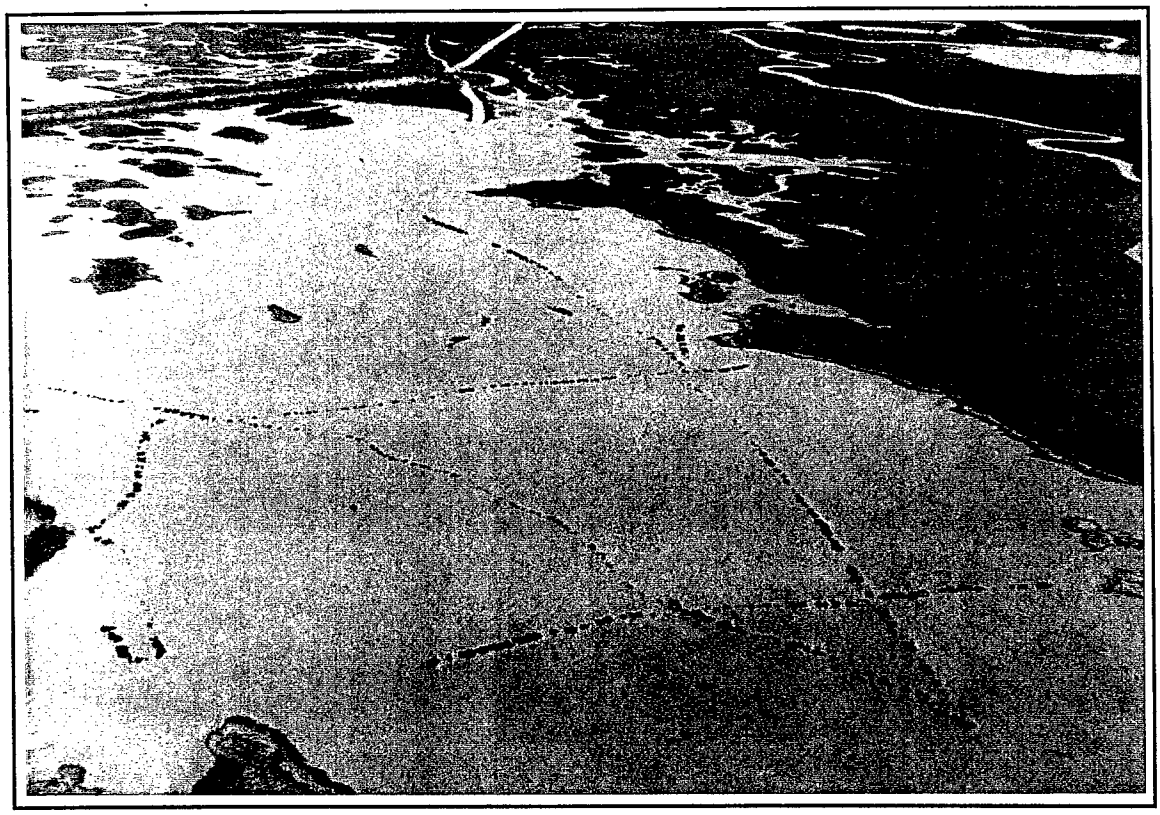


Figure 4-30. **Linear patterns highlight the erosion prevention structures associated with this Christmas tree project near the Gulf Intracoastal Waterway south of Franklin. This project is an impressive attempt at public participation in an effort to slow the state's coastal land loss. Date: March 11, 1998.**

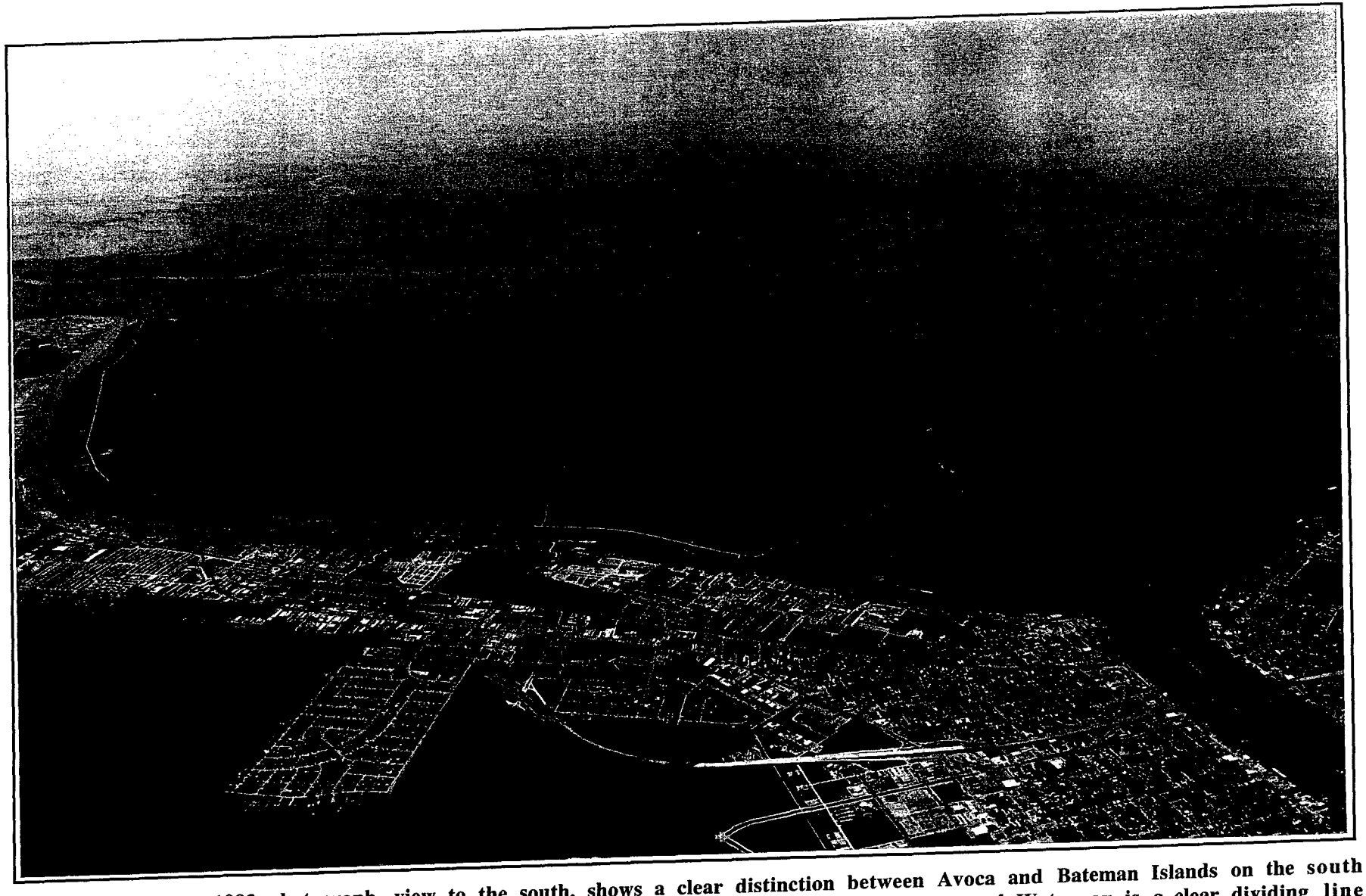


Figure 4-31. This 1983 photograph, view to the south, shows a clear distinction between Avoca and Bateman Islands on the south and Morgan City on the north. The distinction continues today, as the Intracoastal Waterway is a clear dividing line between developed and undeveloped property (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 16734K-23).

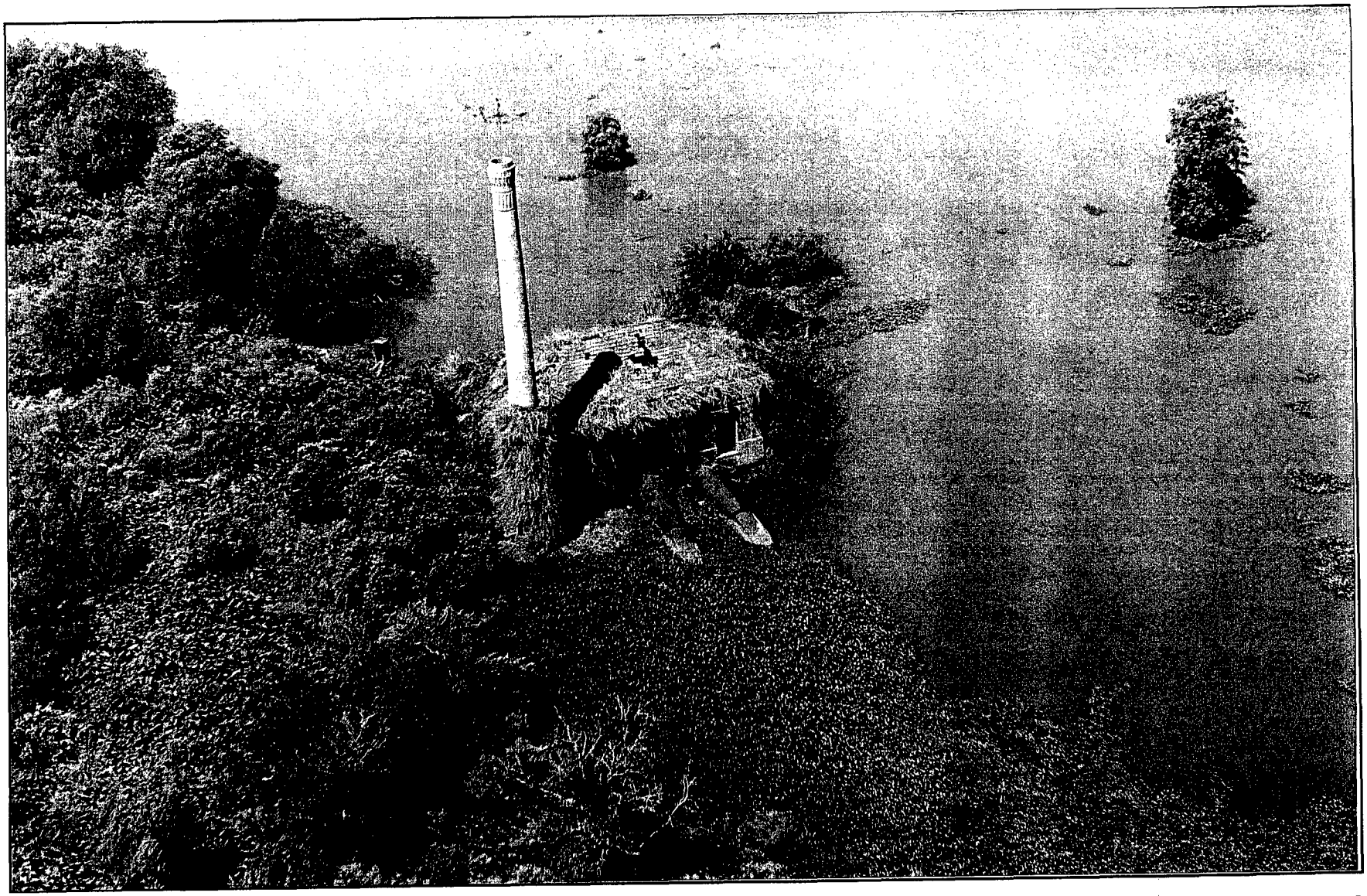


Figure 4-32. This abandoned pumping station is a visual reminder of the land reclamation effort associated with Avoca Island near Morgan City. Date: September 8, 1983 (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 16808V-19).



Figure 4-33. Outside Reef, also known as Nickel Reef, was located southeast of Marsh Island in East Cote Blanche Bay and is part of a barrier reef system that has been devastated by shell dredging, sedimentation, and increased fresh water flow from the Atchafalaya River. Date: February 1978 (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).



Figure 4-34. The emerging Atchafalaya delta continues to expand. It is an indicator of the quantity of sediment diverted through the Atchafalaya, as well as the speed with which new land can be formed in Atchafalaya Bay's protected waters. Island growth has been enhanced by deposition of dredge spoil. Date: July 27, 1982 (source: New Orleans District, U.S. Army Corps of Engineers, Image No. 16608K-13).

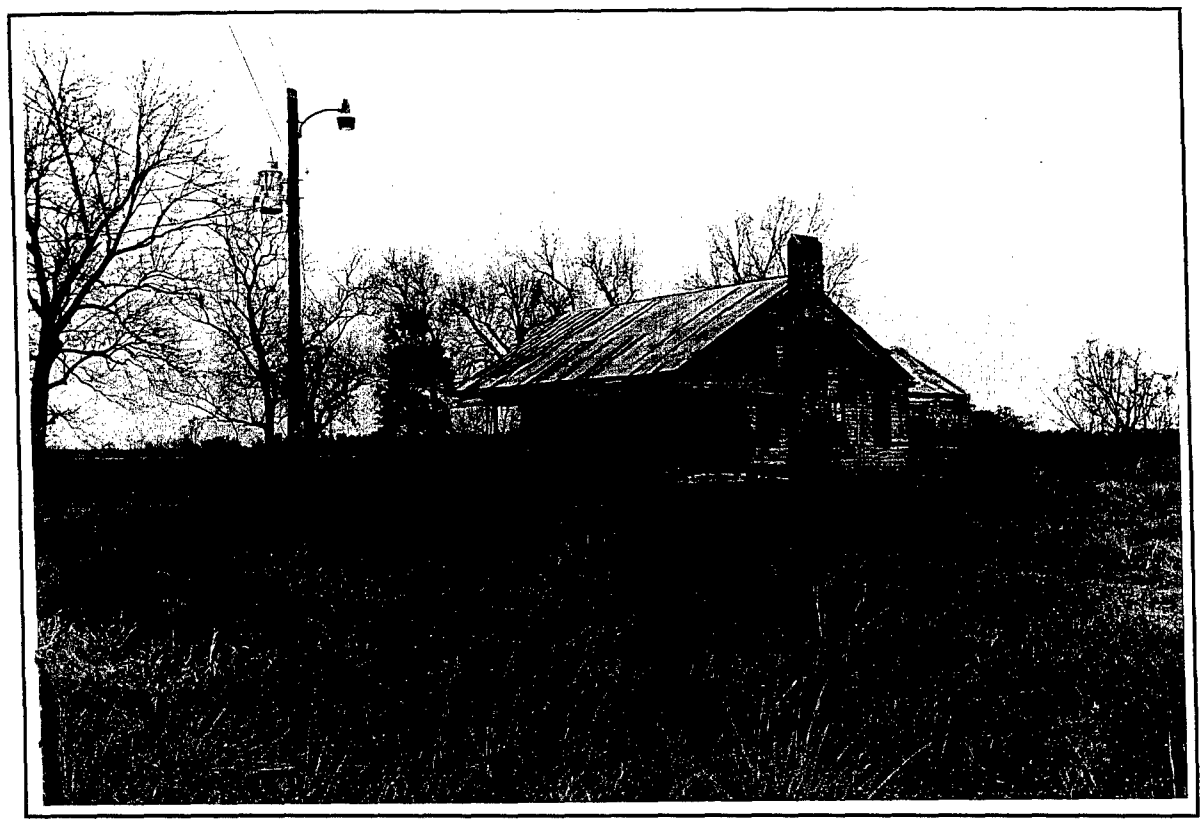


Figure 4-35. This abandoned plantation house along Highway 83 near Freetown in St. Mary Parish, may be an indicator of the precarious future of the sugar business in Louisiana. Date: December 11, 1997.



Figure 4-36. Old structure associated with an abandoned farm site along lower Bayou Pointe au Chien. The remains of several houses were observed in this area, which is accessible only by boat. August 16, 1995.

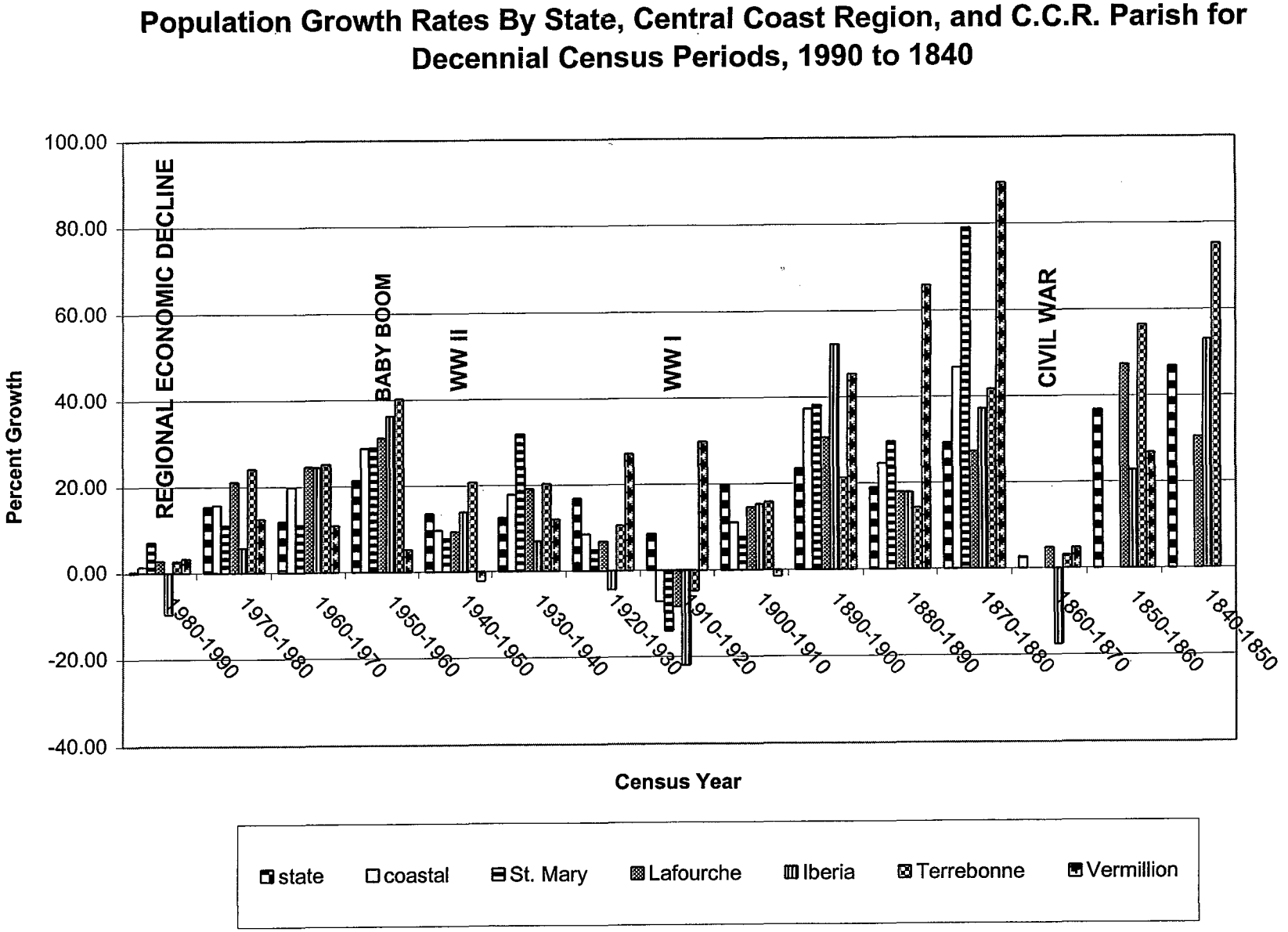


Figure 4-37. Graph showing population growth rates.

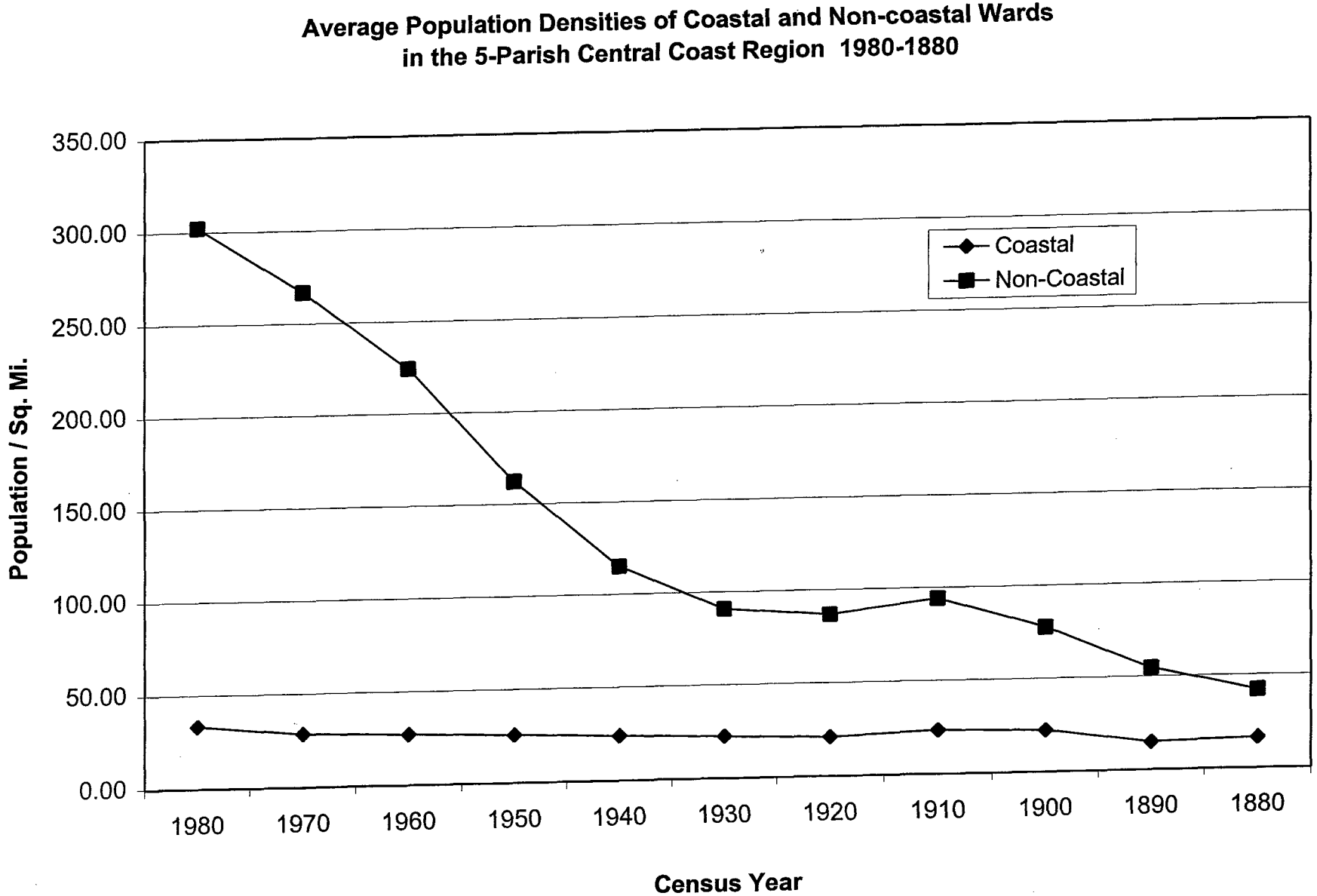


Figure 4-38. Graph showing average population densities.

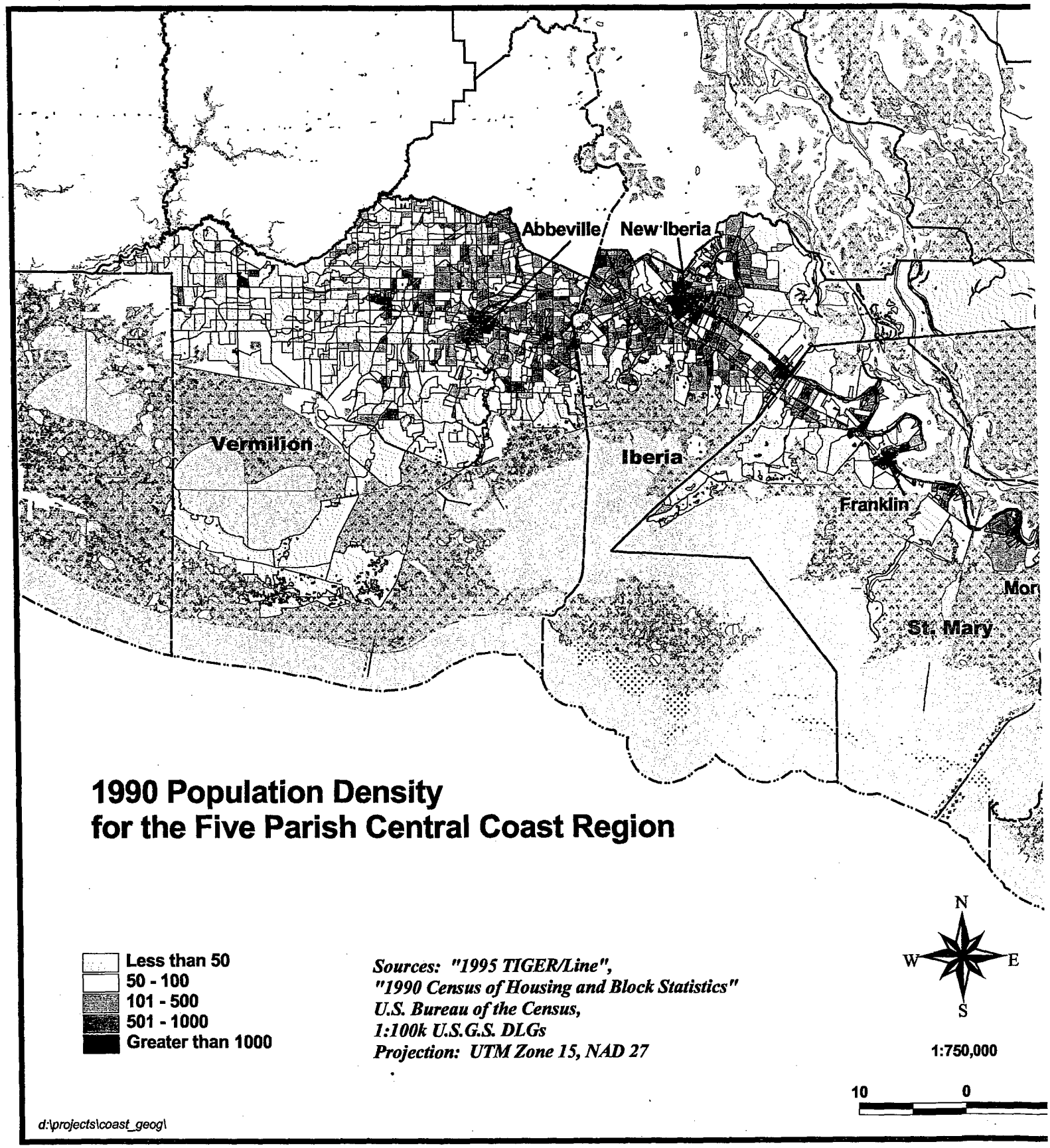
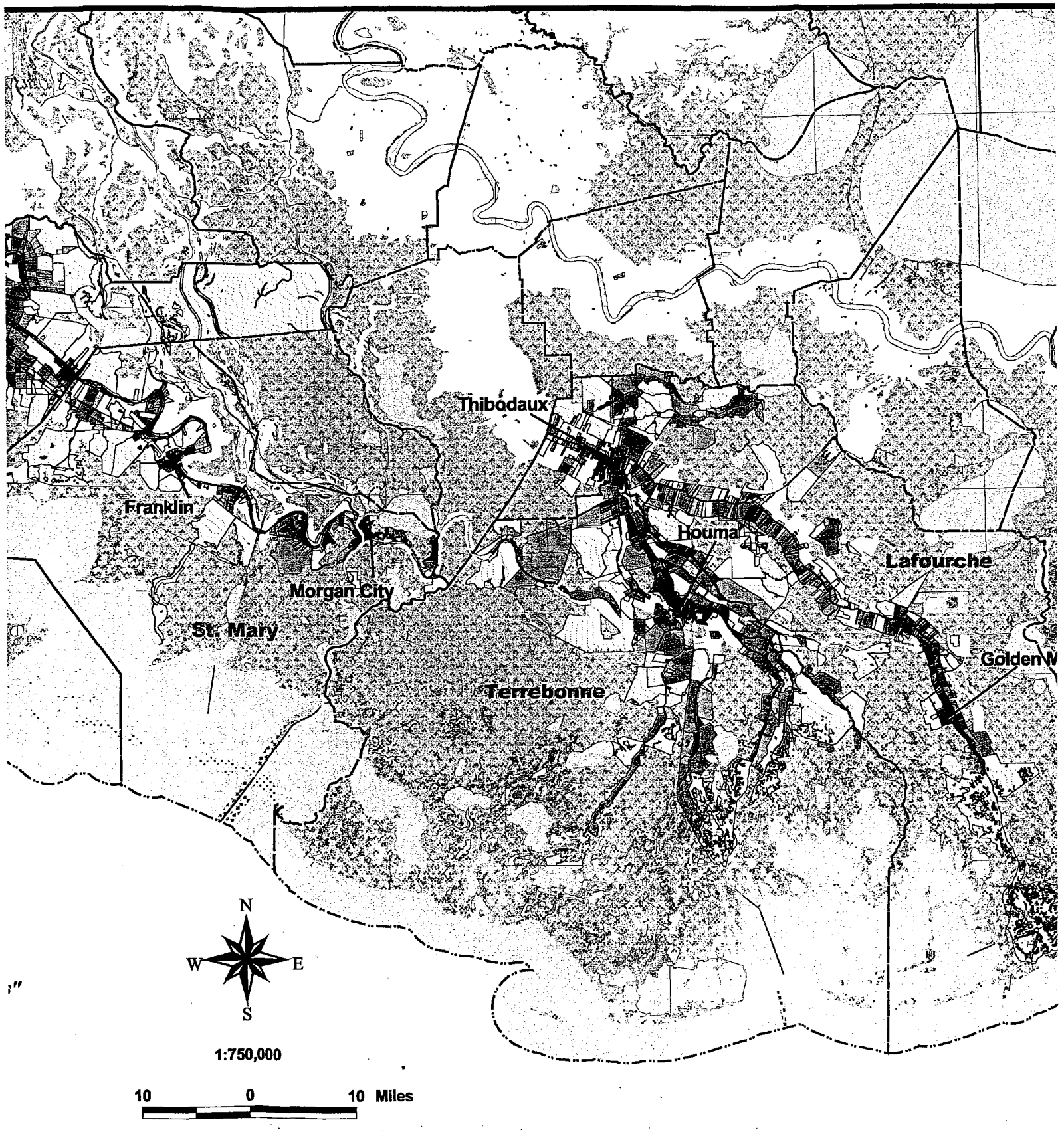
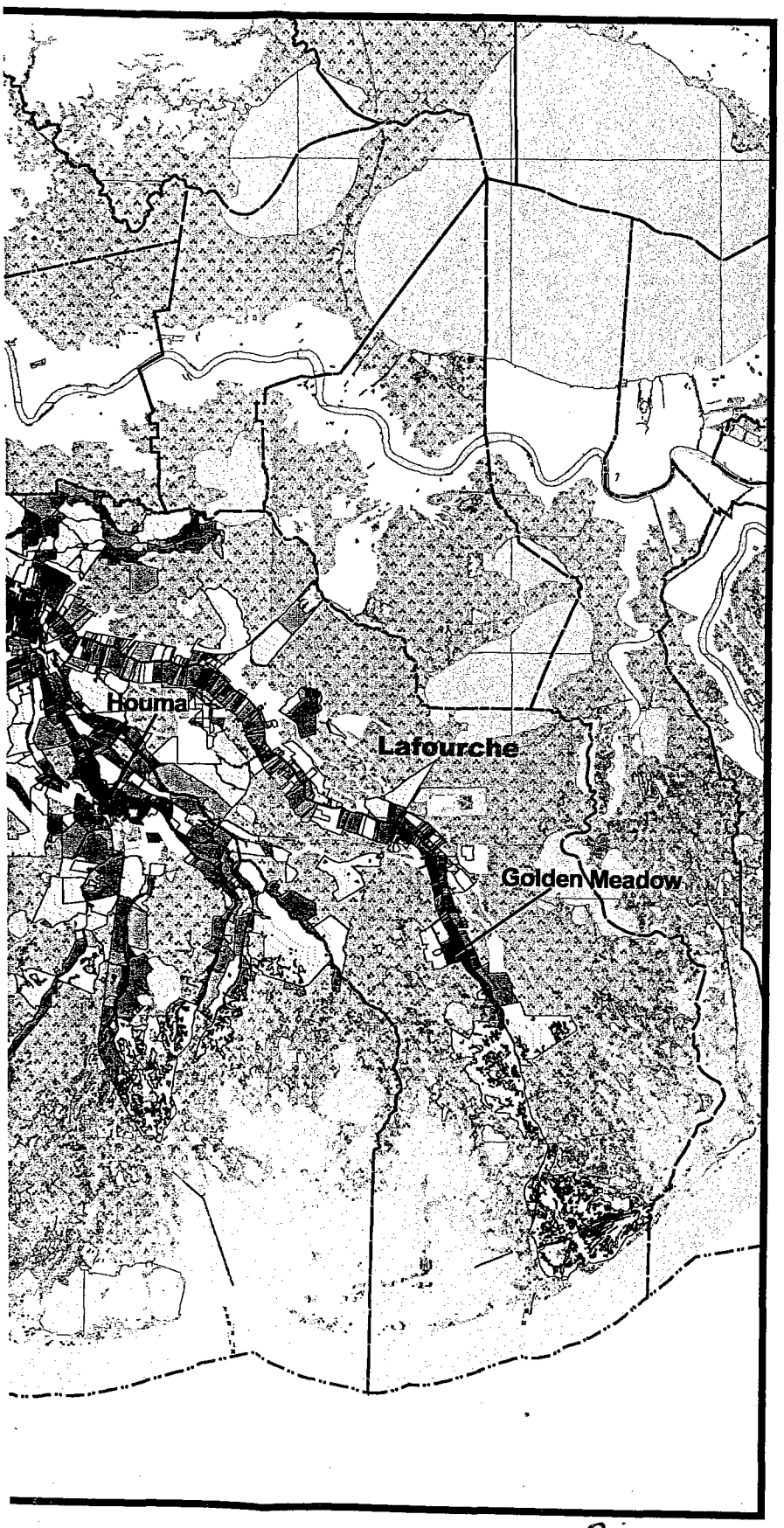


Figure 4-39. Map showing population density in 1990.


Thibodaux
Franklin
Houma
Lafourche
Morgan City
St. Mary
Terrebonne
N
W
E
S
1:750,000
10 0 10 Miles


Houma
Lafourche
Golden Meadow

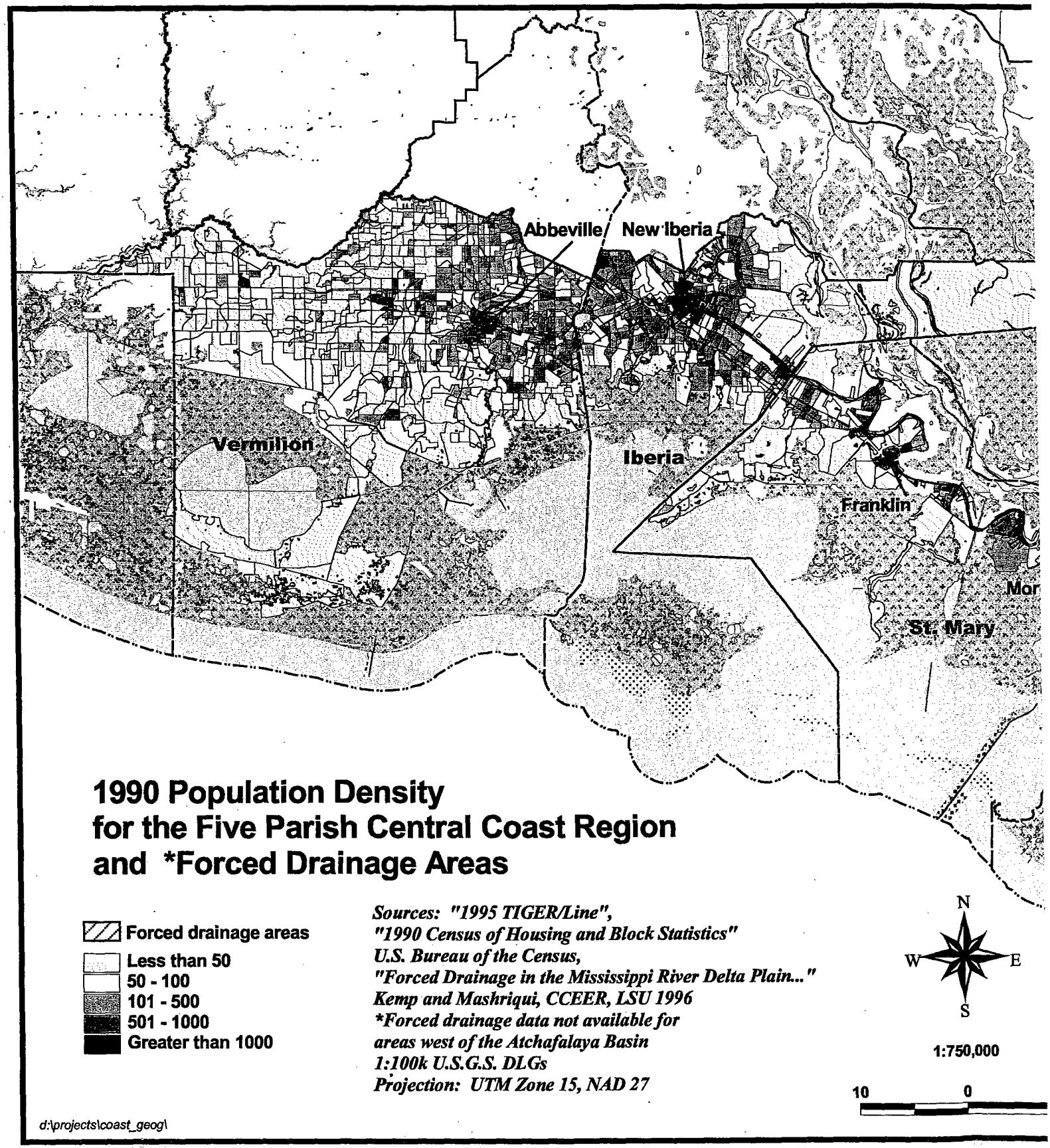
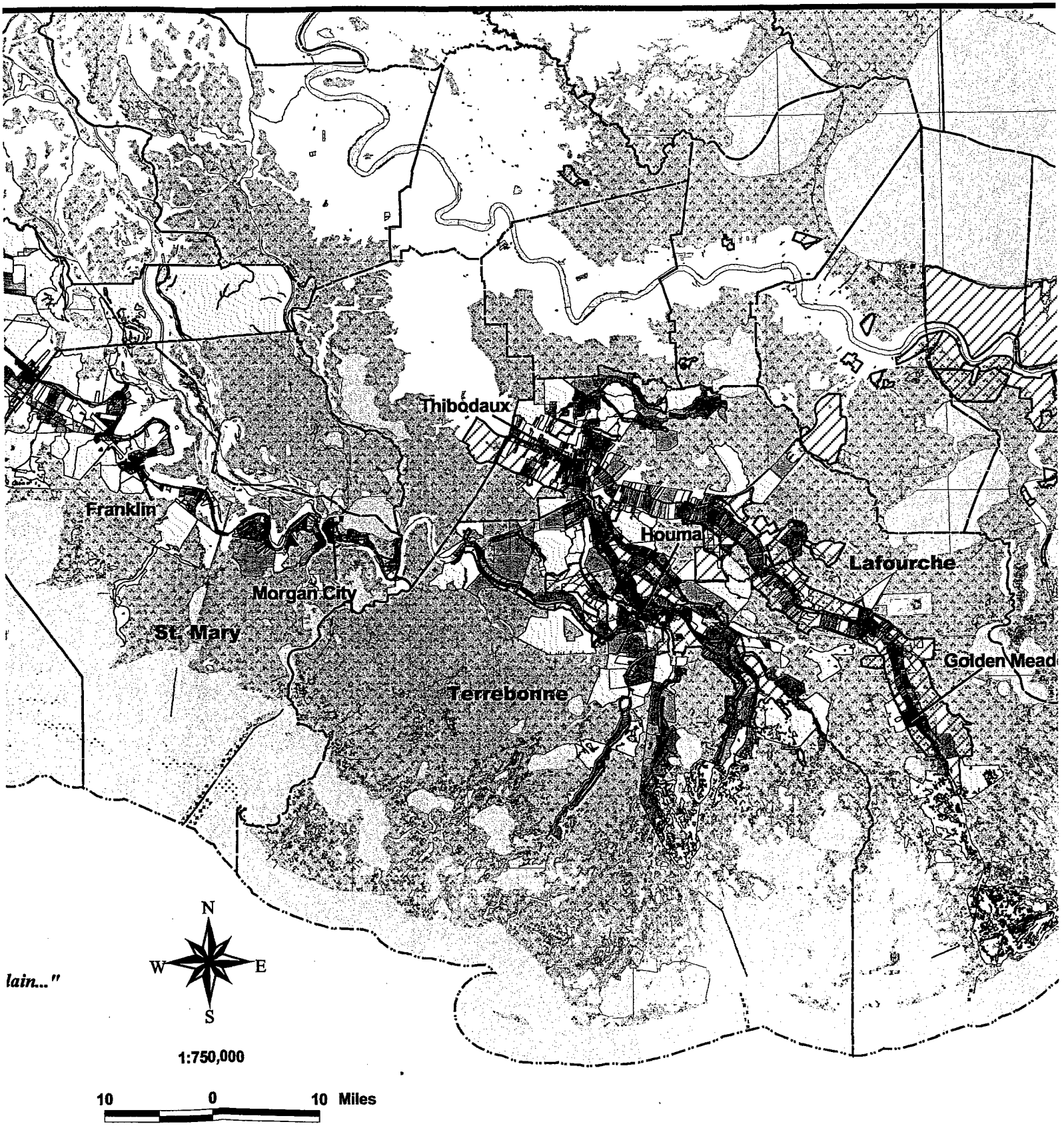
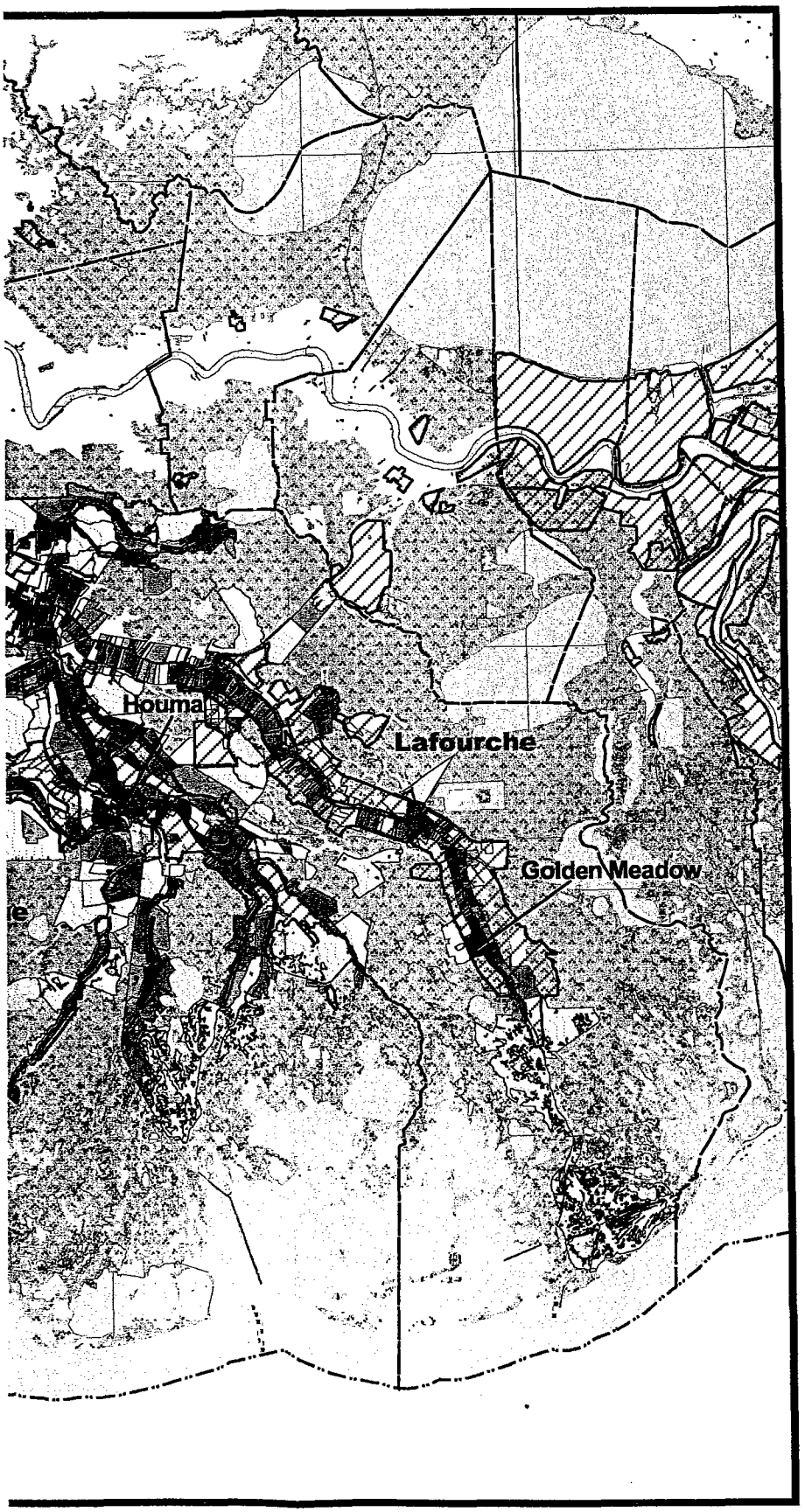


Figure 4-40. Map showing population density and forced drainage. Note: Forced drainage data plotted only for th



lain..."

drainage data plotted only for the area east of Atchafalaya River.



er.



Figure 4-41. **The new camp development (A) at Cypremort Point will increase dramatically the size of this camp-oriented community. Date: March 11, 1998.**

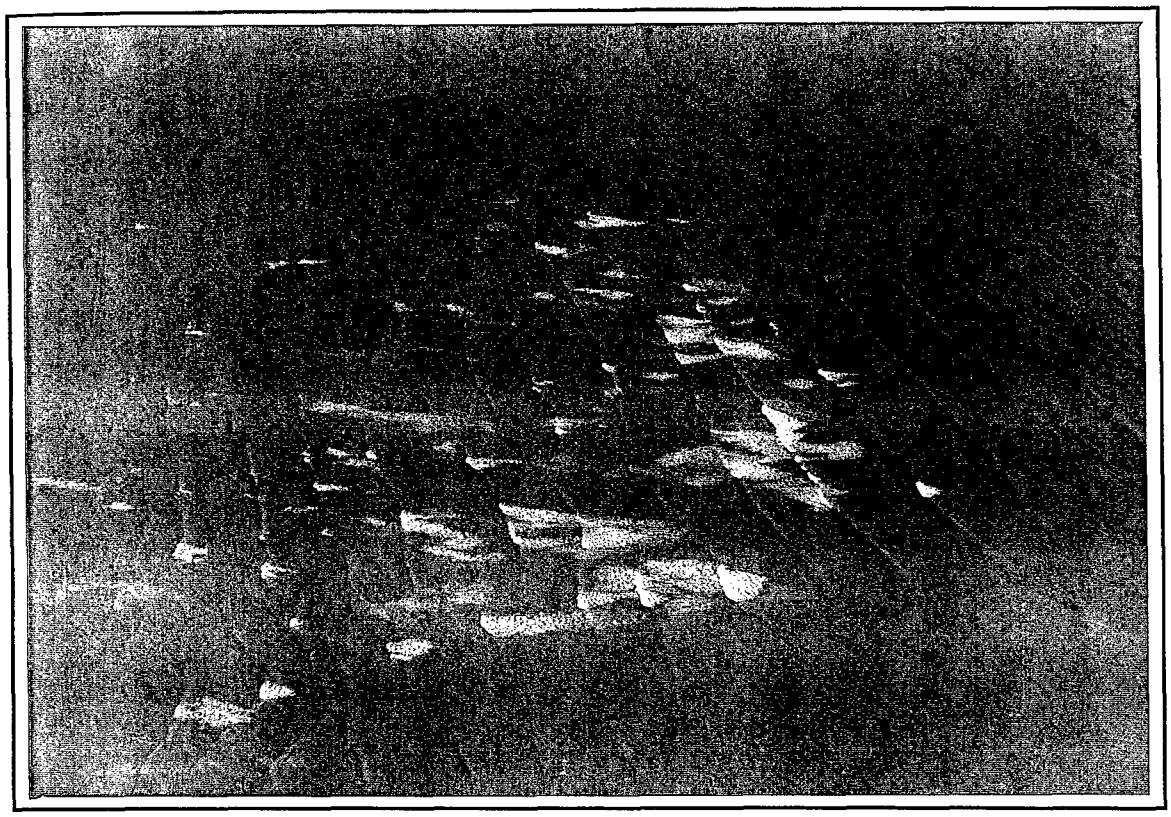


Figure 5-1. On the Mississippi River, high water was always of some concern. In 1890, this convict-labor wheelbarrow brigade worked to close the Morganza crevasse. All potential crevasses were of some concern, because if they were not plugged up they could cause economic disasters by flooding large areas (source: the U.S. Army Corps of Engineers, New Orleans District, Photographic Archives).

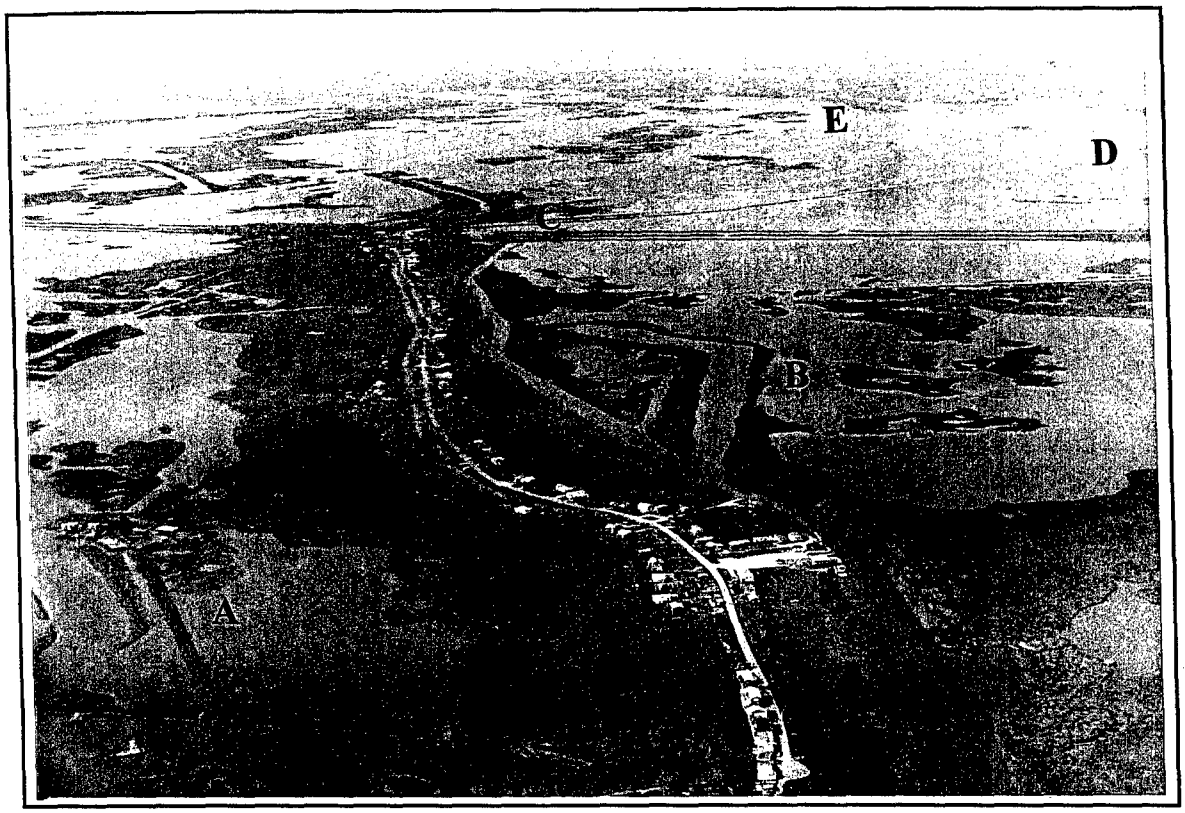


Figure 5-2. **Isle de Jean Charles is threatened by land loss. Note deteriorating brackish marsh (A & B) disected by canals. The access road connection (C-D) is faintly visible on this photo and acts as a barrier to saltwater intrusion; oysters are not yet growing in the northern deteriorated marsh region (E). Date: March 11, 1998.**

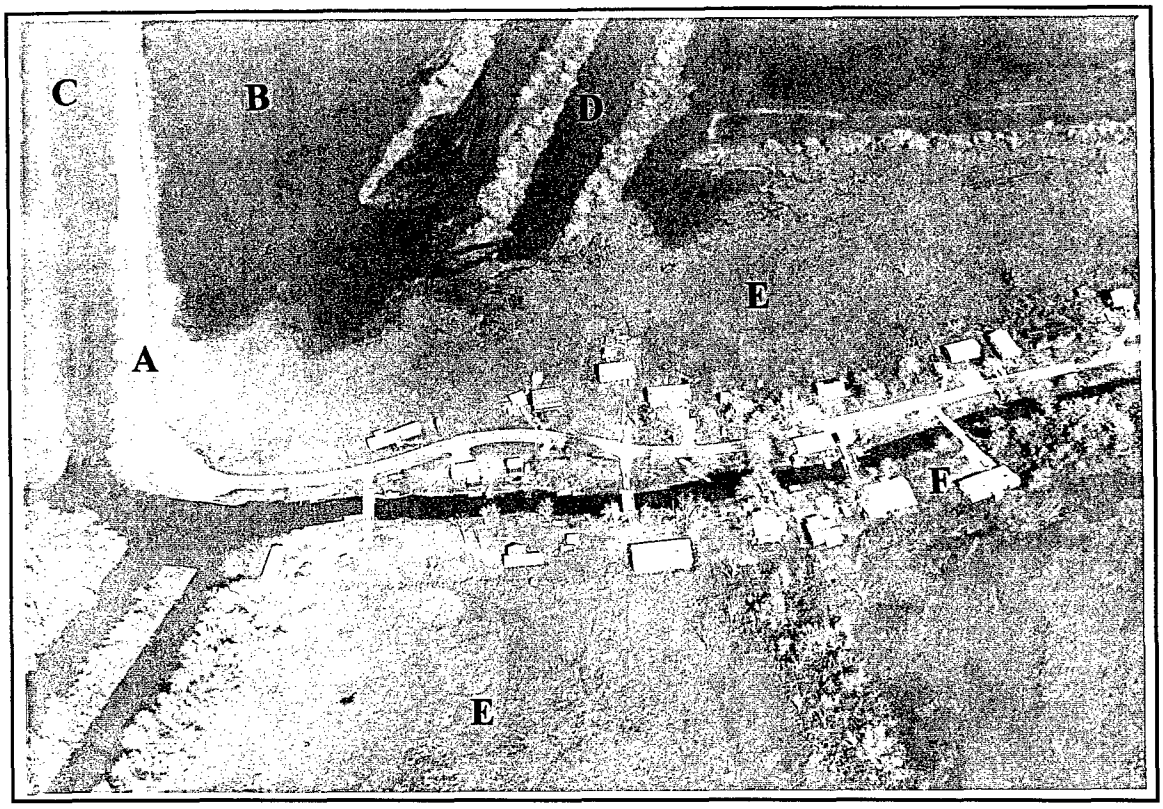


Figure 5-3. Houses and camps at the north end of Isle de Jean Charles. Note the access road (A), flanked by brackish (B) and fresh (C) open water areas, pipeline canals (D), and surviving marsh (E) along the flanks of inhabited Bayou St. Jean Charles natural levees (F). Date: March 11, 1998.

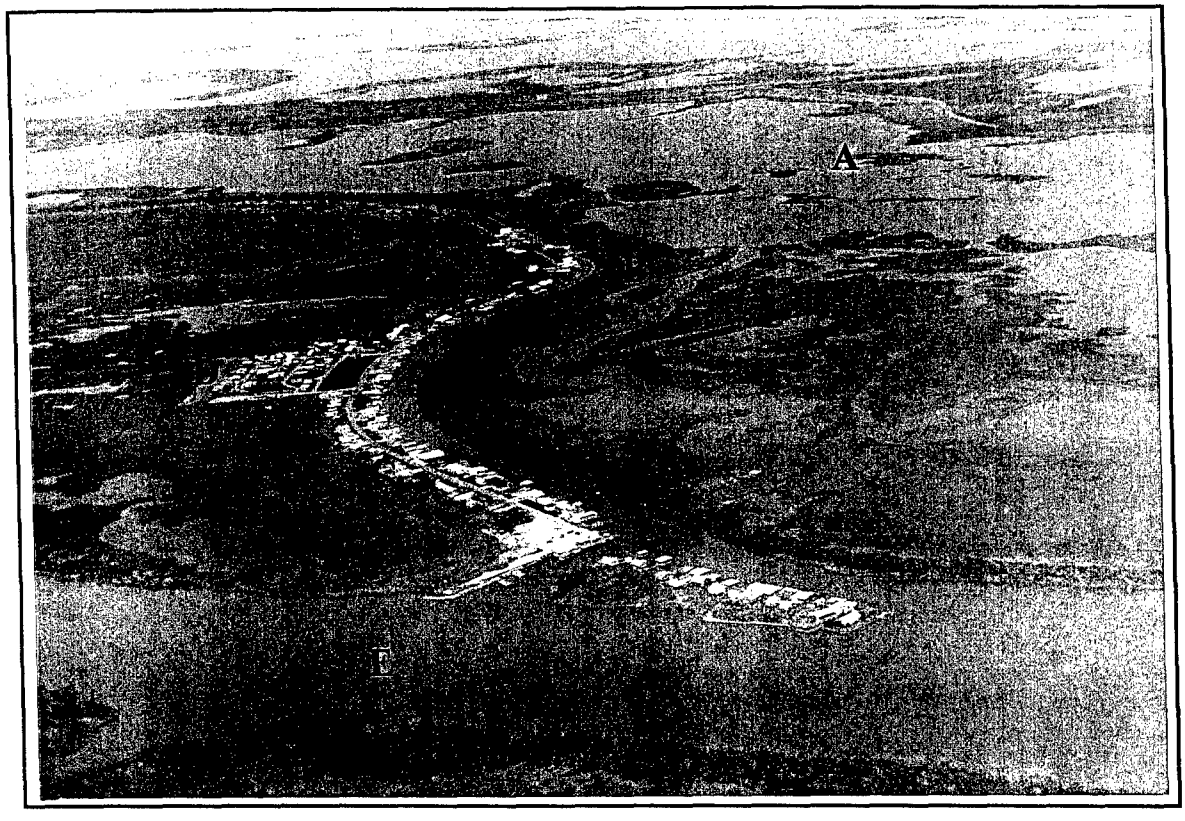


Figure 5-4. Natural levee ridges along Four Point Bayou. Note decaying marsh at top and right in photo (A), undeveloped and vegetated natural levee ridge along east side of bayou (B), camp development on natural levee ridge along west side of bayou (C), marina development (D), and Houma Navigation Canal (E). Date: March 11, 1998.

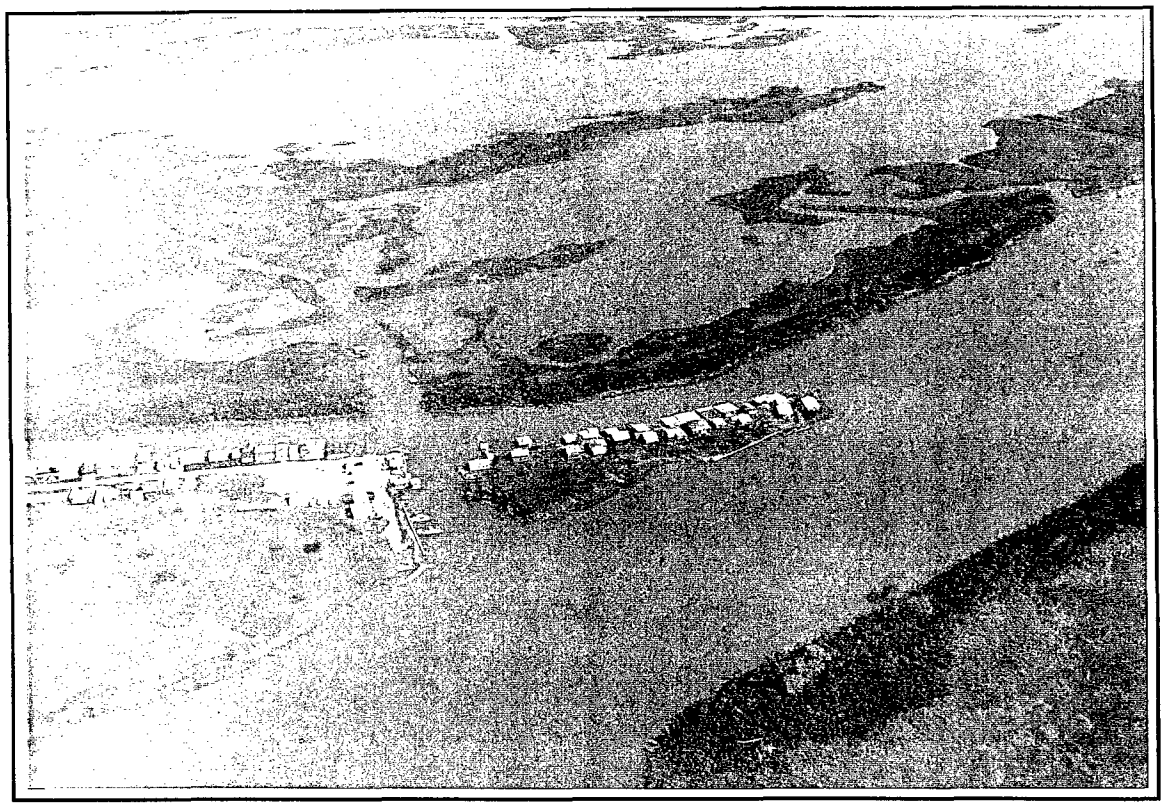


Figure 5-5. Four Point Bayou at Homa Navigation Canal. Note decaying marsh at top of photo, forested natural levee ridge along east side of bayou, and camp development on natural levee ridge along west side of bayou. Date: March 11, 1998.

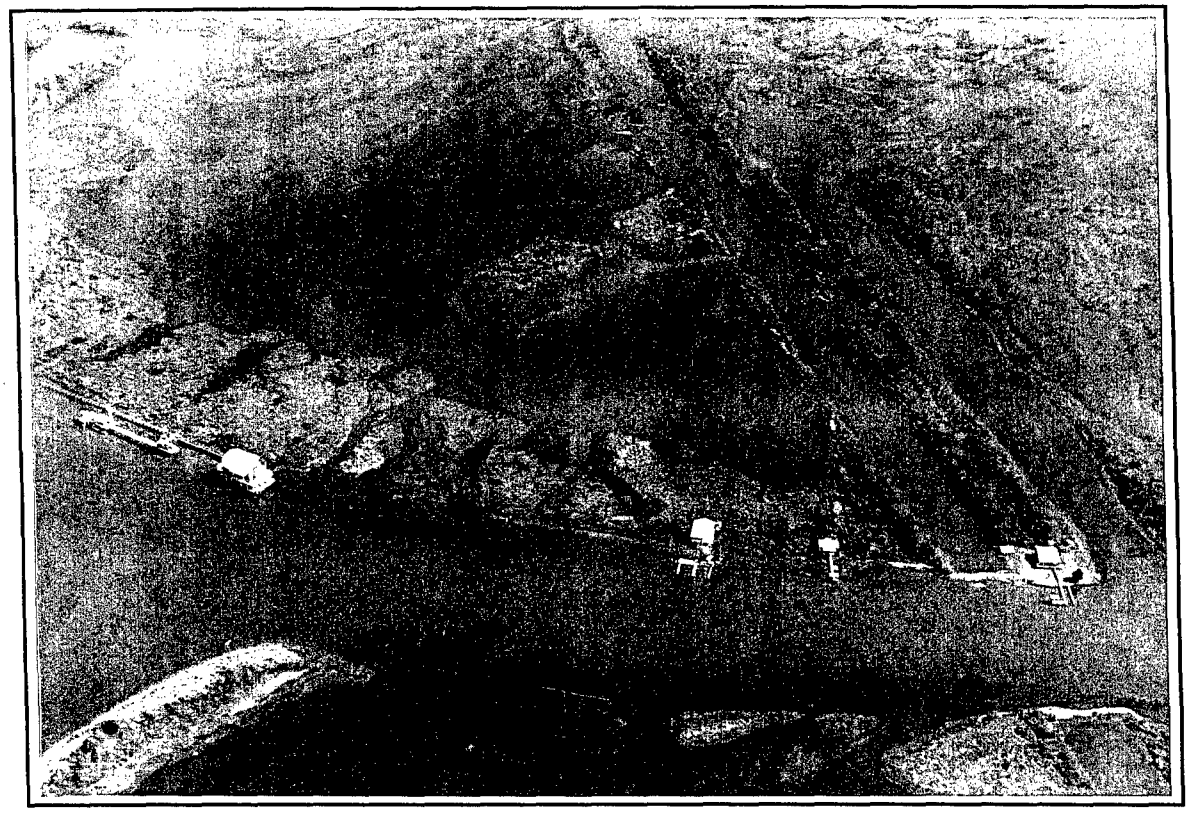


Figure 5-6. Camps along bayou at intersection with canal near Lost Lake, Terrebonne Parish. Date: March 11, 1998.

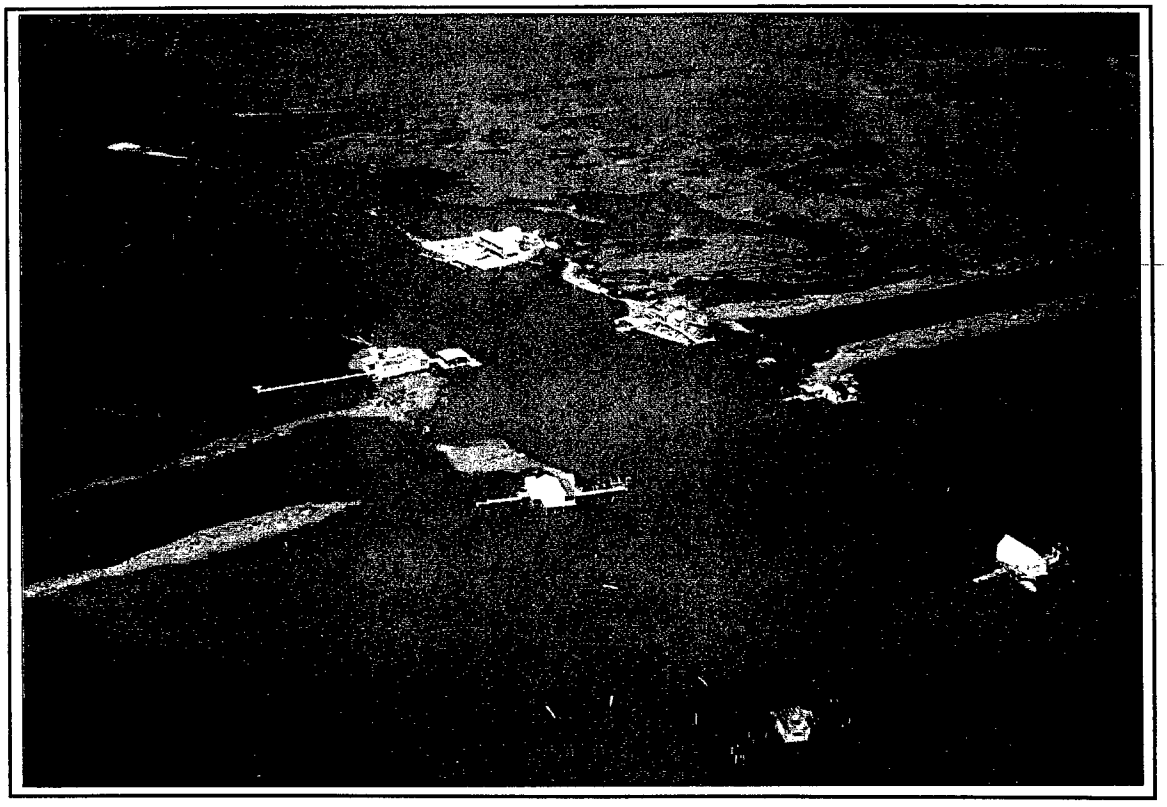


Figure 5-7. "Stranded" camps along subsided natural levees flanking Bayou Cook in Plaquemines Parish. Bayou Cook is oriented from upper left to lower right in photo.



Figure 5-8. Aerial view of oyster reefs along the south side of Marsh Island near the first point west of Mound Point, about two miles from Mound Point, facing northwest. February 1978 (source: Ory Miguez, Miguez Photography, Inc., Franklin, Louisiana).

APPENDIX A

INTERVIEWS

APPENDIX A-1

INTERVIEW WITH TED BEAULLIEU

By George J. Castille, III, Ph.D.
Interviewed at his office in Lafayette, La.

Note: editorial comments by George Castille are in brackets [ ].

GC: It's December 2, 1997, and it's George Castille. I'm talking to Mr. Ted Beaullieu. 9 o'clock in the morning in Lafayette, Mr. Beaullieu lives in Lafayette, and has a camp at Cypremort Point. Ok. You started to say something about your dad had a camp

TB: My dad's first lease at Cypremort Point was in 1935. And due to availability of getting labor out there, he and my uncle started their camps together in 1936, and actually completed the camps in '38, of which. Then we started occupying our camp at Cypremort Point, Louisiana.

GC: And you are living in Lafayette at this time?

TB: We are living in Broussard at the time. However, my dad's camp was located at Cypremort Point on the same lot that we still have now.

GC: Ok. Where you born, then, in '35?

TB: I was born in 1927. I was nine years old when, actually probably around seven when I first started going out there as a kid.

GC: So you were born in the big flood?

TB: Yep. One that started a lot of the messes we're in now, with floodways, etc.

GC: How often did y'all go out to the camp? Was this weekly thing, or...

TB: Weekends. My dad was working, and in those days a big big... We looked forward to the weekends, we'd leave Broussard at one o'clock on Saturday afternoons after he got off of work at the First National Bank of Lafayette, and actually got to the camp, I guess around four or five o'clock in the afternoon, Saturday afternoon. And we'd do some fishing, at which in those days there was truly a sportsman's paradise, because we had no Wax Lake Outlet, none of the levees had been built, so therefore we were not affected by the floodwaters that came down the Mississippi, because I do not know for sure whether or not when the other structures were built above the basin, which acted as a floodplain, and most of the water that came down the Atchafalaya just came down and dumped out into the lower Atchafalaya River, into Atchafalaya Bay. And back in 1927, Congress passed a Flood Act, giving the Corps of Engineers authority to construct various facilities or structures that would control water, flood-waters, and at that time the levee, east and west levees of the basin were built, actually the Atchafalaya Basin. And we were then protected to a certain extent because the waters were channeled through the basin and far out into the Lower Atchafalaya River and to the Atchafalaya Bay. And in 1936 the Corps of Engineers decided they needed another outlet or Congress instructed them for another outlet, I don't know which took place, and they began building what is know as the Wax Lake Outlet, which is what's

the release for Morgan City. And at that time the waters diverted to the Wax Lake Outlet and the Atchafalaya River, and through the Basin, Lower Atchafalaya River was 80 percent, designed for 80 percent water flowing through Morgan City, and 20 percent flowing through the Wax Lake Outlet.

GC: That's original design construction.

TB: That's original design construction, since that time it has changed and I think now the criteria is waters from the Mississippi River are diverted through the Morganza Locks Spillway, at a rate of 70 percent going down the Mississippi, and 30 percent coming down the Lower Atchafalaya River, out through the Basin. Through the levee system.

GC: Has the percent increased through Wax Lake Outlet?

TB: Yes sir.

GC: What is it now?

TB: This past high waters that we had in 1997, I think that around May or June we were getting 55 percent of the waters down the Wax Lake Outlet. And the remainder going through Morgan City.

GC: Has that had an impact on any anything in Vermilion Bay?

TB: Absolutely. Yes sir. We... I'll give you this. The bay systems as we refer to are Atchafalaya Bay, East Cote Blanche Bay, West Cote Blanche Bay, Vermilion and Weeks Bay. And of that area, which is shown on this map here, from Pointe au Fer, which would be this point here, which includes all of Atchafalaya Bay. This estuary comprises of the total saltwater estuaries in the state of Louisiana, this estuary of ours comprises it is 21 percent of this total saltwater estuaries in the state of Louisiana. And of the 21 percent, figuring on a study that was made in 1996 by Louisiana Wildlife and Fisheries, Mr. Jimmy Jenkins, and this was an independent study, shows that commercial fishing harvests was totaling 1.5 billion dollars a year, to the State of Louisiana. Now, if you equate 21 percent to this 1.5 billion, we in our bay estuaries, we should have reaped a harvest of should be a value of 315 million dollars a year. I'm going to give you this if you need it. And here's the study that tells you who they were and what have you, and this 1.5 billion comprises of your, all of your, shrimp and shellfish accounts for 70 percent of Louisiana's total commercial fishing harvest outside value, as well as the processing, wholesale, retail, and restaurants totaling 1.5 billion. That's where these figures and these are from this study by Southwick and Associates. Which was an independent study made by the Wildlife and Fisheries of which I will give you a copy of this.

GC: How has this area been impacted then?

TB: This area has been impacted I would say, in the last 1963, 1964, 19.., I have documentations of letters that were written by the Louisiana Sportsman, the Lafayette Sportsman's Association to the various Congressmen requesting help. Due to the amount of sulfates, phosphates, river-waters coming into the Bay system, which was very detrimental to the growth of the shrimping industry and the fishing industry.

GC: In other words, too much fresh water was getting into the Bay.

TB: Excuse me, too much river water, it's not fresh water, it's river water. Because of the temperatures of the waters coming out of the Mississippi all the way down from Minneapolis, Minnesota, or the Canadian border, actually, from where the Mississippi, the head of the Mississippi is, including all your twenty-two states that we are receiving these waters from. Down either Mississippi River to New Orleans, or down to our area, it has definitely formed an impact on the fisheries. And I would venture to say, and this figure's off the top of my head, this estuary today, instead of being worth 315 million dollars, I would say perhaps might be worth a million, or perhaps two million, I'm not, there's no way to documenting, no document to back these figures up. However, I have pictures of a fisherman that we interrogated going out; this old gentleman here who's from Cuba and been in the States for seventeen years and has been crabbing this area with his son, and he showed us crabs that he had harvested that morning and this was about ten o'clock in the morning, when we ran into him,

and he was taking up his traps, and the crabs were dead to the point where they would not live by the time he got them into the market. This is a natural study, that by going out and running this route around the bay system that we have, proof to this, and we just happened to run across this fisherman that was out there.

GC: Why were the crabs dead?

TB: Because of the amount of pollutants. I say pollutants: phosphates, nitrates, the bloom, the algae bloom.

GC: In the water. Where was this?

TB: This is, actually this was pretty much right out of The Jaws of the Intracoastal Canal coming into East Cote Blanche Bay.

GC: Ok

TB: Which was the first secondary to be affected. The first one affected was the Atchafalaya Bay. But from the Atchafalaya Bay and before the Wax Lake Outlet was there we had a reef system extending from Port au Fer to South Point of Marsh Island, which gave us some protection from these waters going because the reefs would act as a barrier for the river waters and the siltation, and the phosphates etc. that were coming down, and into the system. When I say the system, I'm saying the bay systems which is again, Atchafalaya Bay, East and West Cote Blanche Bay, Vermilion and Iberia, and Weeks Bay.

GC: So these, this reef system from Marsh Island to Point au Fer, this kept fresh water to the north and salt water to the south?

TB: Kept river water to the north and the reason it did that is because predominantly we have southeasterly winds from.... That affects the bay system. And this flows, and again I have no exact figures, but we're estimating about three hundred days out of the three hundred sixty five days where there is southeasterly flow of wind, now the southeasterly would be this way blowing right into all of these waters coming in.

GC: Ok, I think I missed something. So this reef system would have kept river waters north of ...

TB: North of, not go into the Gulf

GC: Not go into the Gulf, ok. And now this area your saying is open to the Gulf so it flows out into the gulf?

TB: No. What has taken place is, the state of Louisiana, unfortunately, allowed or allows shell dredging to go on and these shell dredges have come in and have taken out the reefs which it was a barrier that used to be a natural barrier that protected us from this invasion of the river waters. Because of the salt waters coming in and by the wind flows kept the river waters into the bay system and eventually began to the point of this.

GC: So instead of the river water, when the reefs were in place, ok, the river water stayed in here, right?

TB: Right.

GC: Now that the reefs are wiped out where does the river water go?

TB: The river water just flows as the wind is blowing. However before this in, like I said Wax Lake Outlet was not completed till '42, so therefore we did not have that much of an influx of river waters into the bay systems per say, other than Atchafalaya Bay, because the lower Atchafalaya River emptied into this bay system. It's a very complex situation that has taken place over the years.

GC: So, what has been the impact in Vermilion Bay then?

TB: The impact in Vermilion Bay is the algae bloom that has accumulated, and the amount of siltation has lowered, has raised the level of the bays from the depths of used to be twelve an average of ten to twelve feet.

Now the average of the bay system is about, East Cote Blanche Bay, I'd say the average areas that is still navigable is six feet. But there's some areas as I'd showed you here when we came out of The Jaws right here, for instance, this is a marker and this is where we came out of The Jaws and met this crabber and his son, and he, you see a, about half a mile, you see trees and the depth of the water here was about two feet at the most. It was clear, clear green water but no salt which told us that we were getting the effects of the river waters and the algae..

GC: So you're saying the East and West Cote Blanche Bay are slowly filling up now?

TB: East and West are definitely slowly filling up. The only way you can get from The Jaws to out to here, would be to go along this channel that they have marked, and if you, you cannot cut across and go where, these bays used to be navigable from anywheres from eight to ten to twelve feet of water. As I was a kid growing up and fishing in that area.

GC: Now, how has this changed, obviously you're talking about a long-term change, how has this affected the fishing in the area in your lifetime?

TB: The fishing in this area? As a kid we'd go out and fish with what we called slaughter poles, I can't use the term that we used to call them...

GC: Cane poles?

TB: Cane poles, right. We called them cane poles or slaughter poles, and we just fished right off the banks before our pier was built and finished at Cypremort Point, and we would catch any variety of saltwater species that we could possibly catch. Speckled Trout, to name a few, speckled trout, red fish, drum, flounder, white trout, naturally sharks.

GC: And can you still catch that kind of fish at Cypremort Point?

TB: Absolutely not. Only at a certain period of time during the year when the waters reach a level at Butte la Rose, which is Atchafalaya River, markers that we use. When it reaches there that's two feet, we're not getting any flow from the river waters coming in, and if we happen to sustain, we get weather that sustains, and gives us south, southerly winds, and south westerly winds, blows the salt water into the bay and because of the turnarounds of the fronts that comes through above the water out of the bay and then the waters coming back in we eventually get an influx of salt water from the Gulf. Which actually, by the time it gets into the mixture of the waters we have, the river waters that we have in the bays, we actually have saltwater estuaries, which are better known as a brackish water because it's not completely saltwater.

GC: So when the Atchafalaya stage is high, then Cote Blanche Bay, Vermilion Bay, are fresh water, predominantly?

TB: River water

GC: Well, river water is fresh water

TB: It is fresh water. Fresh water is not, the difference, river water as we see it as I've studied, it is because of the temperatures of the waters coming down the Mississippi from up north, we have, it curtails the growth of the shrimp, growth of the fish that are spawned in the Gulf, come into the estuaries to grow, and into the marshes too, and then they move back into the bays to grow and to mature, and then the cycle would be for them to go out into the Gulf. But that cycle is completely destroyed.

GC: Ok, so what kinds of fish do you catch most of the year?

TB: Most of the year? Catfish.

GC: Catfish

TB: If you catch any of those

GC: So that's how...

TB: That's how detrimental it's been to our bay system, our estuaries.

GC: Are you familiar with the Caenarvon water diversion?

TB: Somewhat, not enough to be able to speak intelligently about it.

GC: That's off the Mississippi on the other side

TB: The east side, that's right.

GC: There've been a lot of newspaper articles I've noticed about the improvement of fishing in the Caenarvon area as a result of the fresh water diversion going into the marshes there. I was just curious as to why that would be different from this area here.

TB: I would say that probably the reason for that is the, not directly affected by the temperatures of the water that by the time it gets to the Caenarvon or whatever system that they have and claiming that the fisheries are better there, is because of the temperature of the waters.

GC: The temperature of the water?

TB: Yes sir. The temperature of the waters coming down the Mississippi River is the biggest detriment that we have and that's the reason we refer to it as river water.

GC: So you think it's colder here than Caenarvon?

TB: I would think it's much so, because by the time it gets from wherever they're diverting this water to get into the Caenarvon area is it has a temperature, it drops some of its phosphates, nitrates, sulfates and the temperature changes by the time it gets into that area, therefore you would not have the same type of effects that we are receiving here due to the Wax Lake Outlet and the Lower Atchafalaya River influx into our bay system.

GC: Do you know, are you familiar with the marsh areas, fishing in those... do you fish those areas too, or...

TB: Yes sir, we used to fish in the bay system, we used to go into bayous that we were able to navigate in with in those days outboard motors, that type you wouldn't have electric starter to it, you would have to spin it or pull a rope to get it started, and which no longer exists today because of the siltation that has taken place from the gradual..

GC: So these marsh lands bordering Cote Blanche Bay and Vermilion Bay, the channels along going to the marshes are filling up too?

TB: Silt, yes.

GC: How about the fishing, is it, has that changed at all in there?

TB: Completely, there's none existing. There's no place for them to come in.

GC: The fishing isn't good in these areas now?

TB: No sir.

GC: How about...

TB: Only other than that specific time in October have we witnessed this, and I have proof of that, and I can show you a picture here that was taken on the back of, if you don't see it, but this was taken of speckled trout that was caught off of my pier in 1986 and 1987 and the reason it was, is because there was warm weather up north, no snow, a dry season, and therefore we were not affected by the river waters, therefore the waters remained brackish in Vermilion Bay, now this is right in front of my camp as you can see the pier that we fished off of and here are speckled trout and red fish, and striped bass that we caught, then, due to the fact that we did not receive any river waters into our bay systems, because of the drought up north, the weather warmth in '86 and '87, and that's historical, it's proven fact, I've got these pictures dated.

GC: When I was a kid, I remember, people used to shrimp in Vermilion Bay, I don't know how much shrimping occurs there now. Is that still pretty common, or people shrimp farther out or what?

TB: The shrimping, for instance this season we tracked it pretty closely this year, because of the amount of river waters and because of our bays being devastated and have been, due to the river waters. When we went out this particular day the shrimping season was open, there was no shrimp boat whatsoever in Atchafalaya Bay, East Cote Blanche Bay, West Cote Blanche Bay, and very little in Vermilion Bay, which was somewhat protected from the river waters. And due to Southwest Pass giving us a little bit of an influx of salt water from the Gulf....and warmth.

GC: So there was some shrimping in Vermilion Bay

TB: Very little shrimp.

GC: So where do the shrimpers go now?

TB: They go out into the Gulf

GC: Into the Gulf.

TB: They have to go out into the Gulf.

GC: And how long, you have any idea how long, I realize you're not a shrimper but it seems to me that years ago people used to do a lot of shrimping in the bays, that has obviously declined...

TB: Yes. When I was a kid, when we were able to afford a boat we had, and we used to go shrimping and most of the people that were not necessarily commercial fisherman would buy sixteen-foot trawls and go out and trawl. In those days it started at midnight and my gosh, it was completely chaos.

GC: That does not occur now?

TB: This does not occur whatsoever. The people that go out there now and the shrimpers that come in, they raid the bays in one weeks time, of whatever shrimp that might be inside, in the bay system.

GC: Do you have a feel for when that change occurred? When people started giving up on shrimping in the bays?

TB: It was a gradual change when the, it began when the Wax Lake Outlet began to flow, not immediately, because it was opened in 1942, and we caught fish in the bays into the sixties. Because there was shrimp, there were oysters, there was food for the fish to come in and stay in the bay system and to be able to exist and live off of. So in the middle sixties, late sixties, say 1970, we really started feeling the effects so much so that that's when we had the correspondence with the various congressmen for Louisiana Senators Ellender, Edwin Willis from St. Martinville, Long, Congressman Hebert from Houma, and all the way down. In fact at the point where in 1973 there were proposed a jetty to be built from the Wax Lake Outlet into the three mile limit of the state waters. And that way we were hopeful, they were hopeful at that time, I was a young fella but I gave testimony

at the hearings that they had in those days, where what has happened, the same as what I'm telling you now, what had happened to our fisheries.

GC: Do you know if there are any oysters being grown in this area?

TB: None whatsoever. Again I refer back to 1986 and '87 when we had this salinity, the brackish waters in our bays, the oyster spats began to take, the oysters began to accumulate and began to grow again.

GC: So there are no leases that you know of

TB: Not inside the bays, no sir.

GC: Vermilion, West Cote Blanche, or East Cote Blanche?

TB: None whatsoever because they're just throwing good money after bad money. All your leases are outside of Marsh Island and outside of the pass.

GC: With reference to Marsh Island and some of the other coastal marsh areas, how has this increased sediment that you're talking about, how has that affected the erosion, do you have any feel for that? Has it decreased the erosion or is it still eroding away? I know Marsh Island is a concern for a lot of people because it was a lot bigger a hundred years ago.

TB: Yes it was a lot bigger and it is definitely, because again, say from the lack of, and I can show you pictures, lack of some of the reefs that were there at the time. [he shows aerial photos of oyster reefs] Here's Mound Point in February of '78.

GC: This is off of Marsh Island?

TB: This is Marsh Island here. [he points to photo] Here's the reefs that were there.

GC: These are natural?

TB: Natural reefs.

GC: Natural oyster reefs?

TB: Right. Now what has happened to those reefs, some of the sedimentation has covered these reefs and some of these reefs have been blown away from storms. That would be this in here [he points to photo]. See all these oysters reefs?

GC: To the south, and the Shell Keys National Refuge Area?

TB: Shell Keys, National Refuge, this is South Point, this is East Point, and you see we got reefs in here and these reefs used to extend all the way to, except when the state allowed them to start dredging shell, oysters.

GC: Ok, this is the South Point?

TB: And this is East Marsh Island, east point of Marsh Island

GC: So this is, where is Shell Keys?

TB: This is Shell Keys, all of this is..

GC: This photo is of Shell Keys, I got you. Are these there today? Are the reefs, are they exposed?

TB: They're not exposed, only at a very low tide are they exposed, yes.

GC: Low tide. Do you know if they're viable if there oysters growing?

TB: Yes, yes, definitely. Because they have the salinity from the Gulf and not the river waters affecting them. Because the river waters do not have a chance to get that far around because they go on into the bays, due to the predominantly southeasterly winds.
This area here, with your southeasterly winds, it blows it right up the slot. But some of the sedimentation has gotten in there and some of the areas have been blown out, and some of these reefs, someone has gone in there and dredged out, whether they have permits or not, we don't know, it's hard to say. Nobody ran tracks of that other than... This is another picture of Shell Key. Now that's showing you the reef completely exposed.

GC: That's a nice shot, a nice photograph.

TB: This is another one of the same thing. That was done by Mr. Ory Miguez

GC: That guy from Franklin?

TB: Franklin, right. This is another picture here

GC: Wow, that's a beautiful picture.

TB: That's how I got them, and you see it has some cuts in there, where you can get into these areas and fish.

GC: 1970's?

TB: This is in the '70's, right. But this is actually a photo of 1978, and it shows you where these reefs were deteriorating. These reefs used to come out of the water, were predominantly out of the water all the time.

GC: 1978. I'm going to ask him if I can get a copy.

TB: He'll give you a copy of it, he'll charge you. Maybe he won't.

GC: I'm not worried about it. This is something that is really useful, and shows something important, it's worth getting, and it really shows the reefs very well, and it shows that beach. That beach front barrier island.

TB: This is evidently taken at a low tide, because today at a mean tide they don't come out of the water. You got to know your way around to be able to get into these reefs.

GC: Yeah, I understand. It's a beautiful, beautiful picture.

TB: This shows you a broader view of the reefs, and how far they extend out. Now, coming back to reefs, at Cypremort Point and Vermilion Bay, we had what was called a dry reef, which extended out from Cypremort Point out to the middle, two miles off shore, in the bay, and it was exposed as a kid, nine, ten, eleven years old, I fished off of this reef, and it came out of the water four feet at mean tide, it stayed out of the water constantly.

GC: That's that old Cypremort Point Ridge from that old channel

TB: That old channel, same one that went out to the pass. Now, eventually, with the flows and the reefs being eliminated here, constant winds and hurricanes and storms, etc, eventually knocked these reefs down. And at the time, we used to eat oysters off of these reefs.

GC: The ones off Cypremort Point?

TB: At Cypremort Point, on dry reef. We'd go by boat, and go round and get out and we would wade, fish, as though you were on shore. And in those days, I'll never forget my dad used to tell us to wear long pants when we'd go out fishing, well we always knew better, but he wore some old coveralls, and he'd put his shrimp in his

pockets, and line to tie his trout on, and we would go out in high top tennis shoes so the oyster shells wouldn't cut my legs, but the man o war and because of the jellyfish and the man o wars that were in there would wrap around our leg, and we'd run like heck up on the reef and try to scrape the man o wars and they'd form big welts around our legs. And the only thing we could use were shells to scrape the fish, I mean the man o war, off, to get the sting out.

GC: I know that hurt.

TB: Yes it did.

GC: Are there any people living at Cypremort Point?

TB: Yes sir.

GC: Was that always the case?

TB: No sir. There was, when we first started going out there, there was one caretaker, a fellow by the name of Bill Walker, William Walker. And he was the caretaker for the Morrisey(?) family, who owned the property at Cypremort Point. And this was back in the late thirties, again, I come back to, because the first time I spent the night at Cypremort Point was I think in '36 or '37, and Bill Walker had a camp where people could come sleep there and spend the weekend. And he had a long pier that if you wanted to go swimming you could walk out on the pier and go into the water for bathing.

GC: And then people built camps out there, weekend camps?

TB: Weekend camps, as it progressed.

GC: Now, you have any idea how many people live out there now?

TB: I would say the population of Cypremort Point permanent residents there, I would say would be in the vicinity of two to three hundred people. And this is just the opposite of people leaving an area, but coming into an area, because of its ability for fishing and recreational purposes.

GC: So people are moving into that area.

TB: Camps are being built. You cannot buy a campsite at Cypremort Point today.

GC: Why not?

TB: Because the people are hesitant to giving it up, hopeful that we will get the jetties that we're trying to get the Corps of Engineers to construct for us, so that it would form a barrier and protect, come up, give us back the original barriers we had with our original reefs.

GC: What do most people do who live there now? Is it a retirement community, or fishing?

TB: Somewhat retirement, but they do fishing, they go out fishing into the Gulf. They have to fish the Gulf, other than the times late in the season, in the fall, when the water happens to get good, when the water is down to where the river waters are not affecting certain areas of Vermilion Bay only.

GC: Are there any commercial fisherman that live there, that you know?

TB: Yes.

GC: And what kind of fishing do they do?

TB: Well, primarily they're doing, a lot of them have resorted to becoming, most of the commercial fishermen I ask these questions directly, is shrimping. And they do, before the ban was put on the types of netting that they were using, the association was formed, better know as the Gulf Coast Conservation Association, started investigating what was happening to our population of fish, in addition to the river waters not allowing them to grow, etc, come to find out there were a bunch of these gill nets that were put out that were just killing the fish. The laws were that they're supposed to tend these gill nets, and you would think that the commercials would have seen to it themselves and now only today do they realize what has happened, what they've done to themselves because of the type of netting they were using. We had a meeting, the Bay Association we call ourselves, the Bay Association has formed a group of about four or five thousand people, and we've even gotten the oyster people to join, the commercials, the commercial fishermen, the shrimpers, and what have you, they also belong to this group, and at the last meeting that we held with the Corps of Engineers in Lafayette, about three months ago, we had over two hundred people attend it. That meeting including the commercials.

GC: Are gill nets legal now?

TB: No sir.

GC: They're outlawed in Louisiana?

TB: They're outlawed in Louisiana. And they're outlawed in Florida, what really hurt our area, for whatever amount of fish that we used to get was speckled trout was when Florida and some of the other coastal states banned the strike netters. Well they moved from Florida and would come into Louisiana and if you happened to be fishing well you might be able to catch some fish at a late date of the season. They'll come in there and just surround you and take all them out, and most of them were from Florida.

GC: Strike fishing, what kind of fish were they catching?

TB: Speckled trout primarily. And that's the reason why we went to the CCA is well known today, CCA is the Coastal Conservation Association was able to get the legislature to pass laws banning strike netting in our waters.

GC: Is mullet fishing, is that a form of strike netting?

TB: That's a form of strike netting, and it is has allowed to go on around, that was a deal that was made when Edwards was Governor because some of the commercials over on Houma and that area were catching mullet, and the roe of the mullet was shipped over to Japan and was a big item, like two hundred dollars a pound, for the roe of the mullet.

GC: Is there mullet caught in the bays?

TB: Oh, we might, we seldom see any mullet in our area because of the devastation of our bay system.

GC: So this is not a mullet area. They're mostly to the east?

TB: To the east, because they do not have the river water that's coming into their area, like we have.

GC: Ok, in, you mentioned strike fishing, that's been outlawed?

TB: You cannot strike fish with any strike boats or nets

GC: Now what is strike fishing, that's, you go into an area and throw out a net?

TB: It's boats equipped with your motors are centered in the middle of the boat, and then you take your nets and drop them off around, and go around in a circle, and wherever you see the birds going, wherever they might be trout feeding, they'll go and surround that area and rape, catch all kinds, whatever's there, they'll catch and

kill, other than the trout, and they'll take off and go and sell that. This is what they used to do. Now that we got the laws passed, it disallows that.

GC: So it's a shallow water method, just used in shallow areas?

TB: Yes. The old methods used to be the seining, where you'd walk from the shore and go round in a circle and four or five people would hold on to the seine and walk ashore and bring in the fish. This is a method that was learned over in Florida and Florida banned, disallowed it, the state laws, and so did some of the other states. And we finally did it, a couple of two or three years ago.

GC: You mentioned a motor, boat motors in the middle of the boat, have you ever heard of the term well boat?

TB: No.

GC: Ok, I did a little study in St. Benard/Plaquemine Parish area, mullet fishermen, they have two types of boats that they use for this type of strike fishing for catching mullet, and one type boat had a motor in the middle, very middle of the boat, and was referred to as a well boat, and the second type had the motor on the rear, but to the side, in a corner, so you could work off the rear, with a little board that poked out to keep the net away from the propeller, and they call those side winders.

TB: Side winders?

GC: Well boats and side winders.

TB: Other than positioning of the motors, I only knew it as a strike netter's boat because it did not interfere with the props and they were able to circle round.

GC: Well, it seems obvious that there are not many in your area anyway

TB: Not any more. Thank goodness for the laws that were passed.

GC: Those are more common to the east.

TB: Mullet fishing is still allowed in that area, the strike netting.

GC: But mullet fishing is not allowed in this area?

TB: Well, we have none. It's silly for them to buy a license for mullet fish in our area because of again, the devastation of our bay system due to the river waters.

GC: One of the things you mentioned a few minutes ago was there are some commercial fishermen living in the Cypremort Point area, and most of those are shrimpers, do you know what the others do? What type of fishing, are there any crabbers?

TB: Oh there's crabbers out there too, but they again, something will have to be done to that because the people that are crabbing out there are crabbing 365 days a year, twenty-four hours a day, so the other, the only time they pull their traps out of the bay system, is when the shrimp season opens, as you well know they got various areas where they have shrimping going on, the east zone, the west zone, those zones, and when they do that, well the commercials, crab commercial fishermen remove their traps because they will get caught in the shrimpers' trawls. And that becomes a big battle,

GC: Between the crabbers and the shrimpers?

TB: Right. There's been some guns fired across the bow because of that.

GC: That's interesting, but there's more shrimpers than crabbers in that area?

TB: Well not any more. There's more crabbers than shrimpers because the shrimping has dropped off to zilch.

GC: Ok, but living at Cypremort Point?

TB: Living at Cypremort Point, ex-shrimpers that were there are going out off-shore and they have, their numbers have not increased, only the families that were there fishing years ago as they were born and brought into the system of commercial fishing, they still have a fleet there of local boys.

GC: Are there any other types of commercial fishing that you know of that's going on besides crabbing and shrimping in the bay system?

TB: In the bay system, no.

GC: How about off-shore?

TB: Off-shore there's a lot of shrimping going on, there's fishing, I mean crabbing and shrimping and oyster.

GC: And oyster

TB: Yes sir, just out of the pass, just out in the Gulf.

GC: Are there oystermen living in Cypremort Point?

TB: Yes, there's an association of oystermen that, I think they're headquartered in Franklin, but they also have their leases outside of the pass so they move, through the oyster season they work them. In fact Mr. Bacala,

GC: Do you know how to spell that?

TB: Bacala. B-a-c-a-l-a, in Franklin, he heads up the...

GC: You don't have an address do you?

TB: Fact, he just sent me that. Maybe it would be 4814 La. 83, Krewe of Cypremort Sippers, this is for...

GC: That's not oysters?

TB: No no, this is not oysters, this is they call themselves the Krewe, he heads up the Krewe,

GC: Ok but his address.

TB: His address would probably be this address here

GC: 4814 La. 83, in Franklin

TB: He heads up the oyster association in the state of Louisiana

GC: Oh

TB: This same gentleman, due to the work that we have been doing, trying to conserve and bring the bays back by going for the jetty and going for the, keeping, trying to keep the river waters out of our bay system, he saw fit to join our organization, as a commercial, and we were predominantly recreational fishermen, but now we have a good mix of recreational as well as commercials, whether it be oysters, crabbers, or shrimpers.

GC: That's the GCCA?

TB: CCA, we're known as CCA, Coastal Conservation Association.

GC: And it's just Louisiana?

TB: No, it's nationwide, it used to be the Gulf Coast Association which was Texas, Louisiana, and Florida, and Alabama, and Mississippi, but now each one of them, we have become one association individually in each state, but as the Coastal Conservation Association.

GC: Is there a head quarters here in Louisiana?

TB: In Baton Rouge. Fellow by the name of Jeff Angers, A-n-g-e-r-s.

GC: That's a good New Iberia name.

TB: Right. His dad, they were really from Jeanerette(?) and his dad used to be an editor of *The Franklin Tribune*.

GC: Ok, I may give him a call.

TB: You can call Jeff in Baton Rouge, he can give you a better history of the Coastal Conservation Association and our fight trying to preserve.

GC: Well, it'd be good to get his perspective too. That's what I'm trying to do, is get, talk to as many people as I can, particularly people who have been around a long time and know changes that have occurred.

TB: Well, he can give you the statistics on the fisheries, because they're.

GC: Ok, back to Cypremort Point, all the camps and houses are on stilts there?

TB: Those that have since the hurricanes, yes. Those that have had to rebuild are now off of the ground.

GC: How high are they usually?

TB: Mine, for instance, before they passed the law having to be twelve feet above water, mean tide, or ground level, mine happens to be ten and a half or eleven feet, only because there was no rule to do it. I just chose that number because of having witnessed Audrey, my camp would have survived. There was only one camp that survived, and, because it was on stilts, at about an eight or nine foot level, but I went to a ten foot level on mine to ride out the hurricanes.

GC: There was more than Audrey. There was Audrey, Hilda...

TB: There was a bunch of them, but Audrey's the only one that wiped out Cypremort Point completely, excepting for one.

GC: Really?

TB: Yes sir, and that was in '57.

GC: Yeah, I remember Audrey.

TB: We happened to be on the western [eastern?] quadrant, it hit Cameron as you well know, and we had a surge, a tidal surge there of about fifteen feet.

GC: There are several I remember as a teenager that hit, Betsy of course in '65, then Hilda, Carmen

TB: We had Juan, we had a bunch of them.

GC: Juan was a little later.

TB: Juan was one of the latest, other than Andrew, Andrew was the latest.

GC: Andrew was pretty bad.

TB: But we were fortunate at Cypremort Point, we happened to be on the eastern [western?] quadrant, and it passed between Franklin and this area here, went just about right up Wax Lake Outlet, almost, way up into the east side of, west side of Franklin, in fact Franklin was in the eye I think.

GC: So you were on the

TB: We were on the eastern quadrant, I mean the western quadrant, which did nothing but suck all the water out of the bay, and we had nothing but wind and rain damages, in fact the branches busted my roof so I had to build a new roof onto my cabin, and the waters were blown in from the velocity of the winds and the rains, under my, soaking, around the perimeter of my camp our porch on the front, and the water just got underneath my carpeting in my camp, and it got into the subflooring, which buckled due to the waters that were there, and I had to change, take out everything and change all of my flooring.

GC: Are you familiar with Lake Peigneur, Jefferson Island, and Delcambre Canal?

TB: Yes sir, when Texaco

GC: Remember that, Texaco, is the water there saltier now?

TB: No no, there's no salt at all.

GC: One of my brothers who fishes a lot in the bay, said that for a while, they were catching red fish in that lake because of the, it had sucked all the water in from the Gulf and also because of the exposure to the salt dome, that it was saltier environment.

TB: Well you see, that's the natural, and this is the reason why we're trying to get our jetty built, and a structure in GIWW or Intracoastal Canal, to keep the river waters out of this area, because without the river waters, if we could keep the river waters out it would not take long, as I've showed you with this picture here in '86 and '87 dry spell that we would get. But you see the natural flow is for the oysters, the shrimp, the fish to spawn in the Gulf, and come into these estuaries, providing they're brackish water and conducive to, and the warm waters of the bay systems, and into the marsh. And it's not uncommon for those same marsh areas going into Delcambre, where you have red fish and speckled trout in these canals, due to the workings of the currents, in and out. When they come in to spawn, after the spawning rather they come in to grow and mature. They come in from the Gulf, into the marsh area, after they're born, they move in there to grow, and once they're to certain size, they move into the bays and grow. But because of the river waters, that has predominantly messed up our system completely and devastated our estuaries, that that does not happen as much.

GC: How bout the phenomenon of coastal erosion and the long term impacts of that. What do you think that's going to be on the Cypremort Point area? Subsidence and erosion?

TB: Well, I could show you pictures again of Cypremort Point, and this is early sixties. This is what is known as, we used to call this Mud Point. This other finger went out as far as, this is Cypremort Point, and this other finger went out and you can see some of the leases.

GC: This one right here? Dead Cypress Point?

TB: Dead Cypress Point. We used to call it Mud Point, cause we used to come around here and go fish right off of here, but as you see here, but as you see here it's broken, well this finger came out as far, both of these came out, other than, because of erosion has cut it the size down and this is completely gone away.

GC: Well eventually this whole area at Cypremort Point is going to sink into the Gulf, I mean it's going to take awhile, but eventually it's going to happen. What do you think is going to happen to the people who have camps out here when that happens?

TB: I don't foresee, why do you make the statement that eventually it will sink into the Gulf?

GC: Well because the coast is subsiding, the entire coastal area. I mean historically that's what's happened. It's a continuing process, it's a geological process. It's a very slow process, but eventually this area, unless there's a new way to get sediment to build this area up, it's going to eventually sink, most of the coast along Louisiana, the Louisiana coast is going to sink. I'm just wondering what's going to happen, when that, to the people who have camps and live there and so on. As this area starts...

TB: Well I guess, they won't have any choice but to move out to. [end of tape]

[tape 2]

TB: This is our pier here, and the shoreline since the pier was built. We had a hundred foot off of the shore.

GC: So you've lost a hundred feet?

TB: Say a hundred to a hundred twenty-five feet, I really don't know the exact dimensions, but I would say that since we've, I've been keeping track of it, we average about a foot a year, due to erosion.

GC: A loss of a foot a year.

TB: Yes sir. And this takes place when the cycles of the winds, when they come from up front, the north wind blows right into the bay and beats it up. That happens and then it goes to the east, and when it goes to the east, you get your southeasterly winds that blow the tides up and gives you high tides and this starts out as you go around the cycle, the water moves to south, and to the southwest, well your tides are still in. Then when it moves to the southwest and to the northwest, then you have a high tide, and we've lost parts of our piers throughout the years, due to that cycle, and due to the winds knocking the piers down, just sections of it, that we had to rebuild.

GC: Has there been much land loss on this side, the east side at Cypremort Point?

TB: Yes. This gentleman here [he points to air photo] that bought this, he had put a bulk head all around the pier as you well see, and this was back in around '60, that he bought this and built this canal, dredged this canal and these slips, and his was the only camp out there with a pier on the end of the point.

GC: That's on the east side?

TB: No, that's on the west side of point. I'm going to show you a picture [shows on photo], this is from the east. This is that camp and you see the dredge boat actually operating in there? But this is the only camp, you see, they had this camp which is right here, they had this boat house, right here, and then another boat house, and another boat house, and this other camp, they didn't even have a pier there. And if you look right now that water line, I guess the road is still there and I guess they got about fifteen feet of land. It was eaten away.

GC: So the land that was behind the bulkhead is gone.

TB: It's gone and the bulkhead is gone too.

GC: Ok so they have a new bulkhead now?

TB: Some of them have bulkheaded to protect what they have. Or they put a lot of riprap to keep the water from washing away the land.

GC: Again, this is erosion on the west-side.

TB: The west side.

GC: Ok, and the east side, this big marsh area, is it has any of that gone too?

TB: Well yes, that's what I was telling you when they had this picture here, that's all gone. See Mud Point or as it's referred to...

GC: Dry Cypress Point, Dead Cypress Point.

TB: Dead Cypress Point.

GC: That's gone?

TB: That's gone. You have what is known, what we used to, this used to be Hammock, it wasn't a bay, it was a cove, Hammock Cove, and that led into Hammock Bayou, and went on into, let's see if I can show it to you here, it shows it going out to here, to a certain point, but anyways, there's a lake right in here, no I'm sorry, on this side, that's the reason it's not showing, and it's not showing over here either, but we used to have a lake, I forget the name of the lake, but it's so silted up that it's not navigable any more.

GC: Did you take these?

TB: No, that was taken by the gentleman that the developed this, Mr. Cross.

GC: Is it James P. Cross?

TB: James P. Cross. He's the guy, now he's dead now, but his son...

GC: He was an engineer I think?

TB: Yeah, he did a lot of work for the Corps of Engineers and most of it was construction, piling and what have you, all over the country, Florida, etc. and the Keys,

GC: This is a nice aerial. I remember his office, I was raised in New Iberia. I remember his office building, James P. Cross

TB: Now his son works for, Acadiana Travel Agency. And he worked for his dad on jobs.

GC: I wonder if he's got the negatives, these are nice photos

TB: These came from his sister, and the fella that bought one of the camps out there Jed Flemming, he found those in his camp, and he had them enlarged and he gave me a set that he had, and they came from Cross, taken by Mr. Cross. And this is dated around 1960. The old pier of the caretaker, Bill Walker I spoke to you about, this used to be, this is where his place was.

GC: It went out a lot farther too.

TB: It went all the way out, see theirs was the only one out there.

GC: The beach is down this way I think.

TB: The beach would be in the cove.

GC: I remember when that was first put in.

TB: The beach would be, it was about right in here, this was in the cove.

GC: Is it still a beach?

TB: Yeah, it's still there. Still got sand, I don't know if they have to go back and pump some more every once in a while, losing it or what.

GC: Ok,

TB: But, the Bay Association, which was formed out of concern for salvaging East and West Cote Blanche... Atchafalaya Bay is just about gone, it's all silted up, in fact the wildlife, US Wildlife and Fisheries now have... It's all silted up and all this is more or less silted up, and by getting, if they want to build land, this our proposal, not our proposal, this is what we're trying to get the Corps, the Corps... We're trying to get them to build this jetty as I show on this from Point Chevreil. [he points to a map] This, it doesn't necessarily come out in this way, if they were to point, to come out an estimated twelve miles, it may go out a little longer, depending and coming up about four feet of water, which would give us, the reef systems we had before, and the protection that we have, which would keep all of the river waters going out into the Gulf, and all of the siltation and everything that comes down the river and everything, would be put back in here, and then you'd have your land building, which is taking place already here.

GC: In the Atchafalaya

TB: In the Atchafalaya Bay, right. And as far as us, the people that have camps at Cypremort Point, we just have to protect it ourselves with build our own bulkheads. I have a bulkhead in front of my camp, that three or four camp owners have gotten together and I guess that length of it was probably four or five hundred yards, and mine for some reason or the other, is the only one that lasted and I've got about, I've kept taking care of it however, I must say this, that I continually take care of it and had pilings redriven, and shored up, the bulkhead that I have, but I've got about ten or fifteen feet of land in front of my camp that my sister does not have right along side of me.

GC: So when you build a good bulkhead it works, huh?

TB: Yes sir, and actually it was Walker Folse, at Coastal Timbers out of New Iberia, you probably know that name, too. Folse, F-o-l-s-e. But he's the one who built up bulkheads, and he's the one who built most of the piers out there. After Jimmy left this area and went to work and doing all the work for the Corps, well then he, Walker Folse at Coastal Timbers took over. And I think he worked in conjunction with Jimmy at one time, years ago.

GC: Is Cypremort Point the biggest camp area around here?

TB: Between Big Lake in Lake Charles, and Cocodrie, yes. It's the only area.

GC: So there are no other big camp areas, like along Bayou Sale or...

TB: No. Bayou Sale has a road coming on down through it, but that's business point, where the landing is, jumping off point I guess

GC: I remember, we used to call it Burns Point, it's labeled Salt Point here.

TB: Yes, Salt Point, but it's actually known as Burns Point today.

GC: Yeah, I remember that.

TB: Now, in this area here, you cannot navigate this, due to the siltation.

GC: The Wax Lake Outlet dellta?

TB: Wax Lake Outlet. You have fingers that are going out that people... cause I've hunted out there.

GC: The delta's building.

TB: The delta's building. That's why, by giving us a jetty here, and protecting Marsh Island, and letting the phosphates, sulfates, whatever, go out into the Gulf and mix with the saltwater, it keeps the river waters, and the saltwater would overcome the river waters, and the temperature of the Gulf would overcome the river, and would not be a detriment to the fishing industry in this area.

GC: Has the Corps indicated any plans?

TB: They're weighing the plans right now, of getting prices on that and we've been negotiating with them and we've been, they have formed a western study group of which I belong to, and co-chairman of the western study group for this area and fellow by the name of John Zimmer in New Iberia, is the chairman of the western study group and he's the only one that votes at these meetings that we have with the Corps.

GC: Yeah, I spoke with him on the phone. In fact, I'm supposed to go by his office this afternoon.

TB: He's a fine fellow and he knows what he's talking about cause he's really a study at this area, cause he has a spot at Cypremort Point and the irony of the whole thing, I don't know if this you wanted to come out, but I don't mind saying it, when we first got interested in this thing three years ago, we went to the Wildlife and Fisheries when, actually Jimmy Jenkins went in there, before that we had no allies over there. We went in there and Jimmy put us in with some of the biologists and that he inherited from the state from the previous administration, and we were told point blank at that meeting, that we'd just make up our minds to catch catfish, and eventually no fish at all, go fish in the Gulf. They'll give us a channel to get to the Gulf. In other words they're going to let it fill up. Now, that's the big picture, big picture I guess is to build it up but we hopefully we can salvage our estuaries.

GC: I understand that point of view, particularly since Louisiana is losing so much coastline, any area where the state can gain land, they view as a positive thing. With every positive comes a negative, and I certainly see what you mean.

TB: There's a price.

GC: Yeah, there's a price for everything, and even with Caenarvon and that area that I mentioned, there, fishing has improved in the area, but its impacted the oystermen, because they're having to move farther out than they planned, so the areas where the oystermen had leases are now too fresh to grow oysters, they have to move farther out.

TB: Too fresh for the, see you have to have a certain amount of salinity in your parts per million.

GC: It has to be brackish.

TB: Brackish, and that's all we're trying to get back here by having, by diverting the river waters down into the Gulf, which would give us our brackish water.

GC: It's too salty for oystermen anyway, the predators come in, if it's too fresh the oysters don't taste good and the oysters eventually die, so it has to be in a certain range.

TB: Well, within this area era that I'm talking about between 1938 and present day if you will, we have, I have witnessed the deterioration of the fishing due to the lack of salinity in the waters and mainly brackish water. It was never known as a saltwater bay, it was always a brackish, and brackish bays give you your ultimate for your fishing, your spawning, coming in and moving in to grow as well as your oysters.

GC: Well, that's certainly an interesting area. It's one that I'm more familiar with than any other because I've been to Cypremort Point as a child, I used to go out there camping and stuff in Boy Scouts, and Cote Blanche Island.

TB: How old are you? May I ask?

GC: Forty-seven.

TB: Forty-seven. Let's see I'm seventy-, I'll be seventy-one, but I can remember the only way to get out there was a cow trail, I mean there was no, nothing. Just a cow trail between in and through the wooded area to get to the point.

GC: We used to camp on Cote Blanche Island, too, and back then, I imagine it's still the case today, there was a ferry, and old gasoline powered ferry with a cable.

TB: Still there. When we went across the Intracoastal to get to the, to get these pictures last spring, we saw where the ferry was. That was at Cote Blanche, and that was a fabulous fishing spot incidentally, we used to call it "The Bluffs" or we'd call them "The Cliffs" like in England your White Cliffs of Dover, we called them "The Cliffs" because we used to be able to go fishing just about to the base of the cliffs and the reefs were all around there, but which now no longer exists. You have some shell bottom, some spots of shell bottom, but no oysters are growing any more, and if we get our brackish water back, the oysters would be back right in there again.

GC: Ok, well I think that's

TB: Well I hope I've been of some help to you.

GC: Oh yeah

TB: I will make this last statement. I've seen tarpon jump, where is that, here, I've seen tarpon jump in this hammock,

GC: Right off Cypremort Point?

TB: Oh yes, tarpon in the bays. I've seen Jack Crevelle(?) in there, I've seen

GC: Years ago?

TB: Oh yes, that was back in the early forties before the opening of the Wax Lake Outlet, and in to the forties, came back from the service in '47. We caught fish and had not, the flow of waters coming down the Wax had not been increased but to the twenty percent, and then they gradually put it up to thirty percent, and then forty percent, now it's supposed to be sixty:forty, and we just got through going over a number of lowering the amounts of alternates that we want, to try and arrive at to satisfy everybody, the people in Terrebonne, the people in Morgan City, and ourselves on the western end, on this bay system area, and the next meeting we'll bring it down to one, one alternate, at which we will then proceed and go along with our plan, but in the meantime the Corps is doing work in regards to getting the location of the pipelines and getting actually where the jetty, the proposed jetty will go hopefully.

GC: Who would construct it, the Corps?

TB: The Corps would be the one write up the specs on it, and put it out for bid.

GC: But it would be a Corps project.

TB: Corps project yes, because as far as we're concerned the federal government, it's a federal government project, because they are the ones who have caused, they've called for the, and we understand that part, we're

not trying to get anybody drowned, but by the same token, they have taken away from us an estuary that's valuable, very, very valuable. That's from these figures that I've shown you there.

GC: Should be a fascinating topic.

TB: Twenty-one percent of total saltwater estuaries in the state of Louisiana is down the drain at this particular time. That, amount of money may be down, maybe a million, two million dollars that come in. Normally the shrimpers that come in, in the Gulf they all go into Delcambre, and some of them come in to Cypremort Point and then they haul their takes off to the processing plants, and or restaurants to buy.

GC: Ok, well I don't want to take any more of your time

TB: That's quite all right, and the last point I would like to make just coming back to the crabbers, I said something will have to be done with the crabbers because there, three inches is the size of the crabs they're able to catch. Now, some of them are even cheating on that, so, the reason they're doing that is because their making them soft shell crabs out of those crabs, but it they should have a season for crabbing, just like they have a season for shrimping. To give the shrimps or the crabs a chance to come back. The crabs come back but they're not allowed to grow because crabs will grow in fresh water, they'll grow in the bay, they'll grow anywhere, so crabs are not directly affected as much as the shrimp or the oysters and your fishing, because crabs will grow, whether they get fresh water or saltwater.

GC: I didn't realize that they're caught all year.

TB: Other than the opening of the shrimp season, and then after that, a week after that they're back in action, prior to that they used to fight each other all the time. Sounds like they still do if they happen to pick up two or three and ruins... If a shrimper ruins his nets he's going after somebody.

GC: They'll blame somebody, huh?

TB: Yes, and every crabber has now been identified, has a marker that identifies his particular traps, so they can trace back as to who owns it and who is the culprit. And instead of when they have a trap that's bad, instead of pulling it out, the crabbers don't, they'll just leave them down, and that's why the shrimpers are so irate about the whole situation.

GC: The traps are supposed to be marked.

TB: They're supposed to be marked, and when they're bad and not usable again, they're supposed to be taken out and brought in, out of the bays, instead of just left there. And when trawling, shrimpers out there trawling when the season opens, they pick it up from the bottom and they tear up their nets.

GC: And if you leave it out there, all it does is kill crabs, too.

TB: That's another thing. They have nothing but a detriment.

APPENDIX A-2

INTERVIEW WITH MR. SIDNEY CALAHAN, HOUMA

By George J. Castille, III
Interview made at Calahan home.
Jan. 6, 1998.

Note: editorial comments are in brackets [ ].

GC: January 6, 1998. I'm using a tape recorder because it's just easier for me taking notes, I can't take notes fast enough, usually. And your name is Sidney Calahan?

SC: Right.

GC: And how old are you?

SC: 70.

GC: 70.

SC: Not far from 71.

GC: What I'm doing is trying to get some information on the Louisiana coast and how it's changed over the last fifty years. Someone, I can't remember who, had referred me to you. Julie Normington, I think, is the one who mentioned your name. I don't know if you know her or not.

SC: That's my niece, well, she's married to my nephew. She's married to Jeff Normington.

GC: She lives in Houma?

SC: Yeah.

GC: I had talked to her about changes in the coastal area, and she said you were probably one the people most familiar with the Bayou du Large area.

SC: I'm very familiar with it.

GC: Were you a commercial fisherman?

SC: No.

GC: Recreation fishing?

SC: No. I was a trapper.

GC: You were a trapper? What did you trap?

SC: Muskrat, nutria.

GC: Mostly muskrat and nutria?

SC: Mostly nutria lately, last few years.

GC: You still trap?

SC: Once in a while, once in a while, do a little trapping. The boys are with me, I have my two sons. I'm a retired firefighter. My two boys are in the same line of work. My oldest son, you met him, Barney, works for Shell pipeline. He's the one told me, gave me your phone number to call you.

GC: Oh, I talked to him on the phone. OK, I called here one time, looking for you, and he was in for the holidays or something. That was around Thanksgiving. He suggested I talk to you.

SC: He works for Shell pipeline. He works out of Sorrento. He lives in Gonzales, over.

GC: Ok, I remember talking to him. How long have you been trapping? Is this something you been doing a long time?

SC: Sixty years, I guess.

GC: You been trapping sixty years?

SC: Since I'm a little bitty kid.

GC: Where did you first start trapping? Was it down Bayou du Large?

SC: Bayou du Large, uh-huh, down du Large.

GC: How far down was that?

SC: Down around Theriot. We used to go out camping. We used to live in a camp for three months out there while we were trapping.

GC: Is it Lake Theriot, or...

SC: No no, Theriot, Louisiana.

GC: Ok, here we go, I see it on the map right here. So you lived in Theriot

SC: Yeah, we lived just a little below there. I was born and raised down in Theriot .

GC: What is this, Marmande?

SC: Marmande, yes, Marmande Plantation, Marmande Canal, yeah.

GC: So that's the vicinity.

SC: We used to go over. We trapped on the Marmande property, and we trapped for the Mollows(?), in a place they called Bayou Sanbout(?).

GC: Bayou what?

SC: Sanbout(?). That's below Lake de Cade. Past Lake Penchant.

GC: Past Bayou Penchant.

SC: It's not on the map here.

GC: It's the next one over or is it just too small.

SC: I bet it's the next one over.

GC: Let me get the next map and see where it is.

GC: Uh-oh, didn't bring that one. I've got that one in the truck though.

SC: Right by this oil field here, Union Oil Company, further down.

GC: Just to the west of Bayou Penchant field. It was Bayou, what was that?

SC: Sanbout(?) It belonged to the Mollers(?).

GC: How do you spell it, S-a-

SC: I have no idea.

GC: Sam-bote?

SC: Sam-boot

GC: Sam-boot, ok, I'll see if I can find it.

SC: And then we did quite a bit of trapping. When I was a kid I used to trap. My father was ill. He had a stroke when he was very young, and sometimes we couldn't go out to the camp and I'd stay up in front and I'd do a little trapping up around in the woods, around the house. Across both sides the bayou. My grandmother on my father's side lived across the bayou, and her parents and us we lived, and my grandfather on my mother's side was on the left hand side of du Large.

GC: That was in the Theriot area.

SC: Uh-huh. All around in that area there.

GC: Ok. One of the things I noticed on this map, is what appeared to be a bunch of little canals. Are these trappers trainasses?

SC: That's probably what they are. That's all around Grand Caillou. That's trapper's canals. They call them trainasses.

GC: Trainasses? So between Bayou du Large and Bayou Grand Cailou, all those little canals are trappers trainasses?

SC: Mostly all that's trainasses. You got some oil fields, there's bayous, too. This section here, there's a lot of, that's the Harry Burke place, lot of that's oil canals, lot of canals.

GC: But there's still a lot of trapping too?

SC: Quite a bit, now. Look like the nutria prices starting to pick up a little bit, so the people are doing a little bit more trapping this year than they did in the past few years because you couldn't hardly give them away. Look like it's picking up, so, they're doing quite a bit of trapping now.

GC: Has the trapping changed through time, has it gotten better or worse or have you noticed any?

SC: It's worse. It's not what it used to be.

GC: How is it worse?

SC: Well the price of the fur is not there. When the nutria took over they chased all the muskrats away. The muskrats are coming back now. The hurricane did hurt the muskrat population, too. Right now there's some places out there there's quite a few muskrats, around Lost Lake, and them places down there.

GC: Down in Lost Lake? Let me go see if I can find that map. Hold on a sec. [other maps retrieved] The maps to the west, of the Atchafalaya Bay area. Do you see Lost Lake?

SC: That's the Ascotia Canal here, let's see Sanbout, that's probably Bayou Sanbout here.

GC: So at the east end of Lost Lake, Bayou Sanbout.

SC: A little to the north of Lost Lake. What is this here? Is this Crochet Canal, can you make that out?

GC: Let me see. I need a magnifying glass.

SC: Wait a minute now, Lake Carencro.

GC: That might be it over there.

SC: This is it over here.

GC: Bayou de Cade

SC: Bayou de Cade

GC: And there's another one that starts with an "S" right here.

SC: That's Sanbout right there. That's it. That's it right there. It was for the Mollows(?) but not anymore. You see all this here? People used to trap all these marshes, they used to walk all over that marsh. Today there ain't no way you can walk it no more.

GC: Why, it's too broken up?

SC: It's all broken up.

GC: So this area north of Lost Lake is all broken.

SC: It's like that all over. All those marshes, this end over here, where I used to do a lot of trapping. All that marsh, we used to go all over that marsh.

GC: Where? Up in between Bayou du Large and Grand Cailou?

SC: No, towards the west side of Theriot.

GC: North east of Theriot, back in here?

SC: All up in here. Where is Marmande Canal at? This is Marmande Canal here.

GC: Marmande from Lake Theriot to Marmande.

SC: I got a lease right up in here. This is pretty good marsh in here.

GC: So you have a trapping lease just to the west of Lake Theriot?

SC: Just west of Lake Theriot, yeah.

GC: Above Marmande ridge.

SC: That's fairly good, but on further down you go over here.

GC: Farther to the west?

SC: Farther to the west, around Lake de Cade, before you get to Lake de Cade, off the Marmande Canal, there's nothing but water.

GC: Nothing but water.

SC: Nothing but water.

GC: And that's changed in your lifetime?

SC: Oh, yes indeed. We used to walk all that marsh, and we used to trap all over up in there. You can't walk, you got to go by boat now. Strictly boat.

GC: So it's not firm anymore.

SC: No indeed.

GC: Once the area started breaking up, opening up into water, how did that change as far as the animals that lived in there?

SC: Well, it didn't affect the nutria population very much... The nutria have plenty to do with the erosion of the marsh too. They ate. They had enough of them in them days. I mean you could just go out there and see em by the hundreds all over out there. They helped out the marsh, but when they dug the Navigation Canal, well that finished it.

GC: The Houma Navigation?

SC: Yeah.

GC: How did that change things?

SC: Saltwater come in the fresh water marsh.

GC: Have you seen any fresh water marshes that have died along the Houma Navigation Canal?

SC: Oh yeah. It's all dead in there.

GC: How about swamps?

SC: Swamps too.

GC: Cypress?

SC: A lot of Cypress, dead Cypress. You can go riding down Falgout Canal down there, going towards Grand Caillou, and you can see the dead cypress all over out there.

GC: Along Falgout Canal, near Grand Caillou?

SC: Yeah, from Bayou du Large to Grand Caillou. You can see the dead cypress in there.

GC: I think I drove that road

SC: Fina's got a little mitigation property there, project there off of...Let's see if we can find it. [he looks at map]

GC: There's Falgout Canal...

SC: Ok, Falgout Canal, they got a project right up in, this is Bayou du Large?

GC: Yeah.

SC: They got a project right here, then.

GC: Just north of Falgout Canal?

SC: Yeah. Right there. You go all the way to Falgout Canal, and you go all the way to to Marmande Canal. They built a levee around here, and they got a floodgate, put a floodgate up in here. What they do

GC: Forced drainage?

SC: It's not forced drainage, they have a floodgate. What they do when the water rises, the salt water comes in there. You cannot bring back a fresh water marsh by putting salt water in there. I don't know why they do it, but they do it. They say they got a letter saying they wanted salt water in there. And you will not bring back a fresh water marsh by putting salt water in it. And that's what they been doing.

GC: Is there still flow going down Bayou du Large?

SC: In du Large itself? It's mostly drainage now, a few boats go in there.

GC: But is there water draining down? It still drains the area around Houma and so on?

SC: Not Houma, no. But Bayou du Large itself doesn't come all the way to Houma, it stops on the other end there, about three or four miles from Houma. That drains du Large, all this stuff up over here, like forced drainage. A big old piece of it here, right next to that Fina project here, all this is under forced drainage over here.

GC: Along the upper portion of Bayou du Large? Around Theriot?

SC: You got a pumping station right here.

GC: Ok, there's one on the Falgout Canal, I noticed. I saw that.

SC: All this is under forced drainage, that Fina project is right behind that.

GC: So Fina project is closer to Lake Theriot?

SC: No, not close to Lake Theriot.

GC: How about Marmande Canal?

SC: It goes all the way up the Bayou toward Marmande Canal, and it's about, it goes all the way to the school section. They got the school section in there now to.

GC: Have you ever done any type of fishing in that area?

SC: I've fished all my life.

GC: What kind of fish do you generally try to catch?

SC: Red fish, Speckled trout, sheep-head, drum.

GC: Did that change at all in the last fifty years?

SC: Well, fishing has gotten better. The fishing is very good.

GC: You mean for saltwater or brackish water fish?

SC: Saltwater and brackish water.

GC: In this area. What was it like before? The saltwater...

SC: Well at one time it got pretty, fishing got pretty poor, because the red fish population was way down. Then they closed down and stopped the people from gill netting, and that helped a lot. The red fish has come back a lot. A lot, a lot of fish now.

GC: So you think stop the gill netting has helped.

SC: Oh yeah, it definitely did, it definitely did.

GC: What about crabbing? Have you ever done any crabbing or shrimping?

SC: No, I never did any crabbing, a little shrimping. I used to have a little, small outboard, just catch shrimp for my own use, you know. But haven't done that, I'll go cast netting sometimes. Catch a few with a cast net. But as far as trolling for a living, I never did that.

GC: Never fished for mullet.

SC: No.

GC: That's something new anyway. People, not much mullet fishing til a few years ago.

SC: Well they do most of that in the Gulf of Mexico, I guess. Mullet fishing.

GC: What species of fish have died out in this area? It was a lot fresher before.

SC: The red fish and speckled trout have really died out. All saltwater fish have really died out a lot, you know.

GC: Even in the areas that are opening up?

SC: Yes. Now it's good, it's really good. Fishing is really good. Fresh water fishing is good. There's a lot of fresh water fishing. Up around Lake Theriot, and Lake Penchant, lot of fresh water fishing around there.

Matter of fact in Lake de Cade, you have fresh water fish in part of it sometime, and you got salt water fish in some of it. Lake de Cade, Lake Theriot, and Lake Penchant over there, that's all fresh water fishing over there. Now the marsh is not bad up in here, it's not bad, it's still pretty good. It's been a few years since I've been in this marsh here, but I don't think you can walk it anymore. Nobody walks in the marsh anymore, but they got trainasses and canals all over, and everybody goes by boat now.

GC: I took a ride down to the end of Bayou du Large the other day, in the car, and I noticed there's lots of oyster places, and lots of crabbing.

SC: Lot of, lot of oysters coming in now, every day, every day.

GC: Has it always been that way?

SC: No.

GC: What was it like, say, fifty years ago?

SC: Years back, during the summertime, people didn't eat oysters. They were strictly wintertime. The only time people eat oysters would be during the wintertime. They would not eat oysters during summertime. Nobody fished oyster in the summertime.

GC: Where there any oyster houses down there, seafood places that bought oysters along du Large, say fifty years ago?

SC: No.

GC: Were there any shrimp places or?

SC: Yes, they had shrimp places.

GC: So a lot of places dealt with shrimp.

SC: Most of the shrimping in them days, and I'm talking about 50 years ago, they were boiling, drying shrimp on a platform.

GC: Shrimp drying.

SC: That was a big business them days.

GC: Ok, what about crabbing? Can you remember...

SC: Years back people didn't have no market for crabs. The only people that ate crab were the crab fishermen, or give some to their friends.

GC: So, let's say, if you were to drive down to Theriot. Could you drive down to Theriot fifty years ago, was there a road?

SC: Yes. I could remember when it was still a dirt road. I was a little-bitty boy when they put shells on it.

GC: When you were little and you drove down to the end of the road, what kind of fishing places, what kind of commercial fishing establishments were down along Bayou du Large?

SC: Well, they had a few people that used to fish speckled trout and red fish. And they used to sell them, mostly to the... Well, I had an uncle who used to be there, he used to sell ice down there, and he used to pick up fish from the fishermen and bring them to town and sell them.

GC: So your uncle sold ice?

SC: Yeah.

GC: Where is that, at Theriot?

SC: Down du Large

GC: From below Theriot, or

SC: All the way from Houma all the way to the end down there. He used to sell ice. And he'd pick up some fish.

GC: Can you remember the name of the ice company?

SC: It was... was it Houma Ice? You had Houma Ice and Terrebonne Ice, I think it was Terrebonne Ice.

GC: Terrebonne Ice?

SC: Yeah.

GC: Were there any, what kinds of places were there? There were, you mentioned shrimp. Were there any other seafood outfits down there that...

SC: No.

GC: So there's shrimp, speckled trout, and reds, and those are the main commercial fishing?

SC: People just didn't, like I say, some people used a catch a few of them, like to sell to an individual. Just like they had a couple of people used to come down there and sell groceries, in trucks. They'd come down there, one would pass one day, and two or three days after another would pass. There was a lot of swapping with eggs and chickens for groceries.

GC: I bumped into a guy who bought muskrat and nutria skins down there, in the Theriot area. He had them all hanging out in his front yard. And I noticed that almost everything he has is nutria.

SC: Mostly nutria, yeah.

GC: He has a few muskrat, and he has occasional raccoon, and I think he had one otter, or mink, if I'm not mistaken. Is that pretty much the way its always been?

SC: Last few years yes. The nutria, mostly nutria, that's all the people catching.

GC: How about when you were a kid? When you were a teenager?

SC: Muskrat, strictly muskrat. Muskrat, otters and coons, no nutria.

GC: Muskrat, otters, and coons. When did the nutria start coming in?

SC: They started in the fifties, around the fifties I believe. Supposedly the say there was a man from Avery Island, or Weeks Island that got some, they come from South America down there. And he had them in a pen, and a hurricane came along and the pen busted, and the nutria got out, and that's what started it. That's the story behind everything, anyway.

GC: So you hadn't seen them in this area until the fifties?

SC: Around the fifties.

GC: And now they've taken over.

SC: Ah, yes indeed. Maybe in the fifties and the late forties, probably.

GC: How many traps do you run?

SC: I used to run about a hundred fifty for nutrias.

GC: A hundred fifty traps?

SC: For nutrias. And muskrat, well, during the muskrat days, I was pretty young, then, my two oldest brothers did most of the trapping, but I used to skin the rats. My sister and I used to skin the rats.

GC: How many would y'all get a day?

SC: Hundred and fifty, two hundred.

GC: So you'd get one for every trap?

SC: Oh no. Both my brothers trapping, I had a few traps.

GC: Oh, I see, so you would skin a hundred fifty a day.

SC: Hundred and fifty a day, sometimes a hundred, between a hundred, hundred fifty, sometime a hundred and seventy-five. It all depended on the weather, you know?

GC: How bout now? How many traps you got?

SC: I don't set many of them. Forty, fifty of them, that's about it.

GC: Which, in a typical day, typical catch, how many will you catch?

SC: Fifteen, twenty nutria, twenty-five sometime.

GC: Fifteen to twenty-five.

SC: Nutria were so thick there, I was running about a hundred and fifty traps then, and I'd pick up a hundred, a hundred and twenty nutria a day. In a matter of fact, I'd run my traps, and then sometimes on the way back after I'd run my traps, I'd pick up two or three nutria on the way back.

GC: That's pretty thick!

SC: We used to get fifty cents a piece, that's skinned, a man used to come pick them up every afternoon.

GC: Fifty cents a piece?

SC: Fifty cents a piece. That's when they first started to have a market for them.

GC: That was in the fifties and sixties, maybe?

SC: That was in the fifties, yeah.

GC: How much can you get for nutria now?

SC: Well I think right now, for a dry, a good pelt, you get five dollars. If it's a good one, now. They divide all on a grade. You go there with a hundred nutria, might have ten or fifteen five-dollar ones. The rest going to be three, two and one, something like that. Look at the length and the amount of fur that's on the skin.

GC: Which kind of fur brings the most money?

SC: Well right now, nutria is about the best thing, I guess.

GC: I mean compared, I mean, if you ever catch a mink, is it worth more?

SC: Well, mink is, there isn't very many. I don't know what the price of mink is this year. It's been, otters, it's been a pretty good price. I guess right now, an otter skin will bring about twenty-five or thirty dollars.

GC: But you don't catch as many.

SC: Oh no. There's a man down du Large, he buys them live, I don't know if they told you about him, Leroy Sevin.

GC: Yeah, Leroy...

SC: Seven, S-e-v-e-n.

GC: He buys...

SC: Otter from the trappers, he buys them live, and he sells for restocking all over the United States.

GC: Where does he live?

SC: He's about...

GC: Is he a young fella?

SC: Well, he's in his fifties I guess, around sixty.

GC: I met a Sevin up near Chauvin.

SC: That's his family, that's his relations.

GC: They had some skins, in fact, they had a live otter in a cage on the porch.

SC: Must be waiting for his brother to come pick it up.

GC: So they must be related.

SC: That'd be his brother.

GC: The woman I talked to said they sold them to zoos and other places.

SC: He sells them to zoos, and he sells them for restocking in a lot of states, up in Kentucky in those places. He's on Beatrice road where I have my place down there. You ever crossed over the bayou on Beatrice road, when you get to Theriot, when you get to Theriot down there?

GC: On the opposite...no, I didn't travel that side.

SC: Ok, that's where he's located, when you go across that bridge when you get to Theriot.

GC: Beatrice Road?

SC: Yeah. You gonna go, I guess, about two miles down there.

GC: So cross at Theriot

SC: Cross at Theriot, yeah. Before you get to the church down there, and the school. And you, down there, about two miles you can ask anybody round there where Leroy Seven lives, they'll tell you. He feeds them, he buys nutria meat from the trappers, those that skin the nutria. He buys the meat from them and he takes it and grinds it up and feeds it to the otters.

GC: It's an otter farm?

SC: Yeah.

GC: Where is your camp?

SC: A little, about a mile past him, down there, it's a trailer on the left hand side, Box 1715 Beatrice Road. If you want to come down there one day when I'm down there, I'll bring you to his house and we'll go look at the otters. He buys...

GC: He's got a bunch of them?

SC: Well, not too many right now. He usually gets over a hundred of them every year.
Last year he had over two hundred of them.

GC: Good grief! If I went to his house he'd have a bunch of them in cages?

SC: I'm sure he's got a few of them right now, not that many, the season just started, but I'm sure he's got a few. He has a few of them. And all the females he buys, they're all pregnant. And he takes them and puts them in different cages by themselves off on the side, because if anybody go there and disturb them they kill the little ones. The little ones are born and he raises them and sells them, too. That's something interesting, I tell you.

GC: How do you get one that's alive, they're caught in the trap, right?

SC: They use a net. A big net. Put the net over them.

GC: A net? So trappers bring nets out in the field, just so they ....

SC: Some of them do, just in case there's an otter, and they just wrap it in the net, and they call him up, and he goes nearly every day, he goes up and down the road, all the way down Bayou Lafourche down there, he goes pick up otter all over. Every day, every day. Either him or his wife go pick them up. He got a son that works for him, too. Whenever you get ready, you come down there, I'll bring you to his house. We'll go see him.

GC: You stay at your camp a lot?

SC: Pretty much, old lady raises hell with me once in a while, about me being down there, but I love it down there. I'd rather the country than the city!

GC: I can understand that. There's something I wanted to ask you about, down at the lower end of du Large, when the asphalt road runs out and it turns into a shell road, today. There's this old oyster house or something on the left hand side, big old place that closed down now. Bay Junop, or something.

SC: Oh yeah, Bay Junop Oyster Company.

GC: It's abandoned, the building's abandoned, and when I went out there last week I was taking pictures and walked around to the back side, and it looked like the trainasse comes right up to the back.

SC: Yeah.

GC: Well, who used the trainasses?

SC: Hunters, fishermen. I used to fish there a lot down there. Now somebody got the whole thing leased down there.

GC: Bay Junop, did they deal with oysters, or did they...

SC: Oysters, strictly oysters, yeah.

GC: Didn't have anything to do with furs?

SC: No. The fella, Wilson Voisin down there, he's an oyster businessman in a big way, he's got the big oyster house right here in town, right there by the Navigation Canal.

GC: Wilson's Oysters?

SC: Wilson, well there's Wilson Jr. Wilson's Oyster House, it's called, I guess Wilson Sr. has something to do with it, too. You get a chance you can stop and visit there.

GC: Yeah, I saw him, there's a curve right next to the bridge. If that Bay Junop only dealt with oysters, why did they have a trainasse that came to the back?

SC: Well, that didn't belong to them.

GC: The trainasse was someone elses?

SC: That was someone, on someone else's property. That belonged to someone else.

GC: Oh, so he just put the oyster house...

SC: It wasn't an oyster house, it's just a camp and they used to unload oysters there. From the outside, from Sister Lake and Lake Mechant and all them places in there.

GC: They unloaded them at that place.

SC: They unloaded them. I guess you noticed that docks they had down there? Where they unload oysters. That goes on every day, every day, every day, they pulling oysters out of there.

GC: So, was the camp just where the oystermen would come in and sleep?

SC: No, they stayed on the boat, they stayed on the boat for two or three days till they get whatever they can put on the boat, you know. What they do, they have one big boat, one big boat that dredges and a bunch of small boats. Maybe four or five small boats, they dredging and they pick up. They each have a few sacks and they bring to the big boat, you see. And when the big boat is loaded they come bring it to the front.

GC: Can they operate in real shallow water?

SC: Pretty much shallow water, yeah. Where oysters are most of the time is in deeper water. Sister Lake had a hell of a lot of oysters in it, but they just, Wildlife and Fisheries let them fish them out this year, let them fish them out about every three years, and then they come back again. They do the same thing with that place further down, Bay Junop. They do the same thing down there. They fish them out about every three years.

GC: Every three years they clean them out?

SC: Just about clean them out, yeah.

GC: And then they shut it down and let them grow back?

SC: Let it come back, then they come back.

GC: What is it, is that State bedding grounds?

SC: State controlled, yeah, State controlled.

GC: So there's still seed grounds out in that area?

SC: Yes. What they do a lot, in the year before that, they go there and put clam shells down there, spread clam shells all over the lake, then them oyster spat latches on to that clam shell and grows into an oyster.

GC: I didn't know there was still an active seed bed out there.

SC: Oh yeah, that Sister Lake has been very good, very good. So has Bay Junop too.

GC: That's interesting.

SC: I know a man that buys furs lives down du Large, Mr. Lefant. He's...

GC: How do you spell that?

SC: L-e-f-o-n-t. Norcise Lefont. He's, let me see if I can explain to you where he lives at. He lives on the right hand side of the bayou going down du Large, about 2 miles from Theriot. Before you get to the Theriot bridge you cross over the, it'll be about two miles. There's a little bridge you can cross on, he lives in a trailer in the back.

GC: So he's a buyer, too.

SC: He buys nutrias and alligators you know. That's something else we do, we do some alligator hunting.

GC: You hunt alligator too?

SC: Oh yeah. Yes indeed.

GC: It's a short season, though, isn't it?

SC: Well, it's thirty days, one month, but we always get our limit.

GC: How many do you usually catch?

SC: I had thirty-eight tags last summer.

GC: You caught thirty-eight?

SC: Thirty-eight, yeah.

GC: What was the biggest?

SC: The biggest one this year was nine and a half foot. The biggest I ever caught was twelve foot. Little over twelve, maybe twelve two, twelve three, something like that. But I been doing that for years, too. I used to hunt alligators at night with a light. When I was a kid, if you killed a four or five footer, well you had fifty cents or seventy-five cents of cash money there. That was good!

GC: Yeah. Dangerous work though, isn't it?

SC: Well it's not that dangerous.

GC: I mean before, when you'd do it at night with a flashlight.

SC: Well, with a head light, no we shoot them and bust his head, there ain't no problem with em then. Most of the time even if you're in deep water you got to have a little gaff with some hooks on it to feel around to you touch him, then you pull him up. I did that quite a few times...

GC: Did you catch them with one of those little poles that hang along the side of the bank?

SC: With bait on it, yeah. That's how we fish them now.

GC: That's how you do it now. But back then how did you do it?

SC: Well back then we fished them when we went into the marsh. We didn't fish along the bayous and the lakes and everything. We used to walk the marsh and go get them.

GC: How did you, you just walked up on them and shot them?

SC: We put a line and some holes up around there close, you know. You catch one and you kill it right there and you had to skin it and just bring the hide out.

GC: So, you leave the line and then come back later and check it?

SC: Come back the next day, see?

GC: Oh, I see.

SC: Or two days later, if you have one on there, pull him out and kill him and just skin him right there.

GC: You have to go looking for the holes where you put the bait out, the lines out there.

SC: Well alligators, they were scarce, when they closed them, they were scarce, you didn't see many of them. Very scarce.

GC: Until they made a comeback.

SC: Oh yeah, they made a big comeback. That's something else that made a big comeback, the alligators. There's a lot of them now.

GC: Now, has the fact that the fresh water has disappeared, and there's more saltwater in here, has that affected where alligators live?

SC: Oh yes, alligator's not seen in saltwater. The only one you going to find in saltwater once in a while, is a big bull.

GC: So big bull will...

SC: He will live in the saltwater, just like frogs do. Frogs will not stay in saltwater. It's coming toward the freshwater.

GC: So if you want to go bull frog...

SC: Go find some freshwater, like Lake Theriot and Lake Penchant, fresh water.

GC: Well, like the, the area where you trap, let me see that map. You still trap just to the west of Lake Theriot. Is that salty?

SC: No, this is fresh water.

GC: Still fresh water?

SC: Still fresh water yeah.

GC: So you can find alligators here, too.

SC: Oh yeah. That's where we do most of the fishing, back over here on this side too, off of Falgout Canal, I have two leases here.

GC: South of Falgout Canal, between du Large and Grand Cailou?

SC: No, right here, where this project is, I've got that leased, ---where Fina has that project.

GC: So the area north of Falgout Canal and

SC: North of there, there's alligators all over up in here. I have a lease right here too. We catch alligators up in here.

GC: North of Falgout Canal and west of du Large.

SC: Yes. I got some more fishermen here and trappers here. That Naquin boy traps here.

GC: You mentioned the Fina project. What project is that?

SC: It's the one I was telling you about, they built that levee around there.

GC: But Fina oil was doing it?

SC: No, I think the State did it. The State put out the money.

GC: Why is it a Fina job, is it because they have a...

SC: It's on the Fina property, on their land. The State is the one that's footing the bill, I believe.

GC: How about on this side. Did you have any leases there?

SC: No. But we do... I used to trap back across here.

GC: On the east of du Large?

SC: On the east side where we used to live at.

GC: By that oil field, or to the north of Falgout Canal?

SC: It was further up here.

GC: North of Falgout.

SC: Probably around up in here.

GC: Lake Theriot?

SC: Yeah, Bayou Prevot, right here. Right around on up in here, now. That's where, I was born and raised right here.

GC: Ok, so near Theriot. On the east side of du Large.

SC: We stayed right up in here somewhere, and my grandmother on my father's side was right across over here.

GC: You mentioned the dead cypress along that Falgout Canal Road. Are there any other big areas that you recall seeing where the saltwater has killed the cypress?

SC: Well, most anywhere you go down there if you see, you going to see dead trees.

GC: So anywhere?

SC: Anywhere down there you're going to see dead trees. Where they have cypress trees, I mean there was a good bit of cypress down in there. On the north side of Falgout Canal they put some gates there too, some wier-like, dam-like. They trying to keep the fresh water up in there, but still a little saltwater gets in there, saltwater got in there a while back. When the tide gets high, saltwater comes in there.

GC: And that kills the trees?

SC: That'll kill the trees. Course they got some green trees in there now, but I noticed the water got real salty about a month and a half, two months ago, killed all the grass in there, they tell me there's no more grass in there.

GC: That's an interesting area. This ridge...

SC: Like I was telling you a while ago, we used to walk all over up in here. Matter of fact we had made a walkway for the cattle, the cattle used to go up in here.

GC: Where's that?

SC: Where we used to live there, on du Large, right there.

GC: You mean on du Large near Theriot?

SC: Right below Theriot here, we made a walkway for the cattle to go in the marsh and eat. They used to go out there and eat in the marsh. It was solid.

GC: Can you remember sugar cane growing down here.

SC: Oh yes. As a boy, yes.

GC: When did they stop growing sugarcane? Along lower du Large?

SC: Let's see, sugarcane, that I remember that was back in the thirties. Now there's still one man down there that raises sugarcane down there, Norman Federick.

GC: Norman Federick?

SC: You know where the little syrup mill, did you ever notice down on the bayou?

GC: The abandoned one, yeah. What's his name?

SC: Norman Fedric.

GC: Fredrick, F-r-

SC: F-e-d-r-i-c, something like that. He's the only one that has sugarcane down there. He had some on the upper end of Bayou du Large, all that sugar cane you saw up by that school, he farmed that, and he has a few of them by his house down there. He's also in the cattle business too.

GC: So Mr. Fedric has sugarcane and cattle. This is the Theriot area.

SC: He lives down there, right by that little syrup mill, there. They used to make syrup down there.

GC: What does he do with the cane now?

SC: They grind it, he hauls it to Raceland, to the mill in Raceland. Fine fella, very nice fella, very good man.

GC: But when you were a boy they grew it a lot farther downstream.

SC: Oh yeah. Everybody had sugarcane when I was a little boy.

GC: How far down can you remember the fields went?

SC: Hell, they went down...

GC: As far as that Bay Junop?

SC: Oh no, not quite that far. But they used to make sugar cane down there around where Mr. Doumond(?) used to live. Old man Doumond used to make sugar cane there.

GC: Did he goes as far as the end of the road today? Where the road ends?

SC: No, he didn't go that far. They went about, about five or six miles past that Falgout Canal.

GC: So, five or six miles...

SC: A few people used to grow sugarcane down there. A lot of us, the small farmers just went to just corn, corn, most all you see is just corn. After the sugarcane, a few years back a lot of people went broke in the sugarcane business. And then, a lot them got out then. I had one of my uncles stayed in there. My grandpa got out of it then, couple of years after. I had one of my uncles went back into the sugarcane business. But he didn't stay very long, and that was the end of it down there. Around our place down there. That was in 1935, '33, '35 somewheres around there. They didn't have any more sugarcane down there, except like I said, Norm Fedric had some across the bayou.

GC: As far as the Theriot area is concerned, when you were a boy, did a lot of people live in that area? Were there many camps or was is mostly people who were down there lived there.

SC: They lived there. Those houses... they didn't have no camps on the road. The only camps they had, was when the trappers used to go out by boat. That's the only camp they had. They had that, those people used to stay there, they lived right there. They had a little farm.

GC: When did people start putting camps down that lower end? Was it sixties, or seventies, or...?

SC: About then. I guess they started putting camps down there in the seventies, I guess.

GC: So now, is it half camps and half houses, or?

SC: Well...

GC: Or can you tell?

SC: There's still a lot of houses people live in. There's still a lot of houses down there. You got camps at Falgout Canal that, across the bayou from the marina there, there's a bunch of camps down in there, and in the marina itself. There's camps in there. Now when you go out into the water...

GC: At the end of the road there's camps, the very end of the road, where it turns into shell road.

SC: There's a bunch of camps there, yes. And up on Bayou de Cade there, Lake de Cade, there's beaucoup camps, they got camps all over there.

GC: Still today?

SC: Oh yeah. This is my wife.

[his wife walks in]

GC: Hi!

[Background Conversation]

SC: On that Bayou de Cade, that's camps all over out there. All the way down to Lost Lake, they got camps down there.

GC: You say Bayou de Cade, there's Lake de Cade, Bayou de Cade is at the west end of Lake de Cade?

SC: Yes.

GC: So the only way to get to these camps is by water.

SC: That's it, no other way.

GC: But there are bunches of them now?

SC: Oh Lord yeah.

GC: Were there lots of them when you were a kid?

SC: No. When I was a kid, when I was very small, my father trapped this section here on Bayou de Cade, and my uncles, that's where they, they did a lot of trapping there. But now that's camps all over in here. Raccourci [Bay], they got camps all over up in there.

GC: How bout the oyster lease areas? Have you had, have you noticed any changes there? Have they come inland?

SC: No. The oysters, as far as, Lake Mechant used to be a lot of oysters in there, but there no more oysters in there now. Unless maybe in the last two or three years, they might not come back, you know? Anytime the fresh water is all over where the oysters are, it kills them. (?) and everything else, the oysters will not survive.

GC: So they need some brackish water.

SC: They need brackish and saltwater.

GC: Has the population along Bayou du Large changed a lot?

SC: Oh Lord yes.

GC: Like, are more people down there now?

SC: Yes. Oh yeah.

GC: How many people were there living in Theriot when you were a kid?

SC: Along here?

GC: Yeah.

SC: I would say from maybe from Houma down to Falgout Canal there they might've had twenty, twenty-five houses.

GC: That's all?

SC: That's all.

GC: When you were a kid?

SC: When I was a kid.

GC: And now, there's hundreds!

SC: They're selling lots all over, building houses all over. And I can remember when they had only about six cars on Bayou du Large, too. I'd get up, I didn't have to see the car, when I'd hear it and knew who was coming. Just by the sound of it, I knew who was coming.

GC: That area that's under pump drainage, is on both sides of Bayou du Large, or just on the west side?

SC: Just on the west side.

GC: So what happens to the people on the east side?

SC: They been talking about doing it on that side, too. With the Corps of Engineers, and the EPA, they got to go through...

GC: Is there pump drainage at Theriot on the east side?

SC: Now there's a pump there but it's to pump fresh water to try to save them cypress trees in that swamp I was telling you about a while ago. But I don't think they ever used it. It's been about 3 or 4 years and they never used it one time.

GC: Up here on the east side...

SC: You got a pump right here, you see. They put that pump there to pump some fresh water into here. But I don't think they ever pump water one time.

GC: But there's no forced drainage on the east side of du Large and Theriot?

SC: No. It's on this side here. Right here in this section. Where I am down here, if it wouldn't be for this here, the water would be all the way to the road. It would be all the way to Beatrice Road.

GC: So the road really goes along way back, far away from Bayou du Large?

SC: It's not that far.

GC: Is this the road here?

SC: I think that's it.

GC: It follows the levee?

SC: In some places, it's 400, 500, 600 feet from the bayou. And it comes all the way to the marina down here at Falgout Canal. And then you cross Falgout Canal you cross on another bridge, that's what they call Brady Road. That's another road.

[part of conversation with his wife not transcribed]

SC: You see all this Marmande Ridge here. I used to run cattle up in here when I was young. And I used to do some farming down there. Way back there on the ridge, I had an uncle that used to live back there.

GC: What did they raise?

SC: Sugarcane.

GC: Sugarcane on Marmande Ridge?

SC: Oh yeah. Way the hell back there. They used to have a little bridge over Marmande's Canal. They had a little bridge there. Old man Marmande used to drive his truck back there. He'd cross the canal and go all the way back on the ridge. He had a bunch of cattle back there, and sugarcane and corn and stuff. They had 4 or 5 farms along the ridge.

GC: Can you drive to it now?

SC: Oh no. No way no more. Most of it's under water.

GC: Most of Marmande Ridge?

SC: Now the front part is still pretty high, and one of the boys raises cattle on there.

GC: So there is cattle being raised on it some now?

SC: On the front part, yeah.

GC: Are there any camps on it?

SC: A couple of boys got a couple of camps on there. They had one man had a trapping camp way back there on the ridge. But he passed away him.

GC: Well I think we covered everything I wanted to ask you about.

SC: Well any time you want to go see Mr. Sevin...

GC: One of the things I'm interested in, and I haven't talked to anybody about, is the Vietnamese fishermen who have moved into the area. Thirty years ago there weren't any, and now there are lots of them.

SC: All the local fishermen...they don't get along.

GC: With the Vietnamese?

SC: Oh no. Several years back they even shot one of the Vietnamese on Pointe au Chien. He had beebees all over his face.

GC: Why don't they get along, because they don't know the laws?

SC: They know the laws. Them people are hard working people. They get out there they fish. They going to stick to it, and they going to do it. And the local fishermen don't seem to like that too much.

GC: That's interesting.

SC: They go on a boat out there and they live on whatever they catch on the boat. They not going to buy anything. They don't throw nothing away. All them fish and everything, they dry it in the sun and eat all that. They don't waste nothing.

GC: They dry all the fish they catch?

SC: Most all them little fish, they dry that. They put it in the sun and dry it. I guess they use... I don't know how it's done. They don't buy anything to go on that boat. Whatever they catch, that's what they eat.

GC: So they use a lot more fish than most people?

SC: Oh yes. The local fisherman or a shrimper, he's going to pull that trawl and whatever he's going to dump on the deck just the shrimp are picked out. All the rest of the stuff is going back overboard. But they save everything, them.

GC: I noticed there are a heck of a lot of them at the end of Bayous as you get close to the Gulf. Grand Caillou, Petit Caillou, when you get down towards the lower end there are lots of shrimp boats and crab boats with Vietnamese working on them.

SC: They sure do. They have a lot of em.

GC: But 20 or 30 years ago there weren't any Vietnamese down here.

SC: Oh no. They only been down here since the Vietnam war. When the Vietnam war ended, they put a bunch of em on a ship and brought em over here.

GC: Are there any big communities that you know of? Any concentrations of em...

SC: Not around here.

GC: So not on du Large, there aren't many on du Large?

SC: Not on du Large. Not many of them down there.

GC: So most of the people who fish down there are Cajuns or locals, the same families who have been doing the same thing?

SC: Yeah.

GC: Voisin is a big family in the oyster business?

SC: Yeah. And Marmande used to be big in the fur business. And the seafood business too. There's only one Marmande boy in the shrimp business. Right there at Falgout Canal, Al...Al's shrimp company. He buys shrimp. But years back, their grandfather, the oldest one was his father, had a grocery store and that was where the old post office is, by the church. He had a grocery store there and he used to buy fur. And the Mallows(?), the one I told you the one at Sanbout's property. But they don't have it anymore. But that's all they used to do in wintertime is buy fur.

GC: Can you think of any other big families or family names that are active in the seafood industry on du Large?

SC: No, that's about the only ones that I know of.

GC: The Voisin's the biggest?

SC: The Marmandes too. That boy Al, he's got two places down there where he buys shrimp at. That's the only one down there. Well there's a Dehart man further. Two or three places that buy shrimp down there. Well I got a nephew down there too. Just about the end of the road down there. He buys crabs and shrimp and all that stuff.

GC: What's the name of his place?

SC: Jug's Seafood. He's married to my niece.

GC: We stopped there. Just before...it was near a floodgate structure. They had a bunch of big boxes full of catfish heads.

SC: Crab bait.

GC: And I took some pictures of the bait. That was at Jugs.

[part of conversation not transcribed]

SC: There ain't no more marsh where you can get out there and walk on it except way down. Right down around Lost Lake they still got some good marsh around there. They got quite a few muskrats in that section now.

GC: What size boat do you use when you go trapping?

SC: I have a 16 foot boat.

GC: Aluminum hull?

SC: No, fiberglass hull. For years and years I had a pirogue with a motor in it. And I had a Joe boat with a motor in it. Oh I used to trap all the time you know. Every day, every day, fighting that cold weather. And I was working besides that on my job. A firefighter for 23 years. On my days I would work for 24 hours and I was off for 24 hours. On my days off I was out there in the marsh trapping. And during summertime fooling with the cattle. I had to take care of my cattle in the wintertime and trapping.

GC: It's a rough life huh?

SC: Oh yeah. But now I let my two sons...Mark and Reese, they're twins...and they take care of the cattle. I don't fool with that anymore. They do the feeding and whatever needs to be done.

GC: They trap too?

SC: Yes they do. And they shoot a lot of em too. The last 3, 4 or 5 years they didn't have no price for em. They used to just go out there and shoot em and leave em there.

GC: Shoot the nutria?

SC: Let the buzzards eat em.

GC: Why would they shoot em?

SC: Try to get rid of em.

GC: Because they were eating out the marsh?

SC: They're eating out the marsh. And there was no market for em. They had fun. Shoot all kind of bullets to get rid of em.

GC: I guess if you don't keep the population down they'll destroy the marsh?

SC: Yes indeed.

[part not transcribed]

SC: The only way you can trap now is by boat. And as far as the nutrias...You've got to trap that by boat because a man can't carry more than 2 or 3 at a time.

GC: What?

SC: Nutria.

GC: Why, because they're so big?

SC: So big yeah. Muskrat, we used to carry 25 or 30 or 40 at a time on your back in those shoulder strap deals with those sacks on the back. We used to carry 25, 30, 40 rats at a time. But not nutria.

GC: How would you kill them, you club em?

SC: With a stick.

GC: I guess it's a lot easier hitting them than shooting them.

SC: Oh yeah.

GC: I used to shoot em when I was a kid. Because they would get in our garden.

SC: Oh they will do that.

GC: And they ate everything.

SC: They'll eat up everything in a little while. I used to make a big garden.

[end of tape]

[next tape]

SC: A man can go out there and catch 25 or 30 and skin em and put em on stretchers, that's a days work. A big day too. Some people tell me they kill and skin 100 and 150 a day like that and go catch em. You couldn't convince me of that. I'm not going to believe that.

GC: You said when you were trapping muskrat you had a pack you used to put em in...

SC: Yeah.

GC: And how many you used to carry.

SC: You could carry about 40 of em. 35 or 40. And if they got too heavy you just stop and skin a few of em.

GC: And just save the skin.

SC: Save the skin. And just push the meat under the float.

GC: But nutria are so much bigger you can only carry...

SC: Oh you can only carry 1 or 2 or 3 of em at the most. We used to go hunt em with a dog years back. And the dog would finally kill em and carry em to the boat. But you couldn't carry more than about 2 at a time in the marsh.

GC: So that's why it's easier to trap nutria by boat than walk the marsh.

SC: Oh yeah. You got to trap by boat. There's no way you can walk the marsh and trap that. No way. A nutria, you don't have to hide the trap to catch em. You just set it down on the ground on a trail where he passes or on a low hill where he comes around. He's going to step in the trap. A muskrat is entirely different. You got to hide it on the bank. You got to hide that trap to catch the muskrat. Got to cover it, put it in the water and cover it up.

GC: So a muskrat is smarter?

[end of transcription]

APPENDIX A-3

INTERVIEW WITH LILLIE BELL DANIELS, HOUMA

Dec. 19, 1997
Interview by George Castille in a retirement home.
Ms. Daniels age unknown.

Note: editorial comments by George Castille are in brackets [ ].

GC: You did a lot of fishing?

LD: Yes. [she looks at map] This is Lake Boudreaux. Boudreaux is one of the first settlers.

GC: Which area were you most familiar with?

LD: The one that you just came from. Pointe au Chien.

GC: Pointe au Chien?

LD: Uh huh. Pointe au Chien, Bayou du Large and... where's the other one...

GC: Did you ever get over to Cocodrie or that area?

LD: Cocodrie? Oh yeah. We used to fish over there.

GC: So Bayou du Large, Caillou Lake, Lake Mechant...

LD: yeah.

GC: Lake de Cade and Theriot? Are you familiar with that area there?

LD: Oh yeah. We used to go fishing all in those lakes(?)

GC: Let me turn this [map] around so you can see it easier.

LD: This is a map of the bayous and everything?

GC: Yeah. Let me start from the beginning. Your name is...

LD: Lilie Daniels.

GC: D-A-N-I-E-L-S?

LD: Right.

GC: You were born and raised...

LD: In Mississippi.

GC: When did you move to Louisiana?

LD: In 1956.

GC: So you're familiar with this area after 1956?

LD: After 1956.

GC: Where did you live when you moved in 1956?

LD: We moved to Houma in 1956. We was living in Texas.

GC: And you used to fish this area here? Commercial fishing or recreational?

LD: Just pleasure fishing.

GC: Weekend fishing?

LD: Yes.

GC: And which area did y'all fish most often?

LD: Point Barre. That's out of Montegut.

GC: [looks at map] Well there's Lake Barre...

LD: Well they're connected.

GC: Here's Bayou Lafourche, Golden Meadow...

LD: Well Golden Meadow's the one I was telling you about. You go to the end of the road...

GC: Fourchon?

LD: Fourchon, yeah.

GC: Well here's Bayou Pointe au Chien, it comes down here. It's a boundary between Lafourche and Terrebonne Parishes.

LD: Right.

GC: What are the areas that you are most familiar with?

LD: The ones that go from Dulac, to Bayou du Large.

GC: Bayou du Large which is over here [points to map]

LD: Right. And we went to Dulac and Grand Caillou. That's where Boudreaux Canal is, on Grand Caillou.

GC: Commercial fishing, how often did you say you'd go?

LD: We didn't go commercial fishing.

GC: I mean recreational fishing, excuse me.

LD: Every weekend. And on vacations.

GC: And what were y'all fishing for, mainly?

LD: Crabs, fish. We didn't go out in a boat. I was scared of boats.

GC: So you were fishing from the bank?

LD: Banks, uh huh.

GC: Along the road?

LD: Yeah. That's beautiful down there. Oh it was. They done messed up now.

GC: How is it messed up?

LD: They built new roads, cut down all the trees, you don't have any more moss growing on anything. They have just ruined it.

GC: So it's changed a lot since 1956?

LD: Oh I guess so. You came over that big double bridge didn't you?

GC: Yeah.

LD: And those things used to just slip up and open up for them boats and all. And then they had those what you call pontoons. Before they had those...if you could go over those...that was scarey. I was afraid I was going to fall in.

GC: When you fished from the bank, what kind of fish did you generally catch?

LD: Mostly it was catfish, perch and redfish.

GC: So you even caught redfish?

LD: Yeah you can if the weather's right.

GC: Did the type of fishing change through time, did you notice?

LD: I think it has.

GC: How so?

LD: Because when we first moved over here you could go out and you could catch all you wanted. And nowadays, there's a limit on everything. You even measure your fish before you get them off your line. [she laughs]

GC: Do you know if it's changed... the type of fish you can catch?

LD: Right, it has.

GC: How so?

LD: Because certain times of the year you can only catch certain fish. I guess it's during the breeding season or something.

GC: But the areas... let's say the areas where you could catch catfish when you were... in the 1950s, can you still catch catfish there today? Has that changed at all as far as the type of fish?

LD: As far as catfish.

GC: So it's pretty much the same?

LD: Yes. Well it's been a couple of years since I went to Pointe au Chien, and we used to go down there as often as we could. But after my husband passed away, and the children were all working, we couldn't just go like we wanted to. You could go down there and just sit on the bayou bank and everything and catch all the catfish you wanted.

GC: Did you fish on Pointe au Chien, on the bayou?

LD: Yes.

GC: Was it one of the better places to go? Did you have a favorite spot?

LD: Well we had a kind of a favorite spot, it was close to the lake(?) docks.

GC: At Pointe au Chien?

LD: Uh huh.

GC: How about Bayou du Large?

LD: Yeah Bayou du Large.

GC: Did you have a favorite spot there too?

LD: Yeah we did, but all of that is posted now...

GC: You can't fish there now?

LD: No. From the boats and you know and things like that. But you can understand that because the way things are now, you've got to be careful who you let on your property. There's so many vandalism and things like that.

GC: When y'all were fishing, you were fishing right on the road or would you go back...

LD: Right on the bayou.

GC: You just park your car on the road...

LD: Well, we went down those little roads. To Pointe Barre and all. But now I think they got a highway back there, and that's all blocked off. You can't go back there any more. Because they have commercial fishing. They had so much trouble back there, people destroying boats and things like that and all, so they had to stop it.

GC: When was the last time you went fishing in that area, in Pointe au Chien?

LD: About two years ago. And I kind of slowed down now. I read about it in books.

GC: Well it is a lot of work.

LD: Oh yeah. Well I enjoy it, but I can't do much of it. I had cataract surgery, then the doctor found out that I've got a heart problem, and they've got me on blood thinners cause I've got a blockage. And I just can't go like I want to. So I guess I have to leave the fishing to somebody else.

GC: Do you know Miriam McMichaels? She has something to do with oysters.

LD: Well they have...at Pointe au Chien, one of my granddaughters... there's one guy down there, and I don't know his last name, but they have a lot to do with oysters too. They're out there fishing now.

GC: So there are a lot of oyster fishermen down Pointe au Chien?

LD: Oh yeah. Down there and Bayou du Large and Dulac. This is the season for oysters.

[part of conversation not transcribed]

GC: There's a couple or three other things I wanted to ask you about. One has to do with the marsh. Have you seen or noticed since you've been down here, that the marsh has disappearing?

LD: Right. They dredging the bayous and everything and it's just draining the marshes. That's the reason why you don't have any moss and things like that, you know. The beauty of the scenery... and those cypress, those are so beautiful in the winter time, and even in the summer time, when you see that moss hanging. In the sunset...

GC: Have you seen any areas where you fish where there have been a lot of cypress or other trees that have died?

LD: Uh huh. One of the things is they have cut a lot of those down and everything, and just cleaned them out.

GC: Have you seen any places where the trees have just died standing up, where the salt water has killed them or anything like that?

LD: No. I don't think you will. I think they grow better in the salt water.

GC: The cypress?

LD: Truthfully.

GC: How about the marsh. Are there any areas where you've seen the marsh is more eroded than others?

LD: In some places yes.

GC: Where's the worse that you can remember seeing?

LD: Well that was between Dulac and Bayou du Large. They used to have a lot, but now they've cleaned all that out now.

GC: There's not as much marsh there as there used to be?

LD: Right.

GC: How about camps? Is there any area were you see a lot more camps than there were back in the '50s?

LD: Down Grand Caillou and Dulac, they have a lot of these old, old camps and everything. A lot of people are building nice camps and all. A lot of people live in those camps other than...

GC: It's not just seasonal, it's all year round now?

LD: Yes.

GC: Are there any areas where you can remember when you were younger, say in the '50s and '60s where there were no camps then but there are lots of camps now. Any of those...

LD: No they had more camps... more old timey camps than they do now.

GC: So you think there are fewer camps in some areas?

LD: Fewer, yeah. But most of where you find the camps and all that is down Grand Caillou and Dulac and the road that goes from Dulac to Bayou du Large.

GC: I haven't been down in that area yet, but I hope to get there in the next week or so.

LD: Yeah they cleaning all them out and now they got sand and everything else for em. Course they had that for years.

[end of interview]

APPENDIX A-4

INTERVIEW WITH MRS. RUBY GONSOULIN

By George J. Castille, III, Ph.D.
Interviewed at her home in Montegut, La.

Note: editorial comments by George Castille are in brackets [ ].

GC: It's January 6, 1998, and I'm talking to...

RG: Ruby Gonsoulin.

GC: and you were describing the hurricane of 1926.

RG: Yes.

GC: And where you at the time?

RG: I was down next to Madison Canal which is...was at the end of the road at that time. Down here along Bayou Terrebonne. My great grandfather dug that canal in 1870 with a shovel. And I want you to see it today. His sugar plantations ran all the way back to Madison Bay. And, I don't know how much you want me to tell you about the storm, but I'll tell you this, that at midnight, my father said that "the barometer, it's as low as it can go, it was 26." Now we have never had that kind of reading that I can remember, not even in Betsy. And I was here for Betsy.

GC: You were in the house?

RG: I was in the house. They wanted us to come to Houma. And they told my daddy there was a terrible storm coming and we had built this great big concrete house. And we said oh, we're OK, we gonna stay with my daddy and my mother.

GC: How old were you at the time.

RG: I was 13. And so we had a great big seafood industry and he didn't want to leave because he was still buying shrimp the day before the storm. He packed all the dried fish to send to China, and the dried shrimp. He had a big, big... Well he was the only one had a big business in those days.

GC: Shrimp drying?

RG: Fish drying and shrimp. So he bought all the day before, the weather was terrible. But he bought the fish, and he bought the shrimp. And by that night, it started blowing, and the next morning I'd say around 9 or 10, it really got bad. And he was still fooling with the shrimp. And around that time, 11:00 o'clock, our cistern went away. The only drinking water we had. And we saw the house, our little rented house across the little canal, Madison Canal, we saw it going. We saw the water and the wind picked it up. And at dusk, my daddy could see my grandmother's house, a great big cypress house, that it was going. That house right there [she points to old photo].

GC: The one in the picture?

RG: Yeah that house.

GC: The one behind your boat building?

RG: Yeah, that was a cypress house. We always spent hurricanes in there because it was so strong, you know.

GC: So this boat building shed was down near Madison Canal?

RG: It was right above Madison [on Bayou Terrebonne].

GC: So this photograph you have was taken down there?

RG: There it is, yes that's down there. And I have another picture I want to show you.

GC: It's a great shot.

RG: I wanted to have some run off for you like that. One of em anyway.

GC: How high did the water get around your house?

RG: Thirteen feet in the house.

GC: In the house?

RG: Yes. Lucky we had a two-story house and lucky it was strong like it was. Because there had to be tornadoes passing all over. And the marsh was coming in, the size of 40 or 50 feet. This room [here] is 40 feet long.

GC: You mean big chunks of flotant?

RG: I mean whole islands were coming in on us. And the water...I guess at that time...Well first of all, around 10:00 or 11:00 in the morning, our great big pecan tree fell over. And we had a boat, a 35 foot boat. He had taken the motor out or it. He had tried getting to the boat to tie it to the tree. The great big oak tree. But he couldn't make it to the bayou because the wind and the water was coming in, you see. We had water, I'd say about two feet deep, and you could see the big old flounders and all the fish in there, you know, just before the storm hit. And below the canal, there was a Mr. Laymon(?), and he had all his cattle down there. He stayed with my daddy to help him in case we needed help. So around 10:00 or 11:00 that morning, the tree fell and then we see the boat airborn. And my daddy had built a bridge over that bayou, he had built it himself. It was high, kind of a round bridge. And we saw the boat go up in the air, go under the bridge, come up in the air, and disintegrate.

GC: A 35 foot boat?

RG: Yes. That's what I'm telling you, I never saw a storm like that storm down here. And then when the tidal wave came in, our cistern was gone, we had no way to get...We had no water. And my mother went to the back window, and she said, " children, run upstairs." There was this tidal wave coming, I'd say 4 or 5 feet high. And the first wave put water over our porch. Papa had built the house real high. And he had put little doors under it so the water would go under it. He knew how bad storms were. So they were still in that warehouse. And we didn't want to go upstairs until we could get them in and they didn't hear us. So finally, when they came out, they had a whole big basket full of dried shrimp. And when they saw where the water was, it had probably got in the floor there too. On the floor. Well they were trying to get to us at the house, and the wind and the water was taking them. And they finally got close enough to the porch and

we reached out and grabbed them and pulled them on the porch. The first thing that he did was take an axe and break the floors. Because you get that vacuum from under, you know, because he knew it would explode.

GC: The waves would...

RG: And then he said get upstairs. We didn't save our clothes or anything. We went upstairs, and by that night, it was really blowing. And by midnight, I would think, and my daddy said too, the wind had to be 200 miles an hour. And he was an old seaman and all of my people were. I had an uncle who stayed in Clifford Smith's boat above where our place was. We didn't know he was there. And there was no engine in that boat, but it was a big yacht. And he said all night he would run from one side to the other. He wouldn't even come look for us the next day, he thought we were all dead. Anyway when the marsh passes by, I going to show you what was land one day and what the next morning was lakes. Behind our house we had a pond maybe the size of that, maybe not even 40 feet... where my dad and all of them used to go hunting. They would go in, get their limit of ducks or something and come on in. I don't know if we had limits, we'd only kill enough to eat because we had no way to keep em, you know. No refrigeration. The next morning, that was a lake. And across Madison Canal, was all land. It was all marshland, but it was land. The next morning it was a lake. Now across the Bayou Terrebonne, where they just put the floodgates, that...We had over 200 trees that they cut down to put that floodgate. So we had nothing left there but water, water, water.

GC: What kind of trees did they cut down?

RG: Oaks. They were in a class action suit with a lot of people here. I didn't join it. But my brother and all my family joined it. I didn't want to join it because my daughter-in-law's father was on that board, you know. I wanted to show...
[tape turned off momentarily]

RG: The bayou was stopped up so the people who came to rescue us had to take a little skiff because no boats could come down. And no boats could come down, as far as I know, for one year.

GC: Because the bayou was stopped up?

RG: The bayou was stopped solid. You could walk across it.

GC: What was if filled with, marsh?

RG: All those islands of marsh.

GC: That got washed up?

RG: They'd hit the trees across the bayou, where...They would stop up. And all the cattle they found them drowned on Little Caillou. My father had a great big panel truck that he would bring seafood to Baton Rouge in, it was on Little Caillou. My grandmother's house they found a little part of the attic in Lake Boudreaux on Little Caillou. Everything goes to Little Caillou when you had a storm.

GC: So the waves and the wind pushed it...

RG: Across, all the way to Little Caillou.

GC: Which is how many miles away?

RG: Oh, I don't know. Maybe four or five miles. I really don't know air miles. You have a map there I could see. [we look at maps; she pulls out old news paper articles and misc. historical information]

RG: I think I must have gotten the papers I wanted to show you mixed up. "Barrier Islands Restoration Rolls Forward" you can have this article if you want it. I have a lot of articles I can give you. Oh here I go. Here are some very good pictures. If you want to ride down there I'll take you to see first hand.
[she pulls out old photographs]

GC: Where were these taken?

RG: Down at Madison Canal.

GC: That's the canal?

RG: That's the canal. That was land in 1926. The next day this is what you saw. This was all our property. That was where I spent the storm. We had a great big concrete house here. They tore it down, but believe me they had a job doing it. Because we had really built it. I helped pour cement for that house. All this is our property up to here. This is Madison Seafood. This is on the left descending bank, this is the right descending bank.

GC: Madison. I asked a guy at a store a few minutes ago where was a good place to buy shrimp. He said Madison.

RG: Right there, Madison Seafood, if you can get it. OK that's Madison Canal, right there.

GC: This is all where those new camps are today.

RG: Yeah. That was the piece that my dad sold, after the big storm. We sold our share down there. Right now there's a place where they make soft-shell crabs right here. They are leasing from my uncle. But all this and all this, is still ours. Here's another picture...Now this right here, right below the canal, that used to be for my family. That's where we had a house that we saw rolling away. This was all land in '26.

GC: You mean that area west of the bayou and across from Madison Canal?

RG: All that you're looking at, right. That's my grandmother's, she has 100 acres right here that goes to...that's Bayou LaCarpe on Little Caillou right there.

GC: So that big lake was nothing but marsh?

RG: That was land the day before the storm. And now it's even worse.

GC: This too, on the east side of Bayou Terrebonne?

RG: Well that was our land too. You see that Madison. That's where I lived, that's where I spent the storm. This is still our land. This is Madison Seafood. This all ours, but there's no more property. There's nothing. But it's really the storms that did it. That's Madison. That's our property. [she laughs] You know they even trawl in there. An oil company came in and cut a bayou right in the back.

GC: And now people are fishing back there?

RG: And they're fishing back in there. Trawling on our property. Well my cousin is a photographer. You can have one of these.

GC: You've got a lot of photographers in the family.

RG: Well he's a professional photographer. Yeah, Jerry, my son loves to take pictures. See there's a good picture of Madison. See, that's where I lived. All this is Allen's Seafood. Now look back of our house today. That wasn't there in '26.

GC: Do you have the negative for this one by any chance?

RG: No. He would have it, if he still has it. You couldn't use that?

GC: Well I could use it, but if you have the negative you can blow it up.

RG: I wonder if you could have it blown up at the laser shop. I bring a lot of my stuff to the laser shop. I had thought of giving some of these to you, I was going to bring em to the laser shop. If there's any that you want I can bring them and have em reduced for you. Don Burn might have them. I can ask him. He's the photographer, and I guess he keeps his negatives.

GC: This one would be a good one because you can see the whole area of land is gone.

RG: Now this was dug with a shovel by my great grandfather in 1870.

GC: Here's that oil canal you were talking about.

RG: That's it. And this was my grandfather's sugar plantation. All that you're looking at. All of the way to Madison Bay. And across the bayou, all of that was the sugar plantation, plus he had a sugar mill right there. Right across the bayou. In fact the bricks are still there. I have so much stuff.

GC: [looking at map] Madison Bay, right here.

RG: Yeah. You see this property line right here, every map I have, this was our property. And then the first thing you know, Weisner and Gresner took...the Atchafalaya Basin Levee District took the...I don't know who took it, La Terre or them. Lapeyrouse's little canal was dug with a shovel right there and there's Madison, he dug that with a shovel. That's Lake Boudreaux. Here's got to be Bayou Petit Caillou. Bayou La Cache is between this and that. Right across the bayou [Terrebonne] my grandmother has 100 acres right there. But thy are even trawling there now.

GC: So it's now open water?

RG: What year is this [map]?

GC: 1983.

RG: I have one like that.

GC: So it's changed a lot since then? That's over 10 years ago.

RG: Oh yeah.

[part of conversation not transcribed; she comments about maps]

RG: See that's Last Island, that's Timbalier Island, this is Brush Island. I want you to know we own that [Brush Island], and this is the gas fields. Do you think they going to fight for that? Right there at Sea Breeze they had big camps in there. The Albert Dupont family, they may have pictures of them, I'm sure they must. Anybody was welcome to go. They were like the Conservation camp. We had a camp, the old Conservation camp that was 25 feet up in the air on account of storms. And the '26 storm took that Sea Breeze camp completely away. It was by Terrebonne Pass going to Caillou Island.

GC: Were there people living at Sea Breeze?

RG: No, not then. But people lived all the way down to Bush Canal. People were still living down there when I was little. They even had a carousel down there, the flying horses. And they had an oyster shucking...they had all kinds of stuff down there. You see that Bill Elsey of Houma. I'm writing him the

story of my hurricane. He wants it to publish it. There was a storm in maybe 1909. The Rhodes family...Leon Rhodes and his family, across Lake Barre. You know Lake Barre...you now what Barre means, don't you? You speak French?

GC: No.

RG: Barre means locked. Lake Barre was a little lake. I talked to a man yesterday, he said "I remember the only opening you had to get out of Lake Barre was a little pass to the islands." We'd get caught in that terrible weather in Lake Barre sometime, and it was really rough. And today there's nothing. No land.

GC: And so it was a land-locked lake?

RG: It was a land-locked lake. That's why they call it Barre. Barre means locked. Land-locked. And anyway, this family lost I don't know how many members of their family. They finally drifted from that little island I'm telling you about. Right across from that camp, that Conservation camp we used to own. They were on that little island and drifted across to Caillou Island when the house broke up. And he survived but his wife finally let go and drowned. It's a very good little article.

GC: Where is this camp?

RG: That's on the edge of Lake Barre. Just before you get to Lake Barre. There's a bayou. This is Bayou Barre.

GC: So it's where Bayou Barre goes into Lake Barre?

RG: Yeah. When I think how little that was. Here's Madison Bay. Grandpa Madison, my great grandfather...his cane field went all the way to that bay there. He named the bay Madison Bay.

GC: All the way to Madison Bay?

RG: Yeah. Yes. [looking at map] You see that sitting there and there's that big bay by this oil field.

GC: Here's Bayou Barre. It splits... Flat Bayou splits off.

RG: You see Jerry would know just where to tell you. Bayou Barre... And I would think the Conservation camp must have been here...right in here before Bay Bourbeaux. [she points to vicinity of Bay Bourbeaux and Flat Bayou] That means muddy. It was a land-locked lake. It's unbelievable. I mean even...we used to go to the island and get sand and get gravel when we were building that house. And even in those days Lake Barre was surrounded by land. Right here was a canal. And when the weather was bad, the water would go in that canal, I can't tell you how fast it could rise in that canal. It looked like the whole lake would come in.

GC: So ya'll bought the old Department of Conservation camp?

RG: Yes, for $25,000.

GC: From the State?

RG: Yes.

GC: Do you still use it?

RG: No we sold it to some man maybe from Baton Rouge. I don't know who bought it. I'm sure it's just an old derelict now.

GC: Well the last photo of it [the camp] was in 1970.

RG: This is what that Tidewater tried to do good with but it didn't work too much. I believe it sank. [newspaper article about Wine Island]

GC: Wine Island restored...

RG: [she looks at old photo] Now you see, this is my daddy and his daddy. This supposedly is Madison Canal. That's Bazettes view of it in 1910. That's what he dug with a shovel. Well that was not our home because we didn't build a home until 1925 and we built right there. But on the edge, the road could have been there, you see. He said that was a boatworks. Maybe that was my great grandfather's boatworks, but not my daddy. My daddy, you saw where they were. That's a little... about a fourth of a mile above, maybe not even that far. I can show you everything where it is.

GC: Memories get fuzzy sometimes.

RG: Yeah. But that's supposed to be Madison Canal right there. And my great grandfather lived there so that may have been his house. Just a sketch of it.

GC: Why did he dig the canal?

RG: To go to his plantation. To go back to his fields.

GC: Did he use it to haul cane?

RG: Well I don't think he hauled cane in that canal, but it may have been easier to get there. I don't know why he dug it, but he dug it in 1870. And it was all patented land. I have the patents on most of that. I don't have the patent on that particular place. I have the maps.

GC: Here's a 15 minute quadrangle map.

RG: I don't know where I got that.

GC: Here's Lapeyrouse, Madison Canal...

RG: OK, you see our line, where it was back there? And every map I have shows we owned all that. Well when they dug...when Tenneco put that well in there La Terre claimed all that. Billy Goat Bay. And this is all...Louisiana Land owns that, as far as I know. And St. Martin. That must be Bush Canal. You asked me about houses down there?

GC: Yes?

RG: Down below here they had a lot of homes. Below Madison Canal. Now they have a lot of camp people who come in there, you know. But people lived all the way down to Bush Canal. That's where the road stopped.

GC: Bayou Terrebonne had lots of people living on it?

RG: Oh yeah they did. Well, I can't say lots. We didn't have any close neighbors, but there were homes across the bayou too. But after '26 it looked like it had been swept clean with a broom. The storm just took everybody's home except the Prosperies(?). They had great big beams bolted through that house so it never took that house. We had absolutely nothing left but the store the next day. To make a living...nothing.

GC: So the store was still there but not the boatshed?

RG: The store was there, the boatshed gone, my grandmother's house was gone, two of my uncle's houses were gone, our house stayed because it was strong. But we nearly died. Here's another map...

GC: Marsh Island?

RG: Yeah, 1915. Yeah you saw that one, 1915.

GC: Yeah, that's similar to the other one.

RG: The first well they drilled was right there in the middle. I love history, I always liked history in school.

GC: Me too.

RG: I like all this. Did I show you this?

GC: Yeah, that's that highway department map of the 1950s.

RG: I want to save this account. I asked my uncle one day, next to the '26 storm... my old, old uncle... what was the worst storm you ever have been in, he said "the '26 and 1909." They were living on the island in 1909. On Brush Island. And the Bayou ran almost... it ran all the way up to Caillou Island. But they probably had land that ran almost up to Brush [Island] because grandma said that grandpa Madison would get there he would whistle and tie up his horse on that side of the little bay and they would go pick him up in a little rowboat. They didn't have engines like we have today. No outboard motors.

GC: It must not have been very wide if he did that?

RG: Oh no. For you this would be a good map, if you'd like it too... the old (?)

GC: I've seen one similar to it from the 1820s.

RG: Trembling marsh.

GC: How long did you live down at Madison?

RG: Well I lived down there until 1926. After the hurricane my father went to work in Houma. He had to go back down there to... Oh God it was such... you couldn't live down there anymore. Everything... There was no more road. I know that it took a year to dig a road out because when you hit that old marsh, it's like peat moss. A shovel won't cut through it. And they had to do that probably with shovels. I don't know how they even opened a road. But there were so many...It was like mountains on each side of the road. And when you'd go through that it was like a tunnel. You could only go through one car at a time.

GC: Mountains of marsh?

RG: Marsh on each side it had gone over the big oak trees. We'd go to school, and we had to walk from down there to Lapeyrouses store. And the storm had taken all our shoes. Can you imagine, I was 13. I had no shoes to go to school. The Red Cross gave me some and they were too tight and they gave me high heels. It was horrible. And here we are with a store so my daddy gave everything to the Indians on Isle au Jean Charles. They were starving and they would come up by Little Biddy Bayou to buy groceries at my dad's store, you see.

GC: The Indians were living on Jean Charles?

RG: They are still there. Of course most of the whites took their land. It didn't matter that they were there all their lives. Wherever there was oil, you know.

GC: Have you ever done any fishing out in this area?

RG: Lord yes.

GC: What kind?

RG: All kinds. You name it I've done it. [she laughs]

GC: Ever harvested oysters?

RG: Yes. That's one thing when I was about 11 or 12 years old my dad would go out there on weekends or whenever we didn't have school and pick up oysters on Timbalier Island. By the way, all the ponds on Timbalier then were fresh water ponds. The ducks would come in there, you wouldn't believe the ducks, they'd be flying. We'd go out there and one shot and you couldn't eat all the ducks you would kill. We had too many to eat with one shot of a shotgun. And my dad would go out there and come in and if he had extra ones he would sell them. Fifty cents a bushel.

GC: Fifty cents a bushel for oysters?

RG: Yes. He just had a little biddy oyster boat in those days. But we'd always go out with him. I've been going to Timbalier Island since lord knows, maybe 6 or 7 years old. And my best fishing days were on Timbalier. But all those nice fresh water ponds, there's nothing left. And Hurricane Betsy, I had wonderful pictures, and I asked Jerry why he didn't bring them...I just gave em to my son Dickie to keep... I said, I'm trying to get rid of a lot of this old stuff, hand it down to them, and the island was cut right about where our camp was, completely in half. And I have air pictures of that. My husband went out and took pictures after Betsy. We're in the oil towing business. Our barges, two of them are still sitting on top the rocks in the Mississippi River. They had to be abandoned. They were on top the jetties or whatever.

GC: That was from Betsy?

RG: Betsy. That was a bad storm. If we had had Juan's water with Betsy's wind, all us old timers say it would have been a 1926. Yet you don't ever see any... I've written to what's his name...John Holt. I never got an answer. I asked him to furnish me with some information on the '26 storm. I wanted more information to be able to write about it. But I tell you. And then Betsy, I have a picture of the eye passing right over Bayou Terrebonne here. I have it right there in my box.

GC: You said you were in the oil towing business?

RG: We still are.

GC: That's what your husband did?

RG: Yeah. We own Le Boeuf Brothers Towing Company.

GC: The which one?

RG: Le Boeuf Brothers Towing Company. And Gonsoulin(?) Industries. When we went into Chapter 11 we lost a lot of stuff. We lost our two biggest boats.

GC: Le?

RG: It still goes under Le Boeuf. L-E-B-O-E-U-F.

GC: Le Boeuf Industries?

RG: Le Boeuf Brothers. You see he went in business with these two men and we left it under that name. I think they are planning on changing the name, but I don't know. But we've done well since after Chapter 11, things picked up again. And my sons... two of them... were in Viet Nam and one of them came back and he the one I had invited for lunch both were running the towing company. They are still running it.

GC: So the '80s recession hit ya'll pretty hard?

RG: Oh gosh yes, the bottom fell out. We had just built this big post office between the two bridges up there. Pressed Steel(?). That belongs to my children. We almost lost that. All we could do was pay interest on it. And finally the government... That's where Minerals Management is. I think it's Minerals Management. What you call that?

GC: MMS.

RG: MMS. They rent our building and so is the post office.

GC: Where in...

RG: Right when you get up...above the two high schools. You saw the two schools coming down?

GC: Yeah.

RG: There's two bridges going across that way. Pressed Steel(?). Well it's right between those two bridges. You can't miss it it's right on the corner there. On the left hand side.

GC: What was the other business ya'll had...you said Le Boeuf Brothers was one and the other was...

RG: And we had Gonsoulin Industries many years ago. We used to own Houma Steel and we had... You know we built tug boats in those days, and barges. And then after the... we had a business... after Chapter 11 we lost some of it. We had a beautiful airplane; we lost it. We had what was those MU2s.

GC: Where was the fabrication yard?

RG: Where was it. Oh gosh, I don't even... It was in Houma. That's where the steel used to come in there. There's nothing there anymore.

GC: Where were the barges built?

RG: At our place back there. I think we built some barges. We built some tug boats.

GC: On Bayou Terrebonne?

RG: No on... up here where you pass Bourg right there. Our business is in the back. Actually I think we're in Lafourche Parish. And we built some big offshore boats.

GC: So it's near the parish line?

RG: You know, in Bourg, that canal is probably the old Intracoastal there going back. We're right on the Intracoastal back there.

GC: Ok, on GIWW. OK. Did you ever do any shrimping when you were younger.

RG: Me? No we didn't have to go anywhere to shrimp. You'd throw a cast net and you'd have more shrimp than you knew what to do with right there at the mouth of Madison Canal. My daddy bought shrimp until the big storm of '26. He was in the shrimping industry. God they had a lot of shrimp too.

GC: He gave it up after '26?

RG: Oh yeah. Well we lost everything. His platforms were all gone. Everything we owned was gone. His shipyard... no tools to make a living anymore. Nothing.

GC: His shrimp drying platforms were...

RG: Washed away. Everything was washed away.

GC: That was on Bayou Terrebonne?

RG: No that was on Madison Canal. You know where that canal curves a little bit?

GC: Yeah.

RG: Right there. Back there.

GC: That's where he had the platforms?

RG: Now they had land all the way back there, you see.

GC: So he dried shrimp?

RG: Yeah.

GC: Does anybody still dry shrimp today in that area?

RG: Not on that area but at Chauvin down on Little Caillou I buy shrimp from a man that dries shrimp. Mr. Price. Steve Price I think is the boy's name. I'm still buying shrimp with him right now. $3.00 a pound all peeled. You can't beat that. Some of em are a little strong, though. But we're in the towing business is what we're in. And we been doing that since... We were doing that when Wonder Lake down here was still a fresh water lake. Now it's salt. Then it became brackish, and now I think it's a salt water lake.

GC: Ya'll have been towing for mostly oil and gas?

RG: Yeah oil and gas. We've towed everything.

GC: Offshore or inshore?

RG: Inshore. We have no offshore boats. All our boats are inshore.

GC: So it's a lot along the Intracoastal?

RG: And a lot up north, all over. We used to tow fish oil. We towed everything. Gasoline. But now I think it's mostly crude oil.

RG: How many boats do ya'll have?

RG: I don't know? I really don't. But they just built one and they named it after me. Then they named the other one after my husband. Beautiful boat. And mine, they said "boy you sure giving us trouble," it hit a sand bar. And then...

GC: It's not at the boat-building place now?

RG: I hope not. I hope it's working. I have pictures of it. It's a big, big...

GC: I was wondering if I could get a picture of it?

RG: I have a picture of it and an article about it. And they said not long ago we took both of them and put them front to front and we wanted to see which one had the most power. And guess what. Earl shoved you back. [laughs] Earl was my husband. They wanted to write an article about him, because when you talk about starting from scratch, and building an industry, you know, like we did, and of course the two boys went to Viet Nam just when they could have used one of them especially... They planned on letting him run everything, you know. And then both of them Le Boeufs... one sold out and the other one died. So they bought his wife out and children. So we own the whole towing company.

GC: Where was the towing company first established?

RG: Oh gosh, in a little biddy room about this big down Bayou Terrebonne. Maybe in 1935 or 36.

GC: So you started on Bayou Terrebonne?

RG: Yeah. Way down below Montegut. They had asked him to be a partner with them in their business. Lord we had $3000 down, and that was a lot of money, and we invested that in a boat and barge, and that's how we started with them. And then they worked for Texaco and he [her husband] worked for Texaco and of course there was a conflict of interest there, so they said anyway, and if they would have had all their employees as honest as my husband was. He received beautiful letters during World War 2 for the work he had done and all the money he had saved Texaco. Good old Texaco. And anyway they let him go. And then he could go out and make money. Then they could buy... They bought a lot of old boats, you know, boats that had maybe caught fire or sunk and restored them. But now they are beautiful boats. They cost about a million and a half apiece.

GC: How many have they had at one time?

RG: Kind of like 60 I think.

GC: 60? Working all over the United States?

RG: Towing all over. I don't know what we own right now. If I even try to take a guess I don't know. Because some.... You know one of em burned, and some of em... One of em... The first boat we ever had they had to scrap. That boat had gears in it from the factory in Germany, the Rhinegest(?) Factory. And when they scrapped it they put those gears in another boat. Isn't that remarkable? Those Germans did good work. It's a good thing they didn't fight a war like they did good work.

GC: Yeah. Did you ever have anything to do with the business...

RG: No.

GC: or was it mainly your husband?

RG: My husband and two partners. And then my two sons. I have four sons, but one works in Lafayette for Smith Tools, and the other one has his own... he's kind of a broker. It doesn't pay to put too many from one family in the business.

GC: I can understand that. Is your son going to come?

RG: Well that's what I'm wondering. Well we're going to eat.

GC: You said you fished out in this area most of your life.

RG: Uh huh.

GC: Do you still go fishing now?

RG: No. I don't know if I can pull in those big 20 and 30 pound reds. Oh we caught some big ones.

GC: Is that what you were mainly fishing for?

RG: Well no, we would fish for mostly speckled trout. But of course, when they'd have oil from the rigs out there in the water... I wouldn't even worry about fishing because you bring em up and they taste and smell oil. I'd stay on Timbalier for weeks. Sometimes two weeks at a time just fishing.

GC: Ya'll would camp out there?

RG: We had a great big houseboat. It's still up in Cameron. It's 135 ft... it's as long as this house.

GC: Wow.

RG: And we used to bring it out there. It was built on one of the barges we didn't use anymore. And we sold it... I don't know who they sold it to... a bunch of doctors I believe.

GC: You camped on Timbalier and fished for a week or two weeks at a time?

RG: Oh yeah. I took Tom Dempsey fishing. I took all of them out fishing...all the Saints. I'd bring everybody out. They'd come out to the camps where they'd come make a talk with something at school and they'd want to go relax somewheres. We had a good friend who was very good friends with them. I still hear from Tom Dempsey sometimes. And Danny Abramowitz sends me little notes now and then.

GC: Oh really.

RG: I took him fishing. They said we want to fish with Miss Ruby. She knows where every fish is out here. I guess I did. And we had a lot of customers, we did a lot of entertaining. And I'd take all the ladies out and we'd come back with a lot with a lot of fish and the men would come back with nothing.

GC: Has the fishing changed a lot over the years?

RG: I guess. I think so. Yes.

GC: How so?

RG: Well you can't catch anymore like you used to. And you can't fish anywheres like you used to. Once upon a time you could go anywhere down there and throw a line overboard and now everybody has got that posted, they can't fish. And the people that I usually get fish from, they either paddle or they go out in a little boat, but they just don't hardly catch anything.

GC: That big lake that opened up to the rear of your property, off Madison Canal, you said people trawl in there?

RG: You mean on our property?

GC: Yeah.

RG: Yeah they trawl in there. I've never been in there, you know, but I've seen the boats in there.

GC: Have ya'll tried to post that?

RG: No.

GC: Would it do any good if you did?

RG: I don't think it would do any good at all. Because down on Little Caillou on that hundred acres that my grandmother owns they were fishing in there and trawling in there and trying to chase other people out. They said it was their land. I told a cousin of mine, how you go and claim land you know is yours, you know the front boundary lines... but now that they have put that flood gate, which they put on our land, which we have never collected for yet... and they gave my daddy $1400 for his share... and they built that big new highway. We wouldn't give em the land. We had already given for two highways. That's the third or fourth road they built. Because each one washes into the bayou, you see. That's where everybody's land is right now.

GC: Washing into the bayou?

RG: Oh yeah. If they could reclaim like right here [in front her house] the water's high today because we had all this rain, but you could see the mud extends... they just have a little old narrow channel in this bayou. That's all your land in there. I'll show you right here how the land is subsiding. When we moved here in the '60s, the early '60s I think. We lived in old house and then we built this place after we bought the whole 120 acres. And at the bayou side you used to be able to just run across the road and run your tractor out there and mow everything. And there's a big old... I don't know what you call it, a guide line from the post? We used to mow on the outside of that guideline. But when you go out I want you to see that. It's all in the water now. And when you go to the bayou, the water does not go out anymore. No matter how low the water is, we cannot mow where we used to mow. There's always water there. And even in this yard I see it.

GC: Is the land sinking?

RG: The whole thing is subsiding, that's right. It's sinking. And the water level is rising. So you have a good combination here. In other words, back of this place here, between here and this way is Larose, you see right up this way. All this is water.

GC: Does anyone in this area raise sugar cane anymore?

RG: Oh yes, right above me here and right below here. All that's sugar cane. The Ellender family.

GC: The Montegut area...

RG: Not down there, now they used to have cotton fields down there, would you believe?

GC: But below Monetegut, are there any sugar cane fields?

RG: I don't think so. Maybe one little patch but once upon a time they used to raise... I know I remember the cotton fields. And I had a great uncle who lived down there who raised that Perique tobacco.

GC: Down here?

RG: Yeah.

GC: I noticed there's lots of oranges or tangerines...

RG: Oh they do grow a lot. I used to have a lot of em too. But once they froze I never tried planting another one.

GC: Has that always been common in this area?

RG: Oh no. Many years ago, we used to have orange trees, maybe one or two trees when I was a young kid. But everybody had his own orange tree and that was it. But today it's a big business.

GC: Down near... I guess it's Lapeyrouse... where they're putting in that new bridge. I noticed there was a house there that sells and has lots of trees behind it.

RG: Lapeyrouse down there?

GC: Wherever that bridge is. Just across that bridge.

RG: Humble Canal?

GC: I don't know what canal it is.

RG: The first one you get to.

GC: Well there's a big construction area where they're putting in a brand new bridge, a higher bridge. Right up...

RG: That's Nettleton. They bought all that land and they just got into that recently.

GC: There's a big house with lots of trees...

RG: You went down there already today?

GC: Not today. I drove down there about a week or so ago and took some pictures down at the end.

RG: You went all the way down to Madison Canal or below? At our canal.

GC: Yeah. I took some pictures of those camps along Madison Canal.

RG: That's what I was going to ask you, if you wanted to go down there today? So you saw the flood gates too then?

GC: Yeah. But when I was going down there I didn't know what I was looking at.

RG: Well we can go. I going to call Jerry again and see. You know if you know where we lived and you know like what I'm telling you what has happened to all this land then you have a much better picture.

GC: Right. Now that I know the land that you own I want to take a picture of it. It makes a little more sense to me.

RG: What are ya'll doing, writing a book on this?

GC: Yes.

[she makes telephone call; we stop for lunch]

[We take a ride down Bayou Terrebonne down to Madison Canal; on the return trip I taped part of our conversation as we passed a small road leading to an oil/gas field to the east of the highway]

GC: The old Lirette oil field?

RG: Yeah. That used to be a gas field, really.

GC: That one right there down that road?

RG: Yeah. Right down there on that little road.

GC: You said your father...

RG: My father worked there when I was born... that's where they were living, where I showed you, right by that road. And he, Mr. Arthur Knapp, was the driller, my daddy was an assistant driller, and I don't know any of the other people. All I know is Mr. Knapp.

GC: That was the first well drilled by Texaco?

RG: Not by Texaco. I have no idea who drilled it.

GC: Do you know when that was?

RG: I can maybe find that out.

GC: In the 1920s or...

RG: I was born in 1913. Maybe in 1915. I may have been two years old. I know that when I was a baby, that's where we lived, right there. I can find that out, I think, if you want to know.

GC: So your father...

RG: Because this man, Melvin Lirette, he's still living in Houma. And he's older than I am. He must be 89. And his dad I'm sure worked on that well. And one of the wells blew out one time and his sister lost her hearing from that blowout of that well right there.

GC: I didn't know your father was involved in the oil and gas industry.

RG: Oh yeah. Well, I mean, papa did everything. He was an architect, he built liberty ships during World War I. We moved to Morgan City during World War I and he was building Liberty Ships. He was a draftsman. My father was an excellent violinist. His brothers, they had a band. My grandmother used to tell me the story, when they'd come back from selling all that seafood in New Orleans when they lived on the island. They'd just come in, and she said it was so beautiful to hear them, they'd bring their instruments and they'd come back in playing their instruments.

[we stop at roadside vendor at the Nettleton home in the vicinity of Point Barre, along Bayou Terrebonne near Humble Canal, location of a satsuma orchard]

RG: Those are satsumas huh.

GC: Yeah.

RG: Well you didn't get any shrimp.

GC: No but I'll get these instead.

[end of interview]

APPENDIX A-5

INTERVIEW WITH PAUL MAYARD

Interviewed at his home in Delcambre, La.
By George Castille.

GC: I like to use a tape recorder because I can't write as fast as I used to. It's December 3, 1997, this is George Castille, and I'm talking to Mr. Mayard. What's your first name?

PM: Paul.

GC: Paul Mayard. You've got a nickname?

PM: Yeah. Chou queue(?).

GC: Chou queue(?). And we're in Delcambre at Mr. Mayard's house.

PM: Which is 406 South Short Street, Delcambre

GC: And how old are you now?

PM: I'm sixty-seven

GC: Sixty-seven, and you've lived in Delcambre all your life?

PM: I was born and raised on the water-front in Delcambre, and we've seen it from a little-bitty shrimp boats and seines to where the first troll boats come out in 1936, as far as I can remember. And we, we had a fleet of boats that was approximately pretty close to a hundred big shrimp boats in the early fifties, and right now if I'm not mistaken, they've got but three people in Delcambre that owns shrimp boats.

GC: Only three?

PM: Only three. Some of the others are people from Houma, Golden Meadows, and a bunch of Vietnamese out of Intracoastal City, and from places there, but they don't... they don't work the bays. They work the Gulf of Mexico.

GC: How many boats are there now, you said in the early fifties there were a hundred.

PM: Well they got, well they have a bunch of small boats that migrate this way with the seasons. They more or less from Biloxi, Mississippi; Bayou la Batre, Alabama; Golden Meadows, Houma, but they don't stay here.

GC: But the hundred you referred to in the fifties, those were permanent...

PM: Permanent Delcambre residents.

GC: Ok, so now you have only three, and would there be as many as a hundred boats in the season here today?

PM: Oh yeah, but you're talking about a season that used to be six or seven hundred boats.

GC: Oh really?

PM: Yes.

GC: So back in the fifties for instance when there was a hundred boats local, there may have been six hundred boats total?

PM: Right, from other ports. And what I've seen in Vermillion Bay actually is fresh water coming in, from the Wax Lake Outlet, and Atchafalaya River, and when it comes in to Vermillion Bay it brings in logs, water lilies, and other words, snags that messes up the nets and whatever, you know.

GC: So the biggest impact you've seen now is the fresh water coming in from Wax Lake?

PM: Wax and Atchafalaya

GC: Where is the water, how does the water get into the bay?

PM: It gets in from Cote Blanche Bay.

GC: The upper end?

PM: Yeah around Point Chevreuil.

GC: In your lifetime, how has the fishing industry changed in this area, other than the fact that there are fewer boats owned by people who live in Delcambre?

PM: Well, we went from pulling trawls by hand, to having winches on the boats, and mechanized hoists to pull the nets in. Then we went from single-rigging to double-rigging to full-riggings. Then we went to... they have also butterfly boats, that uses the southwest pass, in places where they have a lot of current to catch their shrimp. And ...

GC: What do you mean by "butterfly boat?"

PM: Butterfly boats are like two nets hanging on the outside the boat, and they work the current, you see.

GC: And they're stationary?

PM: No, they moving, they moving. You got to have a lot of power to move it though. They have some that's stationary, that anchors out. But it's not too many.

GC: Do people shrimp in Vermillion Bay now?

PM: Yes they do but it it's not like it used to, its just now and then. Or like for the opening day or opening week, let me put it that way.

GC: Why don't people shrimp as much in the bay anymore?

PM: There's nothing in the bay, hardly, and it's... you don't want to snag, you don't want to mess up your rigging. And you can only pull two, twenty-five foot nets, where on the Gulf-side, you can go with forty-five, fifty foot nets as, or what you want, I mean, if you got the power to pull you can put accordingly.

GC: So you can pull bigger nets further off shore?

PM: Right, right.

GC: How about as far as the shrimp are concerned, are there shrimp still in Vermillion Bay?

PM: Yeah, they got a little bit shrimp, but if the water would be salty, most of the time, to me, now I'm not a, I'm not a doctor on that, but I think it would be better. Then they have these weirs on these... On Marsh Island, these preserves, and Rockefeller. If they'd open that, we'd have a little bit more shrimp than what we used to have, cause some of them people will butterfly these canals, private canal, you see they pay a certain fee and they make a killing. They make a killing. So the shrimp can't get away, you know, they... To me that should be against the law, to start off with.

GC: So in other words the shrimp have to go through the canal to get to and from the open Gulf?

PM: Yes, and they don't have a chance. They got these butterfly boats with butterflying these waters, you see, these private canals. And I know for a fact there's some boats that caught up to a hundred thousand dollars worth of shrimp, in these private canals, but they had to pay a three thousand dollar fee to get there, you know? So I don't know. I think that should be eliminated, these weirs should be opened up.

GC: Where are the weirs located?

PM: On these uh... like Marsh Island. And like around Rockfeller Refuge and Miami Corporation.

GC: Are they on public reserves(?)

PM: Yeah.

GC: Are any of them private?

PM: Yes, they have some on private preserves too, like Miami Corporation and around west of Pecan Island, west of the Freshwater Bayou.

GC: Ok, and those are bad for shrimp because...

PM: They just, I mean, just one or two have the capabilities of making quite a bit of money there, and if it would be open to the public or none whatsoever, just let them shrimps come out, everybody would have a chance. But that's when you... everything started to diminish, when they started putting these weirs and dams you see, so...

GC: You've shrimped all your life?

PM: I've shrimped, yes, but I've retired with Texaco. I couldn't make a living at it. That's part of the reason. I sold my boat in 1972.

GC: You've worked offshore too?

PM: Not offshore, no, I worked at Henry gas processing plant. I was a plant electrician there for thirty years.

GC: Have you done any other type of commercial fishing?

PM: No, no, it was strictly shrimping. Then after I retired I went a few trips with friends of mine, then with my son who had a shrimp boat then, and he sold out three or four years ago. And things wasn't too bright there either.

GC: It's a tough way to make a living, isn't it.

PM: It is, it is.

GC: Other, other than shrimping are there any other commercial fisheries that go on in the Delcambre area, crabbing or mullet or anything like that?

PM: They got crabbers, yes, they have the Romero boys that, but they complain at times too. Right now a lot of times if you trolling in the bay and you having a tough time with the crab cages. You catch that in you net or your take a chain and you done lost the drag you know. And a lot of them instead of putting their old cages to the bank, they just cut the float and to hell with it, you know? There should be a little bit stricter laws on stuff like that. Or the Wildlife and Fisheries should see to it they bring the old stuff in. Now I've seen on my son's boat that we caught a bunch of crab cages that they had thrown away. We had to put two whip lines on it to put it on the deck, that's how much they were all gathered together in a bunch, you know. It must have had three or four tons of crabs, with the weights and whatever it takes to...

GC: Somebody just dumped them?

PM: Dumped them over. Right next to Southwest Pass. And the current rolls them things you know? It winds up in the bay again.

GC: So there's always a dispute between crabbers and shrimpers?

PM: Oh yes, right, right.

GC: Someone had suggested to me yesterday I was talking to them, a guy at Cypremort Point, and he said that there should be a season for crabs and a season for shrimp, that way there wouldn't be any...

PM: Any interference on, but they both got to make a living, you know, and whatever and whatever, its...

GC: That's interesting, Ok, I think that's the main stuff I wanted to talk to you about, you know. If your friend is around, maybe we could...

PM: Well, I'll give him a call,

Wife: Who you calling?

PM: Trois, Trois Dubois

[Tape goes off]

GC: You mentioned the port of Iberia,

PM: Port of Iberia

GC: Can you remember when that was started?

PM: The Port of Iberia was started, I'd say in the late forties by Mr. Cornelius Voorhies, Voorhies Machine Shop. That was his dream, to see the port like it is today. I've worked at the port of Iberia where they only had one business, which was Mr. Sully Berard and his two sons, Burns and Sully Jr. And they had crew boats and little drill barges for seismograph crews. I'd work for him off and on, you know, whenever construction or whatever was slow, or shrimping.

GC: Was that the Berard Company, that big company now?

PM: No no, it's Berard, b-e-r-a-r-d. He's still living, he's in his nineties, he's from Loreauville. He was an industrial arts teacher at Senior High in New Iberia for years, until he went into business on his own

GC: But Berard was the first business there?

PM: No, Joe's Shipyard, Mr. Joe Waguespack, he had a shipyard. He raised boats out of the water, to repair, and then Mr. Berard bought that from Mr. Joe Waguespack. Mr. Joe was a Wildlife and Fishery agent at that time.

GC: Was he the one that used to build all those little tug boats and stuff....Joe's Shipyard. I remember one time they built small tugboats out there.

PM: That was his cousins or brothers, they had tugboats.

GC: Joe's was where they had that long ramp, where they pulled the boats up?

PM: Yes.

GC: I remember seeing that as a child, we'd drive out there. I guess the early port...

PM: That was the only business at that time. And Mr. Cornellius Voorhies, that was his dream, to see the Port of Iberia like it is today.

GC: And after that, there was some kind of big boat shed, wasn't there, where people parked their boats.

PM: Yes, yes. A public ramp and boat sheds, they'd rent out.

GC: And then other businesses started moving in?

PM: Moving in, yes.

GC: And today it's...

PM: Oh Lord, I'd like to know how many workers there are around that port.

GC: It's big, huh?

PM: It is big. They had the proper people to initiate different companies to come in I guarantee. We have a little port over here. When we established the Port Commissioners the port district, we had named it, Bayou Petit Anse, Bayou Carlin, Bayou Beauston, and different names. When we come to put that on paper in Baton Rouge, Ted Haike's secretary got all over our case cause she had so many names to put in there. So I said, "Well, why don't we call it Twin Parish Port District?" and that's how it's named today. Years ago we used to have Twin City Coop, which was a bunch of fisherman that had gotten together and formed a co-op. So I said we're in two parishes, why don't we call it Twin Parish? It was much easier for the secretary.

GC: You're right on the border between the two.

PM: Right, yeah, in other words, we take off where Abbeville Tunnel District leaves off, and where Iberia Port District leaves off, so that's Twin Parish Port District.

GC: Is it mainly Delcambre Canal area?

PM: Delcambre Canal area, yes, and but we can go from district to district there, if we want to put up something.

GC: You were Mayor of Delcambre at one point?

PM: I was Mayor of Delcambre for eight and a half years.

GC: When was that?

PM: No, six and a half years. From 1982 to 1988.

GC: Any regrets?

PM: No, I wished I could have done more. But it's a rough job, for a little community that don't have any revenue, not too much revenues coming in. It's a... you gotta stay on your "p's and q's" all the time.

GC: Is the shrimping industry the most important industry for Delcambre?

PM: Not no more, not any more.

GC: What is it now?

PM: Oil and gas. You know our little community was formed with trappers, salt mine, shrimpers, and oil and gas. But now it's more or less oil and gas. There's not too many shrimpers, or businesses relying on shrimping industry. We have two peeling plants, that peel shrimp, but they're from out of town people, and most of them got Mexicans working for them. And they all got exemptions from taxes and whatever, you know, but supposingly it was to hire local people, but now they claim they can't find enough local people, so they import Mexicans.

GC: Was the Delcambre Canal always as big as it is today?

PM: No, no, I can remember, I was a little boy, they had a dredge and I had an uncle of mine that worked on that dredge. And when they finished dredging the canal, they... on Dr. Landry's Estate, not too far from here, they left the dredge there and they instead of using it farther down, they just got what they could off the dredge and it was abandoned right there. That's where... what's that company called... Bagwell Brothers, they got part of their business where that dredge was abandoned. And used to, we could catch crabs, fish, right there in the canal. Now I don't know what's the matter, but you can't catch stuff like you used to years ago.

GC: When they dredged it, when you were a boy, did they go upstream from the bridge too?

PM: Yeah.

GC: All the way up?

PM: Yeah, all the way up. They didn't cross the bridge, it was that away.

GC: The canal was mainly... the upstream part of the canal was mainly accessed for the salt mine?

PM: No, no. Years ago we had a derrick that would load sugarcane on the barges and that sugarcane was transported to Louisa. And they just started using, in the late seventies they started using... The salt mines started using the barges and tugs to get some of their salt out.

GC: So before that the canal was used mainly for hauling sugarcane?

PM: Sugarcane and shrimping.

GC: What, would the shimpers go upstream from the bridge?

PM: Yeah. Well, I mean they'd use the canal to get to Vermillion Bay and the Gulf of Mexico,

GC: Yeah, but that's downstream, how about going upstream towards...

PM: No no, no, the only time they'd go upstream was for a hurricane or whatever to tie on trees, for hurricane protection.

GC: So nobody used that portion upstream?

PM: No, nobody but the salt mine, that's all. Now, years ago they had the sulfur mine that used the lake and Texaco had a few oil wells in the lake also, but they'd use a little boat that was around the Island [Jefferson Island] over there, they'd bring a barge now and then, they'd put a drilling rig on, but otherwise it was very seldom they'd use that.

GC: Can you remember when that salt mine collapsed?

PM: Yes sir, 1980. I was on jury duty. And that afternoon when we got back they said the... I heard it on the radio coming in. I went by the bridge and we had a two foot waterfall at the bridge going towards the mine.

GC: A two foot waterfall?

PM: Yeah, a two-foot waterfall. And that went on for two days.

GC: What did it do to all of the boats that were tied up? Did they just fall to the...

PM: No, no. They come in, the water would come in and, now...

GC: There was a current, must have been a big current?

PM: They had a big current, to form that two-foot waterfall at the bridge there. I was afraid the bridge would collapse there. I'd like to know how much of it is ate up under that bridge. We have one of the bridge tenders who's a diver, and he went down one time, and he said if the people would see what they were passing on...

GC: They wouldn't want to cross?

PM: No.

[end of interview]

APPENDIX B

COMMERCIAL FISHING LICENSE TYPES FOR PARISHES WITHIN THE STUDY AREA, 1992

Commercial Fishing License Types for Parishes within the Study Area, 19
(from La. Dept. of Wildlife and Fisheries Computer Files).

PARISH	TYPE LICENSE	TOTAL BOATS
IBERIA	BUTTERFLY NET	10
IBERIA	CANS, BUCKETS, ETC.	0
IBERIA	CAPTAIN (COM. FISHERMAN)	204
IBERIA	CRAB TRAP	72
IBERIA	CRAB TRAP ON TROT LINE	0
IBERIA	DIP/CAST NET	0
IBERIA	FISH SEINE	0
IBERIA	FLOUNDER GIG	0
IBERIA	FRESHWATER GILL NET	11
IBERIA	HOOP NET	9
IBERIA	MINNOW TRAP	0
IBERIA	MULLET PERMIT	0
IBERIA	OYSTER DREDGE	0
IBERIA	OYSTER HARVESTER	2
IBERIA	OYSTER TONG	0
IBERIA	PURSE/MENHADEN SEINE	0
IBERIA	SALTWATER GILL NET	6
IBERIA	SHRIMP TRAWL	359
IBERIA	SKIMMER NET	9
IBERIA	SLAT TRAP	0
IBERIA	TRAMMEL NET	1
IBERIA	TROT (SET) LINES	6
IBERIA	VESSEL LICENSE	557
LAFOURCHE	BUTTERFLY NET	230
LAFOURCHE	CANS, BUCKETS, ETC.	1
LAFOURCHE	CAPTAIN (COM. FISHERMAN)	819
LAFOURCHE	CRAB TRAP	202
LAFOURCHE	DIP/CAST NET	8
LAFOURCHE	FISH SEINE	8
LAFOURCHE	FLOUNDER GIG	1
LAFOURCHE	FRESHWATER GILL NET	15
LAFOURCHE	HOOP NET	23
LAFOURCHE	MULLET PERMIT	17
LAFOURCHE	OYSTER DREDGE	31
LAFOURCHE	OYSTER HARVESTER	24
LAFOURCHE	OYSTER TONG	7
LAFOURCHE	SALTWATER GILL NET	36
LAFOURCHE	SHRIMP TRAWL	1356
LAFOURCHE	SKIMMER NET	225
LAFOURCHE	SLAT TRAP	3
LAFOURCHE	TRAMMEL NET	8
LAFOURCHE	TROT/SET LINES	29
LAFOURCHE	VESSEL LICENSE	2099
ST. MARY	BUTTERFLY NET	99
ST. MARY	CANS, BUCKETS, ETC.	0
ST. MARY	CAPTAIN (COM. FISHERMAN)	237
ST. MARY	CRAB TRAP	128
ST. MARY	CRAB TRAP ON TROT LINE	5
ST. MARY	DIP/CAST NET	30
ST. MARY	FISH SEINE	10

Commercial Fishing License Types for Parishes within the Study Area, 19
(from La. Dept. of Wildlife and Fisheries Computer Files).

PARISH	TYPE LICENSE	TOTAL BOATS
ST. MARY	FLOUNDER GIG	0
ST. MARY	FRESHWATER GILL NET	16
ST. MARY	HOOP NET	52
ST. MARY	MINNOW TRAP	2
ST. MARY	MULLET PERMIT	4
ST. MARY	OYSTER DREDGE	5
ST. MARY	OYSTER HARVESTER	0
ST. MARY	OYSTER TONG	0
ST. MARY	SALTWATER GILL NET	21
ST. MARY	SHRIMP TRAWL	417
ST. MARY	SKIMMER NET	7
ST. MARY	SLAT TRAP	10
ST. MARY	TRAMMEL NET	4
ST. MARY	TROT (SET) LINES	70
ST. MARY	VESSEL LICENSE	905
TERREBONNE	BUTTERFLY NET	311
TERREBONNE	CANS, BUCKETS, ETC.	0
TERREBONNE	CAPTAIN (COM. FISHERMAN)	862
TERREBONNE	CRAB TRAP	294
TERREBONNE	CRAB TRAP ON TROT LINE	0
TERREBONNE	DIP/CAST NET	13
TERREBONNE	FISH SEINE	0
TERREBONNE	FLOUNDER GIG	2
TERREBONNE	FRESHWATER GILL NET	4
TERREBONNE	HOOP NET	7
TERREBONNE	MINNOW TRAP	17
TERREBONNE	MULLET PERMIT	4
TERREBONNE	OYSTER DREDGE	115
TERREBONNE	OYSTER HARVESTER	111
TERREBONNE	OYSTER TONG	29
TERREBONNE	PURSE/MENHADEN SEINE	6
TERREBONNE	SALTWATER GILL NET	28
TERREBONNE	SHRIMP TRAWL	1647
TERREBONNE	SKIMMER NET	250
TERREBONNE	SLAT TRAP	0
TERREBONNE	TRAMMEL NET	13
TERREBONNE	TROT (SET) LINES	26
TERREBONNE	VESSEL LICENSE	3143
VERMILION	BUTTERFLY NET	45
VERMILION	CANS, BUCKETS, ETC.	0
VERMILION	CAPTAIN (COM. FISHERMAN)	0
VERMILION	CRAB TRAP	57
VERMILION	CRAB TRAP ON TROT LINE	0
VERMILION	DIP/CAST NET	1
VERMILION	FISH SEINE	3
VERMILION	FLOUNDER GIG	0
VERMILION	FRESHWATER GILL NET	20
VERMILION	HOOP NET	12
VERMILION	MINNOW TRAP	0
VERMILION	MULLET PERMIT	2

Commercial Fishing License Types for Parishes within the Study Area, 19
(from La. Dept. of Wildlife and Fisheries Computer Files).

PARISH	TYPE LICENSE	TOTAL BOATS
VERMILION	OYSTER DREDGE	1
VERMILION	OYSTER HARVESTER	6
VERMILION	OYSTER TONG	4
VERMILION	PURSE/MENHADEN SEINE	8
VERMILION	SALTWATER GILL NET	13
VERMILION	SHRIMP TRAWL	347
VERMILION	SKIMMER NET	2
VERMILION	SLAT TRAP	0
VERMILION	TRAMMEL NET	0
VERMILION	TROT (SET) LINES	12
VERMILION	VESSEL LICENSE	577
	TOTAL	16402