COASTAL
RESOURCES PROGRAM

Louisiana
Department of Transportation and Development

# THE VALUE OF WETLANDS IN THE BARATARIA BASIN

# THE VALUE OF WETLANDS IN THE BARATARIA BASIN

by

Anthony J. Mumphrey, Jr., Ph.D., P.E., A.I.P.
Professor of Urban and Regional Planning
Project Director

Jane Schleichardt Brooks, M.L.A., Assoc. A.I.P.
Research Associate and Instructor
of Urban and Regional Planning

Thomas D. Fox, B.A.
Graduate Research Assistant

Cynthia B. Fromherz, M.U.R.P., Assoc. A.I.P.
Graduate Research Assistant

Robert J. Marak, M.U.R.P., Assoc. A.I.P.
Graduate Research Assistant

James D. Wilkinson, B.A.
Graduate Research Assistant

Urban Studies Institute

University of New Orleans

A Member of the Louisiana State University System



The preparation of this report was financed in part through a grant from the U.S. Department of Commerce under the provisions of the Coastal Zone Management Act of 1972.

This study was completed under State Project Number 741-02-39
Louisiana Department of Transportation and Development
George A. Fischer, Secretary

NOTICE



JUNE 1978

## PREFACE

This study is focused on the value of wetlands in the Barataria Basin. To provide the reader with the proper orientation, a discussion of the socio-economic and ecological systems of the Basin is provided. Finally several methods for computing the economic value and the resulting values, in dollar terms, of the Barataria wetlands are presented. Such information is useful in evaluating developmental decisions in wetland areas.

In completing this study, individuals in several organizations were very helpful. They include: Robert Buisson, Nick Constan, Peter Hawxhurst, Suzanne Hawes, E.K. Johnson, David Reese, R.N. Schroeder, and W.E. Shell of the U.S. Army Corps of Engineers; Gino Carlucci, John Glenn, and Paul Templet of the Louisiana Department of Transportation and Development; Frank Craig and Irving Mendelssohn of the Louisiana State University Center for Wetlands Resources; Ralph Latapie of the Louisiana Department of Wildlife and Fisheries, and Paul Wagner of Burk and Associates. Additionally, the authors would like to thank Ralph E. Thayer, Ph.D., John K. Wildgen, Ph.D. and Pandora P. Grewe, Graduate Research Assistant, all of the University of New Orleans, for their advice and consultation during this study. A debt of gratitude is owed these people; however, any errors or omissions are the authors' as well as total responsibility for the contents of this study.

Finally, Mrs. Beverly Biggs has diligently typed this study as well as five others. She has never received recognition of any kind; yet she deserves much credit for her faithful and patient work. Let these few sentences serve to acknowledge her participation and deliver my gratitude.

AJM, Jr.
June 1978

TABLE OF CONTENTS

CHAPTER PAGE

INDEX TO FIGURES

INDEX TO TABLES

TABLES PAGE

TABLES PAGE

# CHAPTER 1

## ABSTRACT OF THE STUDY

A clear understanding of the economic value of wetlands in their natural state is of great importance in making informed decisions concerning proposed development in coastal Louisiana. This study profiles a selected unit of coastal wetlands--the Barataria Basin which comprises Hydrologic Unit IV of Louisiana--and attempts three methods of computing wetlands value.

Background information on the patterns of population location and growth and the structure of the Barataria Region's[1] economy is presented in Chapter 2. Current trends in income and employment reflect the continuing growth and increasing complexity of man's wetlands-related activities in the region. The resource reserves of oil and natural gas within the coastal wetlands and offshore have given rise to major oil and gas producing industries which have in turn generated jobs in the petrochemical manufacturing and boat and shipbuilding fields. Commercial fishing and trapping activities and related seafood processing industries have flourished as a result of the area's natural productivity. Recreational aspects of the Barataria Region, including both hunting and fishing, as well as sugarcane cultivation and processing are also directly or indirectly dependent on the wetland ecosystem.

This chapter includes an historical perspective and geographic description of the area and its population center. Population projections and regional growth patterns are examined and income and employment figures presented. Major economic activities in the region are discussed in detail. The future of the Barataria Region is explored in terms of such larger coastal issues as development of a coastal zone boundary for the State of Louisiana, establishment of a growth/conservation line for the West Bank of Jefferson Parish, construction of an

---

[1]The Barataria Region includes all or part of seven Louisiana parishes: Assumption, Jefferson, Lafourche, Plaquemines, St. Charles, St. James, and St. John the Baptist.

interstate-system bypass highway (I-410), alignment of a state highway from Marrero to Lafitte to Larose, implementation of the Harvey Canal-Bayou Barataria hurricane protection plan, and location of Jean Lafitte Park in the heart of the Barataria country. In effect, this chapter summarizes the growing conflict of competing land uses--productive fish and wildlife habitats vs. urban and industrial expansion--in the Barataria Region.

Chapter 3 provides a description of the Barataria Basin's ecology in terms of geologic, hydrologic and biologic characteristics. Formation of the basin by a combination of river deposition, wave erosion and subsidence is discussed. The complex and delicate balance of hydrologic functioning and the processes creating an integrated biologic ecosystem are explored.

As one of the most productive natural areas in the world, the Barataria Basin is composed of a number of subareas or environmental units. The unique characteristics and independent physical systems of the various units which include swamp forest, fresh marsh, brackish marsh, salt marsh, offshore areas, topographic high areas and beaches are discussed separately as well in terms of their interrelation.

The chapter also identifies the various activities of man in the wetlands such as dredging of canals for navigation and oil recovery; creation of spoil banks by deposition of dredged material; and actual land reclamation for agricultural, urban and industrial purposes which have greatly accelerated the rate of land lost to productive natural use in the ecosystem. The negative impacts of man's intervention in coastal areas are presented as part of the ecosystem discussion.

The dollar value per acre of the natural services provided by wetlands has largely been disregarded in past benefit-cost analysis of development proposals due to the lack of a market mechanism for pricing those services. Chapter 4 investigates three techniques for assigning a dollar value to a unit acre of wetland in the Barataria Basin. These techniques take into account benefits derived from the fact that wetlands serve as nursery grounds and a food source for commercial fish species and furbearing animals as well as provide important sport fishing and hunting recreational opportunities.

The techniques for valuing wetlands presented in this chapter involve three interpretations of the component-function approach which basically requires summation of the respective values for non-competing uses. The first method, or "Gross Benefits Technique," developed by the authors attacks the valuation problem from a point-of-view focused on the question of gross impact on the economy of the four activity categories of commercial fishing, non-commercial fishing, commercial trapping and recreation. Application of the second approach, or "Consumer's Surplus Technique," also developed by the authors involves computation of the net economic value to society of the resource itself, measuring the amount that a consumer would be willing to pay to continue receiving a good or service over and above what the consumer is already paying. Like the first approach, the "Corps of Engineers Technique" as developed and employed by the U.S. Army Corps of Engineers also evaluates wetlands focused on their monetary contribution to the state's economy. Each of the three methods identifies the major wetland service categories as commercial fishing, commercial trapping and recreation.

This study, then, examines economic and ecologic characteristics and contributions of the Barataria Basin wetlands and explores three methods of evaluating the diverse benefits of these wetlands. The study is intended to provide federal, state and local governments with a basis for realistic appraisal in planning situations of the wide-ranging social, economic, and environmental impacts generated by man's wetlands-related activities.

# CHAPTER 2

# POPULATION AND ECONOMY OF THE BARATARIA REGION

## INTRODUCTION

Existing patterns of population location and growth in the Barataria Region are the result of an historical trend toward expansion of the human presence, and intensification of human activity, in the area. Current trends in income and employment reflect the continuing growth--and growing complexity--of the area's economy. The diverse economic activities of the region include sugarcane cultivation, commercial fishing and trapping, recreational hunting and fishing, oil and gas production and processing, and petrochemical manufacturing. Plans for future economic expansion include construction of an offshore oil superport and development of a multiport facility on the Gulf of Mexico at the outlet of Bayou Lafourche. Areas of conflict in planning include such issues as highway construction, reclamation of wetlands, establishment of growth boundary lines and other problems related to accelerating urbanization in the Barataria Region.

This chapter profiles the demographic and economic characteristics of the Barataria Region. An historical perspective is included along with a geographic description of the area and its population centers. Patterns of regional growth are examined and population projections discussed as they will affect the seven-parish Barataria Region. Income and employment figures presented give background on the area's economy and major economic activities are discussed in detail. An examination of wetlands use in the Barataria Basin includes an introduction to various larger coastal zone management issues affecting the area as well as more specific discussions of highway construction, hurricane protection, land reclamation and the Jean Lafitte Park projects planned for the Barataria parishes.

## HISTORICAL PERSPECTIVE

Perhaps as late as little more than two thousand years ago, what is now the State of Louisiana was an area uninhabited by man. The earliest inhabitants apparently

were hunters and fishermen who moved into the coastal areas where fish and game were available in abundance. They settled along the banks of the bayous and other waterways which meandered southward to the gulf. About 500 years after the arrival of man in what is now Louisiana, the descendants of those original settlers began to build villages and to work the softer metals. When the earliest European explorers arrived during the first half of the sixteenth century--that is, about a thousand years after the Indians had begun to establish permanent settlements--there were probably about 15,000 persons living within the present boundaries of the state. During the period of a century and a half which separated the European discovery of the Lower Mississippi Valley and settlement of the Louisiana colony, the indigenous population actually declined by some two or three thousand persons to an estimated 12,000 to 13,000. The Indians of the Barataria Basin were members of the Chitimacha group--Chitimacha, Washa, Chawasha and other tribes--who lived along the shores of the lakes and important waterways in the area. They were expert fishermen, and the remains of numerous shell mounds indicate they consumed oysters and other shellfish in great quantities (Davis, 1971: 13-15).

The first European settlements in the Barataria Region were established in the eighteenth century along the Mississippi, upriver from New Orleans, in an area which is now part of the parishes of St. Charles and St. John the Baptist. The area came to be known as the German Coast because it was settled by farmers from Germany who had originally been brought by John Law, the Scotch-born speculator, to settle along the Arkansas River. Abandoned at the collapse of Law's land development scheme, they went to New Orleans hoping to make arrangements for transportation back to Europe. Instead the colonial government granted them land along both banks of the Mississippi River beginning about 20 miles above the city (Martin, 1963 reprint: 148).

The German Coast rapidly became an important source of food for the growing City of New Orleans. The area's farmers were reinforced by French Acadian immigrants who wandered to Louisiana after being deported from their Canadian homeland by the British. Germans and Acadians also established their farms along the upper part of Bayou Lafourche (Davis, 1971: 71). But it was the rich soil along the banks of the Mississippi which made for the prosperity described by one early nineteenth-century observer in the following terms: "both sides of the Mississippi from the city of New Orleans to the town of Donaldsonville, a space of seventy-five miles, are

occupied by the wealthiest planters in the state, principally engaged in the culture of the sugar cane. This part of the country has been denominated the German and Acadian coasts, from its original settlers; and the wealth of the present has procured to it the appellation of the golden coast" (Martin, 1963 reprint: 11).

In settling along the banks of the Mississippi River and Bayou Lafourche, the Germans and Acadians were conforming to the pattern of population location their Indian predecessors in the Barataria Region had established some two thousand years earlier. The interior of the Barataria Basin remained relatively unpopulated. At the time Louisiana was admitted to the Union as a state, the closest thing to a permanent settlement in the inner-basin area was the "community" of Jean Lafitte, the privateer, and his cohorts. The Baratarians, as they were called, established a market on the bank of Bayou Barataria and there sold their bounty, duty-free, to Orleanians willing to venture into the wetlands in search of bargains. However, American officials were unfavorably impressed by this economic activity; and in September 1813 Governor Claiborne ordered naval forces to suppress the contraband exchange and arrest the privateers. Many of the Baratarians were, in fact, incarcerated at New Orleans and might have languished in prison indefinitely but for the opportunity to serve under General Jackson at Chalmette on January 8, 1814 (Davis, 1971: 180-181).

Writing in the early years of the American era in Louisiana, historian Francois Xavier Martin described the Barataria area as being virtually uninhabited, rich in resources--and ripe for development (Martin, 1963 reprint: 12):

> The whole country affords great facility to new settlers, for providing fish, oysters, and game, all at hand; even large droves of buffaloes are often met with in the great cane brakes of that fine country, which has remained so long unsettled, only on account of the difficulty of penetrating through them.
>
> However, it is probable a communication will soon be established: a great portion of that country has been viewed within the last five years, by the board of internal improvements; roads have been laid out, and a canal route traced all the way to New Orleans, fit for

> steamboat navigation, and having not more than ten miles to cut; six miles of which pass through firm and floating prairies. The fact is that thirty-seven arpents of canal in the firm prairie would join the waters of the Mississippi with those of the Lafourche....

Planning for the first roads and canals in the area established a basis for the rapid expansion of human activity in the Barataria Basin which was to follow. In 1827 the Barataria and Lafourche Canal Company was chartered by the Louisiana Legislature to dig a canal, forty feet wide and six feet deep, from the Mississippi River to Bayou Segnette--and from there, by means of other natural and man-made waterways, to provide a continuous navigable water route to Berwick Bay. The Barataria and Lafourche Canal never achieved the status of a major waterway envisioned by its planners, who had been inspired by the example of the Erie Canal and other successful canals in the east. However, the canal did provide the people of New Orleans their first means of direct communication with Grand Isle and the Barataria country. This means of communication was maintained into the twentieth century by packet boats which plied the Company Canal, as the waterway came to be called, on regular schedules (Chase, 1960: 247).

Today the Barataria Basin is criss-crossed by canals of all sizes; from the ditches dug to accommodate pirogues to the Intracoastal Waterway which cuts through the heart of the Barataria country, connecting the Mississippi River and lower Bayou Lafourche.

## THE BARATARIA REGION

The Barataria Region includes seven parishes, each of which is intersected by one of the two waterways which, along with the Gulf of Mexico, form the bounds of the Barataria Basin. The parishes of Assumption and Lafourche are each divided by Bayou Lafourche which runs approximately ninety miles in a southeasterly direction from the City of Donaldsonville on the Mississippi River, in Ascension

Parish,[1] to the Gulf. The parishes of St. James, St. John the Baptist, St. Charles and Jefferson are each divided by a 60-mile stretch of the Mississippi River which runs in an easterly direction from Donaldsonville to New Orleans. Plaquemines Parish is also split by the river which, turning south again, runs some 75 miles in a generally southeasterly direction to the sea. Plaquemines, Jefferson and Lafourche are bordered by the Gulf of Mexico.

The larger towns and cities of the Barataria Region lie mostly along Bayou Lafourche and the Mississippi River (see Figure 2.1). In Lafourche Parish--the largest of the seven parishes, with a land area of 1,141 square miles, and the second most populous (pop. 68,941-74,541)--all of the principal population centers are located along the western bank of Bayou Lafourche. Thibodaux, the parish seat and site of Nichols State University, has a population of 14,925. Other towns with populations in excess of 1,000 inhabitants, in order of size, are Raceland (pop. 4,880), Larose (4,267), Golden Meadow (2,681) and Lockport (1,995). All of these towns are located along the route of Louisiana Highway 1 and lie just outside the Barataria Basin proper.

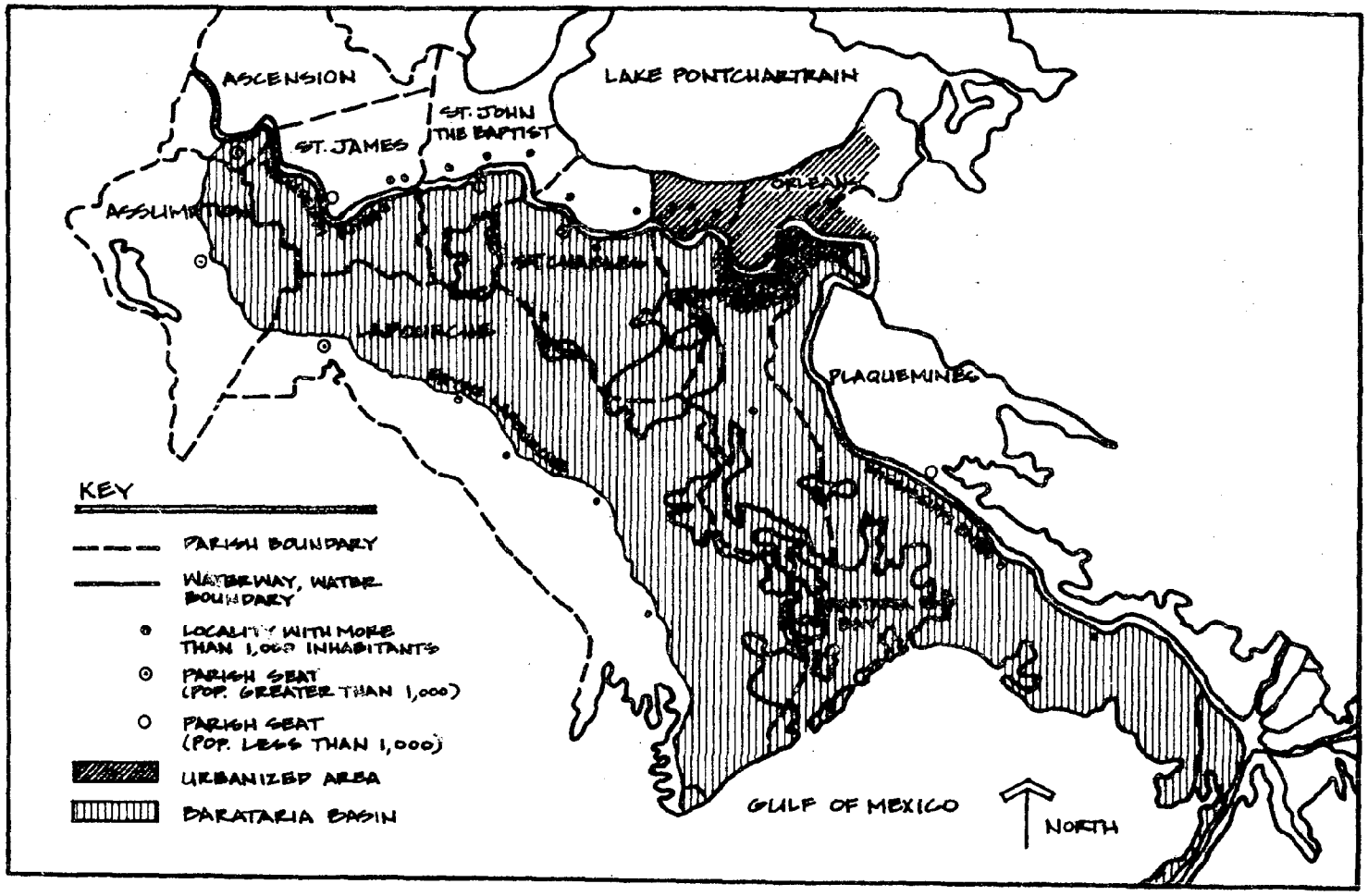
In Assumption Parish, the only population center of more than 1,000 persons is the parish seat of Napoleonville (pop. 1,008), located on the western bank of Bayou Lafourche. Assumption has a land area of 356 square miles and in 1970 was ranked as the least populous of the seven parishes in the Barataria Region, with a population of 19,654. However, a more recent estimate (pop. 20,459) indicates Assumption has since surpassed St. James Parish in number of inhabitants. St. James (pop. 19,733-19,659) is the second smallest of the seven parishes, with a land area of 253 square miles. The parish seat of Convent,

---

[1]Although portions of Ascension and Orleans parishes lie within the technical boundaries of the basin, they are very small and have been eliminated from consideration for the purposes of collecting population and economic data. However, it is worth noting that Donaldsonville, with a population of 7,367, is second in size only to Thibodaux among cities and towns in the Barataria Basin outside the New Orleans SMSA. (All population figures for cities and towns in this section are taken from the 1970 Census. Two population figures are given for each parish: the first is from the 1970 Census; the second is the 1976 estimate by Louisiana Tech which appears in Louisiana State Planning Office, 1977: 4-5. All figures for land area are taken from Rand McNally, 1977.)

FIGURE 2.1

POPULATION LOCATION IN THE BARATARIA REGION




Source: Compiled by the Authors from U.S. Bureau of the Census, 1973.

located on the eastern bank of the Mississippi River, is a town of only 400 inhabitants. The largest population center in the parish is Lutcher (pop. 3,911), followed by Gramercy (2,567) and Vacherie (2,145). Vacherie is the only sizable town located on the western bank of the river, within the actual limits of the Barataria Basin.

St. John the Baptist Parish (pop. 23,813-25,478), with a land area of 227 square miles, is the smallest parish in the Barataria Region. The parish seat of Edgard, located on the western bank of the Mississippi, is--like Convent in St. James--a town of only 400 inhabitants. The larger population centers in St. John the Baptist lie on the other side of the river: Reserve (pop. 6,381), Laplace (5,953) and Garyville (2,474). In St. Charles Parish (pop. 29,550-32,973 with a land area of 294 square miles), the larger towns are more evenly divided between the two sides of the river. In fact, a majority of them lie on the western (or, more precisely, southern) side of the Mississippi: the parish seat, Hahnville (pop. 2,483), Luling (3,255), Des Allemands (2,318) and Mimosa Park (1,624). The largest population center in the parish, Norco (pop. 4,773) is located on the eastern bank, as is the town of St. Rose (2,106). Des Allemands--located along Bayou des Allemands, straddling the parish line between St. Charles and Lafourche--is the largest population center in the interior of the Barataria Basin. The only other sizable locality in the inner-basin area, Lafitte (pop. 1,223), lies beside Bayou Barataria in Jefferson Parish, the most populous of the seven parishes in the Barataria Region.

According to the 1970 Census, Jefferson Parish had a population of 337,568. However, a more recent estimate (pop. 407,106) indicates the population has already grown beyond 400,000. A majority of the people in Jefferson live on the East Bank (that is, in the area between the Mississippi River and Lake Pontchartrain) in Metairie (pop. 135,316), Kenner (29,858), Harahan (13,037), River Ridge (15,713) and Jefferson Heights (16,489). The parish seat of Gretna (pop. 24,875) is located on the West Bank, as are the localities of Terrytown (13,832), Harvey (6,347), Marrero (29,015) and Westwego (11,402). In addition to the inner-basin population center of Lafitte, West Jefferson also boasts the only town of significant size located on the Gulf of Mexico shore. Grand Isle (pop. 2,236) is situated on a barrier island which stretches between Caminada Bay and the Gulf. Much of lower West Jefferson is under water; and the parish as a whole has a land area of only 369 square miles, despite its considerable length.

Plaquemines, the delta parish, has the second largest land area, 1,030 square miles; but in population (25,225-26,168) it holds only the median rank. The parish seat, Pointe a la Hache, is located on the eastern bank of the river and has a population of 300. Larger population centers--Port Sulphur (pop. 3,022) and Buras-Triumph (4,113)--are located on the western bank of the Mississippi.

In summary, almost all of the important population centers in the Barataria Region are located along the major waterways which enclose the Barataria Basin. However, increasing urbanization--particularly in the area south of the City of New Orleans--may herald a new trend toward population of inner-basin areas.

## PATTERNS OF GROWTH

In the fifty years from 1920 to 1970, population in the coastal zone of Louisiana grew by slightly less than 1,000,000 inhabitants, representing an increase well above 100 percent (see Tables 2.1a and 2.1b). As a result of this high growth rate, the number of people living in the coastal zone now exceeds the number living in all of non-coastal Louisiana (see Table 2.1c). During the period from 1960 to 1970, population growth in the coastal zone--which includes approximately one-third of the state's 64 parishes--accounted for close to two-thirds of the total population increase in the state (see Table 2.1d).

Population in the coastal zone increased by almost 15 percent between 1960 and 1970. At the same time, the number of people living in the seven-parish area which includes the Barataria Basin increased by almost 45 percent. Population growth in the Barataria Region--which includes approximately one-third of the state's coastal parishes--accounted for more than two-thirds ot the total increase in the coastal zone between 1960 and 1970. Almost 80 percent of the regional increase was counted in Jefferson Parish, where a growth rate greater than 50 percent prevailed.

Within the context of recent population trends (as defined by the latest census-to-census figures) the coastal zone is the fastest-growing section of the state; the Barataria Region is the fastest-growing area in the coastal zone and Jefferson Parish is the fastest-growing parish in the region. These growth relationships are part of an historical trend which began more than half a century ago.

TABLE 2.1a

POPULATION OF LOUISIANA, COASTAL ZONE, BARATARIA REGION & JEFFERSON PARISH, 1920-1970

| AREA | 1920 | 1930 | 1940 | 1950 | 1960 | 1970 |
|---|---|---|---|---|---|---|
| Louisiana | 1,798,509 | 2,101,593 | 2,363,880 | 2,683,516 | 3,257,022 | 3,641,306 |
| Coastal Zone[1] | 857,273 | 943,926 | 1,057,835 | 1,256,780 | 1,616,729 | 1,855,868 |
| Barataria Region[2] | 121,723 | 139,576 | 163,584 | 221,157 | 362,713 | 524,524 |
| Jefferson Parish | 21,563 | 40,032 | 50,427 | 103,873 | 208,769 | 337,568 |

1. Coastal Zone is here defined as the 22-parish area which includes the following parishes: Ascension, Assumption, Calcasieu, Cameron, Iberia, Iberville, Jefferson, Jefferson Davis, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, Vermilion (Based on coastal zone boundary proposed by McIntire et al., 1975: 3).

2. Barataria Region includes the parishes of Assumption, Jefferson, Lafourche, Plaquemines, St. Charles, St. James and St. John the Baptist.

Source: U.S. Bureau of the Census, 1931, 1952 and 1973.

TABLE 2.1b

POPULATION CHANGE: LOUISIANA, COASTAL ZONE, BARATARIA REGION & JEFFERSON PARISH, 1920-1970, PERCENT

| AREA | 1920-1930[3] | 1930-1940 | 1940-1950 | 1950-1960 | 1960-1970 | 1920-1970 |
|---|---|---|---|---|---|---|
| Louisiana | 16.9 | 12.5 | 13.5 | 21.4 | 11.8 | 102.5 |
| Coastal Zone | 10.1 | 12.1 | 18.8 | 28.6 | 14.8 | 116.5 |
| Barataria Region | 14.7 | 17.2 | 35.2 | 64.0 | 44.8 | 330.9 |
| Jefferson Parish | 85.7 | 26.0 | 106.0 | 101.0 | 61.7 | 1465.5 |

3. Percent change = 100 $(P_{1930}/P_{1920})-1$ = 100 $(P_{t+10}/P_t)-1$ .

Source: U.S. Bureau of the Census, 1931, 1952 and 1973.

TABLE 2.1c

RELATIVE POPULATION OF LOUISIANA, COASTAL ZONE, BARATARIA REGION & JEFFERSON PARISH 1920-1970

| AREA/AREA | 1920 | 1930 | 1940 | 1950 | 1960 | 1970 |
|---|---|---|---|---|---|---|
| Coastal Zone/Louisiana | .477 | .449 | .448 | .468 | .496 | .510 |
| Barataria/Coastal Zone | .142 | .148 | .157 | .176 | .224 | .283 |
| Jefferson/Barataria | .177 | .287 | .308 | .470 | .576 | .644 |

TABLE 2.1d

RELATIVE POPULATION CHANGE: LOUISIANA, COASTAL ZONE, BARATARIA REGION AND JEFFERSON PARISH, 1920-1970

| AREA/AREA | 1920-1930[4] | 1930-1940 | 1940-1950 | 1950-1960 | 1960-1970 | 1920-1970 |
|---|---|---|---|---|---|---|
| Coastal Zone/Louisiana | .286 | .434 | .622 | .628 | .622 | .542 |
| Barataria/Coastal Zone | .206 | .211 | .289 | .393 | .679 | .403 |
| Jefferson/Barataria | 1.035 | .433 | .928 | .741 | .793 | .785 |

4. Relative Change = $\Delta$ Area$_1$/$\Delta$ Area$_2$.

Source: U.S. Bureau of the Census, 1931, 1952 and 1973.

In the period from 1920 to 1970, the coastal zone accounted for more than half the total population increase in Louisiana. Forty percent of the increase in the coastal zone was counted in the Barataria Region, and almost 80 percent of the regional increase was registered in Jefferson Parish. In 1920, 14 of every 100 persons living in the coastal zone were located in the Barataria Region. By 1970 that figure had doubled. Similarly, in 1920, approximately 18 of every 100 persons living in the region were located in Jefferson Parish. By 1970 the ratio was 64 of every 100.

The number of people living in the Barataria Region has been increasing at a significant rate since 1920, after remaining virtually unchanged over the period spanned by the first 20 years of this century.[2] Regional population in 1970 was over 300 percent higher than regional population as recorded in the Census of 1920. The State of Louisiana, and its 22-parish coastal zone (including the Barataria Region), increased in number of inhabitants by a little more than 100 percent each during the same period. Jefferson Parish registered a phenomenal growth rate of nearly 1500 percent over the same 50 years.

The regional growth rate has been increasingly influenced since 1930 by suburban and exurban growth in the metropolitan New Orleans area, particularly in Jefferson Parish (see Figure 2.2). During the period from 1950 to 1970, the regional increase in population was well above 100 percent; the Jefferson Parish increase was well above 200 percent. Similarly, from 1930 to 1950, regional population increased 60 percent; the number of people living in Jefferson increased 160 percent. The only other parish, during the past century, to register a 20-year increase in excess of 100 percent was St. Charles (see Table 2.2). The population of St. Charles grew by 121 percent between 1950 and 1970, as the parish began to experience the effects of expanding urbanization. This trend in growth leadership was foreshadowed in the period from 1910 to 1930 when Jefferson and St. Charles were the only parishes in the area to record net increases in population (see Table 2.3).

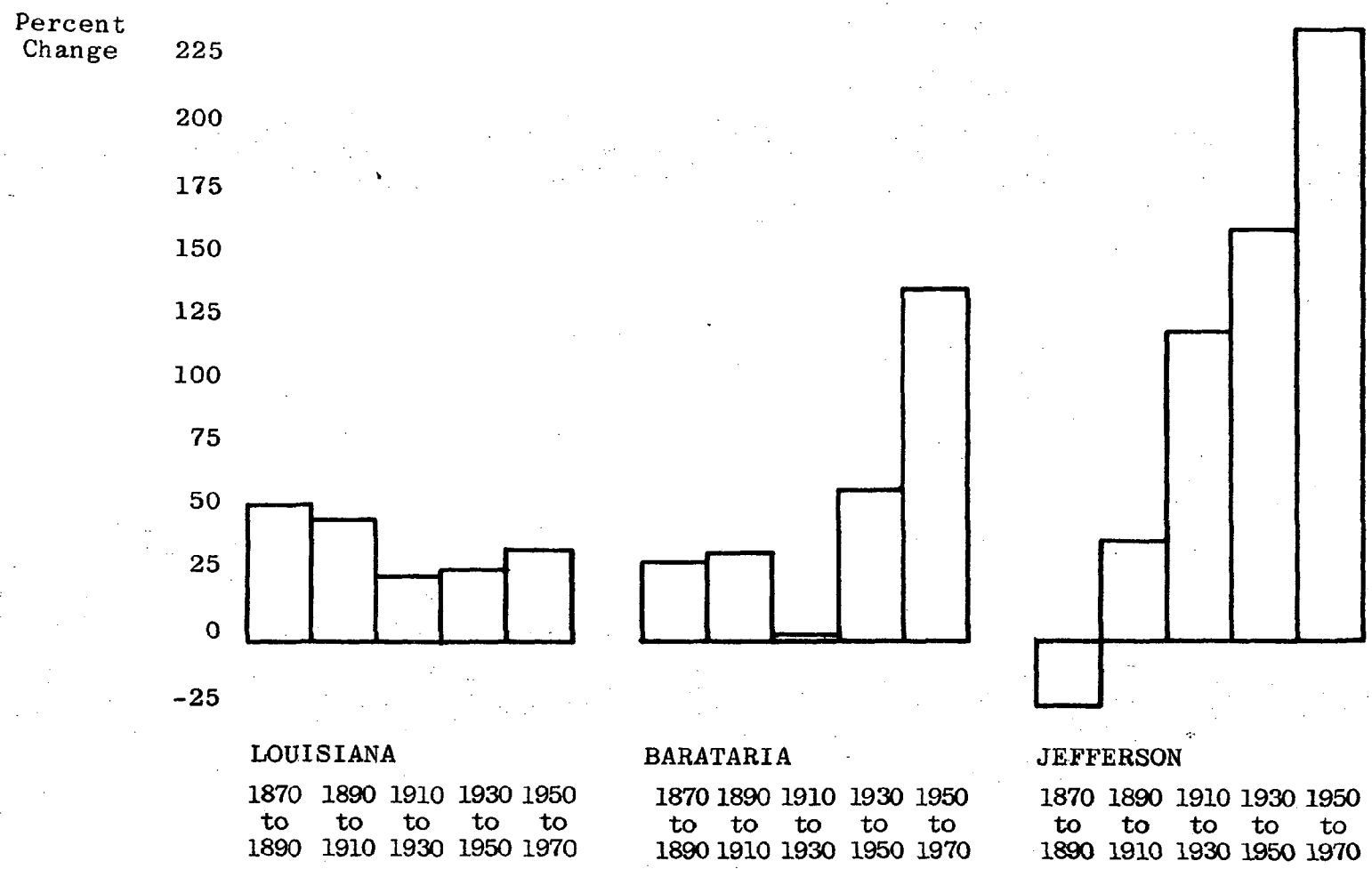
Three of the other five Barataria parishes--Lafourche, Plaquemines and St. John the Baptist--increased in

---

[2]According to the Census of 1900, there were 120,461 people living in the seven-parish area. The 1920 count was 121,723. The change from 1910 (136,564) to 1930 (139,576) was only slight. However, the change from 1920 to 1930 amounted to an increase of almost 15 percent.

FIGURE 2.2

POPULATION CHANGE: LOUISIANA, BARATARIA REGION AND JEFFERSON PARISH, 1870-1970




Source: Compiled by Authors from U.S. Census Office, 1872 and 1883; U.S. Bureau of the Census, 1931, 1952 and 1973.

TABLE 2.2

POPULATION CHANGE IN THE BARATARIA REGION BY PARISH, 1870-1970

| PARISH | PERCENT CHANGE | | | | |
|---|---|---|---|---|---|
| | 1870-1890 | 1890-1910 | 1910-1930 | 1930-1950 | 1950-1970 |
| Assumption | 48.3 | 22.9 | -33.7 | 8.1 | 13.8 |
| Jefferson[1] | -25.6 | 38.0 | 119.4 | 159.5 | 225.0 |
| Lafourche | 50.1 | 49.9 | -2.1 | 30.2 | 63.3 |
| Plaquemines | 18.9 | -0.1 | -23.3 | 48.2 | 77.2 |
| St. Charles | 59.0 | 44.9 | 8.1 | 10.3 | 121.1 |
| St. James | 54.8 | 46.4 | -33.3 | 0.0 | 29.0 |
| St. John the Baptist | 68.0 | 26.2 | -1.8 | 5.6 | 60.2 |
| Barataria Region | 31.1 | 33.5 | 2.2 | 58.5 | 137.2 |
| Louisiana | 53.9 | 48.1 | 26.9 | 27.7 | 35.7 |

[1]In 1877, part to Orleans.

Source: U.S. Census Office, 1872 and 1883; U.S. Bureau of the Census, 1931, 1952 and 1973.

TABLE 2.3

POPULATION OF THE BARATARIA REGION BY PARISH, 1810-1970

| PARISH | 1810 | 1830 | 1850 | 1870 | 1890 | 1910 | 1930 | 1950 | 1970 |
|---|---|---|---|---|---|---|---|---|---|
| Assumption | 2,472 | 5,669 | 10,538 | 13,234 | 19,629 | 24,128 | 15,990 | 17,278 | 19,654 |
| Jefferson[1] | - | 6,846 | 25,093 | 17,767 | 13,221 | 18,247 | 40,032 | 103,873 | 337,568 |
| Lafourche | 1,995 | 5,503 | 9,532 | 14,719 | 22,095 | 33,111 | 32,419 | 42,209 | 68,941 |
| Plaquemines | 1,549 | 4,489 | 7,390 | 10,552 | 12,541 | 12,524 | 9,608 | 14,239 | 25,225 |
| St. Charles | 3,291 | 5,147 | 5,120 | 4,867 | 7,737 | 11,207 | 12,111 | 13,363 | 29,550 |
| St. James | 3,955 | 7,646 | 11,098 | 10,152 | 15,715 | 23,009 | 15,338 | 15,334 | 19,773 |
| St. John the Baptist | 2,990 | 5,677 | 7,317 | 6,762 | 11,359 | 14,338 | 14,078 | 14,861 | 23,813 |
| Barataria Region | 16,252 | 40,977 | 76,088 | 78,053 | 102,297 | 136,564 | 139,576 | 221,157 | 524,524 |
| Louisiana | 76,556 | 215,529 | 517,762 | 726,915 | 1,118,518 | 1,656,388 | 2,101,593 | 2,683,516 | 3,641,306 |

[1]Chartered in 1825. In 1877, part to Orleans.

Source: U.S. Census Office, 1872 and 1883; U.S. Bureau of the Census, 1931, 1952 and 1973.

population by more than 60 percent between 1950 and 1970. The other two parishes, Assumption and St. James, have lagged in growth since 1910. Population in those two parishes peaked around the time of the 1910 Census, declined precipitously over the next 20 years and has increased at a relatively slow pace since then.

As of 1970, there were about 915 persons per square mile of land area in Jefferson Parish. St. John the Baptist Parish, only fifth in total number of inhabitants, ranked second in population density with 105 residents per square mile. There were about 100 inhabitants per square mile in St. Charles. St. James Parish ranked fourth with 78 persons per square mile. Lafourche, the second most populous parish, ranked only fifth in population density with 60 inhabitants per square mile. Assumption and Plaquemines trailed with density ratios of 55 and 25 respectively. Total population density for the seven-parish area was 143 persons per square mile, a rate considerably higher than the ratio of 31/1 for the entire State of Louisiana.

A little more than half a million people were living in the seven parishes of the Barataria Region at the time the 1970 Census was taken. Of that number, almost two-thirds were located in Jefferson Parish. Approximately 13 percent of the population was located in Lafourche Parish. The parishes of Plaquemines, St. James, St. John the Baptist, Ascension and St. Charles collectively accounted for less than a quarter of the area's total population.

An intercensal estimate of population in the Barataria Region placed the number of people living in the area in 1975 at almost 600,000 (see Table 2.4). Jefferson's share of that total is slightly more than two-thirds. The Lafourche share is about 12 percent, and the other five parishes collectively account for a little more than one-fifth of the total population.

A projection of population in the seven-parish area in the year 2000 indicates the number of inhabitants will be approaching the one-million mark. Almost three-quarters of that total will be located in Jefferson Parish. Approximately 15 percent of the total will be located in the parishes of Lafourche and St. Charles. The other four parishes collectively will account for a little more than one-tenth of the area's total population.

TABLE 2.4

PROJECTED POPULATION OF THE BARATARIA REGION, BY PARISH, THROUGH THE YEAR 2000

| Area | 1970 Census | 1975 Revised Estimate | PROJECTED POPULATION 1980 | 1985 | 1990 | 1995 | 2000 | PERCENT OVER 1970 |
|---|---|---|---|---|---|---|---|---|
| Assumption | 19,654 | 20,281 | 20,545 | 21,182 | 21,870 | 22,378 | 22,837 | 16.2 |
| Jefferson | 337,568 | 398,747 | 471,543 | 539,249 | 606,121 | 658,628 | 702,729 | 108.2 |
| Lafourche | 68,941 | 72,999 | 76,527 | 80,731 | 84,759 | 87,751 | 89,859 | 30.3 |
| Plaquemines | 25,225 | 26,077 | 27,453 | 29,007 | 30,055 | 31,370 | 32,480 | 28.8 |
| St. Charles | 29,550 | 32,162 | 36,250 | 40,206 | 44,271 | 48,378 | 52,003 | 76.0 |
| St. James | 19,733 | 19,599 | 19,900 | 20,073 | 20,379 | 20,532 | 20,607 | 4.4 |
| St. John the Baptist | 23,813 | 24,796 | 27,059 | 28,864 | 30,917 | 32,724 | 34,250 | 43.8 |
| Barataria Region | 524,524 | 594,661 | 679,277 | 759,312 | 838,372 | 901,761 | 954,765 | 82.0 |
| Louisiana | 3,641,306 | 3,805,575 | 3,989,432 | 4,183,112 | 4,361,426 | 4,513,569 | 4,632,220 | 27.2 |

Source: U.S. Bureau of the Census, 1973; Louisiana Tech University (in Louisiana State Planning Office, 1977: 4-5); Segal, Saussy et al., 1977.

Regional population, as a percentage of total state population, has increased at an accelerating rate in the period since 1940. In 1940 a little less than seven percent of the people living in Louisiana were located in the Barataria Region. By 1970 that figure had more than doubled to 14.4 percent, the highest relative population figure for the area since the 1850 Census. Projections indicate this trend toward greater and greater relative population concentration in the region should continue at least through the rest of the century. By 1995 one of every five Louisianians will be living in the Barataria Region, according to Segal, Saussy et al. By the year 2000 the ratio of regional-to-state population should be approaching the highest recorded level: the 21.2 percent figure derived from the 1810 Census which was taken at a time when much of upper Louisiana was still comparatively unsettled.

The projections also indicate the population of Jefferson Parish will more than double by the end of the century, making Jefferson by far the most populous parish in the state. If this projected growth is to materialize, it will require urbanization of a large portion of West Jefferson, involving the reclamation of thousands of acres of wetlands lying within the Barataria Basin. Significant growth is also projected for the Parish of St. Charles, although much of the increase in population is likely to take place along the eastern bank of the Mississippi River. Steady growth rates are projected for the parishes of St. John the Baptist, Lafourche and Plaquemines. Assumption Parish is expected to enjoy only a slight increase in number of inhabitants, and minimal growth is projected for St. James.

According to the projections of Segal, Saussy et al., total population in the Barataria Region should increase by more than 400,000 (82 percent) between 1970 and 2000--as compared to an increase of almost one million inhabitants (27.2 percent) projected for the State of Louisiana. If regional population is to near the one-million mark by the end of the century, as projected, the increase will be of a magnitude which will inevitably involve urbanization of inner-basin areas that have heretofore remained relatively unpopulated.

## INCOME AND EMPLOYMENT

Among the seven parishes of the Barataria Region, per capita income is highest in the two--Jefferson and Plaquemines--which adjoin the Parish of Orleans (see Table 2.5). However, while the relatively high level of personal

TABLE 2.5

PER CAPITA INCOME IN THE BARATARIA REGION BY PARISH, 1970-1975 (DOLLARS)

| PARISH | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | INCREASE 1970-1975 | PERCENT INCREASE |
|---|---|---|---|---|---|---|---|---|
| Assumption | 2,255 | 2,415 | 2,644 | 3,368 | 3,926 | 4,127 | 1,872 | 83.0 |
| Jefferson | 3,781 | 3,928 | 4,262 | 4,725 | 5,332 | 5,970 | 2,189 | 57.9 |
| Lafourche | 2,674 | 2,871 | 3,159 | 3,606 | 4,071 | 4,500 | 1,826 | 68.3 |
| Plaquemines | 2,964 | 3,080 | 3,456 | 3,983 | 4,501 | 5,055 | 2,091 | 70.6 |
| St. Charles | 3,054 | 3,216 | 3,418 | 3,811 | 4,426 | 4,893 | 1,839 | 60.2 |
| St. James | 2,725 | 2,945 | 3,233 | 3,706 | 4,418 | 4,732 | 2,007 | 73.7 |
| St. John the Baptist | 2,606 | 2,831 | 3,050 | 3,430 | 4,041 | 4,571 | 1,965 | 75.4 |
| Barataria Region | 3,405 | 3,572 | 3,889 | 4,364 | 4,956 | 5,530 | 2,125 | 62.4 |
| Louisiana | 3,090 | 3,296 | 3,574 | 3,961 | 4,456 | 4,895 | 1,805 | 58.4 |

Source: U.S. Bureau of Economic Analysis, 1977.

income in Jefferson is directly related to that parish's proximity to New Orleans, nearness to the city is not a decisive factor in the per capita income level of Plaquemines Parish. Average income in Jefferson has obviously been profoundly influenced by the suburban-type population growth which has prevailed in recent decades. As a result the parish not only ranked first in per capita income among Louisiana parishes in 1975 but was the only parish to exceed the national average of $5,902 for that year (U.S. Bureau of Economic Analysis, 1977). Urbanization has not been a significant factor in the rise of personal income in Plaquemines which seems instead to be tied to the high level of labor participation in that parish. (Labor participation levels and other employment factors are examined later in this section.) The other five parishes in the region were ranked in the following order according to level of per capita income in 1975: St. Charles, St. James, St. John the Baptist, Lafourche and Assumption. All five fell below the average income for all of Louisiana. However, average income for the seven-parish area was more than $600 (about 13 percent) above per capita income for the whole state.

Per capita income in Louisiana increased by more than half--about 58 percent--in the period from 1970 through 1975 inclusive.[3] Average income in the Barataria Region increased at a slightly higher rate--about 62 percent--during the same period. Jefferson was the only one of the seven Barataria parishes to register a rate of increase below that for all of Louisiana. The highest rate was registered in Assumption, the parish with the lowest per capita income. St. John the Baptist, St. James, Plaquemines, Lafourche and St. Charles ranked second through sixth, respectively, in rate of growth. Generally speaking, the higher a parish's level of per capita income, the lower was its rate of increase--with the notable exception of Plaquemines, which enjoyed a sustained high level of growth. The apparent trend is toward reduction of differences in average income among the parishes. In 1970, per capita income in Assumption was less than 60 percent of income in Jefferson. By 1975 that ratio had risen to almost 70 percent.

Approximately 150,000 persons--or one-fourth the number of people living in the area--were employed in the Barataria Region in 1976 (see Table 2.6). Almost 100,000

---

[3]The purchasing power of the dollar declined by about one-third during the same period (U.S. Bureau of the Census, 1976).

TABLE 2.6

LABOR MARKET PARTICIPATION IN THE BARATARIA REGION, BY PARISH, 1976

| PARISH | ESTIMATED POPULATION | NUMBER OF EMPLOYEES[1] | EMPLOYEES/ POPULATION |
|---|---|---|---|
| Assumption | 20,459 | 4,095 | .200 |
| Jefferson | 407,106 | 98,005 | .241 |
| Lafourche | 74,541 | 16,142 | .217 |
| Plaquemines | 26,168 | 13,982 | .534 |
| St. Charles | 32,973 | 11,609 | .352 |
| St. James | 19,659 | 4,355 | .222 |
| St. John the Baptist | 25,478 | 4,688 | .184 |
| Barataria Region | 606,384 | 152,876 | .252 |
| Louisiana | 3,840,973 | 1,129,008 | .294 |

[1]Employment figures are taken from data reported by the Louisiana Department of Employment Security and include only those jobs covered by the Louisiana Employment Security Law.

Sources: Louisiana Tech (in Louisiana State Planning Office, 1977:4-5); Louisiana Department of Employment Security, 1976.

jobs, or two-thirds of total employment in the seven-parish area, were located in Jefferson Parish. Lafourche, Plaquemines and St. Charles ranked second, third and fourth in total employment. The parishes of St. John the Baptist, St. James and Assumption each had a work force of less than 5,000 reported employees in 1976. Collectively, those three parishes accounted for a lesser share of total employment in the Barataria Region than Plaquemines Parish alone. That inequality assumes particular significance when one considers that the combined population of the three parishes is two and one-half times greater than the population of Plaquemines. The disparity in employment is largely attributable to the fact that Plaquemines has by far the highest level of labor market participation in the area. More than half the number of people living in Plaquemines are employed in the parish, which had less than five percent of the area's total estimated population in 1976 but almost ten percent of its total work force. A relatively high labor participation rate was also registered in St. Charles Parish where employment amounted to more than a third of total population. In the other five parishes, participation rates in the 18 to 24 percent range prevailed. In the state as a whole, approximately 29 of every 100 persons were working at jobs included in the quarterly employment count.

The high levels of labor market participation in Plaquemines and St. Charles are probably due in large part to concentration of oil and gas industry activities in those parishes. More than one-fourth of total employment in Plaquemines Parish is concentrated in the mining sector (see Table 2.7). About 40 percent of the Barataria area's total mining employment is located in Plaquemines. (Jefferson leads the region in all other sectors.) More than one-third of total employment in St. Charles is concentrated in the manufacturing sector and involves primarily petrochemical manufacturing jobs. (Location of oil and gas-based jobs will be discussed in the next section.)

Employment in the Barataria Region accounts for 13.5 percent of total employment in the State of Louisiana. The regional share is higher in all individual sectors except the finance and service sectors. Total employment in the seven-parish area more than tripled in the period from 1956 to 1976 (see Tables 2.7 and 2.8). Total employment in the state doubled during the same period. The regional share of employment by sector increased in every sector except mining.

TABLE 2.7

EMPLOYMENT BY INDUSTRY DIVISION IN THE BARATARIA REGION, BY PARISH, SECOND QUARTER, 1976

| PARISH | TOTAL | MINING | CONST. | MFG. | TRANS. | TRADE[1] | FINANCE | SERVICE | OTHER[2] | SECOND QUARTER TOTAL WAGES[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| Assumption | 4,095 | 627 | 143 | 2,303 | 91 | 691 | 93 | 125 | 22 | $ 11,763,858 |
| Jefferson | 98,005 | 3,526 | 11,682 | 17,496 | 9,239 | 34,692 | 3,741 | 16,789 | 840 | $ 246,907,486 |
| Lafourche | 16,142 | 1,458 | 1,009 | 3,215 | 3,241 | 3,965 | 591 | 2,227 | 436 | $ 39,400,996 |
| Plaquemines | 13,982 | 3,797 | 2,213 | 1,984 | 1,731 | 1,865 | 119 | 1,847 | 426 | $ 46,635,888 |
| St. Charles | 11,609 | 206 | 3,430 | 4,059 | 934 | 1,496 | 206 | 862 | 416 | $ 39,234,197 |
| St. James | 4,355 | 68 | 85 | 2,759 | 199 | 657 | 121 | 365 | 101 | $ 15,528,635 |
| St. John the Baptist | 4,688 | 14 | 891 | 1,610 | 266 | 1,285 | 123 | 474 | 25 | $ 14,225,029 |
| Barataria Region | 152,876 | 9,696 | 19,453 | 33,426 | 15,701 | 44,651 | 4,994 | 22,689 | 2,266 | $ 413,696,089 |
| Louisiana | 1,129,008 | 62,268 | 116,501 | 194,198 | 100,917 | 304,517 | 60,989 | 241,997 | 47,621 | $2,827,283,553 |
| Barataria/ Louisiana | .135 | .156 | .167 | .172 | .156 | .147 | .082 | .094 | .041 | .146 |

1. Wholesale and retail.
2. Agriculture and public administration.
3. Paid by employers subject to the Louisiana Employment Security Law.

Source: Louisiana Department of Employment Security, 1976.

TABLE 2.8

EMPLOYMENT BY INDUSTRY DIVISION IN THE BARATARIA REGION, BY PARISH, SECOND QUARTER, 1956

| PARISH | TOTAL | MINING | CONST. | MFG. | TRANS. | TRADE[1] | FINANCE | SERVICE | OTHER | SECOND QUARTER TOTAL WAGES[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| Assumption | 1,074 | 77 | 29 | 643 | 15 | 211 | 47 | 52 | 0 | $ 802,508 |
| Jefferson | 25,685 | 2,084 | 2,779 | 11,588 | 2,347 | 5,038 | 413 | 1,376 | 60 | $ 26,536,103 |
| Lafourche | 7,266 | 1,547 | 656 | 1,490 | 987 | 1,700 | 156 | 703 | 27 | $ 6,785,035 |
| Plaquemines | 6,377 | 3,787 | 351 | 992 | 567 | 265 | 10 | 202 | 203 | $ 7,796,206 |
| St. Charles | 3,746 | 191 | 199 | 2,414 | 557 | 307 | 18 | 60 | 0 | $ 4,790,592 |
| St. James | 1,244 | 62 | 34 | 802 | 31 | 265 | 18 | 24 | 8 | $ 1,004,943 |
| St. John the Baptist | 1,418 | 4 | 17 | 959 | 83 | 284 | 6 | 65 | 0 | $ 1,144,057 |
| Barataria Region | 46,810 | 7,752 | 4,065 | 18,888 | 4,587 | 8,070 | 668 | 2,482 | 298 | $ 48,859,444 |
| Louisiana | 548,664 | 44,768 | 52,023 | 147,877 | 69,448 | 157,022 | 23,878 | 51,799 | 1,849 | $497,636,715 |
| Barataria/ Louisiana | .085 | .173 | .078 | .128 | .066 | .051 | .028 | .048 | .161 | .098 |

1. Wholesale and retail.

2. Paid by employers subject to the Louisiana Employment Security Law.

Source: Louisiana Division of Employment Security, 1956.

The period from 1956 to 1976 was a period of tremendous growth in employment in Jefferson Parish, particularly in those sectors most affected by urban expansion: finance, service, trade, construction and transportation. Similarly, Plaquemines Parish experienced rapid expansion in the service, trade and construction sectors. Significant increases in the trade and construction sectors were registered in St. Charles Parish. The highest rate of growth in manufacturing employment was registered in Assumption Parish. Manufacturing employment tripled in both Assumption and St. James.

On a regional basis, the trend in employment over the last 20 years has been toward accelerating growth in non-basic sectors related to rapid population growth. At the same time, more basic activities, such as mining and manufacturing, have lagged in rate of expansion. Mining employment remained virtually unchanged, except in Jefferson Parish; and manufacturing employment expanded at a rate of less than four percent per annum.

## MAJOR ECONOMIC ACTIVITIES

The diversity of economic activity in the Barataria Region reflects the variety of resources at hand in the area: a variety conducive not only to economic development but to economic conflict and economic-ecologic conflict as well. Fresh water, wetlands, fertile farmland, fish and wildlife, petroleum and natural gas are among the area's more important natural resources. Significant resource-related activities include oil and gas extraction and refining; chemical--especially petrochemical--manufacturing; boat and ship building and repair; sugarcane cultivation and sugar processing; seafood processing, commercial fishing and trapping and recreational hunting and fishing.

In terms of current economic return, the most important natural resources in the Barataria Region are the area's reserves of petroleum and natural gas. In 1974 more than 10,000 persons in the seven-parish area were working at jobs directly related to oil and gas extraction and refining (see Table 2.9). Production employment was largely concentrated in the "first-tier" coastal parishes of Plaquemines, Jefferson and Lafourche, one indication of the increasing ascendancy of offshore production. While declining onshore drilling poses a potentially significant employment problem for the area, the rapid expansion of the offshore industry in recent years presents more immediate--if less momentous--difficulties. Among these

TABLE 2.9

OIL AND GAS PRODUCTION AND REFINING EMPLOYMENT
IN THE BARATARIA REGION, BY PARISH, 1974

| PARISH | NUMBER OF EMPLOYEES | | |
|---|---|---|---|
| | OIL AND GAS EXTRACTION | PETROLEUM REFINING | TOTAL PRODUCTION AND PROCESSING |
| Assumption | 100-249 | - | 100-249 |
| Jefferson | 5,696 | 100-249 | 5,796-5,945 |
| Lafourche | 940 | - | 940 |
| Plaquemines | 2,500-4,999 | 250-499 | 2,750-5,498 |
| St. Charles | 149 | 500-999 | 649-1,148 |
| St. James | 20-99 | 250-499 | 270-598 |
| St. John the Baptist | - | - | - |
| Barataria Region | 9,405-12,132 | 1,100-2,246 | 10,505-14,378 |

Source: U.S. Bureau of the Census, 1977.

is the necessity of expanding community facilities and services to meet the growing needs of populaces enlarged as a result of stepped-up activity on the Outer Continental Shelf (OCS). Almost 6,000 persons in the region were employed in OCS-support jobs in 1974 (see Table 2.10). The total population related to this was in excess of 22,500. The rapid growth of the offshore industry may be seen in a comparison of the 1974 figures with data from 1967. During that seven-year period OCS employment almost quadrupled and the related population nearly tripled. A trend toward greater concentration of OCS activity in the Barataria Region (or adjacent waters) seems to be indicated by comparison of regional growth rates with those for the entire coastal zone of Louisiana, including Barataria. OCS support employment and related population in the 22-parish coastal area were both something less than two and one-half times greater in 1974 than in 1967. During that period the Barataria Region's share of offshore-support jobs increased from 17 to 27 percent, and the region's share of population expanded from 22 to 28 percent. However, while expansion of offshore production may be offsetting the onshore contraction at present, an eventual decline in overall production is recognized as inevitable. Promoters of the Louisiana Superport hope the proposed facility will counter the impact of diminishing reserves by providing a new source of crude oil for the state's refineries and petrochemical plants.

According to the Louisiana State Planning Office (1977: 121), projections indicate the Superport will result in more than 16,000 new jobs and almost $2.3 billion worth of added investment in the state's petroleum complex during its first year of operation. The new jobs total is projected to reach 30,000 by 1990 with about $5.6 billion worth of new investment generated in the same period. The port itself, and related facilities, will cost almost $1 billion to build. Louisiana Offshore Oil Port, Inc. (LOOP), a consortium of five refining and pipeline firms, plans to locate the single-point rotational mooring facility for supertankers approximately 18 miles off the coast of Lafourche Parish. A pipeline leading from the deepwater dock will cross the coastline near the mouth of Bayou Lafourche and connect with a national supply line in St. James Parish. Approximately 40 percent of Superport crude oil will be retained for use by area industries, according to LOOP President William Read (Henriques, 1978).

Major petroleum refineries in the Barataria Region are located in the parishes of Jefferson, Plaquemines, St. Charles and St. James. Refinery products include

TABLE 2.10

EMPLOYMENT AND POPULATION IN THE BARATARIA PARISHES DUE TO OCS SUPPORT ACTIVITY, 1967 AND 1974

| PARISH | 1967 EMPLOYMENT | 1967 POPULATION | 1974 EMPLOYMENT | 1974 POPULATION |
|---|---|---|---|---|
| Assumption | 19 | 174 | 54 | 767 |
| Jefferson | 1,021 | 5,442 | 4,396 | 15,298 |
| Lafourche | 182 | 1,052 | 559 | 2,952 |
| Plaquemines | 95 | 263 | 333 | 739 |
| St. Charles | 114 | 392 | 245 | 1,149 |
| St. James | 58 | 278 | 131 | 690 |
| St. John the Baptist | 26 | 302 | 125 | 1,000 |
| Barataria Region | 1,515 | 7,903 | 5,843 | 22,595 |
| Coastal Zone | 8,836 | 35,231 | 21,679 | 80,190 |
| Barataria/CZ | .171 | .224 | .269 | .282 |

Source: Mumphrey, et al., 1977: 23 and 25.

motor gasolines, jet and diesel fuels, home heating oil, fuel oil, diesel oil, propane, ethylene, benzene, kerosene, white mineral oil, carbon black feedstock, sulfur, petroleum coke, asphalt, liquified petroleum gas, petrolatums, soluble cutting oils and other petroleum derivatives. Chemical manufacturing complexes employing in excess of 1,000 workers in 1974 were located in each of three parishes in the region: Jefferson, St. Charles and St. James. Another 1,000 workers were employed in the manufacture of chemicals and allied products either in Plaquemines or St. John. The total sectoral labor force in the region was in the range of roughly 4,500 to 6,500 persons. Chemical manufacturing output covers a wide range of products including ethyl alcohol, nitric acid, hydrogen peroxide, sulfolane, hydrochloric acid, calcium chloride, acetone, vinyl chloride, methyl-ethyl ketone, secondary butyl alcohol, styrene, sulfuric acid, acrylonitrile, urea and anhydrous ammonia, herbicides, pesticides, emulsifiers and surfactants for agriculture, glycerin, soil fumigants, paper resins, cleaners, solvents, grease-cutting compounds, floor waxes, disinfectants, chlorine bleaching compounds, industrial water-treating chemicals, lube oil additives, hydraulic fluids, lubricating greases and oils, fluorocarbon refrigerants, glazing compound, putty, asphalt roof coatings, caulking compound, sealants, synthetic rubber, printing inks and chemical supplies, carbon dioxide, plasticizers and numerous other chemicals and chemical products. Another important manufacturing sector, employing as many as 10,000 workers in the Barataria Region, is that of ship building and repair. At least 5,000 of those jobs are located at Avondale Shipyards in Jefferson Parish, the area's largest single employer. Smaller boat and ship operations are located in Lafourche, Plaquemines and Assumption parishes (Louisiana Department of Commerce and Industry, 1975).

The Barataria Region's principal agricultural activity is sugarcane cultivation. Total sugarcane acreage, under cultivation in 1975, was over 100,000 acres (see Table 2.11). That represented a little more than one-third of total sugarcane acreage in the state. Approximately 2,000-3,000 persons in the area were employed in sugar-processing plants located in the region's four leading sugarcane parishes: Assumption, Lafourche, St. James and St. John the Baptist (Louisiana Department of Commerce and Industry, 1975). Another important agricultural activity, soybean cultivation, is relatively new to the region but has shown a capacity for rapid expansion. In 1965 only 200 acres, in a single parish, were devoted to soybean farming (see Table 2.12). By 1971 total acreage had increased to 14,500 with soybeans planted in all of the Barataria parishes except Jefferson.

TABLE 2.11

SUGARCANE ACREAGE IN THE BARATARIA REGION, BY PARISH, 1950-1975

| PARISH | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 |
|---|---|---|---|---|---|---|
| Assumption | 30,853 | 25,686 | 29,873 | 32,370 | 31,833 | 36,900 |
| Jefferson | - | - | - | - | - | - |
| Lafourche | 29,246 | 24,235 | 26,458 | 31,568 | 29,298 | 34,800 |
| Plaquemines | - | - | - | 1,084 | - | - |
| St. Charles | 1,531 | 1,330 | 1,502 | 2,814 | 1,850 | 1,500 |
| St. James | 17,325 | 14,383 | 16,994 | 20,940 | 19,269 | 24,400 |
| St. John the Baptist | 15,048 | 12,560 | 9,249 | 9,948 | 8,301 | 8,600 |
| Barataria Region | 94,003 | 78,194 | 84,076 | 98,724 | 90,551 | 106,200 |
| Louisiana | 296,581 | 249,576 | 281,615 | 314,241 | 286,402 | 308,000 |

Sources: Louisiana State University Department of Agricultural Economics Report No. 436 (April 1972): "Louisiana Crop Statistics by Parish, Through 1970" except for 1975 figures which come from LSU D.A.E. Report No. 523 (August 1977): "Agricultural Statistics for Louisiana, 1973-1976."

TABLE 2.12

SOYBEAN ACREAGE IN THE BARATARIA REGION, BY PARISH, 1965-1976

| PARISH | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumption | - | - | 1,000 | 3,000 | 6,000 | 3,500 | 3,500 | 2,700 | 2,500 | 2,500 | 2,600 | 2,000 |
| Jefferson | - | - | - | - | - | - | - | - | - | - | - | - |
| Lafourche | - | - | 100 | 600 | 2,500 | 1,900 | 3,600 | 3,000 | 3,500 | 4,000 | 3,000 | 3,000 |
| Plaquemines | - | 100 | 500 | 1,700 | 1,200 | 500 | 700 | 600 | 400 | 500 | 400 | 200 |
| St. Charles | - | - | 100 | 200 | 300 | 1,000 | 500 | 400 | 300 | 400 | 300 | 100 |
| St. James | 200 | 1,000 | 1,300 | 1,500 | 1,800 | 1,400 | 3,000 | 3,000 | 2,200 | 3,300 | 2,500 | 2,400 |
| St. John the Baptist | - | 100 | 1,000 | 1,500 | 1,800 | 3,000 | 3,200 | 4,000 | 2,800 | 3,600 | 3,800 | 3,600 |
| Barataria Region | 200 | 1,200 | 4,000 | 5,500 | 13,600 | 11,300 | 14,500 | 13,700 | 11,700 | 14,300 | 12,600 | 11,300 |
| Louisiana | 622,000 | 871,000 | 1,306,000 | 1,436,000 | 1,608,000 | 1,688,000 | 1,644,000 | 1,667,000 | 1,580,000 | 1,760,000 | 1,920,000 | 2,120,000 |

Sources: Louisiana State University Department of Agricultural Economics Report No. 436: "Louisiana Crops Statistics, by Parishes, through 1970" (April 1972); D.A.E. Research Report No. 496: "Agricultural Statistics for Louisiana, 1971-1974" (November 1975); and D.A.E. Research Report No. 523: "Agricultural Statistics for Louisiana, 1973-1976" (August 1977).

Major economic activities related to renewable resource use include commercial fishing, seafood processing, trapping, recreational hunting and sport fishing. Fishing is the area's oldest industry and continues to be a vital factor in the regional economy and culture. Commercial landings in Louisiana in 1976 totaled nearly 1.25 billion pounds and amounted to almost one-fourth of all the fish caught by United States fishermen that year. Dockside value of the 1976 catch was over $135 million. Four of the top six commercial fishing ports in the United States, in terms of total fish weight, were located along the Louisiana coast. Major fishing ports in the Barataria Region include Empire, Golden Meadow-Leeville and Lafitte-Barataria (National Marine Fisheries Service, 1977: 4-5).

The commercial fishing industry in Louisiana produces significant quantities of oysters, shrimp, crabs, crawfish and other shellfish, as well as a wide variety of fishes including, among others, menhaden, croaker, catfish, drum, flounder, pompano, sea trout, shad, sheephead, snapper, and Spanish mackrel. According to Wagner (1977), the state's pre-eminence in the fishing industry is directly attributable to the fact that Louisiana has the most extensive marsh and estuarine region in the world, including a fourth of total estuarine acreage in the United States. The Barataria Bay estuarine system produces 44 percent of the total state fishery harvest on an average annual basis. Over four million pounds of oyster meat produced in the Barataria system--nearly half the state total--are harvested each year. Barataria Bay and its adjacent waters also lead the state in production of menhaden, an oily fish used exclusively for industrial purposes, accounting for about one-third of the state total of approximately one billion pounds per year. The estuary also produces 20 million pounds of shrimp each year, almost two million pounds of catfish and bullhead, almost five million pounds of croaker and over one million pounds of speckled trout.

Barataria Bay is located in the middle of the state's prime oyster-producing region. The top five oyster-producing parishes include the Barataria parishes of Plaquemines, Jefferson and Lafourche and the parishes which flank them: St. Bernard on the east and Terrebonne on the west. The combined oyster acreage of these five parishes exceeds 575,000 acres and accounts for more than 99 percent of the state total. In recent years, these five parishes have produced a combined average of 270,000 barrels or 3,923,100 pounds of oyster meat per year. The parishes of Plaquemines and St. Bernard account for approximately 90 percent of all oyster bottoms in the Louisiana coastal zone. The future of the oyster industry in Louisiana may

depend on these water bottoms, since they include more than 450,000 acres of seed grounds which are being nurtured for future cultivation. During the past two decades, however, accelerating saltwater intrusion has reduced the yield of these seed grounds by almost two-thirds. As a result, oyster fishermen have been forced to steadily increase the range of their activity in order to maintain the existing level of production. Principal among the acknowledged causes of destructive saltwater intrusion are the channelization and dredging associated with industrial development and construction of the Mississippi River-Gulf Outlet Channel (Louisiana State Planning Office, 1976: 33-36).

Seafood processing employs roughly 1,250-2,500 persons in the Barataria Region, 1,000-2,000 of them at 11 different plants located in Jefferson Parish. Fish and shellfish processing plants are also located in Lafourche and Plaquemines. Products include fresh and frozen shrimp, canned shrimp and oysters, soft shell crabs, canned crabmeat, packaged shrimp dinners, shrimp meal, frozen crabs, peeled plain and deveined shrimp, seafood specialties, breaded shrimp, headless shrimp, menhaden fish meal and scrap, fish oil and fish solubles (Louisiana Department of Commerce and Industry, 1975).

Commercial trapping is another regional activity, with roots in the distant past, which continues to play an important part in the area's economy. Louisiana trappers enjoyed a boom season in 1976-1977, taking a record 3.25 million pelts worth over $24 million. That was nearly double the value of pelts taken the previous season and approximately four times the value of furs sold by trappers five years earlier. Economically the most important furbearers in Louisiana are nutria and muskrat. Over 1.5 million nutria pelts were taken in 1976-1977, and 740,000 muskrat pelts were sold by trappers. In addition, the meat of those two animals is sold to supply pet-food and fertilizer producers. Other important fur-bearing animals taken in sizable quantities included raccoon (180,000 pelts), mink and oppossum (about 35,000 pelts each). Fewer otters, foxes and bobcats were taken; but the price per pelt for those animals was much higher (Louisiana Wild Life and Fisheries Commission, 1977).

Finally, the economic impact of recreational hunting and fishing in a state which calls itself "Sportsman's Paradise" cannot be overlooked. Projected participation during 1975 in southeastern Louisiana--including, in addition to the Barataria parishes, the parishes of Orleans, St. Tammany, St. Bernard and Terrebonne--is shown in Table 2.13. The State Parks and Recreation Commission

TABLE 2.13

PROJECTED RECREATIONAL HUNTING AND FISHING PARTICIPATION IN SOUTHEASTERN LOUISIANA IN 1975

| ACTIVITY | PROJECTED HIGH-QUARTER PARTICIPATION IN 1975 (number of user-days) | | | |
|---|---|---|---|---|
| | REGION 1-A[1] | REGION 1-B[2] | REGION 3[3] | TOTAL (1-A, 1-B & 3) |
| Saltwater Fishing | 2,112,148 | 205,674 | 519,811 | 2,837,633 |
| Freshwater Fishing | 5,716,565 | 559,582 | 1,414,260 | 7,690,407 |
| Crawfishing | 1,864,779 | 181,586 | 458,932 | 2,505,297 |
| Crabbing | 1,826,722 | 177,880 | 449,566 | 2,454,168 |
| TOTAL FISHING/ SHELLFISHING | 11,520,214 | 1,214,722 | 2,842,569 | 15,487,505 |
| Big-Game Hunting | 1,997,978 | 194,557 | 491,713 | 2,684,248 |
| Small-game hunting | 3,567,818 | 347,423 | 878,059 | 4,793,300 |
| Waterfowl hunting | 1,579,354 | 153,792 | 388,687 | 2,121,833 |
| TOTAL HUNTING | 7,145,150 | 695,772 | 1,758,459 | 9,599,381 |
| TOTAL HUNTING AND FISHING | 18,665,364 | 1,829,494 | 4,601,028 | 25,086,886 |

1. Jefferson, Orleans and St. Bernard parishes.
2. Plaquemines and St. Tammany parishes.
3. Assumption, Lafourche, St. Charles, St. James, St. John and Terrebonne parishes.

Source: Louisiana State Parks and Recreation Commission, 1974.

(1974) projected high-quarter hunting and fishing participation in excess of 25 million user-days. Of that total, roughly 15 million high-quarter user-days were projected for fishing (saltwater and freshwater) and shell-fishing (crawfishing and crabbing); and roughly 10 million high-quarter user-days were projected for hunting (big-game, small-game and waterfowl). Obviously, the economic ramifications--including expenditures for equipment, supplies, transportation and so forth--are extensive and sizable enough to qualify recreational hunting and fishing as a major economic activity in the Barataria Region.

## WETLANDS USE IN THE BARATARIA BASIN

### Introduction

The issue of wetlands use in the Barataria Basin is not so much a single unified issue as a collection of interrelated controversies linked by the overlapping problems of environmental protection, economic growth and urban expansion in the coastal zone. More specifically, the various controversies spawned by the larger issue of wetlands use are also connected to one another by the questions common to them all: questions regarding the need for management of coastal resources; questions related to the purpose and scope of coastal resources management; and questions concerning jurisdiction and procedure in the regulation of coastal activities.

The following section attempts to focus on the principal areas of disagreement which have shaped the issue of wetlands use in the Barataria Basin. Four areas of conflict are outlined, including coastal zone management, highway construction, reclamation and hurricane protection, and the concept of a national park as a wetlands preserve. Focal conflicts examined include those over delineation of a coastal zone boundary for the State of Louisiana, establishment of a growth/conservation line for the West Bank of Jefferson Parish, construction of an interstate-system bypass highway (I-410), alignment of a state highway from Marrero to Lafitte to Larose, implementation of the Harvey Canal-Bayou Barataria hurricane protection plan, and location of Jean Lafitte Park in the heart of the Barataria country.

## Coastal Zone Management

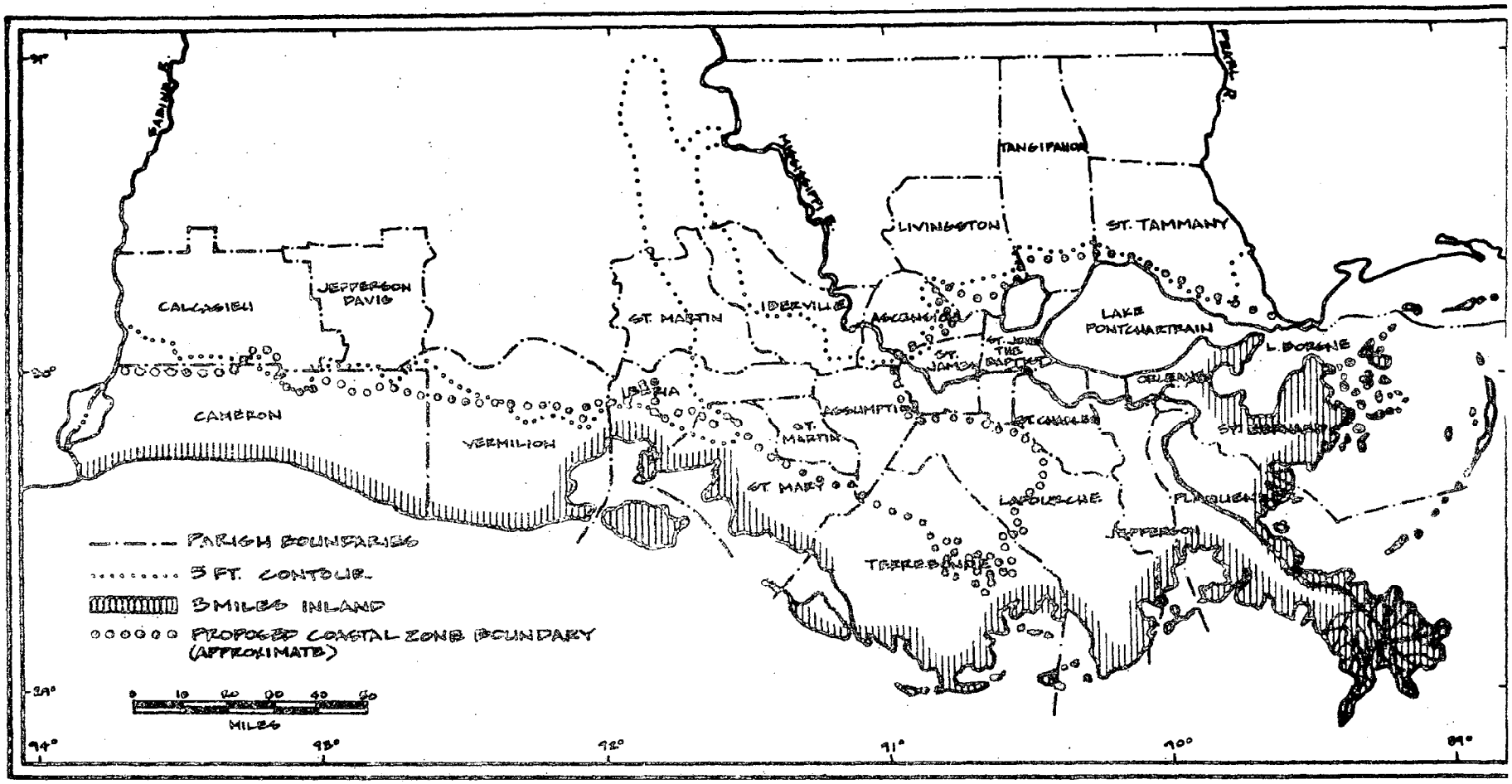
The official coastal zone of Louisiana, as established by Act 705 of the 1977 legislative session, does not include most of the coastal wetlands located in the Barataria Basin. Almost all of the Des Allemands-Salvador-Barataria estuarine system lies outside the management zone (see Figure 2.3). The fact that one of the world's most productive estuaries could be excluded from the area of jurisdiction outlined by the state's Coastal Zone Management (CZM) Act is indicative of the intense political pressures brought to bear in the battle over delineation of Louisiana's coastal zone boundary.

From one point of view, the debate over coastal zone management is in itself an affirmation of the need for development and implementation of public policy regarding coastal environments. The acuteness of that need is underscored by the record of havoc wreaked on the estuarine systems in this country over the course of the past century. An estimated 45 million acres of wetlands--about half the nation's total acreage--have been lost during that period. Coastal swamps and marshes in the United States continue to disappear at a rate of more than 200,000 acres a year (Bernstein, May 1977). The most extensive damage is being done in the "unofficial" coastal zone of Louisiana where approximately one-fourth of the nation's remaining wetlands are located (Catalano, 1976). It is hardly surprising that in the area where activities directed to the modification of wetlands are most intense, opposition to the regulation of such activities should also be strongest. Moreover, when one considers the source of that opposition--the powerful landholders, building contractors, and agricultural and industrial interests whose input into the political decision-making process is maximized by virtue of their close ties to those who hold elective office--one can hardly wonder at its effectiveness.

Governmental efforts to manage the use of wetlands began at the federal level in the 1960's. Alerted to the rate at which valuable wetlands were being lost to highway construction, urban expansion, conversion to agricultural use, and natural erosion and subsidence, officials in the Department of the Interior inaugurated a comprehensive inventory of the nation's coastal estuaries. The study described in detail the conditions of estuarine systems along the Atlantic, Gulf, and Pacific coasts and documented the continuing destruction of wetlands. A second study, the Stratton Commission report, noted the need for a coordinated effort to protect surviving swamps and marshes

FIGURE 2.3

PROPOSED COASTAL ZONE BOUNDARIES




Source: Compiled by the Authors from McIntire et al., 1975; Louisiana State Planning Office, April 1977; Louisiana Department of Transportation and Development, May 1978.

and also pointed out the absence of a planning capability, within existing governmental agencies, equal to the challenge. The report recommended that states establish their own coastal authorities but recognized that the resources necessary to establish and implement programs on the state level were lacking (Louisiana Department of Transportation and Development, December 1977).

Legislation designed to meet the need for coordinated effort and adequate funding was introduced in Congress in 1969. The Coastal Zone Management Act was finally adopted in 1972, and the National Oceanic and Atmospheric Administration (NOAA) was given authority to administer the program. In the period of more than five years since passage of the CZM Act of 1972, the State of Louisiana has moved falteringly toward full participation in the program. In 1973 the Advisory Commission on Coastal and Marine Resources, established by the Louisiana Legislature in 1971, issued its final report, The Wetlands Prospectus, recommending implementation of a state coastal zone management program. The following year Governor Edwin Edwards named the State Planning Office (SPO) as coordinating agency for coastal zone management activities in Louisiana. Under Section 305 of the CZM Act of 1972, federal funds were allocated to Louisiana for use in planning an official coastal resources management program (Louisiana State Planning Office, June 1975).

During the summer of 1975 representatives of the SPO's Coastal Resources Program met with local officials in the state's coastal parishes to lay the groundwork for CZM in Louisiana. Public information meetings were held in coastal cities and towns during the fall of 1975 (Louisiana State Planning Office, December 1975). In 1976 a CZM bill was introduced in the Louisiana Legislature. However, strong opposition surfaced in committee hearings; and the bill was redrafted to set up a study group, the Louisiana Coastal Commission (Louisiana State Planning Office, September 1976). The commission drafted a new coastal zone management bill for introduction in the 1977 legislative session; and it was this bill which eventually passed, substantially unchanged, officially reducing the state's coastal zone to a strip of land and wetland located three miles or less inland from the Gulf of Mexico. Members of the legislature were divided into two main camps in the battle over delineation of the state's coastal zone boundary. One camp included those legislators who favored the proposed three-mile limit. They were opposed by a group of lawmakers who called for designation of the five-foot elevation contour as the zone's upper boundary. A number of amendments were offered, including one which

would have attached Lake Pontchartrain to the three-mile zone and another which would have substituted the I-10/ I-12 interstate highway right-of-way for the five-foot contour. However, all of the proposed amendments were rejected; and the strict three-mile limit was specified in the CZM bill which ultimately won approval (Louisiana Department of Transportation and Development, September 1977).

The coastal zone boundary adopted by the legislature in 1977 was subsequently rejected by federal officials as incompatible with guidelines established by the CZM Act of 1972. The rejection placed in jeopardy Louisiana's participation in federal programs designed to aid the states in proper development of coastal resources. In addition, the state was threatened with the loss of millions of dollars in federal impact funds (Louisiana Department of Transportation and Development, December 1977). The Coastal Energy Impact Program (CEIP), created by an amendment to the CZM Act of 1972, was established to help compensate states and eligible communities for the adverse effects of coastal energy activity and offshore energy development. The program makes available two principal kinds of financial aid: formula grants and credit assistance. The formula grants are intended to help reduce the impact of coastal energy activity on environmental and recreational resources--and where such negative impacts cannot be ameliorated to compensate states for their losses. Credit assistance made available from the Coastal Energy Impact fund is intended to supplement state aid to communities which must expand local services and facilities to meet the needs of increased populaces (Carrier, May 1977).

Of the $10 million in formula grants for environmental or recreational losses appropriated by Congress for the 1977 fiscal year, more than half--about $5.5 million--was allocated for use in Louisiana. Among the projects which will benefit from the CEIP fund are a new water-supply system for Grand Isle, which will cost about $900,000, and a hurricane protection levee system in Lafourche Parish. The state should receive another $160 million of the $400 million total authorized for disbursement before 1984. However, Louisiana's share of 1977 formula grants was based on an unofficial coastal zone which included all land and wetlands below the five-foot contour. By officially setting the upper limit at the three-mile mark, the legislature drastically reduced the area eligible for impact funds. The narrow definition of the state's coastal zone also might result in only towns in the "first-tier" parishes being eligible for credit assistance in seeking to expand

facilities and services. Congress has authorized $800 million for credit assistance. Based on the broader definition of its coastal zone, Louisiana would receive about $90 million. Of $110 million appropriated for disbursement in fiscal 1977, the state's share was $20 million, based on the five-foot contour coastal zone (Carrier, May 1977).

Following the federal rejection of the state's coastal zone management plan, administration of the Coastal Resources Program was transferred from the State Planning Office to the Department of Transportation and Development (DOTD). In an effort to define the coastal zone in a manner acceptable to federal officials and local political interests alike, the state's coastal planners delineated a new boundary which essentially represents a compromise between the five-foot contour and three-miles inland limits. The new line was drawn as part of a revised CZM proposal prepared for submission to the Louisiana Legislature during its 1978 session. The proposed boundary generally would follow the route of the Gulf Intracoastal Waterway from the Texas border eastward to the vicinity of Houma, then angle sharply northward to take in lakes Maurepas and Pontchartrain (States-Item, April 1978). Significantly, the expanded coastal zone would include all of the Des Allemands-Salvador-Barataria Estuary.

The controversy surrounding efforts to establish a satisfactory coastal zone boundary for the State of Louisiana has its parallel on the parochial level in the debate over delineation of a growth/conservation boundary for that portion of Jefferson Parish which stretches from the Mississippi River to the Gulf of Mexico. The proposed boundary would draw a line between growth and non-growth areas: that is, between areas suitable for future development and areas which would be considered off-limits for developmental activities. In effect, the growth/conservation line would prohibit further encroachment on the Barataria estuarine system by limiting future growth to existing high ground and low-lying areas already enclosed by levees.

There are, at present, almost 10,000 acres of undeveloped land on the West Bank of Jefferson Parish within existing levee systems (Carrier, October 1977). Nonetheless, individual landowners and real estate development companies continue their efforts to reclaim viable wetlands on a piecemeal basis. Early in 1977 conservation-minded area residents, commercial and sport fishermen, and members of environmentalist groups persuaded the Jefferson Parish Council to consider adoption of a growth/conservation boundary which would give direction to future urban

expansion. The Coastal Zone Management Advisory Committee was commissioned to undertake the task of defining the limits of future growth (Louisiana State Planning Office, February 1977).

The growth/conservation line proposed by the committee, after five months of study, was based on the recommendations of marine biologist Dr. Paul Wagner of Burk and Associates, the consulting firm retained by the Jefferson Parish Council to provide technical assistance. The proposed boundary would have embraced an area of almost 54,000 acres, including about 36,000 undeveloped acres, which would be available for future growth. The growth area would have included about 19,000 acres of natural or leveed wetlands already marked for drainage and development. However, the advisory committee's proposal did not take into consideration the area's actual suitability for development, and it is possible the soils in some areas would not safely support construction. Moreover, portions of the proposed growth area lie outside existing hurricane protection systems; and adequate levees and drainage facilities would have to be provided before development could safely proceed. Generally speaking, the line was drawn to include areas of natural high ground and leveed land, along the Bayou Barataria alluvial ridge, as far south as Lafitte (Nolan, July 1977).

The Coastal Zone Management Advisory Committee formally presented its proposal for a growth/conservation line at a public hearing in the Jefferson Parish Courthouse on August 8, 1977. The plan met with strong opposition from a coalition of business, industry and real estate groups which included the Harvey Canal Industrial Association, the West Bank Council of the Chamber of Commerce, and an ad hoc group of builders and landholders called the Sensible Growth-Conservation Committee. The last group summoned an economist, an engineer, an environmental consultant and an attorney to testify against the proposal. The consensus of opposition opinion presented at the hearing was that the study and planning which had gone into demarcation of the growth/conservation line had been inadequate. Opponents criticized the advisory committee for not considering possible legal ramifications of the line; for not examining the potential economic consequences of banning development in the proposed non-growth area; for not studying the feasibility of alternative conservation methods; and, finally, for proposing any line at all since any growth-limiting line, wherever located, would represent a violation of basic property rights (Nolan, August 1977).

At a meeting on October 3, 1977, members of the advisory committee failed to reach agreement on a proposal for submission to the Jefferson Parish Council (Nolan, October 1977). As a result, the issue remained in limbo for another seven months. Then, in the wake of disastrous flooding caused by the record rainfall of May 3, 1978, public criticism of the existing drainage system inspired a renewed effort to define the limits of future growth. Meeting on May 15, the Coastal Zone Management Advisory Committee voted to recommend adoption of a compromise growth/conservation line. The new line would define a development zone considerably larger than the one originally proposed. Most notably, the revised plan transfers the 3,100 acre Bayou aux Carpes swamp from the conservation side of the line to the growth side. The plan also leaves unresolved the issue of flood protection for Lafitte. Although the proposed growth boundary proceeds southward along the alluvial ridge of Bayou Barataria to take in the Village of Jean Lafitte, none of the proposed alignments for the Harvey Canal-Bayou Barataria levee system, being considered by the U.S. Army Corps of Engineers, include this low-lying fishing community (States-Item, May 1978).

## Highway Construction

Perhaps the most controversial single issue involving the use of wetlands in the Barataria Basin has been the proposal for construction of an interstate-system bypass highway across the Barataria Estuary. The road, as originally proposed, would have followed a roughly semi-circular route south of New Orleans. Between its western connection with Interstate-10 in St. Charles Parish and its eastern link in St. Bernard, I-410 (the "Dixie Freeway") would have cut across the wetlands of Jefferson Parish.

On March 8, 1974, a coalition of commercial fishing and environmentalist groups filed suit in Federal District Court, seeking to block construction of the highway. The plaintiffs included the Ecology Center of Louisiana, the Delta Chapter of the Sierra Club, the Orleans Audubon Association and the Louisiana Shrimp Association. They claimed construction of the road would disrupt normal drainage patterns in a wetlands area encompassing some 175 square miles, adversely affecting the ecological "chain of life" in the Barataria Estuary and resulting in permanent damage to the state's shellfish industry. However, their suit was based primarily on the contention that officials improperly segmented the project in assessing its probable environmental impact. Opponents of the I-410 proposal

claimed the limited-access highway had been conceived as a development ring around West Bank suburbs. They argued that the road was unnecessary as an alternate traffic artery and could not be justified as a hurricane evacuation route, since it would lead not so much out of low-lying flood-prone areas as across them (Jefferson Democrat, January 1976).

In July of 1974, Federal District Court Judge James Comiskey summarily dismissed one portion of the suit and deferred action on the remainder pending completion of an environmental impact statement. However, the plaintiffs appealed to the Fifth Circuit Court of Appeals and in July of 1975 won a reversal sending the whole suit back to the district court for trial on its merits. Comiskey had dimissed that portion of the suit relating to construction of Section I (the "western segment"), ruling the plaintiffs had filed their suit too late. While the plaintiffs' appeal was under consideration, the first phase of the project--construction of a bridge across the Mississippi River near Luling in St. Charles Parish--got underway (Jefferson Democrat, November 1975a). Governor Edwin Edwards presided at groundbreaking ceremonies for the bridge intended to link I-10 with the proposed southern loop. However, as early as the summer of 1974, Edwards had disconcerted local officials by expressing the opinion that I-410 would never be built because of legal opposition. Edwards had warned litigation could tie up the project for years and result in the loss of $400 million in federal funds allocated for transportation improvements in Louisiana. He suggested those funds be diverted to help defray the expense of building a north-south state highway (Jefferson Democrat, August, 1974).

Despite intense pressure from local politicans and business interests committed to construction of I-410, state officials eventually agreed to an out-of-court settlement which scuttled most of the project. On January 8, 1976, Federal District Court Judge R. Blake West signed a consent decree binding highway officials and I-410 foes to an agreement they had reached in negotiations out of court. Under terms of the settlement, the U.S. Department of Transportation, Federal Highway Administration and Louisiana Department of Highways agreed to abandon plans for approximately three-fourths of the proposed roadway. The agreement eliminated that portion of the road which would have bisected the Barataria wetlands: that is, the portion from U.S. Highway 90 near Boutte to the northern bank of the Mississippi River-Gulf Outlet (MRGO) Channel east of New Orleans. Short sections at either end of the

route were left intact. The plaintiffs agreed to allow construction of the Mississippi River bridge near Luling, a 13-mile stretch of roadway from the bridge to Boutte and a 2.6-mile spur leading from the proposed eastern nexus with I-10 to the northern bank of the MRGO Channel. However, the settlement also required the Department of Highways to prepare a new environmental impact statement before proceeding with construction of those parts of the proposed roadway not banned by the consent decree. In addition, the plaintiffs were given the right to oversee preparation of the new impact statement (States-Item, January 1976).

According to John R. Hammond, regional planner and vice-president of the Ecology Center, the I-410 settlement marked the "first time in any environmental lawsuit in the nation where highway officials have actually agreed in court to deauthorize an interstate highway." The critical factor in the decision of highway officials to capitulate in the I-410 case was their inability to resolve the so-called "Chalmette bulge." Bonding requirements of the Greater New Orleans Mississippi River Bridge stipulated no toll-free bridge could be built within 10 miles of the existing bridge, otherwise bondholders would be entitled to redeem their bonds immediately. Federal regulations banned inclusion of a toll bridge in the interstate system. In an attempt to circumvent the bonding obstacle, the Department of Highways developed an I-410 plan which included a five-mile detour below Chalmette. Federal Highway Administration officials would not approve the bulge, and state highway planners could not come up with an acceptable alternative (Brumfield, January 1976).

Official opposition on the local level did not end with the consent decree which terminated the I-410 suit. The Parish of Jefferson, which had intervened in the suit on the side of the defendants, was not a party to the agreement. On the day the settlement was signed, the Jefferson Parish Council adopted, without objection, a resolution authorizing the parish attorney "to take any and all legal action necessary in order to keep a viable I-410 Project and to retain the funds allocated for especially that segment of I-410 which traverses Jefferson Parish." The resolution, offered on a joint motion of all councilmen present, maintained the "roadway does not in fact traverse any wetlands in the Parish of Jefferson." Moreover, according to the resolution, "construction of this roadway would have a tremendous economic impact on Jefferson Parish and would provide a vitally needed and planned improvement...." (Jefferson Parish Council, January 1976).

Another roadbuilding project which has met with serious opposition is the proposed state highway which would link the upper West Bank of Jefferson Parish with lower Lafourche Parish. The road would connect with Ames Boulevard just below Marrero, lead southward to Lafitte and then follow a generally southwesterly route to Larose. The Marrero-to-Lafitte segment would replace existing state Highway 45, a winding two-lane highway considered unsafe and inadequate as a hurricane evacuation route. The Lafitte-to-Larose segment would cut across open marsh, establishing a new route below the Gulf Intracoastal Waterway.

The U.S. Army Corps of Engineers' New Orleans District headquarters originally informed the Louisiana Department of Highways, in late 1973, that only that section of the proposed highway linking Lafitte and Larose would require a federal permit. However, a subsequent interpretation of permit guidelines, outlined in Section 404 of the federal Water Pollution Control Act of 1972, led to an order halting dredge-and-fill work in the Crown Point area below Marrero in October of 1975. The Department of Highways was required to file an after-the-fact application for permission to proceed with construction of the northern portion of the proposed highway. In the face of mounting opposition from environmentalist groups, planning for the southern segment from Lafitte to Larose was abandoned early in 1976. In a letter dated February 27, 1976, Department of Highways Director W. T. Taylor informed Corps and Coast Guard officials the department intended to hold the southern segment in abeyance "pending the results of some long-term, in-depth studies, which we hope will put this department in a somewhat better perspective environmentally" (Jefferson Democrat, March 1976).

Construction of the northern segment resumed in May 1977 after a delay of more than 18 months. The work was allowed to go forward after representatives of the National Wildlife Federation, the Louisiana Wildlife Federation, the Fund for Animals, the Orleans Audubon Association and the Ecology Center of Louisiana agreed to withdraw a suit alleging federal authorities violated their own environmental guidelines in approving the project. In return highway officials pledged in an out-of-court agreement to build a bridge across Bayou des Familles instead of damming the waterway; to lay enough culverts under the roadway in marshy areas to insure sufficient water flow; and not to pursue construction of the southern segment without studying alternative alignments, holding public hearings and notifying the plaintiffs (Nolan, May 1977).

## Hurricane Protection and Land Reclamation

In the same way proponents of highway construction in wetland areas have sought to justify proposed roadways as hurricane evacuation routes, the proponents of land reclamation projects in the Barataria swamps and marshes seek to justify the construction of drainage facilities as necessary for flood protection. Whether such levees, dams, canals and pumping stations are intended to upgrade or to extend existing flood protection systems is a question which has stirred a great deal of debate in recent years. Much of that debate has been focused on the largest flood project in the Barataria Basin, the Harvey Canal-Bayou Barataria Hurricane Protection Plan.

The project, as formulated by the U.S. Army Corps of Engineers, was originally described in terms of both hurricane protection and land reclamation at the inception of planning in 1961. The levee system was seen as a way of protecting not only areas already inhabited but adjacent open spaces marked for future urbanization. However, increasing public concern for endangered wetland environments led to reappraisal of the project and, reinforced by federal legislation enacted in the early 1970's, eventually resulted in modification of the plan. The project, as originally proposed, called for construction of a levee system along the western banks of Harvey Canal and Bayou Barataria, as well as related drainage facilities, including a pumping station on Bayou aux Carpes at Crown Point. The first phase of levee construction and associated closure work on Bayou aux Carpes and Bayou des Familles was completed by the end of 1974. At a public hearing on January 7, 1975, opposition to the plan--and, in particular, to the pumping station and dams--was expressed by area residents, sport and commercial fishermen and members of environmentalist groups. Support for the plan came from inhabitants of flood-prone areas, land owners and developers, and local politicians (Wilkinson, January 1975).

Following the public hearing, New Orleans District Engineer (Col.) E.R. Heiberg indicated implementation of the Harvey Canal-Bayou Barataria plan would proceed. However, one month later, a formal objection from the acting regional director of the U.S. Fish and Wildlife Service forced referral of the dispute to higher headquarters. In a letter to Heiberg, Phillip S. Morgan quoted from a Corps release dated November 15, 1961, which said the project would "....permit reclamation of about 17 square miles of

low swampy area between the Gulf Intracoastal Waterway and Bayou des Familles." He also pointed out that a Fish and Wildlife Service report dated September 13, 1962, had noted reclamation would eliminate wildlife from the area. Morgan said completion of the levee system, including installation of the Bayou aux Carpes pumping station, would make possible drainage of 2,175 acres of relatively unaltered wooded swamp and freshwater marsh "with the subsequent loss of associated fish and wildlife resources." "The Fish and Wildlife Service is not opposed to protection of developed areas from damaging floods," the letter read. "However, we cannot condone projects which entail reclamation of huge areas of relatively unaltered wetlands." He recommended against construction of the Bayou aux Carpes pumping station and suggested the dam across the bayou be removed in order to restore historic water circulation patterns (Wilkinson, March 1975).

Construction of the proposed pumping station was subsequently endorsed by the Corps of Engineers' division engineer at Lower Mississippi Valley Division headquarters in Vicksburg, Mississippi. However, continuing objections from regional administrators of the Fish and Wildlife Service and Environmental Protection Agency necessitated referral of the matter to Washington, D.C. for consideration by top-level Army and Interior Department officials. Meanwhile, Jefferson Parish proceeded to collect building materials required for the pumping station on the proposed site near the juncture of Bayou aux Carpes and Bayou Barataria. Voters on the West Bank of Jefferson Parish had approved a bond issue allocating $200,000 for construction of the station in a 1967 election; but when bids for the work were opened by the Parish Council on September 5, 1974, the low bid was just under half a million dollars. On September 12 the council accepted the low bid of Southbend Contractors, Inc. in the amount of $476,479 and authorized the use of federal revenue sharing funds to make up the difference in cost. Previously the council had appropriated $183,689 to pay Building Construction Company to build a dam on Bayou aux Carpes. Federal funding for the overall project was limited by law to a total of one million dollars, an amount exhausted by the Corps in the first phase of levee construction. Opponents of the project questioned the legality of using federal revenue sharing funds to match a direct federal grant (Jefferson Democrat, August 1975).

After being held in abeyance for a period of almost two years, plans for construction of the Bayou aux Carpes pumping station were abandoned in November 1976 when General Drake Wilson, chief of civil works at Corps

headquarters in Washington, D.C., issued an order which deleted the proposed facility from the overall Harvey Canal-Bayou Barataria project. General Wilson's order required substitution of removable floodgates for the pumping station. Under terms of the compromise agreement reached between local political and environmentalist interests, the floodgates on Bayou aux Carpes would remain open most of the year, being closed only during times of storm threat. However, the existing shell closure is to remain in place until the floodgates have been installed. In addition, the dam on Bayou des Familles is to be replaced by removable floodgates (Cooper, 1978). Landowners in the area affected by the decision not to build the Bayou aux Carpes pumping station have filed suit seeking to force the parish to follow through on plans for a complete levee and drainage system. One suit is now pending before the Supreme Court of Louisiana and the other has not yet come to trial in 24th Judicial District Court (Bailey, 1978).

The overall Harvey Canal-Bayou Barataria levee-construction project is currently being held in abeyance by the Corps of Engineers pending a decision by the Jefferson Parish Council regarding the location and limits of future growth. The Corps has proposed three possible levee alignments for the purpose of hurricane protection on the West Bank of Jefferson. The first would enclose only areas which have been developed. A second proposal calls for extension of the existing system to include wetland areas already modified to some degree. The third alignment takes in the largest area, extending the levee system as far south as Crown Point (States-Item, May 1978).

Private developers have also encountered increasing opposition in their efforts to alter the character of existing wetlands in the Barataria Basin. The case of Bayou des Familles Development Corporation is an illuminating one in this regard. In 1973 the company undertook construction of a ring levee system which would have enclosed an area adjacent to Highway 45 about midway between Marrero and Crown Point. The levee, proposed closures on Bayou Boeuf and Kenta Canal, and a pumping station built on high ground just off the highway would have made possible drainage of a 2,300-acre site which included 924 acres of cypress-tupelo gum swamp and 439 acres of freshwater marsh. The project was complete with the exception of the two proposed dams when the Corps of Engineers issued a cease-and-desist order in July 1974. Permit guidelines implemented in accordance with the 1972 Water Pollution Control Act authorized the Corps to regulate disposal of dredged material in areas located below the elevation of mean high tide. In April 1975

Federal District Judge Lansing L. Mitchell fined Bayou des Familles Development Corporation $25,000 for failing to file an application for the required dredge-and-fill work permit. He also ordered the company to file an after-the-fact permit application. Within a matter of days, the land firm formally requested permission to dredge about 16,000 cubic yards of material from existing borrow canals and to place some 3,500 cubic yards of shell at proposed channel closures. In addition, the application asked approval of completed dredge work involving displacement of some 200,000 cubic yards of material. VTN of Louisiana, Inc. was retained by Bayou des Familles Development Corporation to assess the probable environmental impact of the project. The draft environmental impact statement prepared by the consultant firm noted the project area included 355 acres of cleared natural levee ridge and 606 acres of bottomland hardwood forest in addition to the almost 1400 acres of wetlands. According to the impact statement, the swamps and marshes in the area were integrally associated with the Lake Cataouatche-Salvador-Barataria Bay estuarine complex. According to a Corps release announcing a public hearing on the permit application, completion of the project "would eliminate all wildlife habitat within the project area and would eliminate the freshwater, nutrient and detritus contribution of the project area to the Barataria Estuary" (Jefferson Democrat, October 1975a).

Plans for development of the 2,300-acre tract included construction of 17,000 residential units (single-family homes and multiple-family complexes). At the public hearing held in October 1975, one opponent pointed out waste from the development would empty directly into the area designated for location of Jean Lafitte Park. An official of the U.S. Fish and Wildlife Service also recommended against approval of the permit request, saying completion of the project would adversely affect wildlife and waterfowl habitat, fish feeding and spawning grounds and water quality in the Barataria Estuary. Testimony on behalf of Bayou des Familles Development Corporation was offered by a number of public officials, including Jefferson Parish District Attorney John M. Mamoulides who said a lack of flood protection in the past had "stymied growth"; Parish Attorney Bruce Burglass, a former director of the Louisiana Shrimping Association, who said it was his opinion the wetlands in question were without commercial fishing or other economic value; Councilman Beauregard H. Miller, Jr. and Walter Frey of the Drainage and Sewerage Department (Jefferson Democrat, October 1975b).

In the wake of the public hearing, letters opposing approval of the permit application outnumbered those in favor by "eight or ten to one," according to Charles Decker, chief of the Corps' Permits and Statistics Section. Formal objections were registered by a number of governmental agencies, including the Department of the Interior and the Environmental Protection Agency. The Interior Department's regional administrator in Albequerque, New Mexico, recommended construction of a dike system which would provide flood protection for previously developed areas while avoiding enclosure of undeveloped wetlands. The EPA regional administrator in Dallas, Texas, said discharge of dredged material should be permitted only if a less damaging discharge site could be located. He also noted such areas of concern as wastewater treatment, potential auto pollution, and possible impacts on freshwater marshes and woodland swamps located downstream (Jefferson Democrat, November 1975b).

Subsequently two state agencies also registered formal objections to the permit application. In a letter to Col. Early J. Rush, III, New Orleans district engineer, Patrick W. Ryan, executive director of the State Planning Office, asked that the permit be held in abeyance until a coastal zone management plan for Louisiana could be developed. He noted that while the land firm had been tried, convicted and fined for the illegal work performed, adverse impacts on the natural system persisted. Ryan said granting the requested permit would set an unfortunate precedent: given sufficient financial resources, a company could simply ignore legal requirements and effectively bypass the administrative process. He also expressed concern about the project's potential impact on Lafitte Park and the Barataria Bay estuarine system. Concern for the park was the main consideration in a letter of objection filed by State Parks Director Gilbert C. "Whitey" Lagasse who said the proposed development would "greatly jeopardize" plans for Lafitte Park (Jefferson Democrat, December 1975).

As of March 1, 1978, Bayou des Familles Development Corporation's permit application was still under consideration. A final environmental impact statement had not yet been filed, and Corps officials were waiting for additional information requested of the company before taking action. The pumping station and levees constructed before issuance of the cease-order were still standing and the gaps at Bayou Boeuf and Kenta Canal had not been closed (Swindler, 1978).

Jean Lafitte Park

The idea for a natural wetlands park in the Barataria Estuary--a recreational facility which would, in effect, act as a wetlands preserve--originated with conservation-minded residents of West Jefferson in the early 1960's. The possibility of establishing a park in the area once frequented by Jean Lafitte, the privateer, and his band of Baratarians resulted from the donation of a 1,200-acre tract to Charity Hospital of New Orleans. Members of the West Jefferson Civic Federation, a coalition of West Bank citizen groups, launched an active campaign in 1963 to have the state-owned Charity tract designated a park. Governor John J. McKeithen was subsequently persuaded to endorse the park concept, and in 1966 the Louisiana Legislature passed an act designating 3,500 acres for inclusion in an expanded park. However, no funds for implementation of the proposal were appropriated at that time; and a later attempt to secure funding, during the 1970 session of the legislature, failed (Ehret, 1978).

Undismayed by the failure of efforts to obtain funding on the state level, park supporters launched a campaign to achieve national park status. U.S. Rep. Hale Boggs pushed a bill through Congress appropriating $45,000 for a feasibility study which the National Park Service (NPS) undertook in 1972. Land values in the area began to soar as a result of the national park proposal, and the rapid turnover in ownership of individual tracts prompted the Jefferson Parish Council to impose a temporary moratorium on sales. However, in October of 1973 the council began to rezone land in the vicinity of the park and in May of 1974 declined to adopt a resolution which would have established a buffer zone around the site in which development would be prohibited. The National Park Service subsequently recommended against inclusion of Jean Lafitte Park in the national system (Ehret, 1978).

Following the NPS rejection, members of the Jefferson Parish legislative delegation succeeded in adding Jean Lafitte Park to the state's capital improvements bond issue for state parks. A $3 million bond proposal for the park was added to the capital improvements package, contingent on the availability of federal matching funds. The legislature also amended the state parks bill to authorize the use of over $200,000 in gambling tax revenues from Jefferson Downs racetrack held in escrow for planning and land acquisition. In addition, the legislature passed enabling legislation allowing the State Parks and Recreation Commission to accept donation of the 1,200-acre tract owned by Charity Hospital (Jefferson Democrat, July 1974).

The size of the park has been a matter for continual debate between proponents--who want to maximize the park area in order to forestall the threat of destructive impacts by adjacent development--and local developers and politicians who want to minimize the area to be taken out of commerce. Thus, the dimensions the park may ultimately attain have complicated peripheral issues involving resubdivision, highway construction, levee-building and other land-use decisions (Wilkinson, December 1974). Supporters continued to push for inclusion of Jean Lafitte Park in the national parks system, and in July of 1977 Senator J. Bennett Johnston introduced a bill in Congress which would have authorized the government to buy more than 23,000 acres for a Jean Lafitte National Historical Park linking the Barataria wetlands with Big Oak Island in eastern New Orleans, Chalmette National Historical Park, portions of the French Quarter and Garden District, forts and plantations in the area and Acadian villages in the vicinity of St. Martinville in a cultural and recreational complex under the auspices of NPS. The various segments of the proposed complex would be linked by a visitors' information center in the French Quarter, possibly located in the Old Mint (Ball, 1977).

However, acting on a proposal adopted by NPS--and in order to forestall the opposition of landowners in the area--Johnston subsequently amended his bill to reduce the park size to 8,000 acres. Fifteen thousand acres of adjoining land would remain in the hands of private owners or the state, with regulation of land use in the buffer area being the responsibility of Jefferson Parish officials. NPS officials told a Senate subcommittee considering Johnston's bill that the Carter administration had rejected the larger park proposal because it would have cost $53 million to acquire the 23,000 acres. They said the 8,000-acre park would cost an estimated $34 million to acquire (States-Item, February 1978). Johnston also agreed to delete the provision in his bill relating to Big Oak Island in Orleans Parish because the 2,400 acres would cost an estimated $15,000 per acre (Hanna, 1978). On April 24, 1978, the Senate adopted the Jean Lafitte National Historic Park and Preserve bill without opposition, authorizing $40 million for implementation of the proposal. A similar bill, sponsored by U.S. Rep. Lindy Boggs, was under consideration in the House of Representatives (Times-Picayune, April 1978).

## CONCLUSION

As detailed in this chapter, wetlands-related activities form a vital part of the Barataria Region's economy. The resource reserves of oil and natural gas within the coastal wetlands and offshore have given rise to major oil and gas producing industries. These in turn have generated jobs in the related field of petrochemical manufacturing. Commercial fishing and trapping activities and seafood processing industries have flourished in the Barataria Basin as a result of its natural productivity for shellfish, fish and fur-bearing animals. Sugarcane cultivation and sugar processing, boat and ship building and repair as well as recreational hunting and fishing are all significant resource-related activities directly or indirectly based on the wetland ecosystem of the Barataria Region.

The competing land uses associated with urbanization have also been attracted to the wetlands by the diverse economic activity in the Barataria Basin. Many productive fish and wildlife habitats have become prime locations for urban expansion as economic development occurs in the region.

Expansion of the wetlands-dependent economy brings pressures for highway construction and wetlands reclamation. Attempts to preserve significant parts of the estuarine system (e.g. Jean Lafitte Park) may actually drive up land prices and make adjacent wetlands more susceptible to development. Growing population pressures must be tempered with understanding of the delicate balance inherent in wetland ecologies. More complete utilization of coastal resources in the Barataria Region should not lead to their total destruction.

## REFERENCES


Bailey, Rita (1978) Legal Secretary, Jefferson Parish Attorney's Office, Gretna, Louisiana, Telephone Interview, February 28.

Ball, Millie (1977) "Plans for Lafitte Park Find Favor at Hearing," The Times-Picayune, New Orleans, Louisiana, December 18.

Bernstein, Peter J. (1977) "Earth's Most Productive Areas Disappearing at Alarming Rate," The Times-Picayune, New Orleans, Louisiana, May 22.

Brumfield, Les (1976) "I-410 Makes a U-Turn," The States-Item, New Orleans, Louisiana, January 13.

Carrier, Cornelia (1977) "Impact Aid Hangs on Coast Zone Size," The Times-Picayune, New Orleans, Louisiana, May 24.

_____ (1977) "West Bank Should Save, Use Wetlands," The Times-Picayune, New Orleans, Louisiana, October 7.

Catalano, Diane (1976) "Louisiana's Embattled Coasts," NOAA Magazine, Washington, D.C., January.

Cooper, Leroy (1978) Design Engineer, U.S. Army Corps of Engineers, New Orleans, Louisiana, Telephone Interview, February 21.

Chase, John (1960) Frenchmen, Desire, Good Children and Other Streets of New Orleans. New Orleans, Louisiana: Robert L. Crager and Company.

Davis, Edwin Adams (1971) Louisiana: A Narrative History. Baton Rouge, Louisiana: Claitor's Publishing Division.

Ehret, Frank (1978) President, Barataria Boulevard Civic Association, Marrero, Louisiana, Telephone Interview, March 31.

Hanna, Sam (1978) "Lafitte Park OK'd by Panel," The States-Item, New Orleans, Louisiana, April 11.

Henriques, Dorothy (1978) "Do We Really Need a Superport?" New Orleans Magazine, New Orleans, Louisiana, March.

Jefferson Democrat (1974) "Lafitte Park Moves Closer to Reality," Gretna, Louisiana, July 19.

_____ (1974) "Jeff Officials Not Giving Up on Lafitte-Larose...Or on I-410 Loop," Gretna, Louisiana, August 9.

_____ (1975) "Pumping Station Wins Vicksburg Approval," Gretna, Louisiana, August 29.

_____ (1975a) "Land Firm Permit Hearing Subject," Gretna, Louisiana, October 17.

_____ (1975b) "Bayou des Familles Development Debated," Gretna, Louisiana, October 31.

_____ (1975a) "Interstate Loop Court Date Slated," Gretna, Louisiana, November 21.

_____ (1975b) "EPA Urges Denial of Permit Request," Gretna, Louisiana, November 28.

_____ (1975) "State Agencies Oppose Permit," Gretna, Louisiana, December 19.

_____ (1976) "Settlement Turns I-410 Funds Loose," Gretna, Louisiana, January 16.

_____ (1976) "Lafitte Highway Length Reduced," Gretna, Louisiana, March 12.

Jefferson Parish Council (1976) Minutes, Resolution No. 26943. Gretna, Louisiana, January 8.

Louisiana Department of Commerce and Industry (1975) 1975 Louisiana Directory of Manufacturers. Baton Rouge, Louisiana: Louisiana Department of Commerce and Industry.

Louisiana Department of Employment Security (1976) Employment and Total Wages Paid by Employers Subject to the Louisiana Employment Security Law, Second Quarter 1976. Baton Rouge, Louisiana: Louisiana Department of Employment Security.

Louisiana Department of Transportation and Development (1977) Côte de la Louisiane: Louisiana's Coastal Resources Program Newsletter. Baton Rouge, Louisiana: Louisiana Department of Transportation and Development, September and December.

_____ (1978) Côte de la Louisiane, May.

Louisiana Division of Employment Security, Department of Labor (1956) A Report of Employment and Total Wages Paid by Employers Subject to the Louisiana Employment Security Law by Parish by Industry Division, Second Quarter 1956. Baton Rouge, Louisiana: Louisiana Department of Labor.

Louisiana State Parks and Recreation Commission (1974) Outdoor Recreation in Louisiana 1975-80. Baton Rouge, Louisiana: Louisiana State Parks and Recreation Commission.

Louisiana State Planning Office (1975) Côte de la Louisiane: Louisiana's Coastal Reosurces Program Newsletter. Louisiana State Planning Office, June and December.

_____ (1976) Côte de la Louisiane, September.

_____ (1977) Côte de la Louisiane, February.

_____ (1976) The Coastal Zone: An Overview of Economic, Recreational and Demographic Patterns. Baton Rouge, Louisiana: Louisiana State Planning Office.

_____ (1977) Louisiana '77: State of the State. Baton Rouge, Louisiana: Louisiana State Planning Office.

Louisiana State University Department of Agricultural Economics (1972) D.A.E. Report No. 436: "Louisiana Crops Statistics, by Parishes, through 1970." Baton Rouge, Louisiana: Louisiana State University, April.

_____ (1975) D.A.E. Research Report No. 496: "Agricultural Statistics for Louisiana, 1971-74." Baton Rogue, Louisiana: Louisiana State University, November.

_____ (1977) D.A.E. Research Report No. 523: "Agricultural Statistics for Louisiana, 1973-1976." Baton Rouge, Louisiana: Louisiana State University, August.

Louisiana Wildlife and Fisheries Commission (1977) Comparative Takes of Fur Animals in Louisiana. New Orleans, Louisiana: Louisiana Wildlife and Fisheries Commission.

McIntire, G. et al. (1975) A Rationale for Determining Louisiana's Coastal Zone: Report No. 1, Coastal Zone Management Series. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

Martin, Francois Xavier (1963 reprint) History of Louisiana. New Orleans, Louisiana: Pelican Publishing Company.

Mumphrey, Anthony J. Jr. et al. (1977) OCS Development in Coastal Louisiana: A Socio-Economic Impact Assessment. New Orleans, Louisiana: Urban Studies Institute, University of New Orleans.

National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (1977) Fisheries of the United States. Washington, D.C.: U.S. Government Printing Office.

Nolan, Bruce (1977) "Lafitte-Marrero Highway Work Is Resumed," The Times-Picayune, New Orleans, Louisiana, May 10.

_____ (1977) "Jeff's Problem: Where to Stop Growing," The Times-Picayune, New Orleans, Louisiana, July 31.

_____ (1977) "Growth Line Plan Hits Opposition," The Times-Picayune, New Orleans, Louisiana, August 9.

_____ (1977) "No Jeff West Bank Line Proposed," The Times-Picayune, New Orleans, Louisiana, October 4.

Rand McNally and Company (1977) 1977 Commercial Atlas and Marketing Guide. Chicago, Illinois: Rand McNally and Company.

Segal H., G. Saussy et al. (1977) Projections to the Year 2000 of Louisiana Population and Households. New Orleans, Louisiana: Division of Business and Economic Research, College of Business Administration, University of New Orleans.

States-Item (1976) "Judgement Brings Dead End to Dixie Freeway Bypass" (no byline) New Orleans, Louisiana, January 8.

_____ (1978) "Park Compromise?" (editorial) New Orleans, Louisiana, February 8.

_____ (1978) "New Coastal Plan Expands Coverage" (no byline) New Orleans, Louisiana, April 12.

_____ (1978) "Jeff Levee Plans Under Study" (no byline) New Orleans, Louisiana, May 20.

Swindler, Roger (1978) Permits and Statistics Division, U.S. Army Corps of Engineers, Telephone Interview, March 1.

Times-Picayune (1978) "Jefferson Historic Park Approved by U.S. Senate" (no byline) New Orleans, Louisiana, April 26.

U.S. Bureau of Economic Analysis, Department of Commerce (1977) Local Area Personal Income 1970-1975, Volume 6: Southeast Region. Washington, D.C.: U.S. Government Printing Office.

U.S. Bureau of the Census, Department of Commerce (1931) Fifteenth Census of the United States: 1930--Population, Volume I: Number and Distribution of Inhabitants. Washington, D.C.: U.S. Government Printing Office.

_____ (1952) Census of Population: 1950--Volume I, Number of Inhabitants. Washington, D.C.: U.S. Government Printing Office.

_____ (1973) 1970 Census of Population--Volume I: Characteristics of the Population. Washington, D.C.: U.S. Government Printing Office.

_____ (1976) Statistical Abstract of the United States 1976. Washington, D.C.: U.S. Government Printing Office.

_____ (1977) County Business Patterns 1974: Louisiana. Washington, D.C.: U.S. Government Printing Office.

U.S. Census Office, Department of the Interior (1872) Ninth Census--Volume I: The Statistics of the Population of the United States. Washington, D.C.: U.S. Government Printing Office.

_____ (1883) Compendium of the Tenth Census: Part I. Washington, D.C.: U.S. Government Printing Office.

Wagner, Paul (1978) Marine Biologist, Burk and Associates, New Orleans, Louisiana, Memorandum, n.d.

Wilkinson, J.D. (1974) "Resub Said Threat to Plans for Park," Jefferson Democrat, Gretna, Louisiana, December 13.

_____ (1975) "Levee Work Fate Debated," Jefferson Democrat, Gretna, Louisiana, January 10.

_____ (1975) "Pump Station Fate Out of Local Hands," Jefferson Democrat, Gretna, Louisiana, March 14.

# CHAPTER 3

# THE ECOLOGY OF THE BARATARIA BASIN

## INTRODUCTION

The Barataria Basin of southeastern Louisiana is one of the most productive natural areas in the world. It encompasses 2,427 square miles, bounded by Bayou Lafourche on its western edge and the Mississippi River to the east (see Figure 3.1). This area is roughly triangular in shape, seventy miles long and thirty miles at its widest point, with the apex at Donaldsonville. While the Barataria Basin is composed of a number of subareas with different environmental characteristics, it functions in totality as an integrated ecosystem. That is, the various physical systems are interdependent, and act together so as to balance and regulate the basin as a whole. This chapter will in turn present the basic parameters of the geologic, hydrologic, and biologic processes governing the Barataria Basin. The various environmental units found in the area will then be discussed in detail. Although it is necessary to consider each system separately for clarity of presentation, interrelations between them will be illustrated whenever possible.

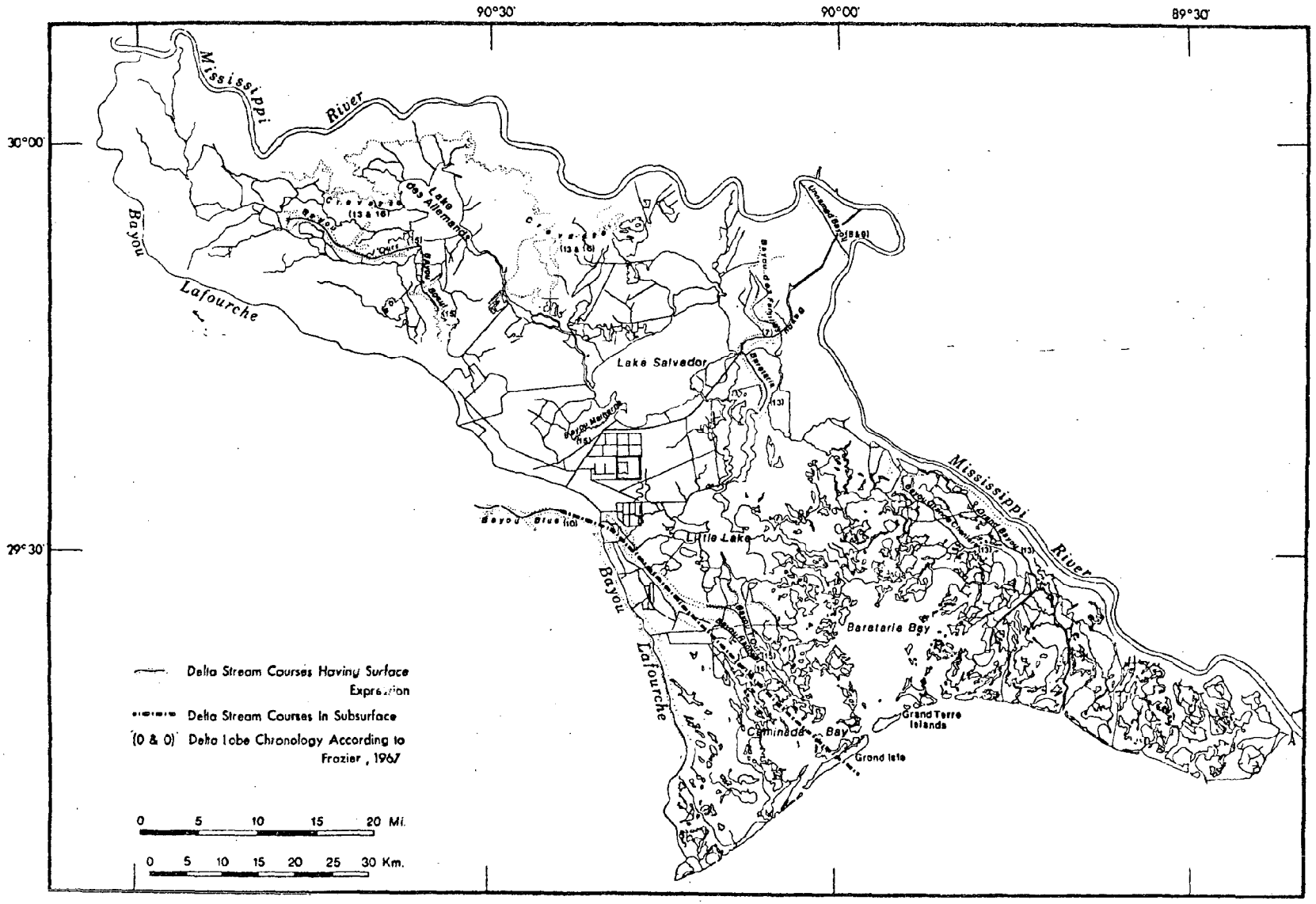
## GEOLOGICAL DESCRIPTION

The landforms within the coastal zone, with the exception of the salt domes, were formed as the result of the dynamic interactions between river deposition, waves and currents, and subsidence. This section will present a brief overview of the evolution of the Barataria Basin, then describe the changes it is presently undergoing in its declining stage.

The Mississippi River, with its periodic changes of course, is the factor having the greatest geographical impact on the Louisiana coastal zone. When the river shifts into a new channel, land is built rapidly. The juvenile or building stage is characterized by relatively short lengths of land-water interface, and thus fairly low productivity. (See the "edge effect," discussed below.) As more water discharges through major distributary channels, the process of erosion begins to balance that of sediment deposition. This loss of land causes the

FIGURE 3.1

THE BARATARIA BASIN




Source: Adams et al., 1976: 24.

formation of small bays, ponds, and tidal channels, and so increases the interface length. Total productivity reaches a maximum during this mature stage, after sediment input has diminished. There reaches a point, however, when the losses due to erosion are greater than the benefits derived from increasing interface, and total productivity begins to decline. The Barataria Basin is currently in this senescent stage (Bahr and Hebrard, 1976: 13-14).

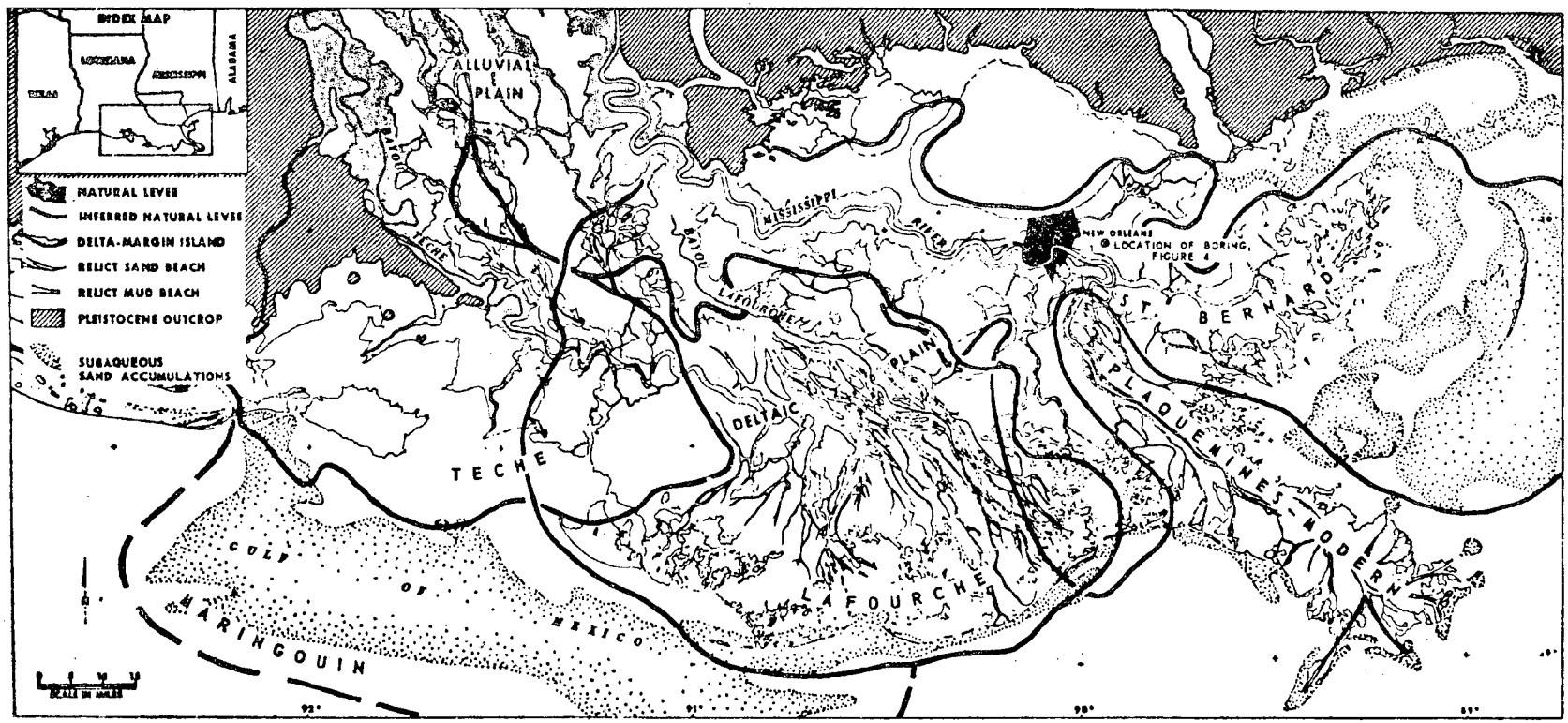
The Mississippi River, in its seven thousand year history, has flowed through five major delta complexes (see Figure 3.2). These deposits are in varying degrees of deterioration today due to subsidence and eustatic sea level changes. Portions of three of the complexes overlap the Barataria Basin. They include: the Bayou Lafourche, Bayou des Familles, and La Loutre lobes of the St. Bernard Delta, dating from 4700 years ago: the Bayou Blue and Bayou Lafourche lobes of the Lafourche complex, almost 2000 years old; and the Plaquemines and Birdfoot (present) lobes of the modern delta complex (Adams et al., 1976: 15, 19, 21). The river is currently attempting to divert its course to the Atchafalaya River basin, but the U.S. Army Corps of Engineers has created control structures to deter this switch.

The natural cycle of deltaic development--the continuous building and eroding of river basins--is no longer operative today. Artificial leveeing has confined the river to its present channel, thus precluding a change of course and the associated development of new delta regions. The levees, by containing overflows, also prevent the addition of fresh water and nutrient rich material to the adjacent wetlands, adversely affecting their ecological balance and productive capacity. The Mississippi River has been effectively walled in since the early nineteenth century, and with the artificial damming of Bayou Lafourche in 1904, the last freshwater inflow into the Barataria Basin was severed. Thus, the land building processes in this area have long been terminated while the natural processes of land destruction, intensified by the activities of man, continue.

There are three major natural causes of land loss: subsidence, erosion due to wave energy and storms, and erosion associated with the decay of abandoned river deltas. Each of these processes are currently operative in the Barataria Basin. Deltaic decay was discussed above; subsidence and wave erosion will be discussed in the remainder of the section.

FIGURE 3.2

MISSISSIPPI RIVER DELTA COMPLEXES




Source: Adams et al., 1976: 14.

Land subsidence, in the most general terms is "the lowering of land surface relative to sea level" (Craig and Day, 1977: 110). There are four basic causes of subsidence. The first is a rise in eustatic sea level, a worldwide change associated with the melting of polar icecaps or the isostatic adjustment of the continents. A second factor is regional subsidence caused by downwarping of the earth's crust due to the pressures of large sediment accumulations. Tectonic activities, including faulting, folding, fracturing, and flowing within this thick sedimentary section, are a third contributing factor. Finally, compaction of sediments can lead to subsidence (Craig and Day, 1977: 110-112).

Sediment compaction is the result of several factors, some natural and others man-induced. A major natural cause is varying degrees of consolidation due to textural variability in the sediments and their rearrangement leading to "tighter" compaction. A second factor is the consolidation of underlying sediments from the weight of features such as natural levees or beaches. Local subsidence also results through the consolidation or displacement of compressible materials by objects such as buildings, pile structures, artifical levees, or land fills. The extraction of oil, gas, sulphur and water from salt domes is a contributing factor, as is the lowering of the water table through ground-water, salt, or sulphur extraction. The resulting voids are compressed. Finally, subsidence may be the result of various reclamation practices involving diking or draining leading to drying, shrinkage, and oxidation of organic soils (Craig and Day, 1977: 110-112). In all cases, the type of substrata (clay, silt, peat, natural levee, beach, etc.) is a major determinant of subsidence levels.

Erosion due to the action of waves and currents is another major cause of land loss in the Barataria Basin. This process manifests itself in the retreat of the coastline, the widening of inlets, and the destruction of barrier islands. In the period from 1932-1969, 4,515 acres of the gulf front of the basin were destroyed, equivalent to a retreat of 44 feet per year. Natural wave action was the major factor in this loss, aggravated by such activities as the improper placement of pipelines and groins. Inlets or tidal passes are highly variable in nature. Their position and widths are affected by the predominant direction of wave approach, the resulting littoral currents, and the action of individual storms. Overall, however, the width of the inlets is increasing, an average of one mile during the thirty-seven year period cited above. The barrier islands--Grand Isle and the

Grand Terre Islands--provide an important defense against hurricanes and other marine processes. These were listed as areas of "critical erosion" by the U.S. Army Corps of Engineers in the National Shoreline Study. Between 1932 and 1969, the average rate of barrier island erosion in the Barataria Basin was 119 acres per year (Adams et al., 1976: 46-57).

Man's activities, primarily dredging and filling operations, have directly contributed to the rate of land loss. A variety of canals constructed for navigation, oil recovery, and other activities interlace the coast. They currently represent 2 to 4 percent of the land surface with an annual width increase of 2 to 14 percent, the wider the canal the greater the rate (Craig and Day, 1977: 118). Canals adversely impact the wetlands by: interfering with sheetwater flow; allowing destruction by wave action; reducing nutrient exchange; decreasing interface; and increasing salinities. Wetland is also lost to spoil banks, created by the deposition of material dredged from the canals. Finally, land reclamation project for agricultural, urban, and industrial purposes have destroyed many acres of viable wetland.

The interaction of erosion in a waving deltaic environment, the natural process of subsidence, and human activities result in a substantial amount of marsh deterioration. The estimated annual loss of marshland in the Barataria Basin is between 3,135 and 6,510 acres, these figures not including the 4,515 acre yearly loss from the basin's gulf front (Adams et al., 1976: 58). The cumulative impacts of this land loss adversely affects the hydrologic and biologic components of the ecosystem. Specifically, they include: changes in the hydrology of the various systems resulting in salt water intrusion and eutrophication (excessive nutrient input); loss of an important storm buffer; loss of the waste treatment function; direct loss of habitat; and loss of nursery grounds for fish and shellfish (Craig and Day, 1977: 129). Thus, the accelerating rate of land loss is of crucial concern to the future of a viable wetland system.

## HYDROLOGIC DESCRIPTION

Water is the integrating factor in the Barataria Basin, as in any coastal ecosystem. It not only supplies the physiological requirements of living organisms through dissolved chemicals and gases and suspended solids, but performs work in the ecosystem through the transport of

these materials. This section will discuss several important aspects of the hydrologic regime--water level, circulation, and salinity--and illustrate the interconnection of hydrology with other systems and processes.

The importance of water is illustrated by the edge or interface principle, which states that biological and chemical activity is most pronounced at the boundary between a terrestrial and an aquatic system. This is because water movement facilitates the delivery of nutrients and the flushing away of waste products, and because both land and water forms can inhabit the transitional zone. Primary production is greatest in such a zone, and in a sense, an estuarine ecosystem may be considered as a giant interface (Bahr and Hebrard, 1976: 10).

The level of the water, as it determines the boundaries and relative mix of aquatic and terrestrial areas, is thus crucial to the functioning of the system. Water level is defined as the mean elevation of the water when averaged over a period of time sufficiently long to eliminate oscillations due to surface gravity waves. Heights are generally measured relative to mean sea level (MSL), the average height of the sea surface over a nineteen year period, or mean low gulf (MLG), an averaged figure slightly below that of mean sea level.

A number of factors interact to determine water levels. The dominant process in controlling these levels, especially in the lower parts of the basin, are the astronomical tides (discussed below). The next most important determinants are the meteorological driving forces. These include atmospheric pressure, which varies inversely with water levels; and wind stress, especially important in shallow water systems and in the storm surges accompanying tropical storms and hurricanes. Thirdly, sea levels may be affected by the net addition or deletion of water mass, or by the replacement of a constant mass with water of a different density. In both respects, precipitation and river outflow increase water levels, while evaporation leads to a decrease. A fourth factor is glacial eustasy, a process that causes long term trends in sea level by the release or storage of water in glaciers. It has been estimated that the Gulf of Mexico is rising at the rate of 0.18 centimeters per year. A more important effect for Louisiana, however, is subsidence, the shrinkage of land forms resulting in a relative rise in water levels (Byrne et al., 1976: 3-6). In the Barataria Basin water levels vary with both an 18.6 year period and a semi-annual period, with levels for the latter highest in September with a secondary maximum in the spring.

Tide may be defined as "the periodic rising and falling of water level that results from effects of gravitational attraction of the moon, sun, and other astronomical bodies acting upon a rotating earth" (Byrne et al., 1976: 134). The tidal influence diminishes as distance from the Gulf of Mexico increases. The tides in the Barataria Basin are diurnal in nature, that is, there is one period--a high water or crest and a low water or trough--per day. The average difference between the two tides is slightly over one foot. The range, however, varies over both a long range period of 18.6 years, and a semi-annual period, with maximums in June and December and minimums in March and September (Byrne et al., 1976: 15-31).

Water circulation is an important estuarine process--it transports nutrients, propels plankton, spreads immature stages of fish and shellfish, flushes wastes from animal and plant life, cleans the system of pollutants, controls salinity, shifts sediments, mixes water, and performs other useful work (Clark, 1974: 12). The combined forces of fresh water flow, tidal action, and wind result in the specific pattern of water movement, strongly influenced in a wetland ecosystem by the physical characteristics of the water bodies. The general direction of flow in the Barataria Basin is north to south, with precipitation and runoff the principle sources of freshwater input. The tidal action permits direct interchange between the estuary and the saltwater gulf, and is most pronounced in the lower reaches of the basin. In shallow waters, wind action may be the dominating force in determining circulatory patterns. Overall, an important factor in assuring adequate circulation is the meandering nature of the smaller water bodies. This serves to maximize the interface area and to prevent rapid drainage of the system. Serious alterations occur when man-made canals are superimposed on the natural system of bayous and tidal creeks.

Water salinity reflects a complex mixture of dissolved salts. Technically, it may be defined as:

> the weight in grammes of the dissolved inorganic matter in one kilogram of sea water, after all bromide and iodide have been replaced by the equivalent amount of chloride, and all carbonate converted to oxide (Byrne et al., 1976: 138).

The level of salinity in a given area is extremely important, as most plant and animal species can survive

only within a limited saline range. In general, salinity decreases as distance from the gulf increases. Variations in salinity levels result primarily as a function of water exchange. These fluctuations may be annual in nature--levels are typically low in the spring and peak in the fall, or they may represent irreversible trends due to natural or man-induced processes. The salinity levels in the Barataria Basin are increasing, largely due to the dredging of canals which permit the direct intrusion of salty water into up-basin areas. This long-term trend has had an adverse effect on the oyster population due to the proliferation of oyster drills which accompany high salinity levels.

A number of other factors are relevant to a discussion of the basin's hydrology. Precipitation, for example, as it represents a major source of freshwater input, has an important influence on the overall system. Different precipitation patterns are associated with the various types of weather systems which characterize the area. Water temperature is a significant factor in the regulation of seasonal system pulses. Wave attack along the coast, primarily associated with storms, can cause a heavy influx of gulf water and thus alter the normal patterns. The Mississippi River, through its dumping of huge quantities of nutrient rich fresh water in the vicinity of the basin's mouth, is also an important influence. Finally, alterations in geologic landforms, such as inlet widening or erosion, may impact on the movement of water. Hydrologic functioning, then, is a complex and delicate balance of many interrelated factors.

## BIOLOGICAL DESCRIPTION

From the biological viewpoint, the Barataria Basin functions as an integrated ecosystem. That is, it is not a random association of organisms, but a set of interdependent biological components that are specifically adapted to local physical conditions. The basin may be divided into five primary and two secondary environmental units (Bahr and Hebrard, 1976). These are comprised of widely different species of flora and fauna, but all function according to the same basic biological principles. The general principles will be discussed in this section, with a detailed description of each environmental unit to follow.

The food chain is the basic process for the cycling of nutrients within the system. The various plants and animals may be grouped into trophic stages, each stage one step further removed from the level of primary productivity. At the primary productivity level, plants through photosynthesis transform carbon dioxide and basic nutrients into plant tissue, available to animals as food stuff. Thus, the plants are labeled as 'autotrophs" or "producers," as opposed to the "heterotrophs" of higher levels. At the second stage, plants are ingested by primary consumers, either "herbivores" which feed on living plant material, or "detrivores" which feed on dead organic matter. The third stage consists of predation by secondary consumers, the "carnivores" or flesh eating heterotrophs (although these species may also engage in primary consumption). Finally, dead material is decomposed by various organisms into the basic nutrients, which are again available for use by primary producers and consumers. The ecosystem is thus organized around the first trophic level, and is ultimately controlled by the factors that limit the building of plant tissue--the supply of basic nutrients, the amount of carbon dioxide available, and access to sunlight.

Another means of viewing the ecosystem focuses on the function that organisms play in the food chain rather than their basic source of nutrition. Living consumers may be thus divided into three categories (Day et al., 1973). The packagers, which exist primarily in the sediment areas, organize organic material into forms available for convenient transfer to higher trophic levels. The regulators are organisms with generalized feeding habits, and by feeding on the most abundant sources of food, serve to keep the system in balance. These are divided into subsystem and whole system regulators. The former feeds on a specific population, while the latter feeds on both the subsystem regulators and what they feed on. The regenerators take wastes from all sources and transform these back into nutrients to start the system over again.

The ecosystem may also be pictured as a system of energy flow. Solar energy, the source of all biological energy, is captured by photosynthesis and later released to do work through oxidative processes such as respiration. (Other external energy sources, not directly related to biological functioning, include tide, ocean currents, river inflow and wind.) All energy is eventually released into the environment as heat, and is no longer available to do work. At each trophic stage a large portion of the original energy is lost as organic carbon is converted to carbon dioxide. Thus, a large reduction in biomass

production (the mass of living matter in a given space) must occur at successively higher trophic levels (Bahr and Hebrard, 1976). In other words, a tremendous number of lower organisms are necessary to support a relatively small number of top predators, because of the energy lost in the progression up the food chain.

Ecosystems undergo succession (stages of development) following major physical disturbances. After maturation an undisturbed ecosystem remains at a steady dynamic state where energy and matter coming into the system are balanced by losses. A number of control mechanisms, whereby resources in limited supply regulate the processes dependent on them, evolve along with the system. The life cycle of certain organisms serves to regulate the system, as primary production is dependent on the availability of decomposed nutrients. Cycles are also triggered by annual physical variations in light and temperature, resulting in seasonal pulses of production and consumption. Perhaps more than any other component, the biological system illustrates the interdependencies and balances characteristic of an ecosystem.

## ENVIRONMENTAL UNITS

The Barataria Basin can be divided into five primary and two secondary environmental units. Primary units include: swamp forest, fresh marsh, brackish marsh (encompassing the sometimes delineated intermediate category), saline marsh, and the offshore area. Beaches and other elevated areas--cheniers, natural levees, and spoil banks--are the two secondary units. Within several of the units a distinction must be made between wetland proper (land that is alternately flooded and drained) and associated water bodies (permanently inundated areas such as lakes and bayous). The areal breakdown within the basin is presented in Table 3.1. Unless otherwise specified, information in this section is from Bahr and Hebrard's work, Barataria Basin: Biological Characterization.

### Swamp Forest

A swamp may be defined as "a woody community occurring in an area where the soil is unusually saturated or covered with water for one or more months of the growing season" (Bahr and Hebrard, 1976: 16). Swampland comprises

TABLE 3.1

SIZE OF ENVIRONMENTAL UNITS IN THE BARATARIA BASIN (IN SQUARE MILES)

| UNIT | SQUARE MILES |
|---|---|
| Fresh water swamp | 378.2 |
| Fresh marsh | 349.2 |
| Brackish marsh | 359.1 |
| Saline marsh | 247.0 |
| Topographic high areas | 472.4 |
| Total water area | 621.2 |
| Total area | 2,427.1 |

Source: Adams *et al.*, 1976: 39.

242,048 acres, or 21% of the wetland in the Barataria Basin. The des Allemands Swamp, located in the northern portion of the basin, contains most of this area, with smaller sections of swamp lying seaward along the fringes of the Bayou Lafourche and Mississippi River levees. The boundary between swamp and marsh corresponds to soil type, with the former occupying recent Mississippi alluvial soil and the latter coastal marsh soils.

Four general categories of plants are found in the Barataria swamps: trees, vines, herbs, and epiphytes (non-rooted attached plants). The swamp areas are dominated by the bald cypress, tupelo gum, and drummond maple, trees which produce dense stands of vegetation, making the swamp markedly different in the character from other wetland units. These swamps are largely a detritus based system, with twice as much energy entering through ingestion by detritivores as by herbivores. Energy not consumed within the system is exported to lower reaches of the basin through a network of sluggish, eutrophic waterways. A swamp has the lowest ratio of water to land--waterways serve as transporters of materials rather than having a significant role in actual production.

The crawfish is the major detritivore in the Barataria swamp forest. Others include insects, crustacea, microbiota, and fungi. The most significant herbivore is the tent caterpillar. Other herbivores of the swamp forest include deer, rabbits, squirrels, small rodents, and seed eating birds. A wide variety of carnivores are found in the swamp: spiders and insects; reptiles, such as snapping turtles, snakes and alligators; mammals, ranging in size from bats to bobcats; and various birds, especially barred owls.

A number of organisms abiding in the swamp are of special interest or economic significance. The bald cypress and tupelo gum are valuable as timber since they are both decay resistant. Crawfish are harvested in quantity in the swamp, as are the blue and channel catfish, large-mouth bass, bluegills, black crappies and bowfin. A number of mammals, including swamp rabbits, deer, raccoons, and nutria are also hunted here. Finally, the swamp forest is the habitat of several rare animals--the alligator, once considered an endangered species, and the osprey and red-shouldered hawk, currently on the "blue list" of declining species.

## Fresh Marsh

Marshland in general may be defined as "a periodically flooded zone characterized by primarily nonwoody vascular plants" (Bahr and Hebrard, 1976: 20). Freshwater marsh is perhaps the most difficlut of the environmental units to define, as it is the most diverse in terms of the number of plant associations. Much of the unit is comprised of flotant marsh, a dense mat of vegetation supported by detritus several feet thick, held together by a matrix of living roots. Fresh marsh is found primarily between the levee systems of the Mississippi River and Bayou Lafourche, beginning around Lake des Allemands and extending seaward to the Industrial Canal. This comprises 223,488 acres, or nineteen percent of the basin's wetland. The major water bodies in this area are Lake Salvador and Lake Cataouatche.

In all marshes there are three major groups of autotrophs: standing vegetation (mostly grasses), epiphytes (microscopic algae on the surface of the vascular plants), and benthic algae (usually diatoms living on or in the marsh sediment). Fresh marsh is dominated by the grasses, especially maidencaine, spikerush, and bulltongue. The marsh provides an almost ideal growing environment, as there is a continuous water supply without the taxing stress of salt. Production is seasonal in nature, with peak growth occurring during May and early June.

A wide variety of organisms are found in the freshwater marsh. Detritivores are the most important primary consumers, consisting largely of small crustacea (amphipods and mysids) which shred detritus fragments. Herbivores in the system include a variety of insects, as well as larger animals such as nutria and muskrats. Carnivores may be divided into four basic categories. These include: predatory insects and spiders; reptiles and amphibians, such as the alligator; insectivorous and raptorial birds; and other predatory animals, such as snakes, mink, and raccoons.

Freshwater marsh contains a number of organisms of special interest. The water hyacinth is a major pest species, clogging the surface of sluggish water bodies and making boat travel difficult. Paddle ducks, valued as game birds, thrive on the widgeon grass produced in this unit. Fresh marsh is the habitat of several declining species such as the predatory marsh hawk and the alligator. A number of mammals, such as nutria, mink, raccoon, otter, and muskrat are trapped for fur. Many fish are also caught in this area, including the blue and channel catfish, bluegill, largemouth bass, black crappie, bowfin, pirate perch, spotted sunfish, and carp.

## Brackish Marsh

The brackish marsh, located between the freshwater and marine ends of the basin, represents an intermediate zone in several respects. This system is the first to be strongly influenced by tidal action, in contrast to the freshwater units where water movement resulting from rainfall runoff is one directional. There are approximately 229,824 acres of brackish marsh, twenty percent of the wetland area. They form a fifteen mile wide band across the basin from below the Industrial Canal to the salt marsh fringing Barataria Bay. There is a significantly higher proportion of water surface than in the freshwater areas. The major water bodies within the area of brackish marsh are Little Lake, Turtle Bay, and Bayou Perot.

The brackish environment offers both advantages and disadvantages to plant life. While energy must be constantly expended in order to pump excess salt from tissues, there are benefits derived both from tidal flushing and from the lessening of competition from plants intolerant to saline water. As salinity increases, the diversity of plant species decreases. The brackish marsh is dominated by wire grass, with salt grass the next most prevalent primary producer.

The most important herbivores in this unit are the muskrat and a variety of insects. Detritivores include the nematode and amphipod groups, as well as penaeid white and brown shrimp who use the brackish marsh as nursery grounds. A variety of predators are found in the area, such as alligators, snakes, marsh hawks, mink, birds, bats, and spiders.

The brackish marsh, like the other units, is the habitat of various organisms of economic significance. Blue crabs, an important food species, are harvested in this area. While only a small portion of actual shrimp production occurs in the brackish zone, it serves an an important nursery area for juvenile shrimp. Sport fish caught here include sheepshead, spot, silver perch, and finfish. Like the freshwater marsh, the brackish unit is the habitat of alligators, marsh hawks, muskrats, raccoons, mink, nutria and otter.

## Salt Marsh

The salt marsh region in the basin surrounds Barataria Bay and its interconnecting water bodies. It includes approximately 158,080 acres, or fourteen percent of the total wetland area. From a geologic perspective, this area is in a senescent state, and the boundary between brackish and salt marsh is gradually moving inland as the coastal zone subsides. The characteristics of the salt marsh are more subject to modification by physical processes--tide, wind, water level--than are the other units. The ratio of wetland to water is lowest in this area, and the highly irregular shoreline results in maximum interface.

Of all the major wetland systems, the salt marsh contains the lowest number of plant species. Oyster grass, a plant with a remarkable salt tolerance, dominates the area. In addition to its productive functions, the roots of this grass serve as a deterrent to erosion and as a nutrient pump to extract phosphorous from subsurface soils. Other primary producers include black rush and salt grass, epiphytes, and benthic algae. The major groups of primary consumers include bacteria and fungi, meiofauna, snails, fiddler crabs, polychaetes, mussels, insects, birds, and mammals, with insects such as grasshoppers the only herbivores. The same general forms of predatory species are found in brackish and salt marsh, although wading birds predominate in the latter area.

The salt marsh is an important habitat of many economically significant species. The shrimp industry, including the brown, white, and pink varieties, is the most valuable fishery in the state, contributing sixty percent of total dollar value. Menhaden is an important commercial fish, the largest Louisiana harvest in terms of total poundage and the second in terms of value. Other important fisheries are the oyster (third in dollar value) and the blue crab (fourth in value). Sport fish include the red fish, speckled trout, sand trout, sheepshead, croaker, flounder and pin fish. Finally, the salt marsh is the habitat of a number of rare birds: brown pelican (the entire introduced Louisiana population has established a nesting site on an island in Barataria Bay), white pelican, reddish egret, osprey, black vulture, loggerhead shrike, and peregrine falcon.

## Offshore Areas

The combined net organic production exported from all four wetland units is eventually transported to the Gulf of Mexico. The area offshore of the Barataria Basin is strongly influenced by the Mississippi River, fifty miles to the east, which dumps 361 billion gallons of fresh water and tons of dissolved and suspended solids daily. Since this outflow is less dense than the gulf waters, it forms a plume and floats on the surface rather than mixing immediately. Depending on wind, tide, and currents, variable salinity conditions affect the Barataria Basin. It has been suggested that the freshwater discharge may be partly responsible for the rich fishing conditions of this area, as animals are prevented from migrating eastward. The discharge may also be responsible for the "jubilee" phenomena sometimes occurring offshore from Barataria Bay. This is a large area of oxygen deficient water, causing the mass migration of organisms toward shallower water and occasional fish kills.

Primary producers in the offshore region are all of the planktonic species, with nannoplankton and ultraplankton the most significant. The wide variety of primary consumers include zooplankton, benthic organisms, nektonic species, and finfish. Predators include an assortment of carnivorous finfish and birds. Shrimp, menhaden, speckled trout, red snapper, king fish, black and red drum, and flounder are all commercially harvested in the offshore area.

## Secondary Units

The beaches of the Barataria Basin represent an extremely small area in proportion to the wetland systems. These areas, subject to varying degrees of wave energy, perform an important function in protecting more vulnerable marsh areas from the eroding effects of waves, tides, and storm surges. The beaches in general are drifting in a westerly direction, and in some areas, rapid erosion and a lack of sand results in a retreating beach. A variety of plants, all evergreen perennials, are found in these areas, including dogtooth grass, beach morning glory, morning glory, frogbit, evening primrose, sandspur, and beach rocket. In most beaches there is a community of tiny detritivores and predators which live in the interstices between sand grains. These are preyed upon by shore birds, such as plovers, sandpipers, and willets, and by small fish.

Elevated coastal areas are of three basic types--natural levees, spoil banks, and chenier ridges. Natural levees form adjacent to bayous and rivers as a result of periodic flooding and sediment deposition. These provide a stable area for many "high ground' plant species, and so increase habitat diversity. Man-made elevations in wetland areas generally take the form of spoil banks resulting from the dredging of canals. Rather than being regulated by natural processes, these are imposed on the system, and can severely impair water movement. Even though many spoil banks eventually erode and subside, permanent damage to adjacent areas occurs through their oxidation and conversion to water bodies. The same types of vegetation are found on these natural and man-made elevations. Chenier ridges are elevated beach areas which have been stranded in the marsh through geologic processes, providing areas of terrestrial habitat. Live oak is the tree species most frequently found on the cheniers.

## CONCLUSION

The Barataria Basin functions as a complex, integrated ecosystem, and as such is one of the most productive natural areas in the world. Unique environmental units within the basin each support a diversity of plants and wildlife that have both commercial and recreational significance for the region.

As a coastal wetland area, the Barataria Basin is subject to the natural alteration processes of deposition and erosion. However, activities such as dredging of canals for navigation and oil recovery; creation of spoil banks by deposition of dredged material; and actual land reclamation for agricultural, urban and industrial purposes have greatly accelerated the rate of land lost to productive natural use in the ecosystem. Man's intervention in coastal areas and the resulting wetland loss have brought about such negative impacts as salt water intrusion and eutrophication; loss of storm buffer; loss of natural waste treatment function; direct loss of habitat and loss of nursery grounds for fish and shellfish.

Because hydrologic functioning of the Barataria Basin is such an intricate and sensitive balance of interrelated factors, man must use caution in utilizing the region's many resources so as not to upset and permanently cripple the ecosystem.

## REFERENCES


Adams, R.D. et al. (1976) Barataria Basin: Geologic Processes and Framework. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

Bahr, L.M. and J.J. Hebrard (1976) Barataria Basin: Biological Characterization. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

Byrne, P. et al. (1976) Barataria Basin: Hydrologic and Climatologic Processes. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

Clark, John (1974) Coastal Ecosystems. Washington, D.C.: The Conservation Foundation.

Craig, N.J. and J.W. Day, Jr. (1977) Cumulative Impact Studies in the Louisiana Coastal Zone: Land Loss. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

Day, John W., Jr. et al. (1973) Community Structure and Carbon Budget of a Salt Marsh and Shallow Bay Estuarine System in Louisiana. Baton Rouge, Louisiana: Center for Wetland Resources, Louisiana State University.

# CHAPTER 4

# ECONOMIC VALUATION OF WETLANDS

## INTRODUCTION

A meaningful assessment of the economic value of wetlands in their natural state is a vitally important part of any balanced effort to weigh proposed developments in areas located below the level of mean high tide. Such an assessment provides a basis for realistic appraisal of the wide-ranging social impacts generated by such activities. By assigning a dollar-value to a unit-acre of wetland, cost-benefit analysis of development proposals is made possible. In the past, "services" provided by wetlands have been largely disregarded due to the lack of a market mechanism for directly pricing those services. For example, benefits associated with the fact that wetlands serve as nursery grounds and a source of food for commercial fish species and furbearing animals have frequently been ignored. Wetlands also provide important recreational opportunities. The most popular forms of recreation in wetland areas are hunting and fishing (including crabbing and crawfishing); but other less intensive uses such as birdwatching, swimming and camping are also of value.

The discussion of wetlands valuation presented in this chapter is based on the component-function approach, a method which basically involves summation of the respective values of non-competing uses. Three interpretations of the component-function approach are presented. The first two variations have been developed by the authors of the present work; the third is the methodology employed by the U.S. Army Corps of Engineers. The first of the two approaches adopted by the authors--like the method employed by the Corps of Engineers--attacks the valuation problem from a point-of-view which focuses on the question of gross impact on the economy. The other approach--"consumer's surplus"--developed in this chapter views the problem from a somewhat different perspective. Application of this alternative methodology involves computation of the net value to society of the resource itself, ignoring production costs and emphasizing willingness-to-pay. Each of the three methods employs its own classification scheme

for the services provided by wetlands; but all three identify the major service categories as commercial fishing, commercial trapping and recreation. The body of this chapter suggests the authors views on the valuation of wetlands. Appendix 4.2 modifies this to conform to Water and Related Land Resources: Establishment of Principles and Standards for Planning (Water Resources Council, 1973) or the April 12, 1978 meeting of the study advisory task force.

## GROSS BENEFITS TECHNIQUE

The first of the wetlands-valuation methods to be discussed in this chapter is based on the concept of gross economic benefits. Values for major activities associated with wetlands are estimated on the basis of gross benefits to the economy. Four activity categories are taken into consideration: commercial fishing, non-commercial fishing, commercial trapping and recreation. The last-named category is further subdivided between the economic impact of expenditures for recreation and the estimated value of user-benefits related to recreational activity. A per-acre value for each wetlands-dependent activity is derived, and the respective values are summed to determine the total estimated monetary worth of a wetland acre in its natural state.

### Commercial Fishing

Estimating the value of commercial fishing, in terms of gross economic benefits, involves two principal tasks. First it is necessary to compute the dockside value of landed fish; then the value added in processing must be ascertained. The total gross economic value of commercial fishing may then be divided by total wetland acreage in the study area to derive a value per wetland acre for commercial fishing. The procedure followed in this section is based on the one recommended in Louisiana Wetlands Prospectus (Louisiana Advisory Commission on Coastal and Marine Resources, 1973: 187-188). However, the value derived in the present discussion is based on the gross contribution of wetlands to income in Louisiana rather than on net economic benefit to the state.

Data presented by the U.S. Army Corps of Engineers (1977) indicate the average annual landed value of commercial fish in Hydrologic Unit IV (the Barataria Basin) is $54,264,744.80, representing an average annual catch of

468,830,000 pounds (see Table 4.1). However, those totals include a number of species which are expected to increase in productivity in future years. Because of projected increases in both quantity and real price, the National Marine Fisheries Service (Stone et al., 1973: 166-173) has estimated that the real value of harvested shrimp will increase at an average annual rate of 4.5 percent, that the real value of crabs caught will increase by 8.01 percent on the average per year and that the oyster catch will grow in real value at an average annual rate of 1.32 percent. No projections were made for other species of fish, and it is assumed their respective levels of productivity will remain constant. The average annual landed value of commercial fish other than shrimp, crabs and oysters is $24,838,624.76, based on the Corps data.

In order to estimate the total market value of the catch, an average figure for value added in processing was derived--using information from the National Marine Fisheries Service (1974, 1975, 1976, 1977)--in the following manner: for each of the years 1973 through 1976 the "value at retail stage" was divided by "value of domestic landings" to determine the percentage increase in value attributable to processing. The average value-added factor for the period of four years considered is 3.0755.[1] Multiplying the average annual landed value of commercial fish (less shrimp, crabs and oysters) by this figure results in a gross retail value of $76,378,771.14. The latter amount may then be divided by the total number of wetland acres in Hydrologic Unit IV--582,700 (U.S. Army Corps of Engineers, 1977)--to derive a per-acre annual value of $131.08.

To compute the present (discounted) value of an annual income stream, equation 4.1 is commonly applied.

$$V = \sum_{t=1}^{n} \frac{a}{(1+r)^t} \qquad (4.1)$$

where V = present value of annual income stream

a = annual income (return)

r = discount rate

t = year t = (1,...,n)

---

[1]The Bureau of Economic Analysis, Department of Commerce estimates multiplier effects for various industries but not for commercial fishing, commercial trapping or recreation expenditures.

TABLE 4.1

ESTIMATED VALUE OF BARATARIA WETLANDS FOR COMMERCIAL FISHERIES

| COMMODITY | AVERAGE ANNUAL LANDED VALUE[1] | TOTAL AVERAGE ANNUAL PROCESSED RETURN[2] | AVERAGE ANNUAL RETURN/ ACRE[3] | PROJECTED ANNUAL INCREASED RETURN/ACRE[4] | PRESENT VALUE PER ACRE[5] |
|---|---|---|---|---|---|
| Shrimp | $25,290,382.80 | $ 77,767,927.11 | $133.46 | 4.5% | $3,211.75 |
| Oysters | $ 3,549,527.41 | $ 10,914,796.79 | $ 18.73 | 1.32% | $ 324.74 |
| Crabs | $ 586,209.83 | $ 1,802,595.23 | $ 3.09 | 8.01% | $ 97.31 |
| All Other Commercial Fish | $24,838,624.76 | $ 76,378,771.14 | $131.08 | No Estimate (assumed to be zero) | $1,906.62 |
| TOTALS | $54,264,744.80 | $166,864,090.27 | $286.36 | | $5,540.42 |

1. Values in Column 1 are based on Table 2, Corps of Engineers, 1977. However, figures from the Corps study--which are based on 1973 exvessel prices--have been updated to reflect the 1977 value of the dollar. Implicit price deflators from Economic Report of the President (Executive Office of the President, 1977) were used to make the adjustment in the following manner: 1973 figures were divided by the 1973 price deflator to obtain base-year (1972) values which were then multiplied by the 1977 deflator.
2. Assume processing increases dockside value by a factor of 3.075.
3. Column 2/number of acres (582,700).
4. See text.
5. Assumes 6 7/8% discount rate using equation 4.1

Disregarding the possibility of development, the potential life-span of wetlands might be treated as infinite for the purpose of valuation. For an annual income stream of unlimited duration, equation 4.1 reduces to the following equation (Barlowe, 1972: 317-318):

$$V = \frac{a}{r} \tag{4.2}$$

Substituting an annual return of $131.08 and assuming an annual discount rate of 6 7/8 percent (Water Resources Council, 1977),[2] the present value per acre would be $1,906.62 for all commercial fisheries except shrimp, crab and oyster production.

The projected increases in real value of shrimp, crab and oyster catches call for application of an adjusted present-value equation which may be expressed in the following terms (Barlowe, 1972: 317-318):

$$V = \frac{a}{r} \pm \frac{i}{r^2} \tag{4.3}$$

where i represents the expected average increment (positive or negative) in dollars to the annual return. Making use of this adjusted equation, the authors estimated the present value per acre of wetland to the shrimp, crab and oyster industries to be $3,211.75, $97.31 and $324.74 respectively. Adding these figures to the sum of values for all other species of commercial fish provides an estimated total present value per acre of Barataria wetlands for commercial fisheries. The data from which the total per acre value of $5,540.42 was derived are summarized in Table 4.1.

## Non-Commercial Fishing

In addition to the catch attributable to commercial fisheries in the Barataria Basin, a significant portion of total landings in the area is related to recreational activity. According to the National Marine Fisheries Service (1976: 23), 2,272,000 sport fishermen caught 485,728,000 pounds of finfish in coastal water of the Gulf

---

[2]The discount rate to be used in planning for water resource projects is set annually by the Water Resources Council, Washington, D.C.

of Mexico during 1970. The average finfish catch per sport fisherman was about 214 pounds. In order to estimate the size of the recreational catch in the Barataria Basin, the latter figure may be multiplied by the number of anglers licensed to fish in the area.

The number of sport fishermen in the study area was estimated on the basis of fishing licenses sold in the nine parishes which encompass Hydrologic Unit IV: Assumption, Ascension, St. James, St. John the Baptist, St. Charles, Jefferson, Orleans, Plaquemines and Lafourche. For each parish the percentage of total population actually located in the Barataria Basin in 1970 was ascertained (see Table 4.2). The percentage for each parish was then applied to the number of licenses--both resident and non-resident--sold during the 1976-77 season (see Table 4.3). The estimated total number of fishing licenses sold in the basin for the 1976-77 season is 24,143. Applying this figure to the per-fisherman catch of 214 pounds results in an estimated total for recreational landings of 5,166,602 pounds.

While the primary product of sport fishing is recreation rather than the fish caught, the economic impact may be assumed to have a real value, particularly where competition with commercial fisheries exists. In Massachusetts, for example, Whitman (1971: A-43) found that as much as 14 percent of total marine landings was attributable to sport catches. Because sport fishing was shown to contribute significantly to total landings, he suggested that each pound of recreational catch be assumed to have a landed value equal to a pound of commercial fish, but with no inclusion of a factor for value added in processing. Sport fish landed in Louisiana in 1977, based on National Marine Fisheries Service (1976) and (March 1978), included the following species: bluefish, catfish, bullhead, croaker, drum (black), drum (red), flounder, grouper, king whiting ("kingfish"), sea trout (spotted), sea trout (white), snapper, Spanish mackerel and spot.[3] The total commercial catch of 14,327,486 pounds was valued at $5,182,603, or approximately $.36 per pound.

---

[3]Although sport shrimping is a significant recreational activity in the Barataria Basin, shrimp were not considered in calculating a value for sport fishing because the available data related only to finfish landed by non-commercial fishermen. According to Greenfield (1978), estimating the size of the sport shrimping catch is virtually impossible.

TABLE 4.2

ESTIMATED POPULATION OF THE
BARATARIA BASIN IN 1970 BY PARISH

| PARISH | TOTAL POPULATION | POPULATION IN BARATARIA BASIN[1] | PERCENTAGE OF POPULATION IN BARATARIA BASIN |
|---|---|---|---|
| Ascension | 37,086 | 4,036 | 10.88 |
| Assumption | 19,654 | 4,258 | 21.66 |
| Jefferson | 337,568 | 125,797 | 37.27 |
| Lafourche | 68,941 | 12,304 | 17.85 |
| Orleans | 593,471 | 52,310 | 8.81 |
| Plaquemines | 25,225 | 22,110 | 87.65 |
| St. Charles | 29,550 | 16,819 | 56.92 |
| St. James | 19,773 | 8,422 | 42.59 |
| St. John the Baptist | 23,813 | 4,647 | 19.51 |

1. Based on population of political subdivisions (wards).

Source: Bureau of the Census (June 1971) and (February 1972).

TABLE 4.3

FISHING LICENSES SOLD IN THE BARATARIA BASIN
FOR THE 1976-77 SEASON
(Estimated)

| PARISH | TOTAL LICENSES SOLD IN PARISH | ESTIMATED LICENSES SOLD IN BASIN[1] |
|---|---|---|
| Ascension | 4,847 | 527 |
| Assumption | 1,585 | 343 |
| Jefferson | 32,470 | 12,100 |
| Lafourche | 8,621 | 1,539 |
| Orleans | 24,948 | 2,199 |
| Plaquemines | 4,001 | 3,507 |
| St. Charles | 4,983 | 2,836 |
| St. James | 1,334 | 568 |
| St. John the Baptist | 2,686 | 524 |
| TOTALS | 85,475 | 24,143 |

1. Based on percentage of parochial population located in Barataria Basin (see Table 4.2).

Source: Louisiana Wildlife and Fisheries Commission, 1977a.

Multiplying the latter figure by the total recreational catch during the 1976-77 season (5,166,602 pounds), the authors estimated the total landed value of sport fish in the Barataria Basin to be $1,859,976.72. Dividing that amount by the number of wetland acres (582,700), an annual per-acre value to recreational fishing of $3.19 was derived. The annual return was then divided by the discount rate (.06875) to provide an estimated present value per acre of $46.40.

Commercial Trapping

In a manner similar to the one already adopted with respect to commercial fishing, the contribution of wetlands to commercial trapping may be calculated on a value per acre basis. However, two important obstacles, not encountered in the evaluation of wetlands for commercial fishing, confronted the authors in their effort to evaluate the contribution of wetlands to commercial trapping. The first problem involved the fact that data for commercial trapping are available only for the entire State of Louisiana; the second was related to the lack of data from which an accurate value-added factor might be derived. These difficulties have been resolved in ways which at least make possible what the authors feel is a meaningful approximation of the value.

Because the Louisiana Wildlife and Fisheries Commission offers trapping data only on a state-wide basis, information from the U.S. Army Corps of Engineers' Value of Wetlands (1977) study was used to estimate the value of the trapping harvest in Hydrologic Unit IV. The Corps study evaluated trapping in the whole coastal zone of Louisiana--based on the assumption that the state's total harvest of fur and meat was produced in the coastal region (however, not just wetlands)--but also provided information which made it possible to attribute a percentage of the overall take to the Barataria wetlands. That percentage was calculated on the basis of the total coastal wetlands contribution to the harvest of furbearing animals by species, and the Barataria Basin's share of total wetland acreage, in the manner described below.

First the total values for fur and meats from furbearing animals harvested in marshes and in baldcypress-tupelo gum swamps, respectively, were added on a species-by-species basis to provide a total value (by species) for the annual trapping harvest in wetlands. The wetlands value for each species was then divided by total species

value to determine the percentage of animals taken in wetlands (see Table 4.4). These percentages were then applied to the average number of animals of each species harvested in Louisiana over the period from 1970-71 through 1974-75 to estimate the number of pelts attributable to coastal wetlands on an annual basis (see Table 4.5). According to the U.S. Army Corps of Engineers (1977), 18.44 percent of all wetland acreage in the coastal zone is located in Hydrologic Unit IV. Assuming a perfectly even distribution of the trapping harvest in the swamps and marshes of coastal Louisiana, a simple proportion will give the percentage of Louisiana production supplied by Barataria wetlands, represented by Y in the following equation:

$$Y = (B)\,\frac{b}{a} \qquad (4.4)$$

where B = percentage of coastal wetland acreage located in the Barataria Basin

a = average annual harvest of pelts in Louisiana (1970-71 to 1974-75)

b = average annual harvest of pelts in coastal wetlands of Louisiana (1970-71 to 1974-75)

Substituting figures from the U.S. Army Corps of Engineers (1977) in the above equation yields the following result:

$$Y = (18.44)\,\frac{2{,}003{,}595}{2{,}068{,}433} = 17.86 \text{ (percent)} \qquad (4.5)$$

The average annual harvest of pelts in the Barataria wetlands may now be calculated by finding the product of Y and the average annual harvest of pelts in Louisiana. Data from Comparative Takes of Fur Animals in Louisiana (Louisiana Wildlife and Fisheries Commission, 1977b) provide the basis for computing an average annual state harvest of 2,386,903 pelts[4] (see Table 4.6). Multiplying the latter figure by Y yields an average annual take for Barataria wetlands of 426,301 pelts.

---

[4]The U.S. Army Corps of Engineers considered only the years 1970-71 to 1974-75 in computing the trapping value per acre for forested and non-forested areas of the Louisiana coastal zone. The Y percentage is based on those years only. However, by using data on state harvest over a longer period of time, it was possible to derive a more representative value for annual harvest.

TABLE 4.4

PERCENTAGE OF TRAPPING HARVEST FROM LOUISIANA WETLANDS (BY SPECIES)

| SPECIES | PERCENTAGE |
|---|---|
| Muskrat | 99.8 |
| Nutria | 99.1 |
| Mink | 70.4 |
| Raccoon | 71.3 |
| Otter | 92.0 |
| Opossum | 88.0 |
| Bobcat | 42.9 |

Source: U.S. Army Corps of Engineers, 1977, and Authors.

TABLE 4.5

AVERAGE ANNUAL HARVEST OF PELTS FROM LOUISIANA WETLANDS (BY SPECIES) 1970-71 THROUGH 1974-75

| SPECIES | AVERAGE ANNUAL HARVEST |
|---|---|
| Muskrat | 406,696 |
| Nutria | 1,462,075 |
| Mink | 22,707 |
| Raccoon | 90,007 |
| Otter | 5,525 |
| Opossum | 16,379 |
| Bobcat | 206 |
| TOTAL | 2,003,595 |

Source: U.S. Army Corps of Engineers, 1977, and Authors.

TABLE 4.6

ANNUAL HARVEST OF PELTS IN LOUISIANA
(ALL SPECIES)1967-68 THROUGH 1975-76

| YEAR | NUMBER OF PELTS | AVERAGE PRICE PER PELT (1977 DOLLARS) | ESTIMATED TOTAL VALUE (1977 DOLLARS) |
|---|---|---|---|
| 1967-68 | 2,130,473 | $2.4152 | $ 5,145,518.39 |
| 1968-69 | 3,469,040 | $3.0112 | $10,445,973.25 |
| 1969-70 | 3,002,043 | $3.2597 | $ 9,785,759.57 |
| 1970-71 | 2,090,761 | $3.3609 | $ 7,026,838.65 |
| 1971-72 | 1,732,682 | $4.8662 | $ 8,431,577.15 |
| 1972-73 | 2,180,332 | $6.2821 | $13,697,063.66 |
| 1973-74 | 2,304,916 | $6.9605 | $16,043,367.82 |
| 1974-75 | 2,038,379 | $5.7881 | $11,798,341.49 |
| 1975-76 | 2,533,500 | $5.4533 | $13,815,935.55 |
| Average | 2,386,903 | $4.5997 | $10,979,037.73[1] |

1. Derived by multiplying the average number of pelts (2,386,903) by the average price per pelt ($4.5997).

Source: Louisiana Wildlife and Fisheries Commission, 1977b and Authors.

The procedure outlined above may also be used to estimate the contribution of Barataria wetlands to the total harvest of meats taken by trappers. In a manner similar to that of Table 4.5 (using Table 4.4) the average annual harvest of meat from animals trapped in the wetlands of Louisiana, during the period from 1970-71 through 1974-75, was 9,918,734 pounds (see Table 4.7). In order to determine the percentage of total meat production supplied by the swamps and marshes of the Barataria Basin--represented by Z below--the formula used in the preceding paragraph may be reworked into the following equation:

$$Z = (B)\,\frac{b}{a} \qquad (4.6)$$

where B = percentage of coastal wetland acreage located in the Barataria Basin

a = average annual harvest of meats, in pounds, in Louisiana (1970-71 to 1974-75)

b = average annual harvest of meats, in pounds, in coastal wetlands of Louisiana (1970-71 to 1974-75)

Substituting figures from the U.S. Army Corps of Engineers (1977) in the above equation yields the following result:

$$Z = (18.44)\,\frac{9{,}918{,}734}{10{,}404{,}000} = 17.58 \text{ (percent)} \qquad (4.7)$$

The average annual poundage of meats from animals trapped in the Barataria wetlands may now be calculated by finding the product of Z and the average annual harvest of meats (in pounds) in Louisiana. Data from Comparative Takes of Fur Animals in Louisiana (Louisiana Wildlife and Fisheries Commission, 1977b) provide the basis for computing an average annual state harvest of 9,815,100 pounds (see Table 4.8). Multiplying the latter figure by Z yields an average annual take for Barataria wetlands of 1,725,495 pounds.

Making the further assumption that the harvest of furbearing animals in Louisiana wetlands is evenly distributed by species, the authors proceeded to estimate the value of the trapping harvest per acre of wetland in the Barataria Basin. In the same way the number of pelts and pounds of meats taken in the study area were estimated, total values for pelts and meats harvested in the Barataria wetlands were derived. First, the Y-percentage for pelts (17.86) was applied to the average annual value of pelts

TABLE 4.7

AVERAGE ANNUAL POUNDS OF MEATS FROM LOUISIANA WETLANDS (BY SPECIES) 1970-71 THROUGH 1974-75

| SPECIES | AVERAGE |
|---|---|
| Muskrat | 279,440 |
| Nutria | 9,116,750 |
| Raccoon | 376,464 |
| Opossum | 146,080 |
| TOTAL | 9,918,734 |

Source: U.S. Army Corps of Engineers, 1977, and Authors.

TABLE 4.8

ANNUAL HARVEST OF MEATS FROM FURBEARING ANIMALS IN LOUISIANA (ALL SPECIES) 1967-68 THROUGH 1976-77

| YEAR | NUMBER OF POUNDS | AVERAGE PRICE PER POUND (1977 DOLLARS) | ESTIMATED TOTAL VALUE (1977 DOLLARS) |
|---|---|---|---|
| 1967-68 | 9,220,000 | $.1667 | $1,536,974.00 |
| 1968-69 | 11,660,000 | $.1625 | $1,894,750.00 |
| 1969-70 | 10,480,000 | $.1393 | $1,459,864.00 |
| 1970-71 | 8,770,000 | $.1324 | $1,187,628.00 |
| 1971-72 | 8,970,000 | $.1288 | $1,155,336.00 |
| 1972-73 | 11,300,000 | $.1310 | $1,480,300.00 |
| 1973-74 | 12,550,000 | $.1486 | $1,864,930.00 |
| 1974-75 | 10,430,000 | $.1375 | $1,434,125.00 |
| 1975-76 | 11,136,000 | $.1369 | $1,524,518.40 |
| 1976-77 | 3,635,000 | $.1883 | $ 684,470.50 |
| Average | 9,815,100 | $.1472 | $1,444,782.72[1] |

1. Derived by multiplying the average number of pounds of meats (9,815,100) by the average price per pound (.1472).

Source: Louisiana Wildlife and Fisheries Commission, 1977b and Authors.

taken in the state: $10,979,037.73 based on the data already presented in Table 4.6. The resulting value for pelts harvested in Hydrologic Unit IV is $1,960,856.14. Next, the Z-percentage for pounds of meats (17.58) was applied to the average annual value of meats from furbearing animals in the state: $1,444,782.72 based on the data already presented in Table 4.8. The resulting value for meats harvested in the Barataria wetlands is $253,992.80.

Because the data required to compute an accurate value-added factor for commercial trapping were not available, the authors elected to use the figure previously applied to commercial fishing, on the assumption that 3.0755 represented a reasonable minimum factor for value added in processing fur and meat. The resulting gross economic values for pelts and meats produced in the Barataria wetlands are, respectively, $6,030,613.06 and $781,154.86. Dividing each amount by 582,700, the number of wetland acres in the study area, yielded per-acre annual values of $10.35 (for pelts) and $1.34 (for meats). Substituting the annual values in equation 4.2, and assuming a discount rate of 6 7/8 percent, the authors obtained the following present values per acre: $150.55 for pelts and $19.50 for meats. The total present value per acre of Barataria wetlands for commercial trapping is $170.05. A summary of per-acre values for trapping in the swamps and marshes of Hydrologic Unit IV is offered in Table 4.9.

## Recreation

The value of recreational activity may be measured by determining the economic impact of recreation-oriented expenditures and by estimating in monetary terms the total value of time devoted to recreational experiences. The first value may be estimated on the basis of average expenditures per participant for each activity considered. Evaluating the time given over to recreation is a less clear-cut task and calls for assignment of an arbitrary value to a day's participation in one activity or another. While not entirely satisfactory, the user-day benefits technique appealed to the authors as the best available method for approximating the worth of unpriced benefits derived from recreation. Alternative methods for determining the demand for recreation are presented in the succeeding section of this chapter ("Consumer's Surplus Technique").

Of the recreational activities listed in Louisiana's outdoor recreation plans for 1970-75 and 1975-80 (Louisiana State Parks and Recreation Commission, 1971 and

TABLE 4.9

COMMERCIAL TRAPPING VALUES PER ACRE
OF BARATARIA WETLAND

| COMMODITY | TRAPPED VALUE | TOTAL VALUE[1] | ANNUAL VALUE PER ACRE[2] | PRESENT VALUE PER ACRE[3] |
|---|---|---|---|---|
| Pelts | $1,960,856.14 | $6,030,613.06 | $10.35 | $150.55 |
| Meats | $ 253,992.80 | $ 781,154.86 | $ 1.34 | $ 19.50 |
| TOTALS | $2,214,848.94 | $6,811,767.92 | $11.69 | $170.05 |

1. Trapped value multiplied by value-added factor of 3.0755 (see text).

2. Total value divided by number of wetland acres in Barataria Basin, 582,700 (U.S. Army Corps of Engineers, 1977).

3. Using equation 4.2 and assuming discount rate of 6 7/8 percent (see text).

Source: Computed by Authors.

1974, the following have been identified as having a wetlands orientation: fishing (saltwater and freshwater), crawfishing, crabbing, birdwatching and hunting (small game and waterfowl). Among those activities, hunting and fishing are the ones which involve significant contributions to the economy in terms of total expenditures. The 1975 National Survey of Hunting, Fishing and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 1977) reported average annual expenditures of $283.57 per hunter and $281.97 per fisherman for food, lodging, fees, equipment and transportation. When updated to 1977 values, using the same procedure applied in Table 4.1, the average expenditures become $317.17 per hunter and $315.38 per fisherman.

In order to determine total expenditures for hunting and fishing in the study area, the above figures may be multiplied by the respective numbers of hunters and sport fishermen in the Barataria Basin. The estimated number of hunting licenses sold in the basin for the 1976-77 season, based on Table 4.10, is 22,987. The estimated number of fishing licenses sold for the same season, shown already in Table 4.3, is 24,143. Corresponding amounts for total personal expenditures in the Barataria Basin are $7,290,786.79 for hunters and $7,614,219.34 for fishermen. Assuming that all fishing is wetlands-dependent but only 60 percent of hunting activity is related to wetlands (Mumphrey et al., 1975), then the figure for hunters may be reduced to $4,374,472.07 for the purposes of the present study. The resulting total for expenditures by both hunters and fishermen is $11,988,691.41.

The above figure represents the direct economic impact of hunting and fishing in Hydrologic Unit IV. In order to measure the overall impact, including indirect contributions to the economy, an appropriate value-added factor may be applied. The authors chose to use an average (2.92) of the factors proposed by Whitman (1973: A36-A38). The resulting total estimated impact of recreational hunting and fishing dependent on the Barataria wetlands is $35,006,978.92 a year. That amount corresponds to an annual value per wetland acre of $60.08--$38.16 for fishing and $21.92 for hunting--based on 582,700 acres. The present value per acre, based on equation 4.2 and assuming a discount rate of 6 7/8 percent, is $555.05 for sport fishing and $318.84 for recreational hunting. Total present value per acre for hunting and fishing is $873.89.

These figures underestimate the real value of recreational activity to some extent. For one thing, it was not possible to take into account the potentially

TABLE 4.10

HUNTING LICENSES SOLD IN THE BARATARIA BASIN
FOR THE 1976-77 SEASON
(Estimated)

| PARISH | TOTAL LICENSES SOLD IN PARISH | ESTIMATED LICENSES SOLD IN BASIN[1] |
|---|---|---|
| Ascension | 6,594 | 717 |
| Assumption | 2,059 | 446 |
| Jefferson | 25,621 | 9,594 |
| Lafourche | 9,990 | 1,783 |
| Orleans | 14,304 | 1,260 |
| Plaquemines | 3,053 | 2,676 |
| St. Charles | 4,535 | 2,581 |
| St. James | 2,156 | 981 |
| St. John the Baptist | 2,441 | 476 |
| TOTALS | 70,753 | 22,987 |

1. Based on percentage of parochial population located in Barataria Basin (see Table 4.2).

Source: Louisiana Wildlife and Fisheries Commission, 1977a.

substantial number of fishermen who, for various reasons, are not required to purchase licenses. Furthermore, the calculations of the authors included only those expenses related to hunting and fishing. Expenditures for crabbing, birdwatching and crawfishing were assumed to be relatively insignificant.

There is another aspect of wetlands-oriented recreation which defies traditional demand analysis: that is, the unpriced benefits people receive from the recreational experience itself. The Water Resources Council, in a 1973 study entitled Water and Related Land Resources: Establishment of Principles and Standards for Planning (hereafter referred to as Principles and Standards), estimated monetary values per day of participation for general and specialized recreational activities. A general recreation day is defined as one which involves primarily those activities attractive to the majority of outdoor recreation participants. Such activities are further specified as being ones which generally require the development and maintenance of convenient access and adequate facilities. The range of values per user day for general recreational activities, established by the Water Resources Council, is $1.01 to $3.03 (updated from 1973 to 1977 dollars). A specialized recreation day is defined as one which involves primarily those activities for which opportunities are limited, intensity of use is low and personal expenditures are often high. For specialized activities the user-day values range from $4.03 to $12.10. The present study used the highest values in each category to evaluate user-benefits, based on the consensus opinion that these values are somewhat low (see for example Stone, 1973). Saltwater fishing and hunting (small game and waterfowl) were treated as specialized activities; freshwater fishing, crawfishing, crabbing and birdwatching were classified as general recreational activities.

In order to determine the total value of user-benefits derived from wetlands-oriented recreation in the study area, the authors estimated user-day totals for each of the above-named activities. Data on relevant participation rates for residents of Louisiana were compiled and are shown in Table 4.11. A total annual participation rate was derived by adding the high quarter and other three quarters of each year. Then the participation rate for each activity was multiplied by the estimated population of the Barataria Basin in 1970, based on Table 4.2, to determine annual user-day totals. The overall number of user-days per year in the study area is 9,163,445.36 (see Table 4.12). The number of user-days for each activity was multiplied by the respective value per user-day to

TABLE 4.11

PARTICIPATION RATES FOR LOUISIANA WETLANDS ORIENTED RECREATIONAL ACTIVITIES, 1968 AND 1974

| WETLANDS ORIENTED RECREATIONAL ACTIVITIES | PARTICIPATION RATE | | | |
|---|---|---|---|---|
| | 1968 HIGH ¼ OF YEAR[1] | 1968 REMAINING QUARTERS OF YEAR | 1974 HIGH ¼ OF YEAR[3] | 1974 REMAINING QUARTERS OF YEAR[4] |
| Saltwater fishing | 1.68[2] | 1.14[2] | 2.22 | 1.506 |
| Freshwater fishing | 4.58[2] | 3.12[2] | 6.04 | 4.102 |
| Crawfishing | .49 | .32 | 1.96 | 1.28 |
| Crabbing | .82 | .22 | 1.92 | .515 |
| Birdwatching | .67 | 1.10 | 2.35 | 3.858 |
| Hunting--small game | 2.31[2] | 2.31[2] | 3.75 | 3.75 |
| Hunting--waterfowl | 1.02[2] | 1.02[2] | 1.65 | 1.65 |

1. Louisiana State Parks and Recreation Commission (1971).

2. In 1968 hunting and fishing were reported in one category each. The 1968 rate for fishing was subdivided into saltwater fishing and freshwater fishing based on their proportion of the total rate in 1974. The same was done for hunting.

3. Louisiana State Parks and Recreation Commission (1974).

4. Calculated assuming the same percentage increase as for the high quarter over the period 1968-74.

Source: Louisiana State Parks and Recreation Commission, 1971, 1974 and Authors.

TABLE 4.12

ESTIMATED USER-VALUE OF WETLANDS-ORIENTED RECREATIONAL ACTIVITIES IN THE BARATARIA BASIN

| ACTIVITY | TOTAL ANNUAL PARTICIPATION RATE[1] | USER DAYS[2] | VALUE PER USER DAY[3] | TOTAL VALUE[4] |
|---|---|---|---|---|
| Saltwater Fishing | 3.726 | 934,119.38 | $12.10 | $11,302,844.50 |
| Freshwater Fishing | 10.142 | 2,542,629.83 | $ 3.03 | $ 7,704,168.38 |
| Crawfishing | 3.24 | 812,277.72 | $ 3.03 | $ 2,461,201.49 |
| Crabbing | 2.435 | 610,461.81 | $ 3.03 | $ 1,849,699.28 |
| Birdwatching | 6.208 | 1,556,364.22 | $ 3.03 | $ 4,715,783.59 |
| Hunting (small game) | 7.5 | 1,880,272.50 | $12.10 | $22,751,297.25 |
| Hunting (waterfowl) | 3.3 | 827,319.90 | $12.10 | $10,010,507.79 |
| TOTAL | | 9,163,445.36 | | $60,795,502.28 |

1. Based on columns 3 and 4 of Table 4.11.
2. Column 1 times estimated population of the Barataria Basin in 1970 (250,703).
3. From Water Resources Council, 1973.
4. Column 2 times column 3.

Source: Compiled by Authors.

determine the total value of each activity in monetary terms. Summing those figures resulted in an overall value of $60,795,502.28 for recreational user-benefits in the Barataria Basin. Dividing by 582,700, the number of wetland acres in the study area, yielded an annual per-acre benefit figure of $104.33. The present value per-acre was calculated using equation 4.3, based on a projected increase in recreational activity of 4.1 percent per year (Mumphrey et al., 1975). In monetary terms, the projected increase amounts to $2,492,615.59 on an annual basis or $4.28 per acre. Substituting the appropriate figures in equation 4.3, and assuming a discount rate of 6 7/8 percent, the authors obtained the following result:

$$\frac{104.33}{.06875} + \frac{4.28}{.0047} = 2428.17 \text{ (dollars)}$$

The total present value per wetland acre for recreation in the Barataria Basin is $3,302.06: $873.89 in expenditures for recreation and an estimated $2,428.17 in unpriced benefits derived from recreational activity. Added to the previously calculated values for fish, fur and meats from trapped animals produced in the Barataria wetlands, the recreational figures result in an overall present value per wetland acre in the study area of $9,058.93. A summary of annual and present values per acre by activity category, as derived by the gross benefits technique, is offered in Table 4.13.

## CONSUMER'S SURPLUS TECHNIQUE

The methodology employed in this section draws on the economic concepts of consumer's surplus and producer's surplus. In theory the economic value of a resource, or its value to society, is determined by assessing society's willingness to pay for the resource and subtracting the costs incurred in extracting it from the natural environment. Costs are not considered a part of the economic rent of the resource because it is assumed that inputs such as labor and capital are transferable to other uses. In order to measure how much the resource adds to the well-being of society as a whole, the consumer's surplus and producer's surplus should be calculated and added together.

TABLE 4.13

ESTIMATED GROSS ECONOMIC CONTRIBUTION
OF A WETLAND ACRE IN THE BARATARIA BASIN

| ACTIVITY CATEGORY | ANNUAL RETURN PER ACRE | PRESENT VALUE PER ACRE |
|---|---|---|
| Commercial Fishing | $286.36 | $5,540.42 |
| Non-Commercial Fishing | $ 3.19 | $ 46.40 |
| Commercial Trapping (Pelts & Meats) | $ 11.69 | $ 170.05 |
| Recreation: | | |
| Economic Impact of Recreation Expenditures | $ 60.08 | $ 873.89 |
| Economic Value of User-Benefits from Recreation | $104.33 | $2,428.17 |
| TOTALS | $465.65 | $9,058.93 |

Source: Authors. Values compiled from text of this chapter.

The consumer's surplus is the amount that a consumer would be willing to pay to continue receiving a good or service over and above what he or she is already paying. The demand curve plotted for a product or service reveals this information, showing the willingness to pay at each quantity level (see Figure 4.1). In a competitive market, however, producers are unable to differentiate prices among consumers; a single price is determined based on the supply-and-demand situation (see Figure 4.2). By examining only equilibrium price and quantity, the consumer's surplus is ignored. Figure 4.1 illustrates graphically the meaning of consumer's surplus. At quantity level $Q_1$, and price $P_1$, the total value to society is $OPAQ_1$, total revenue is $OP_1AQ_1$, and consumer's surplus is $PAP_1$. Since consumers would be willing to pay $PAP_1$ in addition to $OP_1AQ_1$, but are not required to do so in order to receive $Q_1$, a "surplus" is said to exist.

Analogous to the demand concept of consumer's surplus is the supply concept of producer's surplus or rent. Producer's surplus is profit: the difference between the cost of producing each product unit and its selling price. Marginal costs of production are shown by the supply curve. The producer's surplus in Figure 4.2 is represented by $P_1AX$. The total economic rent of the resource is thus the consumer's surplus added to the producer's rent, that is, PAX.[5]

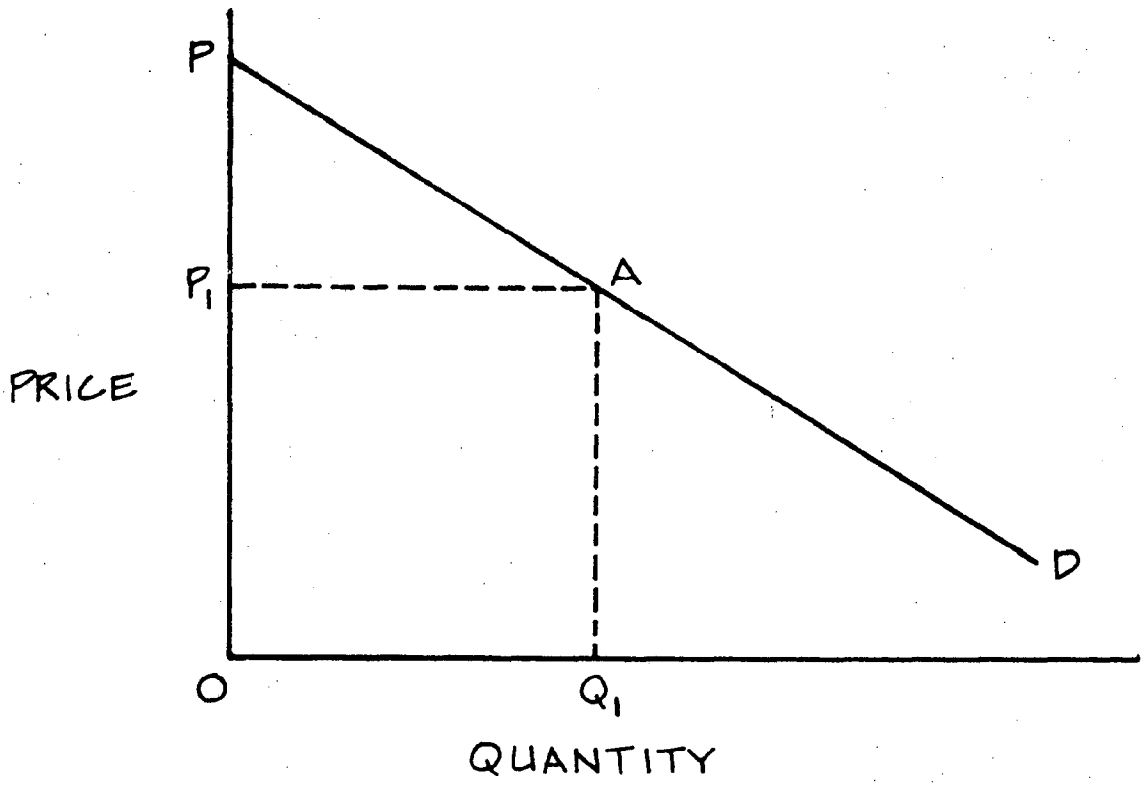
In this section, the authors estimate willingness to pay by means of demand curves, thus making it possible to measure the net value to society of the Barataria wetlands. To correctly compute the net value, the producer's surplus and the consumer's surplus should be calculated. However, data concerning producer costs and profits are not

---

[5]Normally the demand curve for a product or service is developed holding nominal income constant, while the discussion above is based on a utility function approach. The two approaches would produce similar demand curves if the marginal utility of the good in question, relative to the marginal utility of other goods, remains constant with changes in quantitites of all other goods. Robert Willig has argued that this is normally the case ("Consumer's Surplus Without Apology" (1966) American Economic Review. Vol. 66, No. 4, September: 589-597). Thus there is not a problem unless the price change substantially changes real income, and that would only occur if the expenditure for these services represented a significant fraction of the consumer's total budget (Wilman and Krutilla, 1977).

FIGURE 4.1

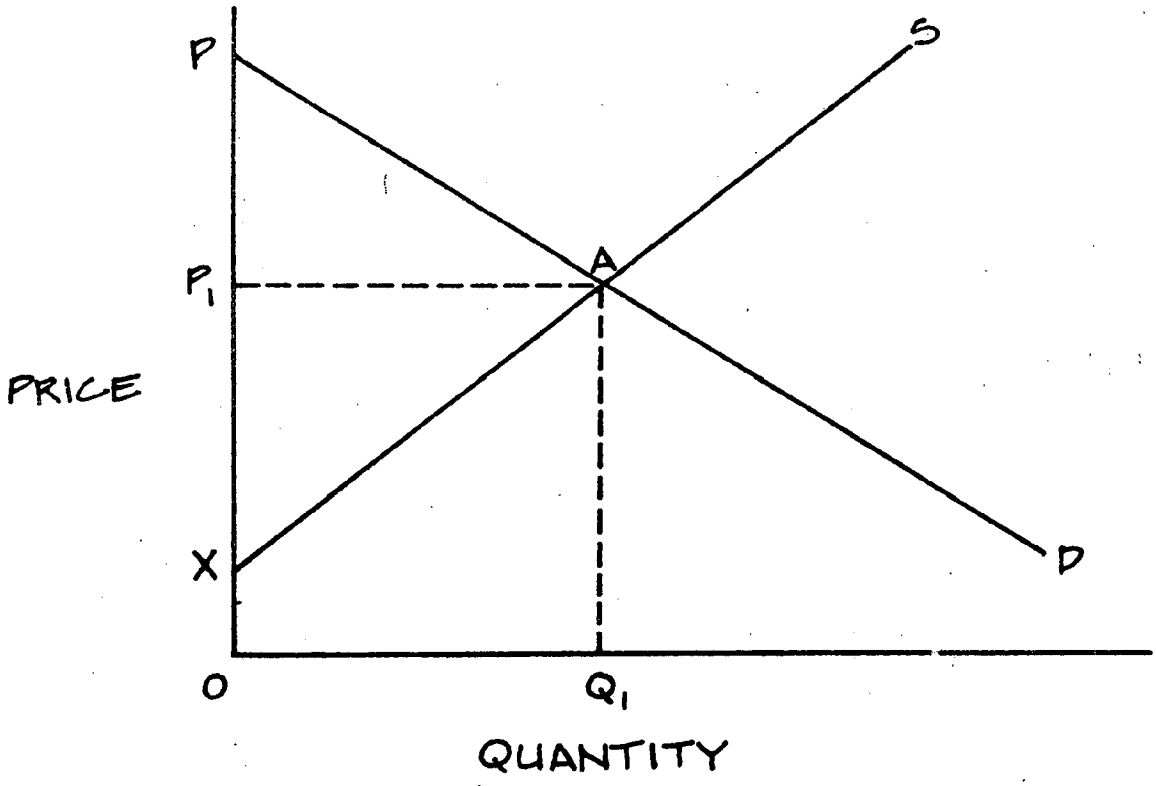
THE DEMAND CURVE




Source: The Authors.

FIGURE 4.2

EQUILIBRIUM OF SUPPLY AND DEMAND




Source: The Authors.

available. For this reason it is necessary to assume that the commercial fishing and trapping industries are perfectly competitive, that is, the per unit production cost is equal to the selling price. Under this assumption the producer's surplus is non-existent. In the case of industries which consist of large numbers of small producers, such as fishing and trapping, this is not an unreasonable assumption since each seller's contribution is too small to significantly affect the market price, and collusion is improbable. Thus, the following paragraphs are concerned only with consumer's surplus.

## Commercial Fishing

The consumer's surplus approach was applied to the commercial fishing industry to determine the net value to society of wetlands in the Barataria Basin. Using annual data from the National Marine Fisheries Service (1967-77), based on landings for the entire State of Louisiana during the years from 1966 through 1976 (see Table 4.14), the authors plotted a demand curve for fish and shellfish employing regression analysis.[6] Data for the Barataria Basin were taken from Value of Wetlands (U.S. Army Corps of Engineers, 1977). Using estimates of catch by hydrologic unit for the period from 1963 through 1973, the authors of the Corps study derived average annual figures for catch size and dollar value. The average yearly catch for Hydrologic Unit IV is 468,830,000 pounds of fish and shellfish. The average annual catch for the whole state, based on the same years, is 1,041,440,000 pounds.

Applying the above figures for average annual landings in the basin and state to the demand curve for fish products, the authors computed a price and quantity for Louisiana minus the Barataria Basin. The change in quantity supplied, resulting from removal of Hydrologic Unit IV from the system, is 468,830,000 pounds. The corresponding change in price is 1.91 cents per pound (from 9.42 cents to 11.33 cents per pound). The change in consumer's surplus was found by calculating the original surplus and subtracting the surplus remaining after removal of the contribution of the Barataria Basin (see Appendix 4.1). The total value lost, representing the consumer's surplus attributable to the

---

[6] Appendix 4.1 to this chapter summarizes the statistical results of the regressions for commercial fishing and commercial trapping and shows the calculations performed to derive the consumer's surplus values for each.

TABLE 4.14

FISH AND SHELLFISH LANDINGS AND VALUE FOR LOUISIANA
1966-1976

| YEAR | TOTAL LANDINGS (LBS.) | TOTAL VALUE (1977 DOLLARS) | AVERAGE PRICE PER POUND (1977 DOLLARS) |
|---|---|---|---|
| 1966 | 647,416,500 | $ 73,481,772 | $ .1135 |
| 1967 | 620,427,500 | $ 68,065,284 | $ .1097 |
| 1968 | 763,968,600 | $ 75,174,510 | $ .0984 |
| 1969 | 1,013,484,600 | $ 64,761,666 | $ .0639 |
| 1970 | 1,115,331,700 | $ 97,368,457 | $ .0873 |
| 1971 | 1,377,013,051 | $ 76,424,224 | $ .0555 |
| 1972 | 1,081,269,660 | $104,234,395 | $ .0964 |
| 1973 | 1,040,769,832 | $130,203,683 | $ .1251 |
| 1974 | 1,233,415,909 | $108,047,234 | $ .0876 |
| 1975 | 1,128,274,979 | $ 99,513,853 | $ .0882 |
| 1976 | 1,232,328,343 | $147,016,771 | $ .1193 |

Source: National Marine Fisheries Service, 1967-77.

study area, is $15,414,177.50. Dividing that total by 582,700, the number of wetland acres in the basin, yielded an annual per-acre return of $26.45. Dividing the annual value by .06875, the assumed discount rate, the authors derived a present value per acre (based on equation 4.2) of $384.73, assuming constant future production.

## Commercial Trapping

A method similar to the one used for commercial fishing was used to evaluate the contribution of Barataria wetlands to the commercial trapping industry. To specify demand curves for furs and meats regressions were performed on annual harvests of fur and meats in Louisiana for the past nine and ten years respectively (see Tables 4.6 and 4.8). The Barataria wetlands' contributions to state totals were assumed to be 17.86 percent of pelts harvested and 17.58 percent of meats harvested (based on the calculations outlined earlier under Commercial Trapping in the Gross Benefits Section). Loss in quantity and change in price were determined assuming removal of the Barataria wetlands from the system. For pelts the price increased by 48 cents and the quantity supplied decreased by 426,301, yielding an annual consumer's surplus value of $1.79 per acre. Total meat production fell by 1,725,494.6 pounds and the price per pound rose by .77 cents, yielding an annual consumer's surplus value per acre of 12 cents. The present values per acre, assuming constant future production, are $26.09 for pelts and $1.75 for meats.

## Recreation

The consumer's surplus criterion is also relevant in estimating benefits of wetlands-oriented recreation. Specification of a demand curve for recreation poses more problems than do demand curves for commercial fishing and trapping, however, because generally the services of the recreation site are not marketed. A number of methodologies have been employed to estimate recreation demand. The most popular is the travel cost approach. This method derives a demand curve by using the cost of travelling to the recreation site as a substitute for willingness to pay. Quantity, as measured by number of trips to a site, is graphed against distance (cost); and after plotting a number of observations, a demand curve can be estimated. See Wilman and Krutilla (1977) for a complete discussion

of this method. The travel-cost approach is difficult to employ in any study but has its best use in estimating demand for site-specific recreational activities such as those related to ski resorts and sports stadiums. Wetlands-oriented recreation in the Barataria Basin can take place on almost any one of 582,700 wetland acres, a fact which would make measurement of origins and destinations extremely difficult if not impossible. This study does not attempt to implement the travel-cost method.

An alternate approach is to conduct a survey to determine how much sportsmen would be willing to pay for various recreational experiences. The major problem with this approach, as with any kind of survey, is that a hypothetical situation is being posed and the response is assumed to be a realistic one. Some surveys of sportsmen have been conducted in Louisiana,[7] but none is complete enough to serve as a basis for using the survey method for demand estimation. A discussion on the ways of implementing this method may be found in Bohm (1971, 1972), Brookshire et al. (1976) and Tideman (in Muskin, 1972).

A third method is to analyze the demand for goods which are consumed in a complementary or substitute fashion, relative to the recreational service, thus eliciting willingness to pay directly from consumers. Wilman and Krutilla (1977), Polinsky and Shavell (1976), Lancaster (1971) and Rosin (1974) provide detailed discussions about this method. Data requirements for this kind of analysis are large, and many of the recreational activities considered in this study require little or no expenditure on the part of the participant.

Due to the difficulty of implementing the available theoretical means of demand estimation, the user-days approach employed in the preceding section of this chapter is included as part of the consumer's surplus valuation. Although imprecise, the estimation of user-days and daily use values represents an attempt to approximate willingness to pay and thus is not inconsistent with the consumer's surplus discussions in this section.

---

[7] See Louisiana State Parks and Recreation Commission (1971) for an explanation of the 1968 survey and Louisiana State Parks and Recreation Commission (1974) for information about the 1973 survey.

Table 4.15 summarizes the results of the consumer's surplus approach to wetlands valuation in the Barataria Basin.

There are numerous difficulties involved in using the consumer's surplus approach to determine a value for wetlands. Commercial fishing and trapping are dependent to a large extent on natural occurrences such as weather, a fact which makes it difficult to relate price and quantity in a clearly defined manner. Another important problem involves the availablility of data. Information on statewide catches of fish and furbearers is available, but some of the data for the study area had to be derived by attributing a percentage of total production to the Barataria Basin. Costs incurred by commercial fishermen and trappers are not available in any form. In order to compute accurately the net value to society of a resource, it is necessary to include the producer's surplus as well as the consumer's surplus; but that cannot be done without information on production costs. For the purpose of commercial fishing and trapping valuation, costs were assumed to be equal to price. The result is an underestimate of the true value of the resource, since the producer's profit is ignored. Finally, one other consideration it was not possible to include is that of the value of certain fish species which are not commercially valuable at present but may become so in the future.

## CORPS OF ENGINEERS TECHNIQUE

In July of 1977 the U.S. Army Corps of Engineers, New Orleans District, completed a study entitled Value of Wetlands and Bottomland Hardwoods (henceforth referred to as Value of Wetlands). This study derives dollar values per acre of marsh and swamp for the coastal region of Louisiana, primarily based on data from the Fish and Wildlife Study of the Louisiana Coastal Area and the Atchafalaya Basin Floodway (henceforth referred to as the Fish and Wildlife Study) completed by the New Orleans District Corps earlier in 1975. The wetlands valuation study was not published for general distribution; it is used by the New Orleans District Corps as an "in-house" document to guide Corps personnel in evaluating proposed water resource-related projects. The following section presents a summary of the methodology and results of the Corps' evaluation of several coastal hydrologic units. However, this summary will consider only Hydrologic Unit IV (the Barataria Basin), study area for the present report, except where otherwise noted. The components on which

TABLE 4.15

ESTIMATED NET ECONOMIC CONTRIBUTION OF A WETLAND ACRE IN THE BARATARIA BASIN

| ACTIVITY CATEGORY | ANNUAL RETURN PER ACRE | PRESENT VALUE PER VALUE |
|---|---|---|
| Commercial Fishing | $ 26.45 | $ 384.73 |
| Commercial Trapping (Pelts & Meats) | $ 1.91 | $ 27.84 |
| Recreation: Economic Value of User-Benefits | $104.33 | $2,428.17 |
| TOTALS | $132.69 | $2,840.74 |

Source: Authors. Values compiled from text of this chapter.

the total value of wetlands is based include commercial and sport fishing, commercial and sport wildlife, and water-oriented recreation.

## Commercial and Sport Fishing

The first step in the Corps' evaluation is a breakdown of total wetland acreage in the study area by habitat type. There is a total of 582,700 acres of wetlands in the Barataria Basin, of which 418,200 acres are marsh and 107,000 acres are swamps (see Table 4.16). The Corps' estimates of acreage are based on 1970 data revised to reflect annual percent losses of marsh in the period from 1970 to 1977.

After determining the composition of the Barataria wetlands, the authors of the study proceeded to derive a total value for commercial fishing in Hydrologic Unit IV. Commercial fish species taken into consideration are listed in Table 4.17 along with production and value figures for each. Production is recorded in millions of pounds and is defined as the total commercial catch of a particular species from the Barataria Basin. Value in millions of dollars was computed on the basis of exvessel prices. The totals indicate an average annual catch of 468,830,000 pounds valued at $40,360,000 in 1973 dollars.

The aggregate figures for production and value are broken down according to wetland type (marsh or swamp) in Table 4.18. The difference in percentage contribution between wetland types is related to the variety of marsh as well as productivity and export levels for both marsh and swamp. The following quote from Value of Wetlands describes the method used in computation of the figures shown in Table 4.18:

> Day et al. (1976) found that 9,217 metric tons of carbon, nitrogen, and phosphorus per year were exported from the 107,000 acres of unleveed swamp in Hydrologic Unit IV. This converts to approximately 50 grams of dry weight/square meter/year (g.d.w./$m^2$/yr). Day et al. (1973) showed that approximately 1,500 g.d.w./$m^2$/yr were produced in saline marshes in Hydrologic Unit IV. Of this, 760 g.d.w./$m^2$/yr were exported. Work by other investigators indicated that productivity of other marsh types is approximately

TABLE 4.16

TYPES OF WETLAND HABITAT IN THE BARATARIA BASIN

| HABITAT TYPE | ACRES (1000's) |
|---|---|
| Saline Marsh | 128.6 |
| Brackish Marsh | 110.8 |
| Intermediate Marsh | 16.4 |
| Fresh Marsh | 162.4 |
| Total Marsh | 418.2 |
| Swamp | 107.0 |
| Total Wetland | 582.7 |
| Percent Marsh | 72.0 |

Source: U.S. Army Corps of Engineers, 1977.

TABLE 4.17

COMMERCIAL FISHERY PRODUCTION AND VALUE OF MAJOR ESTUARINE-DEPENDENT COMMERCIAL FISHERIES IN THE BARATARIA BASIN

| SPECIES | PRODUCTION (million lbs.) | VALUE (million $) |
|---|---|---|
| Menhaden | 430.17 | 18.07 |
| Shrimp | 23.25 | 18.81 |
| Croaker | 5.62 | 0.187 |
| Blue Crab | 3.14 | 0.436 |
| Oysters | 4.07 | 2.64 |
| Seatrout | 1.46 | 0.152 |
| Spot | 0.916 | 0.025 |
| Red Drum | 0.207 | 0.044 |
| TOTALS | 468.83 | 40.36 |

Source: U.S. Army Corps of Engineers, 1977.

TABLE 4.18

SALTWATER COMMERCIAL FISHERY PRODUCTION/ACRE AND VALUE/ACRE FOR MARSH AND SWAMP IN THE BARATARIA BASIN

| | |
|---|---|
| Marsh Acres* | .418 |
| Swamp Acres* | .107 |
| Percent Production from Marsh | 97.2% |
| Percent Production from Swamp | 2.8% |
| Pounds/Acre from Marsh | 1083.2 |
| Pounds/Acre from Swamp | 122.7 |
| Dollar/Acre from Marsh | $93.85 |
| Dollar/Acre from Swamp | $10.56 |

*Millions of acres from Table 4.16.

Source: U.S. Army Corps of Engineers, 1977.

equal to saline marsh. However, export from these marsh types is less: approximately 50 percent is exported from saline marsh, 20 percent from brackish marsh, 16 percent from intermediate marsh, and 10 percent from fresh marsh (U.S. Army Corps of Engineers, 1977: 1).

In order to find the percent that marsh contributes to productivity in the Barataria Basin, the acreage of each marsh type was multiplied by the appropriate export figure using a conversion factor of 4046.72 (the number of square meters in an acre). These individual production figures were then summed, yielding a total in grams. To get a total production figure in grams from swamp, the number of swamp acres in the Barataria Basin was multiplied by the conversion factor and that product was multiplied by 50 g.d.w./$m^2$/yr (production and export included). The production figure for each type of wetland was then divided by the combined total production of both marsh and swamp to derive percentages indicating contribution levels for each. As indicated in Table 4.18, these are 97.2 percent for marsh and 2.8 percent for swamp.

The above percentages were then applied to the average annual figures for production and value to determine total pounds and total dollars attributable to each wetland type. Dividing total marsh value by the number of acres of marsh in the Barataria Basin, the authors derived a per-acre value for commercial fishing of $93.85. A per acre value of $10.56 for swamp was computed in the same way.

Values for sport fishing calculated in the Corps study are based on the economic concept of demand in excess of supply. Total potential fishing supply by type of catch (crawfish, saltwater finfish and freshwater finfish) is shown in Table 4.19. The potential supply available to sport fishermen represents the difference between total and commercially harvested supply. Commercial harvest percentages from the Fish and Wildlife Study were used to estimate the potential sport supply for each category. Estimated demand in 1977 was calculated on the basis of figures for sport fishing man-days from the same study. The authors updated the 1968 figures to take into account a five percent per year increase based on fishing licenses issued.

The Corps of Engineers study attributed values to sport fishing only in those categories for which demand was shown to exceed supply. In the case of a sport fishing

TABLE 4.19

SPORT FISHING IN THE BARATARIA BASIN IN MAN-DAYS
(1,000)

| ACTIVITY | TOTAL POTENTIAL SUPPLY | POTENTIAL SUPPLY AVAILABLE TO SPORT FISHERMEN | ESTIMATED 1977 SPORT FISHING DEMAND |
|---|---|---|---|
| Crawfishing | 431 | 33.2 | 76 |
| Saltwater finfishing | 1,098 | 439 | 1,607 |
| Freshwater finfishing | 2,249 | 1,709 | 740 |

Source: U.S. Army Corps of Engineers, 1977.

activity for which demand did in fact exceed supply, the total demand figure was used to compute a value. Demand figures for sport fishing activities, including shrimping and crabbing,[8] are shown in Table 4.20. Total sport fishing demand, according to the table, is 2,583,000 man-days.

In the same way that the valuation of wetlands for commercial fishing was broken down by wetland type, distinct values for recreational fishing are attributed to marsh and swamp. The procedure followed in estimating the contribution of each is outlined in Table 4.21. Production percentages from Table 4.18 were applied to total sport fishing demand to derive the amount of demand (in thousands of man-days) attributable to marsh and swamp respectively. The authors then divided each figure by the appropriate number of acres and multiplied the resulting numbers by $2.00, the man-day value derived from Principles and Standards. The economic contribution of a marsh acre in the Barataria Basin for sport fishing is $12.01 per year. The corresponding value for a swamp acre is $1.35 per year.

## Commercial and Sport Wildlife and Water-Oriented Recreation

The next component in the Corps' evaluation of wetlands is commercial wildlife. Column 1 of Table 4.22 shows the average annual dollar value of meats and pelts for the entire Louisiana coastal region, based on data supplied by the Louisiana Wildlife and Fisheries Commission. The percentage of each furbearing species harvested from forested areas--based on interpretations of the available data made by New Orleans District Corps personnel--is indicated in the second column of the same table. Values for animals trapped in forested areas, according to species, were derived by applying the percentages in column 2 to the average animal values in column 1. The authors next obtained per-acre values (column 4) by dividing the figures in column 3 by the number of forested acres. The percentage of each species trapped in bottomland hardwood areas (column 5) was derived from Nichols and

---

[8]Sport shrimping and crabbing supply figures are not given in Table 4.19 because, according to the Corps report the yield of shrimp and crabs is presently at a maximum level. Therefore, demand necessarily exceeds supply.

TABLE 4.20

TOTAL SPORT FISHING DEMAND WHERE DEMAND EXCEEDS SUPPLY (1,000 MAN-DAYS)

| ACTIVITY | 1,000 MAN-DAYS |
|---|---|
| Sport Crawfishing | 76 |
| Saltwater Sport Finfishing | 1,607 |
| Freshwater Sport Finfishing | -- |
| Sport Shrimping | 149 |
| Sport Crabbing | 751 |
| Total Sport Fishing Demand | 2,583 |

Source: From Table 4.19 and U.S. Army Corps of Engineers, 1977.

TABLE 4.21

SALTWATER SPORT FISHERY MAN-DAYS/ACRE AND VALUE/ACRE OF MARSH AND SWAMP IN THE BARATARIA BASIN

| | MARSH | SWAMP |
|---|---|---|
| Percent Production | 97.2 | 2.8 |
| Total Sport Fishing Demand (1,000 Man-Days) | 2,583 | 2,583 |
| Demand Attributable | 2,511 | 72 |
| Thousands of Acres | 418 | 107 |
| Man-Days/Acre | 6.0 | .67 |
| Value/Acre P&S ($2.00/Man-Day) | 12.01 | 1.35 |

Source: From Tables 4.18 and 4.20.

TABLE 4.22

COMMERCIAL FURBEARER VALUE PER ACRE FOR THE LOUISIANA COASTAL REGION

| | COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 | COLUMN 9 |
|---|---|---|---|---|---|---|---|---|---|
| SPECIES | AVERAGE ANNUAL VALUE ($) MEATS PLUS PELTS | PERCENT FROM FORESTED AREAS | TOTAL ($) VALUE FROM FORESTED | $ VALUE/ ACRE FROM FORESTED | PERCENT FROM BLHW[1] | $ VALUE PER ACRE BLHW | $ VALUE PER ACRE SWAMP | TOTAL ($) AMOUNT FROM MARSH | $ VALUE PER ACRE MARSH |
| Muskrat | 1,172,325 | 1 | 11,723 | .009 | 13 | .001 | .008 | 1,160,602 | .475 |
| Nutria | 6,805,379 | 5 | 340,269 | .265 | 17 | .045 | .22 | 6,465,110 | 2.648 |
| Mink | 117,565 | 45 | 52,904 | .041 | 65 | .027 | .014 | 64,661 | .026 |
| Raccoon | 856,307 | 35 | 299,707 | .233 | 82 | .191 | .042 | 556,600 | .228 |
| Otter | 196,319 | 10 | 19,631 | .015 | 81 | .012 | .003 | 176,688 | .072 |
| Opossum | 63,290 | 20 | 12,658 | .010 | 60 | .006 | .004 | 50,632 | .021 |
| Fox | 25,439 | 100 | 25,439 | .019 | 100 | .019 | - | - | - |
| Bobcat | 9,005 | 100 | 9,005 | .007 | 57 | .004 | .003 | - | - |
| TOTAL | 9,305,629 | | | | | .31 | .29 | | 3.47 |

1. Bottomland Hardwoods.

Source: U.S. Army Corps of Engineers, 1977.

Chabreck (1973) and multiplied by the dollar per acre values from forested areas to obtain values per acre for bottomland hardwood areas, shown in column 6. Dollar values per acre of swamp (column 7) were calcualted by subtracting the per-acre values for bottomland hardwoods from the corresponding values for forested acres. The rationale behind the latter method for determining the value of trapped animals from swamps is that total forested acreage represents the sum of bottomland hardwood and swamp areas. The resulting annual value per acre for furbearers from swamps is $.29.

Employing a method similar to the one described above, based on the rationale that total acreage in the coastal region represents the sum of forested areas and marsh, the authors of the Corps study calculated total values for furbearing animals from marsh. Each of the figures in column 8 represents the difference between average annual species value and the species value for animals from forested areas. The figures for marsh were then divided by total marsh acreage to derive per-acre values. The overall annual value for furbearers from marsh is $3.47 per acre. Both this figure and the figure for swamp acreage apply to the entire coastal region of Louisiana. Because data for individual hydrologic units were unavailable, the authors did not attempt to calculate values specifically applicable to the Barataria Basin.

The final component in the Value of Wetlands study includes valuation of marsh and swamp for non-commercial (sport) wildlife production and water-oriented recreation (WOR). With respect to sport wildlife, the authors draw a distinction between small game and large game. Man-days data for each recreational category (water-oriented recreation, small-game hunting and big-game hunting) are shown in Table 4.23. For each activity, the respective numbers of man-days attributable to marsh and swamp were multiplied by the appropriate Principles and Standards factor to obtain total values. Per-acre figures were derived by dividing the numbers in the man-days and total value columns by the number of marsh or swamp acres in the Barataria Basin.

Table 4.24 offers a summary of the total annual per-acre values derived in previous tables. By adding the respective values for commercial and sport fishing, commercial and sport wildlife, and water-oriented recreation, the authors of the Corps report arrived at overall values of $112.78 per year for an acre of marsh and $16.26 per year for an acre of swamp in Hydrologic Unit IV.

TABLE 4.23

SPORT WILDLIFE AND WATER-ORIENTED RECREATION VALUES IN THE BARATARIA BASIN

| | MAN-DAYS (1,000) | TOTAL VALUE ($1,000) | MAN-DAYS/ ACRE | VALUE/ACRE P&S |
|---|---|---|---|---|
| | | P&S ($2.00/MD) | | |
| WOR[1] | | | | |
| Marshes | 274.7 | 549.4 | .66 | 1.31 |
| Swamps | 106.9 | 213.8 | .65 | 1.30 |
| | | P&S ($3.00/MD) | | |
| Small Game | | | | |
| Marshes | 90.9 | 272.7 | .22 | .65 |
| Swamps | 69.9 | 209.7 | .43 | 1.28 |
| | | P&S ($9.00/MD) | | |
| Big Game | | | | |
| Marshes | 69.3 | 623.7 | .17 | 1.49 |
| Swamps | 27.0 | 243 | .16 | 1.48 |

1. Water-Oriented Recreation.

Source: U.S. Army Corps of Engineers, 1977.

TABLE 4.24

TOTAL ANNUAL VALUE PER ACRE OF MARSH AND SWAMP IN THE BARATARIA BASIN

| ACTIVITY CATEGORY | MARSH | SWAMP |
|---|---|---|
| Small Game | $ .65 | $ 1.28 |
| Large Game | $ 1.49 | $ 1.48 |
| WOR[1] | $ 1.31 | $ 1.30 |
| Commercial Wildlife | $ 3.47 | $ .29 |
| Commercial Fishing | $ 93.85 | $10.56 |
| Sport Fishing | $ 12.01 | $ 1.35 |
| TOTAL | $112.78 | $16.26 |

1. Water-Oriented Recreation.

Source: U.S. Army Corps of Engineers, 1977.

## Review of Corps Methodology

In reviewing the methodology employed in Value of Wetlands, the authors of the present study noted several shortcomings. The first of these is related to the fact that the authors of the Corps report make no attempt to subtract from the values for commercial fishing and wildlife the costs of obtaining fish, fur and meats: i.e., no consideration is given to expenditures for licenses, boats, labor, equipment, etc. In failing to deduct expenses from total value, Corps personnel apparently overlooked the following guidelines from Principles and Standards:

> The beneficial effects from the increase in output of fish and wildlife products resulting from a plan are measured as the total value to the final users of the output reflected by the applicable market price, minus the expenditures incurred to obtain the fish or game (Water Resources Council, 1973: 53).

However, such costs are exceedingly difficult to obtain.

A second shortcoming of the study involves the way in which values for sport fishing are calculated. The authors attribute a net value to recreational fishing only when estimated demand exceeds supply. When such a situation does in fact exist, total demand is used as the basis for calculating total value. The authors of the present study are of the opinion that actual supply, regardless of demand, should be the prime consideration in determining the value of wetlands for recreational fishing. In other words, valuation should relate to the resource itself rather than demand for it.

The motivation for the Corps approach may lie in a Water Resources Council (1973) requirement relevant to the proposed addition of specific recreational facilities in an area that has no need for such facilities. In analyzing a proposal of this kind, the additional facilities are not included as a benefit; since supply exceeds demand (Water Resources Council, 1973: 50). The distinction, of course, is that Principles and Standards is oriented to evaluating the benefits of a proposed project whereas the valuation of wetlands in their natural state is not. Consequently, supply rather than demand is the issue.

In addition, the demand-oriented methodology adopted for the sport fishing section is not implemented with respect to sport wildlife or water-oriented recreation. Therefore, the demand approach is not only ill-advised, in the opinion of the authors of the present work, but inconsistent with the Corps study as a whole.

Another significant shortcoming of the study is that no attempt was made to take into consideration the multiplied effects of maintaining wetlands. Use of a multiplier is endorsed in the following description of location effects on regional development from Principles and Standards:

> Location effects are generally estimated as a multiplier factor of the more direct project outputs on the region being considered. General alternative means of calculating such a multiplier value are available. They include input-output studies, economic base studies, and the application of Keynesian multiplier concepts to regions. Recent studies have indicated that all three approaches provide comparable values for the same region. The Water Resources Council will provide information on the appropriate multiplier values to use for specific planning studies (Water Resources Council, 1973: 78).[9]

The Office of the Chief of Engineers, Department of the Army, has also recognized the legitimacy of using a multiplier in the following interpretation of Principles and Standards:

> Subsequent impacts. This category includes expenditures made after the NED and direct expenditures. For example, a reduction in agricultural flood losses may mean that farmers have more income which can be expended on additional farm equipment or house furnishings; obviously farm equipment and furniture retailers will, in turn, have increased income to spend; and so forth. Such second and third round economic impacts are generally referred to as "multiplier" effects. Their measurement

---

[9] The use of multipliers relates only to calculations under the Regional Development Account (RDA), not those concerned with National Economic Development (NED) benefits (Roy, 1978).

> is especially difficult, particularly for small regions. These subsequent impacts will be separately shown. The Bureau of Economic Analysis (BEA), U.S. Department of Commerce, has developed some preliminary tools for the estimation of multiplier effects. Whenever a planner decides to display multiplier effects for an area in which BEA is capable of making an estimate at reasonable cost, the BEA data will be obtained; deviations will be explained. In addition, WRC, in conjunction with BEA, is developing a set of regional multipliers. When these become available, they will be used (Office of the Chief of Engineers, 1975: 14).

In conclusion, the authors of this study found the following flaws in the Value of Wetlands:

1) Failure to subtract the costs of operation in commercial fishing and hunting. Inclusion would decrease the value per acre considerably.

2) Sport fishing values based on demand in excess of supply rather than simply total supply. Considering only supply would affect total value per acre.

3) Failure to include multiplied effects. The use of a multiplier would obviously increase total value per acre.

## SUMMARY

This chapter has investigated three techniques for the evaluation of wetlands in the Barataria Basin: two developed by the authors of this study as well as the methodology adopted by the Corps of Engineers' New Orleans District for its own use. A summary of the values derived from employing each of these techniques (plus a revision of the "Gross Benefits Technique" from Appendix 4.2) is provided in Table 4.25. The first method outlined in this chapter involved estimating gross benefits to the economy. For commercial fishing and trapping, a multiplier was applied to include value added due to processing. Because the non-commercial fish catch represents a significant portion of total landings, the value of fish landed by sport fishermen was also claculated by multiplying the average price per pound for commercial fish by the estimated number

TABLE 4.25

SUMMARY OF VALUES FROM ALTERNATIVE METHODS FOR VALUING AN ACRE OF WETLANDS IN THE BARATARIA BASIN

| VALUATION TECHNIQUE | ANNUAL RETURN PER ACRE | PRESENT VALUE PER ACRE |
|---|---|---|
| Gross Benefits | $465.65 | $9,058.93 |
| Consumer's Surplus | $132.69 | $2,840.74 |
| U.S. Army Corps of Engineers | $129.04 | --* |
| Value from Appendix 4.2 | $197.65 | $3,993.28 |

*The U.S. Army Corps of Engineers only computes wetlands value on an annual basis.

Source: Authors. Compiled from the text of this chapter.

of pounds caught by recreational fisherman. A dollar value for sport fish landings was not included in the Corps study and its use herein represents a significant improvement on the methodology employed in Value of Wetlands. Another improvement adopted in the "Gross Benefits Technique" section of this chapter involved calculation of values for total expenditures by sport fishermen and hunters. In addition, the total value of recreational experiences in the Barataria wetlands was estimated by applying user-day data to suggested values from Principles and Standards.

The second approach to valuation of wetlands developed in this chapter was based on the economic concept of consumer's surplus. This approach attempts to measure the amount that a consumer would be willing to pay to continue receiving a good or service over and above what that consumer is already paying. The market price reflects only the value placed on the good by those consumers who are only marginally interested in consuming the product or service; it does not take account of the value placed on it by other consumers, as reflected in their willingness to pay. The consumer's surplus method seeks to determine the entire value attributed to a commodity by all consumers. Another important aspect of the consumer's surplus approach is that it excludes the need to know the costs of production from the valuation procedure. The assumption made here is that the resources employed to produce the good are not part of the value of the resource but are transferable to other uses. Thus, the net value to society of wetlands in the Barataria Basin is properly measured in terms of consumer's surplus.

To apply the consumer's surplus model, demand curves for commercial fishing and trapping were estimated using past landings and price per pound data for the State of Louisiana. Average values for quantity and price were derived and the contribution of the Barataria Basin was subtracted from the state total to determine a new quantity and price. The area of the polygon under the demand curve depicting the net loss of consumer's surplus to society (see Figures 4.1.1, 4.1.2, 4.1.3 in Appendix 4.1) was calculated to represent the value of Barataria wetlands to commercial fishing and trapping.

Because recreational services are generally not priced, the difficulty of applying the consumer's surplus model to recreation made the use of this approach impractical. The user-days model used in the gross benefits section was substituted in this instance.

It should be understood that there is a fundamental difference in philosophy between the consumer's surplus approach and the other two methods discussed in this report. The consumer's surplus approach represents the theoretical economist's concept of the net economic value of a resource to society. The U.S. Army Corps of Engineers' method and the gross impact method evaluate wetlands, for the most part, in terms of their monetary contribution to the economy of Louisiana.

Finally, this chapter outlined the methodology developed by the Corps of Engineers' New Orleans District in Value of Wetlands and Bottomland Hardwoods. The latter study was faulted for its failure to include multiplied effects of commercial fishing and trapping activities and for its computation of the value of sport fishing based on demand in excess of supply rather than supply itself.

## APPENDIX 4.1

## RESULTS OF REGRESSION ANALYSIS

### Commercial Fishing

A demand curve was estimated using annual landings of fish and shellfish for Louisiana for the years 1966-76 (see Figure 4.1.1).

The slope of the line is -.000000000040713

The Y intercept is .13664

$R^2$ is .21155

This is equivalent to:

Δ catch = 10,000,000,000

Δ price = $.41

From Value of Wetlands:

| | |
|---|---|
| average landing per year in Louisiana (in pounds) 1963-73 is | 1,041,440,000.0 |

From Value of Wetlands:

| | |
|---|---|
| average landing per year in the Barataria wetlands (1963-73) is | 468,830,000.0 |

Therefore,

| | |
|---|---|
| average landing per year in Louisiana without the contribution of the Barataria wetlands is | 572,610,000.0 |

Based on the specified demand curve and average landings,

| | |
|---|---|
| average annual price in Louisiana is | $.0942 |
| average annual price in Louisiana without the contribtuion of Barataria wetlands is | $.1133 |

The area of consumer's surplus at price $.0942 is shown as triangle ACF in Figure 4.1.1. The area of consumer's surplus at price $.1133 is triangle ABD. The loss in consumer's surplus is the trapezoidal area BCFD. That area is calculated as follows:

The area of rectangle BCDE is

width = .1133 - .0942 = .0191

length = 572,610,000

length x width = $10,936,851.00

The area of triangle DEF is

base = 468,830,000

height = .0191

$\frac{1}{2}$ x base x height = $ 4,477,326.50

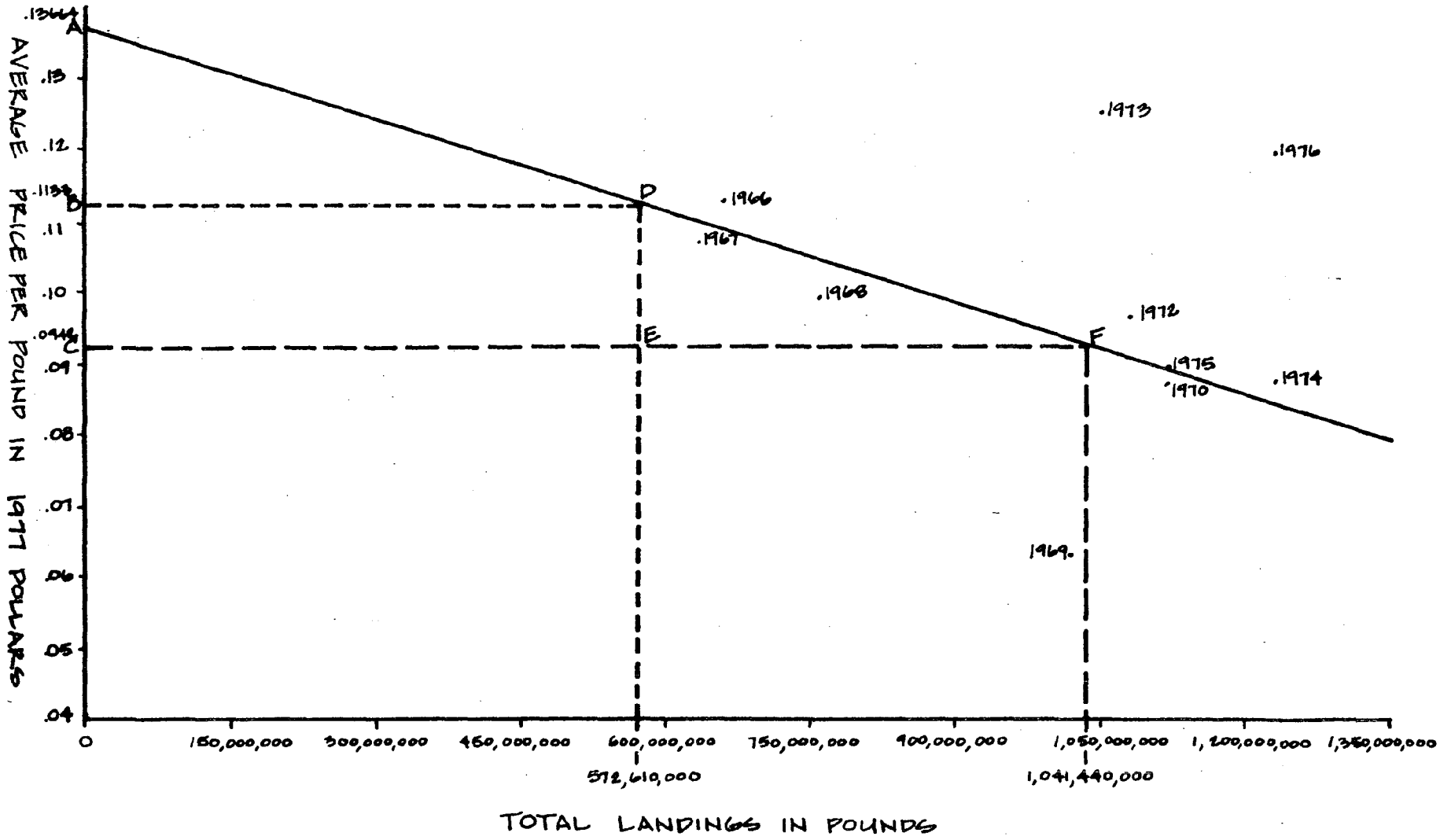
The total area of consumer's surplus is $15,414,177.50

The per acre value is $\frac{\$15,414,177.50}{582,700}$ = $26.45

Present value is $\frac{\$26.45}{.06875}$ = $384.73

FIGURE 4.1.1

ESTIMATED DEMAND CURVE FOR LOUISIANA COMMERCIAL FISH PRODUCTS (1966-76)




Source: National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 1967-77.

Commercial Trapping

1) Pelts

A demand curve was estimated using annual harvest of pelts for Louisiana for the years 1967-75 (see Figure 4.1.2).

The slope of the line is -.00000113

The Y intercept is 7.292

$R^2$ is .1391

This is equivalent to

$\Delta$ catch = 1,000,000

$\Delta$ price = $1.13

From Table 4.6

| | |
|---|---|
| average annual harvest of pelts in Louisiana 1967-75 is | 2,386,903 |

Based on the percentage computed in the text,

| | |
|---|---|
| average annual harvest of pelts in Barataria wetlands is (2,386,903)(.1786) = | 426,301 |

Therefore,

| | |
|---|---|
| average annual harvest of pelts in Louisiana without the contribution of the Barataria wetlands is | 1,960,602 |

Based on the specified demand curve

| | |
|---|---|
| average annual price in Louisiana is | $4.5997 |
| average annual price in Louisiana without the contribution of Barataria wetlands is | $5.0806 |

The area of consumer's surplus at price $4.5997 is shown as triangle GIL in Figure 4.1.2. The area of consumer's surplus at price $5.0806 is triangle GHJ. The loss in consumer's surplus is the trapezoidal area HILJ. That area is calculated as follows:

The area of rectangle HIJK is

width = 5.0806 - 4.5997 = .4809

length = 1,960,602

length x width = $ 942,853.50

The area of triangle JKL is

base = 426,301

height = .4809

½ x base x height = $ 102,504.08

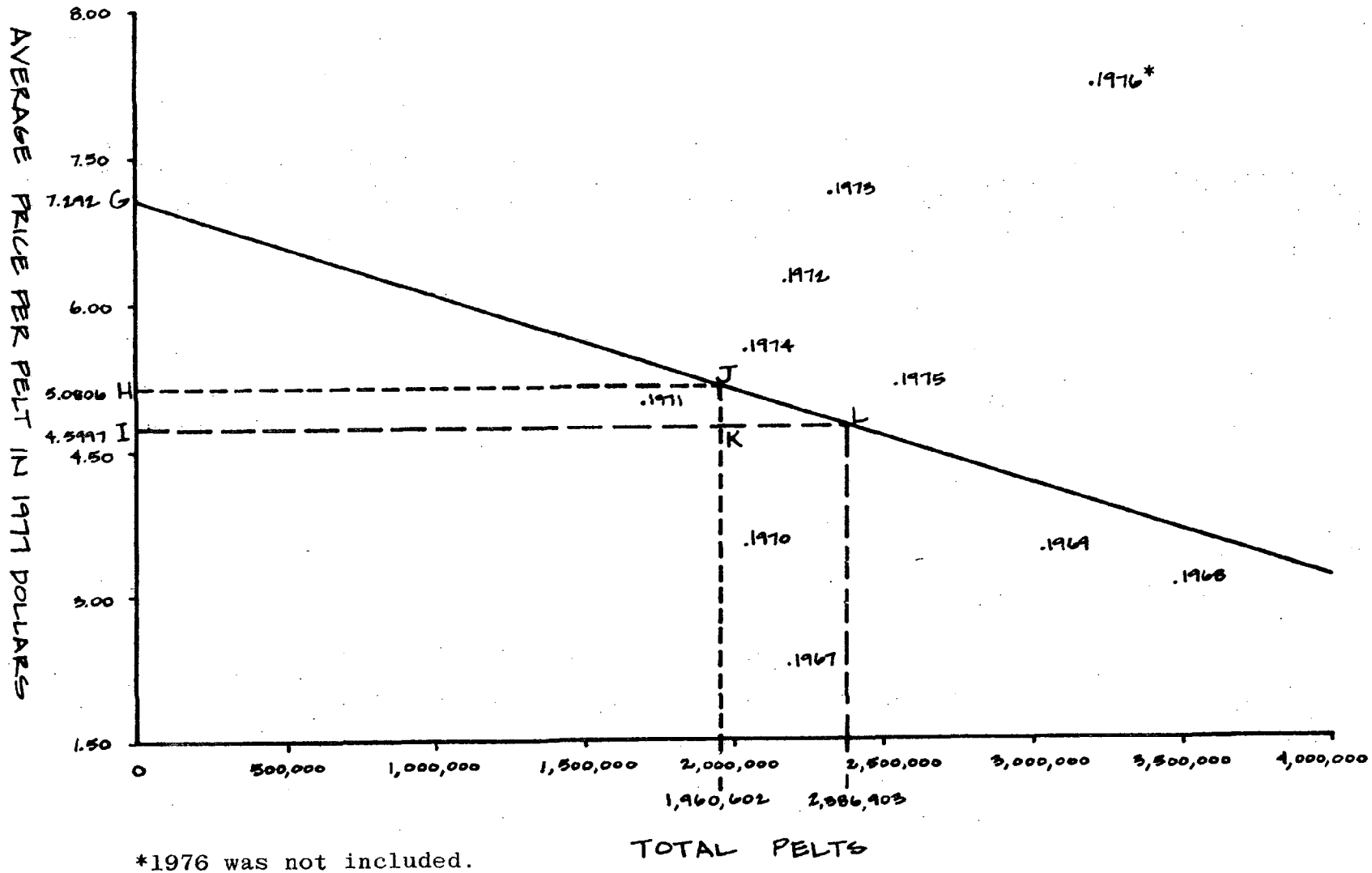
The total area of consumer's surplus is $1,045,357.58

The per acre value is $\frac{1,045,357.58}{582,700}$ = $ 1.79

Present value is $\frac{\$1.79}{.06875}$ = $26.09

FIGURE 4.1.2

ESTIMATED DEMAND CURVE FOR LOUISIANA COMMERCIAL PELTS (1967-75)




*1976 was not included.

Source: Louisiana Wildlife and Fisheries Commission, 1977b.

2) Meats

A demand curve was estimated using annual harvest of meats for Louisiana for the years 1967-76 (see Figure 4.1.3).

The slope of the line is -.0000000045

The Y intercept is .19126

$R^2$ is .333

This is equivalent to:

$\Delta$ catch = 10,000,000

$\Delta$ price = $.045

From Table 4.8

| | |
|---|---|
| average annual harvest of meats in Louisiana (in pounds) 1967-76 is | 9,815,100.00 |

Based on the percentage computed in the text

| | |
|---|---|
| average annual harvest of meats (in pounds) in Barataria wetlands is (9,815,100)(.1758) = | 1,725,494.58 |

Therefore,

| | |
|---|---|
| average annual harvest of meats (in pounds) in Louisiana without the contribution of Barataria wetlands is | 8,089,605.42 |

Based on the specified demand curve,

| | |
|---|---|
| average annual price in Louisiana is | $.1472 |
| average annual price in Louisiana without the contribution of the Barataria wetlands is | $.1549 |

The area of consumer's surplus at price $.1472 is shown as triangle MPS in Figure 4.1.3. The area of consumer's surplus at price $.1549 is triangle MNQ. The loss in consumer's surplus is the trapezoidal area NPSQ. That area is calculated as follows:

The area of rectangle NPRQ is

width = .1549 - .1472 = .0077

length = 8,089,605.42

length x width = $62,289.96

The area of triangle QRS is

base = 1,725,494.58

height = .0077

$\frac{1}{2}$ x base x height = $ 6,643.15

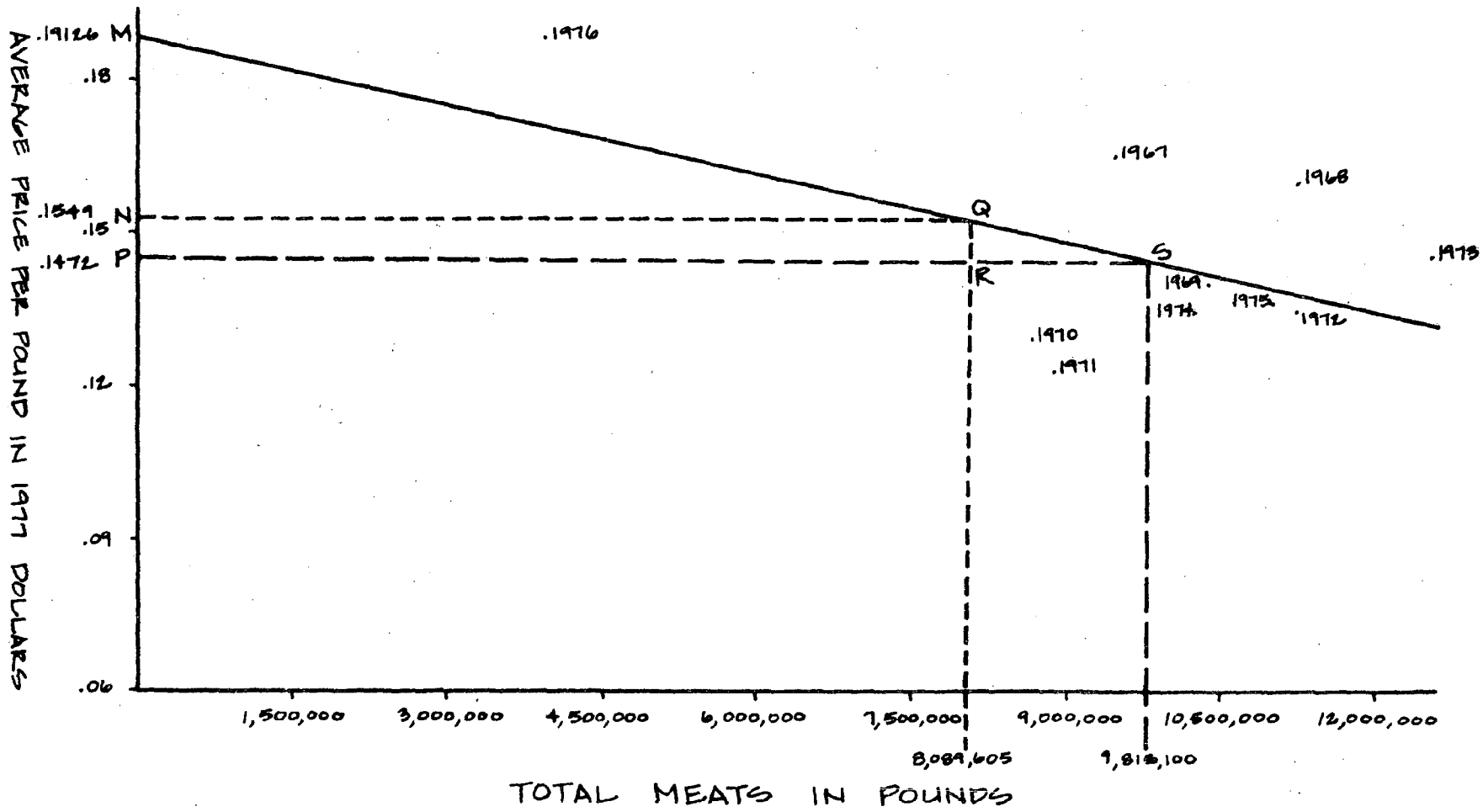
The total area of consumer's surplus is $68,933.11

The per acre value is $\frac{\$68,933.11}{582,700}$ = $ .12

Present value is $\frac{\$.12}{.06875}$ = $1.75

FIGURE 4.1.3

ESTIMATED DEMAND CURVE FOR LOUISIANA MEAT PRODUCTS (1967-76)




Source: Louisiana Wildlife and Fisheries Commission, 1977b.

## APPENDIX 4.2

## REVISED GROSS BENEFIT TECHNIQUE

On April 12, 1978 representatives of the U.S. Army Corps of Engineers New Orleans District, Louisiana Department of Transportation and Development, Louisiana Wildlife and Fisheries Commission, LSU Center for Wetland Resources and Burk and Associates met to discuss the preliminary draft of this report. Some useful suggestions were made and certain changes were incorporated into the final report.

It became apparent at the meeting that the "Gross Benefits Technique" required some revisions in order to make it comply with internal regulations which govern U.S. Army Corps of Engineers wetlands valuation procedures. Two specific changes were proposed. First, it was suggested that the multiplier effects which the authors considered part of the benefits from commercial fishing, commercial trapping, and recreation expenditures be excluded. The second issue concerns the recreational user day values proposed in Water and Related Land Resources: Establishment of Principles and Standards for Planning (1973). The authors of this report updated these 1973 values to reflect 1977 prices, but representatives of the U.S. Army Corps of Engineers stated that their regulations would not allow the use of values other than those published in the original document.

An alternate value per acre of wetlands, incorporating these two changes is presented in Appendix Table 4.2.1. The annual value per acre decreases to $197.65 and the present value per acre becomes $3,993.28.

The "Consumer's Surplus Technique" was found to be in full compliance with Corps of Engineers regulations.

TABLE 4.2.1

REVISED ESTIMATE OF GROSS ECONOMIC CONTRIBUTION
OF A WETLAND ACRE IN THE BARATARIA BASIN
BASED ON U.S. ARMY CORPS OF ENGINEERS REGULATIONS

| ACTIVITY CATEGORY | ANNUAL RETURN PER ACRE | PRESENT VALUE PER ACRE |
|---|---|---|
| Commercial Fishing | $ 93.13 | $1,801.76 |
| Non-Commercial Fishing | $ 3.19 | $ 46.40 |
| Commercial Trapping (pelts & meats) | $ 3.80 | $ 55.30 |
| Recreation | | |
| Economic Impact of Recreation Expenditures | $ 20.58 | $ 299.28 |
| Economic Value of User Benefits from Recreation | $ 76.95 | $1,790.54 |
| TOTALS | $197.65 | $3,993.28 |

Source: Authors. Values based on Table 4.13.

## REFERENCES


Barlowe, R. (1972) Land Resource Economics. Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Bohm, P. (1972) "Estimating Demand for Public Goods: An Experiment," European Economic Review, Volume 3, Number 2, 111-130.

Brookshire, D., B. Ives and W. Schulze (1976) "Valuation of Aesthetic Preferences," Journal of Environmental Economics and Management, Volume 3, Number 4, 325-46.

Council of Economic Advisors (1977) Economic Report of the President. Washington, D.C.: U.S. Government Printing Office.

Greenfield, H. (1978) National Marine Fisheries Service, St. Petersburg, Florida, telephone interview, April.

Lancaster, K. (1971) Consumer Demand: A New Approach. New York, New York: Columbia University Press.

Louisiana Advisory Commission on Coastal and Marine Resources (1973) Louisiana Wetlands Prospectus. Baton Rouge, Louisiana: Louisiana Office of State Planning.

Louisiana State Parks and Recreation Commission (1971) Comprehensive Outdoor Recreation Plan, 1970-75. Baton Rouge, Louisiana: Louisiana State Parks and Recreation Commission.

_____ (1974) Outdoor Recreation in Louisiana, 1975-80. Baton Rouge, Louisiana: Louisiana State Parks and Recreation Commission.

Louisiana Wildlife and Fisheries Commission (1977a) Licenses Sold By Parish, 1976-77 Season. New Orleans, Louisiana: Louisiana Wildlife and Fisheries Commission.

_____. Fur Division (1977b) Comparative Takes of Fur Animals in Louisiana. New Orleans, Louisiana: Louisiana Wildlife and Fisheries Commission.

Mumphrey, A. J., et al. (1975) Louisiana Metropolitan Wetlands: A Planning Perspective. New Orleans, Louisiana: Urban Studies Institute, University of New Orleans.

Muskin, S. (1972) Public Prices for Public Products. Washington, D.C.: The Urban Institute.

National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (1967-77) Louisiana Landings. Washington, D.C.: U.S. Government Printing Office. December.

_____ (1974-77) Fisheries of the United States. Washington, D.C.: U.S. Government Printing Office.

_____ (1978) Louisiana Landings. Washington, D.C.: U.S. Government Printing Office. March.

Office of the Chief of Engineers, Department of the Army (1975) Planning Process. Washington, D.C.: U.S. Government Printing Office.

Polinsky, A. and S. Shavell (1976) "Amenities and Property Values in a Model of an Urban Area," Journal of Public Economics, Volume 5, Number 2, 119-129.

Rosin, S. (1974) "Hedonic Prices and Implicit Markets: Product Differentiation in Price Competition," Journal of Political Economy, Volume 82, Number 1, 34-55.

Roy, James F. (1978) Chief of Planning Division, New Orleans District U.S. Army Corps of Engineers, New Orleans, Louisiana, personal communication, July 3.

Stone, J., et al. (1973) Louisiana Superport Studies, Report 3. Baton Rouge, Louisiana: Louisiana State University, Center for Wetland Resources.

U.S. Army Corps of Engineers (1977) Value of Wetlands and Bottomland Hardwoods. New Orleans, Louisiana: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers, Louisiana Wildlife and Fisheries commission and U.S. Fish and Wildlife Service (1975) Fish and Wildlife Study of the Louisiana Coastal Area and Atchafalaya Basin Floodway. New Orleans, Louisiana: U.S. Army Corps of Engineers, draft.

U.S. Bureau of the Census, U.S. Department of Commerce (1971) Number of Inhabitants, Louisiana. Washington, D.C.: U.S. Government Printing Office.

_____ (1972) Census Tracts: New Orleans, Louisiana Standard Metropolitan Statistical Area. Washington, D.C.: U.S. Government Printing Office.

U.S. Fish and Wildlife Service, U.S. Department of the Interior (1977) 1975 National Survey of Hunting, Fishing and Wildlife-Associated Recreation. Washington, D.C.: U.S. Government Printing Office.

Water Resources Council (1973) Water and Related Land Resources: Establishment of Principles and Standards for Planning, Federal Register, Volume 38, Number 174, September 10, 1973. Washington, D.C.: U.S. Government Printing Office.

Whitman, I. (1971) "Economic and Social Value of Estuarine Recreation" in Environmental Protection Agency and Batelle Institute, The Economic and Social Importance of Estuaries. Washington, D.C.: U.S. Government Printing Office.

Willig, R. (1966) "Consumer's Surplus Without Apology," American Economic Review, Volume 66, Number 4, 589-597.

Wilman, E. and J. Krutilla (1977) Environmental Impacts and Economic Evaluation Research Needs for Major Development Activities in the Coastal Zone. Washington, D.C.: Resources for the Future, draft.