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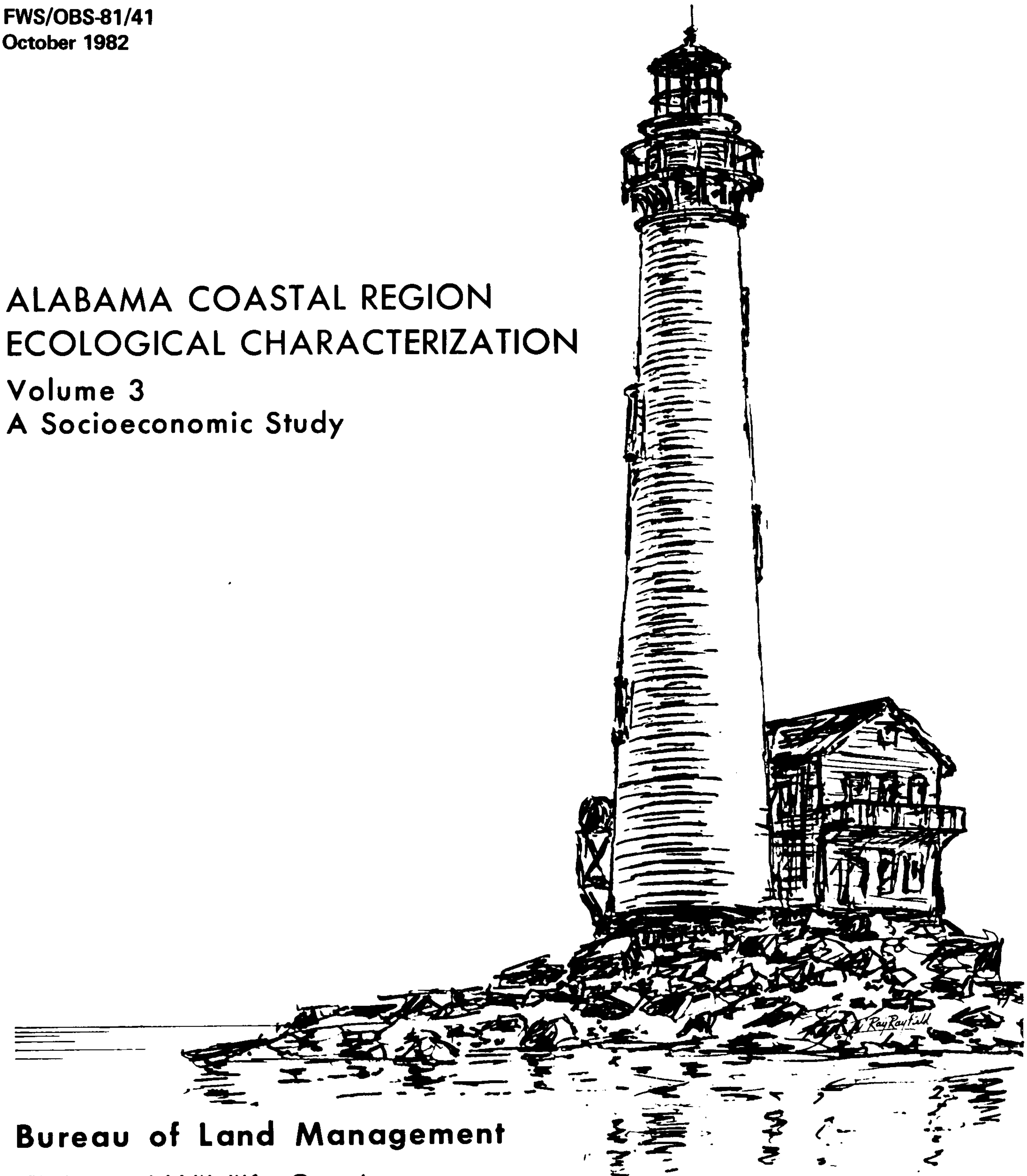

ALABAMA COASTAL REGION ECOLOGICAL CHARACTERIZATION

Volume 3
A Socioeconomic Study

Bureau of Land Management

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ALABAMA COASTAL REGION ECOLOGICAL CHARACTERIZATION
VOLUME 3
A SOCIOECONOMIC STUDY

by

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PREFACE

The purpose of the socioeconomic characterization study is to compile and synthesize information from existing sources concerning the social, demographic, and economic factors in the Alabama Coastal Region. Planners and managers, among others, should find this report and its data base useful for coastal resource planning and management. This report is one of a series of characterizations of coastal ecosystems that is being produced by the U.S. Fish and Wildlife Service. This series attempts to describe the relationships between human population growth and the availability of natural resources in the Nation's coastal areas.

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SUMMARY

PHYSICAL DESCRIPTION

The Alabama Coastal Region is located in the extreme southwest corner of Alabama, bordering Mississippi on the west and Florida on the east. It includes Mobile and Baldwin Counties, Mobile Bay, the adjacent waters of the Mississippi Sound, and waters within the 3-mile limit of the Gulf of Mexico. Mobile Bay and the Mobile-Tensaw River Delta divide Mobile and Baldwin Counties.

The topography of the region generally is flat to slightly rolling but hilly in the northern portion. Mobile Bay is the dominant topographical feature of the area. The Bay is shallow—less than 3 m (10 ft) deep in most areas—but contains several ship channels up to 12 m (40 ft) deep.

Physiographically, coastal Alabama lies in the Gulf Coastal Plain (GCP) province. The Southern Pine Hills, a moderately dissected southward sloping plain, comprise a major portion of the province. Excellent forestry resources and agricultural lands characterize the area. South of the GCP province, the coastal lowlands form a narrow border adjacent to and paralleling the shoreline. This area includes the alluvial-deltaic plains of the Mobile, Tensaw, and Perdido fluvial systems and many streams and rivers.

The climate of coastal Alabama is humid and nearly subtropical. Summers are long and hot, and winters are short and moderate. July temperatures average 27°C (80°F) and January temperatures average 10°C (50°F). Annual rainfall is high, averaging 173 cm (68 inches) according to the South Alabama Regional Planning Commission (1975).

Coastal Alabama contains approximately 7,484 km^2 (2,890 mi^2) of land area: 321,408 ha (793,600 acres) in Mobile County and 427,835 ha (1,056,400 acres) in Baldwin County. Baldwin County is the largest county in Alabama.

SOCIAL AND DEMOGRAPHIC CHARACTERISTICS

Coastal Alabama is a fast growing area. The population of Mobile and Baldwin Counties increased from 174,300 in 1940 to 442,800 in 1980. Rapid growth is expected to continue but at a slower rate. By 2000, the population of the coastal counties may be about 512,600. The population of Mobile, the area's largest population center, currently is about 200,500.

Compared to many areas of the Nation, the people of coastal Alabama are less affluent, less educated, and the population has a larger proportion of Blacks. Recent trends indicate that the gap in income is narrowing.

INDUSTRIAL AND RESIDENTIAL DEVELOPMENT

For an area to grow and prosper, it must produce goods and services that exceed local demand and can be exported. A sector of the local economy that exports goods and services is "basic" in the sense that its growth stimulates growth in local trade and other services. Basic industries are the "prime movers" of the local economy.

The eight basic industries or services in the coastal region are paper and allied products; shipbuilding and repair; chemicals and allied products; construction; transportation, communication, and utilities; lumber and wood products; services; and wholesale and retail trade.

The natural resources that support basic industries are lands that support agriculture, forests that generate raw materials for paper and lumber production, rivers that provide paper and chemical operations with essential water supplies, and a port area that supports shipbuilding and commerce.

Coastal Alabama's employment increased from 131,600 in 1969 to 172,300 in 1978 and should reach 233,400 by the year

2000. Impetus for future economic expansion will be generated by the Tennessee-Tombigbee Waterway, increased coal shipments through the Port of Mobile, and expanded production, storage, and transportation of oil and gas.

The land area of the coastal counties is 7,484 km^2 (2,890 mi^2). In 1975, forested lands made up 48% of the total land area; agriculture made up 19%; transportation, communication, and utilities, 3%; residential, 2%; industrial and commercial, 1%; and 27%, undeveloped.

Mobile County is an urban and industrial complex centered around the city of Mobile. Major industrial developments are along the Mobile River east of the urbanized center and in the Theodore area south of the city. Baldwin County is predominantly rural. Major residential developments are concentrated along the eastern shore of Mobile Bay.

AGRICULTURAL PRODUCTION

Although agriculture and forestry are the dominant land uses in the two coastal counties, income from these sectors is relatively low. In 1978, agriculture, directly and indirectly, generated about 11% of the total employment and income, and forestry generated only 1%.

Most agriculture is concentrated in the southern portions of the coastal counties, whereas much of the timber production occurs in the north. The principal agricultural products are soybeans, vegetables, cattle and calves, and nursery products. The major forestry products are lumber and pulpwood.

MINERAL PRODUCTION

The principal products of the mineral industry are oil, gas, sand, gravel, clay, and oyster shells. Among these, oil and gas production is by far the most economically important.

Oil and gas production represent a relatively new but rapidly growing industry in coastal Alabama. Onshore discoveries of oil and gas began in the 1950's and have continued to the present. In 1979, Alabama ranked 17th nationally in the production of oil and condensate and 20th in the production of natural gas. Of the State total, the coastal region contributed 29% of the oil production, 45% of the condensate production, and 12% of natural gas production.

Until recently, oil and gas production in coastal Alabama was limited to onshore wells, however, the recent discovery of natural gas in Mobile Bay has increased interest in bay, nearshore, and offshore exploration, although the primary exploration and production areas are inland. In April 1980, the State of Alabama leased thirteen tracts in the Mobile Bay, Mississippi Sound, and Gulf 3-mile offshore area; in the near future, the federal government may offer tracts for lease sale in the Outer Continental Shelf (OCS) waters of Alabama.

COMMERCIAL FISHING

During early settlement of the region, fish was a major sustenance food, but as preservation methods and efficient transportation developed, fish were exported to inland and overseas markets. Commercial fishing now is an integral part of the coastal economy, contributing food, employment, and income. In 1975, the dockside value of the marine and freshwater fishery was $33.6 million, the processed value of fishery products was $73.1 million, and boats and vessels of the fishing fleet numbered 1,031. The fishery supported 1,923 fishermen, 3,435 seasonal and full-time employees in processing and wholesaling, and 63 wholesale plants. Bayou La Batre and Bon Secour ranked 11th and 19th among U.S. ports in the value of landings (largely shrimp).

In 1978, 23 species (or groups or species) of finfish and seven species of shellfish were landed commercially in coastal Alabama. Shrimp have consistently ranked first in volume and value since 1955, accounting for 33% to 50% of the total pounds landed and between 80% and 85% of the dockside value. In 1976, Alabama shrimp landings were 8.5 million kg (18.7 million lb) worth $30.4 million. The oyster and crab fisheries are relatively small. Dockside values of oysters and crabs were $1.2 million and $281,000, respectively, in 1976. In recent years, Atlantic croaker (*Micropogonias undulatus*) has become the principal finfish species caught in the coastal waters of Alabama, and in 1976, Alabama fishermen caught 77% of the Gulf harvest of croakers. Other major commercial species in the saltwater finfish catch were spotted seatrout (*Cynoscion nebulosus*), southern flounder (*Paralichthys lethostigma*), and striped mullet (*Mugil cephalus*). Commercial freshwater fishing is common in the Mobile Delta, but landings reported for freshwater species there are not considered reliable because of incomplete statistics. Channel catfish (*Ictalurus punctatus*), smallmouth buffalo (*Ictiobus bubalus*), and freshwater drum (*Aplodinotus grunniens*) are the major species.

In the future, federal fishery management programs provided for by the Fishery Conservation and Management Act of 1975 should help to sustain or enhance the coastal commercial fisheries and to reduce foreign competition in traditional fishing waters. The initiation of long-term monitoring programs by the State also will be helpful. The fishing industry, especially the shrimp fishery, has serious problems because of rising costs of fuel and supplies, high interest rates, and competition from foreign imports. This may cause more nearshore shrimp fishing in smaller boats.

TRANSPORTATION

Coastal Alabama is served by a well-developed transportation system. Terminal facilities for rail, highway, air, and water transportation are centered in Mobile County. Water transportation is dominant and has been a basic contributor to economic development of the area since the 17th century.

Mobile Bay is a natural harbor fed by a system of navigable waterways. Mobile currently handles about 36 million mt (40 million t) of traffic annually and ranks thirteenth among the Nation's ports. Bulk commodities comprise about 90% of port traffic. Coal, grain, and iron ore are the principal bulk products.

The Tennessee-Tombigbee Waterway, scheduled for completion in 1986, will link the Tennessee and Ohio Rivers to the Tombigbee River and the Port of Mobile. The "Tenn-Tom" should generate about 15 million mt (16 million t) of additional traffic through Mobile in its first year of operation. According to the U.S. Army Corps of Engineers' projections, commerce moving in deep-draft vessels through the Port of Mobile (including Theodore) should increase from 15 million mt (16 million t) in 1975 to 78 million mt (68 million t) in 2035 because of natural growth and the added Tenn-Tom traffic.

In preparation for increases in navigation, the Alabama State Docks Department has embarked on a massive capital expansion program that emphasizes new coal and grain handling facilities. In addition, the Corps of Engineers has approved a plan to deepen Mobile Harbor's ship channel from its present 12 m (40 ft) to a 17 m (55 ft) depth required to accommodate large bulk-carrier vessels. A controversial element of this plan is the proposal to create a large dredge disposal area on the western shore of Mobile Bay near Brookley Field.

Although the direct economic impact of greatly increased bulk traffic has not been determined, there are indications that the impact on employment and wages may be relatively small.

Major aspects of the other transportation modes are as follows. Intercity highway transportation is served by Interstate highways 10 and 65, and by five other federal highways (31, 43, 45, 90 and 98). Rail service is provided by four railroads—Louisville and Nashville, Illinois Central Gulf, St. Louis-San Francisco (Frisco), and Southern. Only freight service is available.

Air transportation is available at Bates Field and Brookley Field which are owned by the City of Mobile. Bates Field is a commercial aviation facility served by Eastern, Republic, and Pan-American airlines. Brookley, formerly an Air Force Base, is a general aviation facility.

RECREATION/TOURISM INDUSTRY

Coastal Alabama's recreation-tourism industry is directly related to its geography, climate, and history. Because of the warm climate and abundance of surface water, resident recreation is dominated by swimming, fishing, picnicking, hunting, and sightseeing. In 1980, resident and tourist outdoor recreation in Mobile and Baldwin Counties was expected to add up to over 51 million user days. Most of this user participation was near the shore. In 1980, an estimated 4.4 million tourists visited the two-county area and spent $117.8 million.

Sport fishing and hunting are major sports in Alabama because of the extensive area of fresh water, brackish water, and marine habitat and forests. The principal freshwater fishing area in southern Alabama is the Mobile Delta. Its natural high fertility provides ideal conditions for sport species and at the same time serves as a major nursery for many fish and crustaceans. The most important freshwater sport fish are largemouth bass (*Micropterus salmoides*), sunfish (*Lepomis* spp.), crappies (*Pomoxis* spp.), channel catfish (*Ictalurus punctatus*), and alligator gar (*Lepisosteus spatula*).

Marine fishermen use all estuaries and bays of the region as well as the Mississippi Sound and Gulf waters. The most important sport fish are lesser amberjack (*Seriola fasciata*), Spanish and king mackerel (*Scomberomorus maculatus* and *S. cavalla*), southern flounder (*Paralichthys lethostigma*), striped mullet (*Mugil cephalus*), and spotted seatrout (*Cynoscion nebulosus*). Shrimping and crabbing also are major sport activities.

Hunting seasons in coastal Alabama begin in mid-September and continue to late April. Duck and raccoon are hunted in the winter months in the lower Delta, although duck populations have declined drastically since the 1950's. Whitetail deer (*Odocoileus virginianus*), turkey (*Meleagris gallopavo*), and small game are taken in most areas of the region. Trapping is conducted on a very limited scale.

MULTIPLE-USE CONFLICTS

Many of the social and economic benefits prevalent in coastal Alabama are dependent upon natural resources. Competition for these resources causes multiple-use conflicts and environmental stress. Although the conflicts generate some social, economic, and political repercussions, the issues usually are environmental. Major environmental conflicts are dredging, mining, petroleum extraction, construction, transportation, pollution, waste disposal, farming, and logging. Recreation activities most likely to be affected by these multiple uses are commercial fishing, sport fishing, hunting, recreational boating, swimming, hiking and camping.

ENVIRONMENTAL ISSUES AND REGULATIONS

Because of competition for water, land, and air resources, many environmental issues have emerged. With further industrial and port development and population growth, the sharing of these resources will become more difficult.

Water pollution is a serious problem in and adjacent to Mobile Bay. The shallow water and the distance from the Port of Mobile to deeper Gulf waters have required the construction and maintenance of long ship channels. Spoil disposal from these operations has caused serious environmental concerns. Most spoil grounds are adjacent to the channels or in nearshore Gulf waters.

Alteration or destruction of marshes and shallow bay bottoms are caused largely by industrial, urban, suburban, port, commercial, residential, and recreational development. A major need is the prevention of further adverse impacts on those areas that are essential to estuarine productivity and profitable recreational and commercial fishing.

Water quality problems caused by urban and industrial development are common in the metropolitan Mobile area and in localized areas in both counties. Principal point sources of pollution in the area are inadequate municipal sewage treatment facilities and pollution loads from paper mills and chemical plants. Non-point pollution sources include sediment loads from urban storm water runoff, bacterial contamination of Mobile Bay from surface water runoff north of the City, and septic tank drainfields in low-lying areas.

Land utilization in coastal Alabama is complicated by unregulated growth in several unincorporated areas in the two counties. The lack of zoning authority by either county and residential development in flood-prone areas (e.g., residences built on former marsh lands), particularly along the coastline, are particularly serious problems. As coastal development continues, saltwater intrusion, ground water pollution from septic tanks, and habitat loss will become even greater.

Air pollution is confined largely to Mobile County. The county as a whole is designated a non-attainment area for ozone, and a portion of downtown Mobile has unacceptable levels of particulates. The prevention of air pollution associated with increasing industrialization and the need for adequate monitoring are important environmental problems.

Oil and gas exploration and development in State waters has added to and complicated the environmental problems in coastal Alabama. The discovery of gas reserves in Mobile Bay is likely to cause more intensive exploration and development. A new lease sale of State submerged lands and the development of additional exploratory wells by Mobil Oil Company are indicative of this trend. Onshore siting of petroleum-related facilities, placement of pipelines to shore, and the disposal of drilling wastes are potential environmental problems.

A major environmental issue is the loss of natural habitats, many of which provide direct benefits to man. Some of the benefits of estuaries, marshes, and barrier islands, for example, are storm protection (from wind and waves), waste assimilation, and recreation. Threatened and endangered natural lands and waters and other areas of high ecological value to man are the Mobile Delta, coastal barrier islands, submerged grassbeds, tidal marshes, wet acid pinelands, mesic ravine woods, and habitats of endangered and threatened species.

Federal and State environmental laws have important impacts on any problem or issue principally because the laws regulate many activities that generate issues and are major hedges against large-scale environmental destruction. Of major significance are the federal and State water and air pollution control laws, the coastal zone management laws, and laws and regulations governing petroleum exploration and extraction in State and federal waters.

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ABBREVIATIONS AND SYMBOLS

bbl	barrels
BOD	biochemical oxygen demand
bpd	barrels per day
bu	bushels
bu/h	bushels per hour
°C	degrees Celsius
cm	centimeter
COD	chemical oxygen demand
d	day
(D)	data withheld
dwt	deadweight tons
°F	degrees Farenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
gal	gallon
ha	hectare
kg	kilogram
km	kilometer
km^2	square kilometer
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mcf	thousand cubic feet
Mgal/d	million gallons per day
mi^2	square mile
Ml/d	million liters per day
mmcf	billion cubic feet
mmcf/d	billion cubic feet per day
msl	mean sea level
mt	metric tons
NA	not available
no	number
SIC	standard industrial code
t	tons
TSS	total suspended solids
$\mu g/m^3$	micrograms per cubic meter
--	zero

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INTRODUCTION

Since colonial times, the coastal areas of the United States have been the scene of much of the Nation's economic, social, and political history. About 50% of the population now lives within 50 miles of saltwater coasts or the Great Lakes, and the population growth in coastal areas is three times that of the national average.

Economic development in coastal areas has played a major role in increasing the Nation's production of goods and services to over one trillion dollars annually. The natural resources of the coastal areas are attractive for recreation and residential development, each of which conflict with their demands that alter coastal ecosystems. As the demand for coastal resources increases, land-use and resource planners will be confronted with greater challenges in their attempts to maintain a proper balance among competing users.

To assist planners in coastal areas, the U.S. Fish and Wildlife Service has developed an ecological characterization approach for describing coastal areas. This approach characterizes the socioeconomic features, biological resources, and physical processes of a particular coastal ecosystem and forms a functional framework for understanding system interactions. Accordingly, planning is undertaken more with a view toward the whole rather than toward the parts.

The socioeconomic portion of the ecological characterization study for the Alabama Coastal Region is contained in this volume. It consists of a series of chapters containing quantitative and qualitative descriptions of nine socioeconomic components of coastal Alabama (Figure 1). Recommendations for planners and the identification of data gaps are given for each chapter.

The nine chapters in this volume are (1) Social and Demographic Characteristics, (2) Industrial and Residential Development, (3) Agricultural and Forestry Production, (4) Mineral Production, (5) Commercial Fishing, (6) Transportation, (7) Recreation/Tourism, (8) Multiple Use Conflicts, and (9) Environmental Issues and Regulations.

All figures and tables are given in the data appendix in the order that they appear in the text. Specific tables and figures are easily located by referring to the page numbers given in the list of figures and tables in the front material (pages xiv - xxii).

The data contained in this volume were obtained from various published documents. Except for evaluation and interpretation, the socioeconomic portion of the ecological characterization study for the Alabama Coastal Region is based almost entirely on secondary sources, all of which are cited in the reference sections of the papers.

SOCIAL AND DEMOGRAPHIC CHARACTERISTICS

INTRODUCTION

Coastal Alabama, like many of the Nation's coastal areas, has become more populous, more prosperous, more urbanized, and more industrialized since World War II. Although the growth rate of Alabama's coastal area has not been as high as some of the other coastal regions (e.g., Texas and Florida), recent economic and population trends indicate that the area will continue to grow rapidly (Table 1).

Future growth in the area is a great challenge to planners, so the focus of this section is on population growth. Also included are discussions of race, age, education, income, and occupation.

BACKGROUND

Coastal Alabama was first settled by Indians and later by the French. In 1702, a trading center and military outpost was established near the Mobile riverfront. This settlement was at 27 Mile Bluff (south of Mount Vernon) and was vacated in 1711 in favor of the present site of Downtown Mobile almost at the mouth of the river (Hammer, Greene, Siler Associates 1967).

In the late 1700's and early 1800's, Mobile was a small village of less than 1,000 people. In 1763-1813, Mobile changed from French to British to Spanish and finally to American control. The City of Mobile was incorporated in 1814, but it was not until the 1820's that the arrival of the steamboat and the increase in cotton production placed Mobile in a position to use its strategic location. Mobile became the second largest cotton shipping port in the United States (New Orleans was the first), and commerce supplied a variety of goods and services to inland plantations. The boom produced by the growth of the cotton industry lasted until the 1870's. By 1880, the population of Mobile and Baldwin Counties was 57,000 (Hammer, Greene, Siler Associates 1967).

From the 1880's until World War II, the population of coastal Alabama grew slowly and steadily. By 1940, the population of the coastal counties was 174,000. The most important factors causing the growth were harbor improvements, the growth of the lumber industry in the 1880's, the development of the shipbuilding industry during World War I, and the emergence of a substantial paper industry in the 1930's (Hammer, Greene, Siler Associates 1967).

In the 1940's, the population increased sharply, shipbuilding increased, and Brookley Air Force Base was established (Hammer, Greene, Siler Associates 1967). By 1960, the population was more than double 1940 levels.

In the mid-1960's, Brookley Air Force Base was closed, and the population stabilized. In the mid-1970's, growth again was stimulated by a massive infusion of public and private capital investments, and by 1980, the population of coastal Alabama approached 500,000.

The physical growth of downtown Mobile began in the early 1880's and developed slowly along the radial roads leading from the center of the city. Residential growth after the Civil War was between these major roads. The areas north and south of downtown became Black neighborhoods and those areas to the west were occupied primarily by Whites. During World War I and afterward, with the stimulus of employment associated with shipbuilding activities, the cities of Chickasaw and Prichard incorporated. During World War II and with the establishment of Brookley Air Force Base, residential growth shifted to areas around Brookley and to the south and southwest. The suburban movement began in earnest during the early 1950's. Growth was outward from the older neighborhoods of west Mobile (Figure 2).

POPULATION TRENDS

GROWTH

Changes in population are caused by natural change or net migration or both. Natural change is simply the difference between births and deaths. Net migration is the difference between the number of people who move from an area and the number of people who move into the same area during a given period of time.

The population of the two coastal counties in 1940 was 174,298. In 1960, the population was 363,389—an annual increase of 3.7% (Table 2). In 1970, the population was 376,690, which was little change from 1960, and the population in 1980 was 442,819, a 1.6% annual increase from 1970. The rapid 1940-60 growth was attributable to the high birth rates associated with the post-war baby boom and net in-migration following the establishment of Brookley Air Force Base. The rate of population increase in 1960-70 was slow due to net out-migration caused by the closing of the Air Base, but the increase in 1970-80 was relatively rapid, caused by high capital investment and net in-migration.

In 1940-60, the annual rate of population growth was faster in Mobile County (4.1%) than in Baldwin County (2.1%), but in 1960-80 the rate of population increase in Baldwin County was higher (2.4%) than Mobile County (0.7%).

The future annual rate of population growth in the two-county area is expected to decline (Figure 3). In 1970-80 the rate was 1.6%. Projected growth rates are 0.9% in 1980-90, 0.6% in 1990-2000, and 0.5% in 2000-2030. Baldwin County should continue to grow faster than Mobile County (Table 2).

Alabama's Coastal Area as referred to throughout this document, in accordance with the Federal Coastal Zone Management (CZM) Act definition, encompasses the area of State waters (5.6 km or 3 nautical mi seaward) and the land area from the shoreline up to 3 m (10 ft) above sea level (Figure 1). Population data for the CZM Coastal Area and the inland area of Mobile and Baldwin Counties given in Table 3 are based on a delineation of the CZM Coastal Area (Figure 4) that is not entirely consistent with the CZM 3 m (10 ft) contour definition. Because the Bureau of the Census' small area (census tract) boundaries do not exactly coincide with the 3 m (10 ft) contour, CZM Coastal Area population estimates are somewhat higher than actual.

In 1970, the CZM Coastal Area population was 105,326—69% in Mobile County and 31% in Baldwin County (Table 3). In 1980, the Coastal Area population increased to 124,037—63% in Mobile County and 37% in Baldwin County (Table 3). The Coastal Area population growth rate in 1970-80 was about equal to the overall rate for the two-county area. The Baldwin County CZM Coastal Area grew much faster than the Mobile County Coastal Area. In the former, most growth was in the Eastern Shore, Gulf Shores, Perdido Bay, and Orange Beach areas. In the latter, the Bayou La Batre and Theodore areas grew moderately fast, the Chickasaw and Saraland areas grew slowly, and the downtown Mobile population declined (U.S. Department of Commerce, Bureau of the Census 1981).

The population of the Gulf Shores-Orange Beach-Perdido area of Baldwin County was 2,994 in 1970 and 3,974 in 1980. The permanent population of Dauphin Island was 651 in 1980 (U.S. Department of Commerce, Bureau of the Census 1981). Although the permanent populations of both of these areas are relatively small, there are a large number of vacation homes and tourists in the spring and summer.

DENSITY

Population density patterns in the region are similar to those found throughout the Gulf Coast. In 1980, population density in the region was 59 persons/km^2 (153 persons/mi^2): 113 persons/km^2 (294 persons/mi^2) in Mobile County and 18 persons/km^2 (48 persons/mi^2) in Baldwin County.

In 1970, the population density in the two-county area was 50 persons/km^2 (130 persons/mi^2); in Mobile County it was 99 persons/km^2 (256 persons/mi^2) and in Baldwin County it was 14 persons/km^2 (36 persons/mi^2). The 1970 population densities are illustrated in Figure 5.

URBAN/RURAL DISTRIBUTION

In 1970, 73% of the population in the region was urban (82% in Mobile County and 27% in Baldwin County). In 1960-70, the percentage of urban dwellers declined in Mobile County, but remained stable in Baldwin County (Table 4).

HOUSEHOLDS

The number of households in an area constitutes a crucial input in coastal planning. Although a strong correlation exists between population size and number of households, the relationship between them is changing because of declining birth rates, rising divorce rates, and an increasing tendency for both younger and older persons to live apart from their families. Because of these factors, the number of persons per household is declining and the number of households is increasing at a faster rate than the population.

In 1980, coastal Alabama had 149,800 households, 37% more than the 109,500 in 1970. In contrast, the population increased only 18% and the number of persons per household declined from 3.4 to 2.9 (Table 5).

The number of persons per household will probably decline to 2.7 by 2000. If the population is 512,600 in 2000, there may be about 184,000 households, a net increase of about 34,200.

SOCIAL CHARACTERISTICS

RACE

The percentage of Whites in the region (70%) is smaller than that of the Nation (83%). The rest of the population is mostly Black. In 1980 Whites comprised 68% of Mobile County's population and 84% of Baldwin County's population (Table 6).

AGE

The age distribution of the population is, for the most part, a function of the birth rate. Briefly summarizing past trends, birth rates in the U.S. were generally high prior to 1930, dropped sharply during the depression and World War II, rose again after World War II, and remained high during the "baby boom" era of the 1950's. In the early 1960's, improved birth control techniques and changing attitudes, lifestyles, and values caused the birth rate to decline to present levels (1981). Birth rates probably will remain low during the foreseeable future (South Alabama Regional Planning Commission 1975).

The most significant trend over the last 20 years has been a sharp decline in the proportion of persons under 5 years of age (Table 7). The percentage under 5 years was 13% in 1960, 9% in 1970, and 8% in 1980. This decline is attributed to falling birth rates, a trend that should continue. In contrast, older persons will comprise an increasingly large share of the population (South Alabama Regional Planning Commission 1975).

In 1975, the South Alabama Regional Planning Commission projected the age distribution in Mobile and Baldwin Counties for 1980. These projections were based on 1970 age distributions in coastal Alabama (U.S. Department of Commerce, Bureau of the Census 1972) and U.S. Census Bureau national projections. The 1980 age predictions were 8% under age 5, 18% for ages 5 to 15, 17% for ages 16 to 24, 28% for ages 25 to 44, 20% for ages 45 to 64, and 10% for ages 65 and older.

Slight variations are evident between the two counties. Because Mobile County has a higher proportion of Blacks, whose birth rates are relatively high, its people are slightly younger than that of Baldwin County. Baldwin County, particularly in the Fairhope area, has tended to attract retirees; consequently, its population has a higher percentage of people 65 years and older (South Alabama Regional Planning Commission 1975).

EDUCATION

Perhaps no indicator more accurately reflects the cultural status of an area than education. In this respect, coastal Alabama is below the national level (Table 8). In 1970, the median years of school completed for persons over 25 was 11.0, compared to the national average of 12.2 years. In 1960-70, the median years of schooling increased 8% in coastal Alabama and 16% for the Nation (South Alabama Regional Planning Commission 1975).

Based on the 1970 educational attainment levels in the region, the South Alabama Regional Planning Commission (1975) projected the 1980 educational levels (years of school completed) for people 25 years old and older. The estimated percentage of the 1980 population over 25 years of age that completed various levels of education are as follows: 24%, elementary school; 24%, 1 to 3 years of high school; 32%, high school graduates; 10%, 1 to 3 years of college; and 10%, college graduates (Table 9). Some improvements are apparent. Only 42% of the population were high school graduates in 1970 but the percentage increased to 52% in 1980. In projections for 1980, Mobile County will have 53% high school graduates and Baldwin County 51%.

INCOME

Although per capita income for coastal Alabama and for the southeastern states historically has been lower than the national average, the gap is gradually narrowing. In 1969, regional per capita income was $3,052 (1972 constant dollars), or 74% of the national average. By 1978, per capita income had increased to $4,215 (1972 constant dollars), or about 81% of the national average. By 2000, per capita income should increase to $8,083 (1972 constant dollars) or nearly 90% of the national average (Table 10).

In 1978, Mobile County had a higher per capita income ($4,240) than Baldwin County ($4,090) (U.S. Department of Commerce, Bureau of Economic Analysis 1981b).

OCCUPATION

The occupational profile of an area's labor force reflects a locality's industrial mixture as well as labor force skill levels. According to the South Alabama Regional Planning Commissions' projections for 1980, 47% of the residents employed in the region were classified as "white collar" workers, 36% as "blue collar" workers, 15% as "service" workers, and 1% as farm workers (Table 11). The white collar category includes professional, managerial, sales, and clerical workers; the blue collar designation applies primarily to industrial workers. Service occupations are maintenance and repair, personal services, and various governmental services (e.g., education, police, fire). The farm classification includes farmers and farm laborers (South Alabama Regional Planning Commission 1975).

In 1980, employment in coastal Alabama consisted of relatively more blue collar jobs and fewer white collar jobs than the national average. Mobile County had a higher proportion of white collar resident employees (48%) than Baldwin County (44%) according to the South Alabama Regional Planning Commission (1981).

Since the 1950's, there has been an increase in white collar and service workers and a decline in blue collar and farm workers. These trends should continue.

SUMMARY

Since World War II, the population of coastal Alabama has grown faster than the Nation as a whole. The region's population was 174,298 in 1940 and 442,819 in 1980, an increase of about 150%. The U.S. increase was only 70%.

The population growth of coastal Alabama was faster during the "baby boom" period in 1945-60. In the 1960's, the population remained relatively stable largely because the Brookley Air Force Base in Mobile was closed. In the 1970's, economic expansion helped increase the area's population growth.

In the future, the coastal population should continue to increase, but at gradually declining rates. By 2000, the population should be about 512,600, an increase of 16%, which is about equivalent to the rate projected for the Nation.

Prior to 1960, the rate of population growth was faster in Mobile County than in Baldwin County. Since 1960, Baldwin County has grown faster. This shift was largely attributable to congestion in Mobile County and to highway improvements that stimulated the development of the Eastern Shore area in Baldwin County as a residential community for Mobile.

In 1970-80, the CZM Coastal Area grew at the same rate as in the two coastal counties. In the CZM Coastal Area, growth was far more rapid in Baldwin County than Mobile County. In the Baldwin County part of the CZM Coastal Area, population growth was most rapid in the Eastern Shore, Gulf Shores, Perdido, and Orange Beach areas. In the Mobile County part of the CZM Coastal Area, growth was greatest in the Theodore and Bayou La Batre areas. These recent growth patterns will probably continue in the foreseeable future.

Although coastal Alabama's income levels historically have been below national averages, the gap is gradually narrowing. Per capita income was about 74% of the national average in 1969 and 81% in 1978. By 2000, per capita income should approximate 90% of the national figure.

RECOMMENDATIONS

1. Public and private interests concerned with public utilities, school facilities, health facilities, public protection services, and transportation systems should continue to monitor population and demographic shifts to better plan for future public roads, facilities, and services.

2. County and city governments of coastal Alabama should coordinate their planning for public facilities and services to meet the needs of future populations. This coordination would reduce duplicate facilities and services.

3. Since older persons will comprise an increasingly large share of the population, adequate services and housing for the elderly will be needed and planning should be directed accordingly.

4. The affluence and leisure time of local residents will increase in the future, and additional recreational areas and facilities will be required to meet the demand.

5. To maintain a proper balance of pressures in the Coastal Area, planners need periodically accurate estimates of the Coastal Area population.

DATA GAPS

The most significant data gaps are apparent in the 1980 demographic characteristics. Release of the 1980 *Census of Population* within the next two years will alleviate this problem, however. In this paper, South Alabama Regional Planning Commission projections (1975) were provided in lieu of more current data; the 1980 census findings should prove the South Alabama Regional Planning Commission's projections relatively accurate.

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INDUSTRIAL AND RESIDENTIAL DEVELOPMENT

INTRODUCTION

The purpose of this chapter is to provide an overview and forecast of the economy and land use of coastal Alabama.

From its earliest beginning, the economy of coastal Alabama has been dominated by the Gulf of Mexico and the inland river system that discharges into Mobile Bay. Deep-water and river navigation generated the commerce that led to Mobile's emergence as a major 19th-century port and shipbuilding center. In this century, the availability of industrial processing water in combination with commerce has led to the development of major paper and chemical manufacturing facilities in the area.

From World War II until the mid-1960's, the Brookley Air Force Base was an important component of the local economy, contributing as high as 15% of the civilian employment in Mobile. The development of Brookley Base, coupled with Mobile's port and industries brought about steady economic growth until the mid-1960's. At that time, the Defense Department closed the air force base, which caused a localized depression and temporarily ended Mobile's growth. In the mid-1970's, however, growth was regenerated by a massive infusion of public and private capital investment (which was widespread in the Sunbelt States) and by the discovery of important petroleum reserves in lower Mobile Bay and nearby waters of the Gulf.

The economic future of coastal Alabama is focusing on the potential for major petroleum reserves and on the Tennessee-Tombigbee Waterway (Tenn-Tom) project. Depending on the development and volume of petroleum potentials, major refining and related petrochemical industries may be attracted to the area. The Tenn-Tom, which is scheduled to open in 1986, will sharply increase port tonnages and require new and expanded port and related facilities.

Throughout this chapter and following chapters, reference is made to Standard Industrial Classification (SIC) Codes in discussions involving industrial sectors. The SIC system categorizes establishments by type and is widely used by the U.S. Government and private organizations. The structure of the classification system makes it possible to tabulate and analyze data on a division, a two-digit, a three-digit, or a four-digit industry code basis, according to the level of industrial detail considered most appropriate. For example, Manufacturing is one of 11 industry divisions; Food and Kindred Products (SIC 20) is a two-digit industry classification under this division, Dairy Products (SIC 202) a three-digit classification, and Cheese (SIC 2022) a four-digit classification (Executive Office of the President, Office of Management and Budget 1972).

NATURAL RESOURCES

The economy of coastal Alabama is partly dependent on the area's natural resources. Extensive forests constitute an important supply of raw material for the lumber and paper industries. Significant petroleum discoveries in recent years have resulted in a rapidly growing oil and gas industry. Plentiful ground-and surface-water resources serve many industrial and private uses. The estuarine and marine resources of Mobile Bay, Mississippi Sound, and the Gulf of Mexico support valuable sport and commercial fishing. The coastal bays and waterways are particularly valuable for navigation.

FORESTS

Timber is one of the principal natural resources of Alabama. In 1972, coastal Alabama supported 496.7 thousand ha (1.2 million acres) of commercial forest land (Hedlund and Earles 1972).

The area's forests are valuable because they represent the predominant land use within the area and because they provide raw materials for the lumber and paper industries, two of the coastal area's most important industries. Reference may be made to the chapter on Agricultural Production for more detailed discussion of the area's forest resources and timber harvest.

MINERALS

Encouraging discoveries of oil and gas in coastal Alabama in recent years have accelerated further explorations in the area. Major discoveries, production trends, industrial infrastructure, and future trends are discussed in the chapter on Mineral Production. The future economic importance of oil and gas activities is also discussed in the Emerging Trends section of this chapter.

In addition to oil and gas, other significant mineral resources in the area are sand, gravel, clay, and oyster shells. Production of these minerals supplies raw materials for the area's construction industry. Detailed discussion of sand, gravel, clay, and oyster shell resources and production is provided in the Mineral Production chapter.

WATER

GROUND AND SURFACE

In the Mobile urban area from Satsuma to Dog River, treated public water is generally available. The Mobile public water system uses Big Creek Lake for its supply. The Big Creek Lake reservoir is designed to furnish a dependable supply of about 100 Mgal/d. A second important source of public water is the Prichard Water Works, which serves the cities of Prichard and Chickasaw and the communities of Whistler and Eight Mile (South Alabama Regional Planning Commission 1975).

Large quantities of industrial water are available in the area from Chickasaw Creek to Bucks, Alabama. This system (the Mobile River Industrial Water Supply System) taps the Mobile River about 48.3 km (30.0 mi) north of the city, and transports the water by an aqueduct. Big Creek Lake and the Escatawpa River supply water for the Theodore Industrial Park (South Alabama Regional Planning Commission 1975).

More detailed discussion of water supply and use is provided in the section on Public Utilities and Services.

MARINE

Commerical fishing is a valuable basic industry in coastal Alabama. The commercial fishing fleets are based in Bayou La Batre and Dauphin Island areas of Mobile County, and the Bon Secour, Gulf Shores, Orange Beach, and Perdido Bay areas of Baldwin County. Over 13.5 million kg (29.7 million lb) of seafood were landed in 1978, providing income for many fishermen, seafood processors, and seafood houses. The 1978 value of the shellfish and finfish landed was $35.4 million (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service 1980). Extensive discussion of this industry is in the chapter on Commercial Fishing.

ECONOMIC AREA

GENERAL

Coastal Alabama is tied closely with a 17-county economic area in Alabama, Mississippi, and Florida that approaches economic self-sufficiency. "Self-sufficiency" suggests that virtually all employment and most of the services required by residents of the area are provided within the 17 counties (Figure 6).

Although many relationships exist between coastal Alabama and its economic area, five key economic indices have been selected to illustrate its importance within the area. The five are population, retail sales, wholesale sales, service industry receipts, and value added by manufacture.

POPULATION

The population of the economic region was 1,106,403 in 1970 and 1,310,546 in 1980 (Table 12). The coastal counties of Alabama contained 34.0% of the regional total in 1970 and 33.8% in 1980 (U.S. Department of Commerce, Bureau of the Census 1972a, 1981).

RETAIL SALES

In 1958-77, retail sales more than tripled in Mobile and Baldwin Counties (Table 13). Reflecting coastal Alabama's slightly declining percentage of the economic area's population, however, retail sales (SIC 52-59) in Mobile and Baldwin Counties declined in proportion to sales in the economic area in 1967-77 (Table 14). The coastal counties accounted for 36.8% of the economic area's retail sales in 1967, 34.2% in 1972, and 36.3% in 1977 (U.S. Department of Commerce, Bureau of the Census, 1970a, 1975a, 1980b).

WHOLESALE SALES

Wholesale sales (SIC 50, 51) in coastal Alabama, primarily in the City of Mobile, increased more than 400% in 1958-77 (Table 15). In the coastal counties, wholesale sales as a percentage of regional wholesale sales (Table 16) were 57.1% in 1967, 55.3% in 1972, and 56.4% in 1977 (U.S. Department of Commerce, Bureau of the Census 1970b, 1975b, 1980c).

SERVICE INDUSTRY RECEIPTS

In 1967 service firms (SIC 70-89) in coastal Alabama generated 34.3% of the economic region's total receipts (Table 17). The percentage of regional receipts increased to 36.5% in 1972 and to 39.4% in 1977 (U.S. Department of Commerce, Bureau of the Census 1970c, 1975c, 1980d).

VALUE ADDED BY MANUFACTURE

Value added by manufacture (SIC 20-39) is defined as the value of product shipments (including resales) less the total cost of materials (including materials, supplies, fuel, electric energy, and miscellaneous receipts) plus the net change in the value of finished products and work-in-progress inventories between the beginning and end of the year (U.S. Department of Commerce, Bureau of the Census 1980a).

Coastal Alabama's value added by manufacture has increased steadily since 1967; the coastal counties contributed $303.2 million of value added in 1967, $480.6 million in 1972 and $903.5 million in 1977 (Table 18). No data are available for some counties in the economic region and it is impossible to determine coastal Alabama's share of regional value added during those years (U.S. Department of Commerce, Bureau of the Census 1971a, 1976a, 1980a).

LAND USE

EXISTING

The coastal land area of 7,485 km^2 (2,890 mi^2) is made up of 3,211 km^2 (1,240 mi^2) in Mobile County and 4,274 km^2 (1,650 mi^2) in Baldwin County. Land use is diversified in type and degree of development. The largest land use by far is categorized as resource production, primarily forestry and agriculture (Table 19, Figure 7).

In 1975, about 48% of Alabama's coastal area was forested, 19% was used for agriculture, less than 1% was mined, and 26% was not used for direct economic gain (14% wetlands, 8% idle, 4% water). Other land uses were transportation, communication, and utilities (3%), residential use (2%), government and education (1%), and industrial and commercial uses (1%) (South Alabama Regional Planning Commission 1977a).

Commercial timber lands are primarily in the northern portions of both counties. Farm lands are predominant in southern Baldwin County and in western and southern Mobile County. Residential and commercial development are concentrated in urban areas, principally Mobile. Most industrial development is in Mobile County, primarily along the riverfront, north of the downtown Mobile area; in the Theodore area, which is directly south of the Mobile urban area; and the Bucks area, north of Satsuma along the western bank of the Mobile River (Figure 8). Undeveloped land is most extensive in the northern and extreme western portions of Mobile County and the northern and eastern portions of Baldwin County (Figure 7).

Land-use data are not compiled specifically for the CZM Coastal Area (to 3.0 m or 10.0 ft above sea level). This area is dominated by undeveloped wetlands and residential development. The most intensive residential development is in the Eastern Shore, Gulf Shores, and Orange Beach areas of Baldwin County and the Dauphin Island, Bayou La Batre, and Dog River areas of Mobile County. Many of the homes are seasonal vacation homes. The major industrial areas are located within the CZM Coastal Area, primarily along the Mobile River and in the Theodore area, south of Dog River, in Mobile County (Figures 7 and 8).

PROJECTED

In 1975, developed land in Mobile and Baldwin Counties was 561,354 ha (1,387,136 acres), about 75% of total land area. By 2000, the South Alabama Regional Planning Commission (1977a) projects that the amount of developed land will increase by 4% to 584,475 ha (1,444,270 acres). Projections assume the conversion of some of the undeveloped, forestry, and agricultural land to residential, commercial, and industrial uses (Figure 9). These land conversion estimates are conservative, however, because they are based on population projections that are now known to be low (Tables 19 and 20).

The most intensive single family residential growth is expected in Mobile County in the western Mobile urban area and in Baldwin County along the eastern shore of Mobile Bay. Most intensive multi-family development (primarily condominiums) is expected to occur in the Gulf Shores, Orange Beach, and Eastern Shore areas of Baldwin County.

Industrial growth should continue in the Theodore and Bucks areas of Mobile County. In addition, industrial growth is likely in the Jacintoport area, a newly developing industrial area that is directly east of Saraland on the Mobile River. Although industrial development in Baldwin County will be small compared to that in Mobile County, its focus will be in the Bay Minette and Foley areas. Projected land use for the two counties for the year 2000 is illustrated in Figure 9.

In summary, future development will be more intensive in the CZM Coastal Area than in the remainder of the coastal counties. CZM Coastal Area development will consist primarily of industrial plants and waterfront single- and multi-family housing.

ECONOMIC BASE

In its simplest form, the local economy is either basic or non-basic. The basic sector produces goods and services that exceed local demand and can be exported to other localities. From an income standpoint, basic industries and services bring income into the area from outside. In contrast, the non-basic sector serves the local economy and produces goods and services that are consumed entirely within the limits of the local area. The non-basic sector does not generate income from outside but instead depends on income already present in the area (City of Mobile, Office of Economic Development 1980).

Basic sector firms are "prime movers" of the local economy in the sense that if their employment levels increase, then the non-basic labor force should also increase. The basic-non-basic dichotomy is in the following subsection on coastal Alabama's basic industries.

BASIC INDUSTRIES

A technique known as base sector analysis has been used to identify coastal Alabama's basic industries. This method involves comparison of the proportionate distribution of employment by industrial classification for coastal Alabama with the employment profile of the Southeastern United States. Those employment classifications that have proportionally greater significance in coastal Alabama than in the Southeast are designated as basic industries. The ratio of local to Southeastern employment is called a location quotient. A quotient greater than one indicates a basic industrial sector (Table 21).

The eight basic industries for coastal Alabama in 1978 and their location quotients are paper and allied products, 4.8; shipbuilding and repair, 4.3; chemicals and allied products, 1.8; construction, 1.4; transportation, communication, and utilities, 1.3; lumber and wood products, 1.3; services, 1.1; and wholesale and retail trade, 1.1 (Table 21).

Many of the basic manufacturing industries are closely linked to the resources of the area. For example, forest resources are essential to the paper, lumber, and wood products industries. Abundant water supplies are crucial to paper and chemical processing.

Since this analysis was limited to broad industry groups (2-digit SIC level), the relative importance of some subindustry groups has possibly been obscured. For example, food and kindred products (SIC 20) are indicated as a non-basic industry, even though the area exports large amounts of seafood (SIC 2092).

INDUSTRIAL INVESTMENT

Industrial investment in new plants and equipment is necessary to prevent obsolescence and to maintain or increase productivity and employment; consequently, the level of capital expenditures is an important indicator of past and future growth. For this chapter, the two measures of capital investment are actual expenditures for new plants and equipment as reported by the Census Bureau (Table 22) and announced new and expanding industries as compiled by the Alabama Development Office (Table 23).

According to the Bureau of the Census, capital expenditures by manufacturing firms in coastal Alabama have increased sharply from \$11.1 million in 1958 to \$232.3 million in 1977. Part of this increase was caused by inflation. In 1958-77, Mobile County's share of investment was over 90% of the two-county total (Table 22).

Although investment data published by the Alabama Development Office cover announcements rather than actual expenditures, the information is useful because it is current and provides significant detail. In 1978-80, a cumulative total of \$630.0 million of capital investment was announced by Alabama coastal industries. Mobile County accounted for \$604.0 million of the total, and Baldwin County \$26.1 million (Table 23). The largest investments were in chemicals and allied products (\$185.8 million), petroleum refining (\$100.2 million), petroleum and natural gas extractions (\$85.4 million), and paper and allied products (\$68.2 million).

Interpretations of these investment figures must be qualified, particularly in terms of associated employment. Because the chemical, petroleum, and paper industries are highly capital-intensive, even vast capital expenditures do not necessarily create many jobs.

The petroleum extraction and refining industries have developed in recent years because of oil and gas discoveries in the area. The economic significance of these new industries is discussed in the Emerging Trends section of this chapter.

The full impact of the 1978-80 capital investment announcements will not be reflected immediately because actual expenditures may be phased over several years. Also, it is unlikely that all of the announced projects will actually materialize. Nevertheless, the announcements indicate the important role of the chemical and petroleum industries in the industrial expansion.

VALUE OF SHIPMENTS

The value of all shipments by coastal Alabama's manufacturing firms was about $2.3 billion in 1977. Shipments increased sharply in 1967-77 (Table 24).

The value of chemical and allied product shipments was $526.9 million in 1977, or 23% of the coastal Alabama total. Petroleum shipments were $309.3 million (14% of the total); food and kindred products, $136.2 million (6% of the total); and lumber and wood products, $96.4 million (4% percent of the total). Data for paper and allied products shipments in 1977 are not available but in 1967 paper and allied products accounted for 39% of total shipments, the largest proportion of any industry (Table 24).

EMERGING TRENDS

GENERAL

Economic growth is a dynamic process, continually shaped by an infinite number of social, political, and economic forces. When attempting to project future economic growth, it is necessary to identify those conditions that will influence future trends.

Several emerging trends will have profound effects on traditional growth patterns throughout the Nation as well as for coastal Alabama. These trends are (1) a declining birth rate, (2) a greater proportion of the population seeking employment, (3) less demand for unskilled labor, (4) a shift from the production of goods to the performance of services, (5) chronic inflation, and (6) resource and energy shortages (South Alabama Regional Planning Commission 1975).

In addition to these emerging trends, the economic growth of coastal Alabama will be accelerated by (1) the Tennessee-Tombigbee Waterway; (2) an increase in coal transportation through the Port of Mobile; and (3) the potential for expanded production of oil and natural gas and new capital investment.

TENNESSEE-TOMBIGBEE WATERWAY

Mobile is now on the threshold of achieving linkage with the Tennessee River by the Tennessee-Tombigbee Waterway. Construction of the first of the waterway's locks began in late 1972, and completion of the project is scheduled for 1986.

When the waterway is opened in 1986, increased barge traffic and tonnage through the Port of Mobile will have direct economic and environmental impacts on coastal Alabama. The port's facilities will require significant expansion to accommodate increased tonnages. In addition, the Tenn-Tom will attract other water-oriented industries to the area, as well as new and expanded port facilities. For more details refer to the Transportation chapter.

COAL TRANSPORTATION THROUGH THE PORT OF MOBILE

Compared to petroleum, coal has become a relatively low-cost energy source. Foreign demand for coal, particularly steam coal, has risen sharply in recent years, and export tonnages through the Port of Mobile have reflected increased overseas demand. Most of the port's export coal is currently supplied by the coal fields in northern Alabama. The opening of the Tenn-Tom Waterway will make the port accessible to coal shippers in Tennessee and Kentucky. With an expansion of port facilities, the port of Mobile will play a more important role in meeting the rapidly rising foreign demand for coal.

The development of coal-handling facilities is currently the primary thrust of the port's massive capital improvements program. Efforts to increase port capacity to store and load coal will affect future land use as well as the local economy because extensive tracts of land (McDuffie Island) are being developed for storage and transfer facilities.

OIL AND GAS PRODUCTION

Although oil and gas have been produced in coastal Alabama since 1955, recent onshore and offshore discoveries have greatly increased the importance of the region as a gas-producing area. In Mobile County, the Chunchula and Hatter's Pond fields were discovered in the mid-1970's. In 1976-79, the first four years of production, these fields produced 922.4 m^3 (32.6 billion ft^3) of gas and 11.5 million bbl of condensate. Another gas field was discovered in south Baldwin County, near the city of Foley, in 1979. Current explorations in the Foley area are intense, although the potential gas reserves have yet to be estimated.

In 1979, Mobil Oil also discovered a major gas field near the mouth of Mobile Bay. Estimated reserves of the field are substantial—5.7 to 17.0 billion m^3 (200-600 billion ft^3). This discovery has triggered interest in the nearshore area (Alabama's territorial waters), and a number of oil companies have since obtained leases there.

Payments of lease bonuses to local residents from inland production are the most direct benefits to the economy. For production in Alabama's territorial waters, the State of Alabama received a cash bonus of $449.2 million from its March 1981 lease sale. The proceeds of this sale will be expended on projects throughout the State. Because of the capital-intensive nature of the petroleum industry, new employment generated to date has been limited. In the future, however, additional support facilities and processing plants will be required, and the industry undoubtedly will exert a more important economic impact.

INDUSTRIAL INVESTMENT

In the 1960's, paper companies accounted for the largest share of capital expenditures in coastal Alabama, but in the early 1970's the chemical industry assumed dominance. Recent industrial investment announcements indicate that there is a shift now from the chemical industry to the petroleum industry. In 1973-74, the chemical industry accounted for 81% of investment announcements, and the petroleum extraction and refining industries accounted for only 4% (South Alabama Regional Planning Commission 1975). In 1978-80 the chemical industry (SIC 28) and petroleum industry (SIC 13 and 29) each accounted for 29% of announced investments, or equal shares (Table 23). The role of the petroleum industry in the area's economic growth will be largely dependent on the eventual size of oil and gas discoveries in the area.

EMPLOYMENT

EMPLOYMENT TRENDS IN INDUSTRY

"At-place" employment reflects the number of persons working in an area, regardless of their place of residence. At-place employment data for coastal Alabama are provided by the U.S. Department of Commerce, Bureau of Economic Analysis (Table 25), the Alabama Department of Industrial Relations, Alabama State Employment Service (Table 26), and the U.S. Department of Commerce, Bureau of the Census (Table 27). Because data from the State Employment Service are limited to the coverage of wage and salaried employment, employment data from the Bureau of Economic Analysis (BEA) are preferred. Because BEA data give insufficient industrial detail for the manufacturing sector, however, the Alabama State Employment Service data (which do show manufacturing detail) are given for supplementary purposes. Data from the Bureau of the Census is included because it provides information separately for each county rather than for the coastal region as a whole.

BEA employment data (Table 25) indicate that total employment in coastal Alabama increased from 131,641 in 1969 to 172,278 in 1978, an increase of 31% (Table 25). The nonmanufacturing sector accounted for nearly all of the increase, which reversed the trend of the previous 10 years (Table 26).

In 1978, services accounted for the largest proportion of total employment. Other important employment sectors were manufacturing (primarily paper, chemical, shipbuilding, and lumber) (Table 26), retail trade, and government (Table 25).

In 1959-78, at-place employment in Mobile County increased by about 70% while employment in Baldwin County more than doubled. The actual increase was more than five times greater in Mobile County than in Baldwin County, however (Table 27). In the future, the rate of growth in employment is expected to decrease. In 1969-78, employment increased at an average annual rate of 3.0% (Table 25). From 1978 to 2000, employment is projected to increase at an average annual rate of only 1.4%. Reflecting the trend of the last 10 years, the nonmanufacturing sector is projected to generate the largest portion of future employment increases.

UNEMPLOYMENT TRENDS

The annual rate of unemployment in the two-county area fluctuated considerably in 1960-80, reflecting changes in national and local economic conditions (Table 28). The average rate of unemployment was 5.8% in 1960-64, 4.6% in 1965-69, 5.5% in 1970-74, and 7.2% in 1975-80.

INCOME

"At place" income (personal income received by individuals from all sources) in coastal Alabama is given in Table 29. Per capita income was $3,791 in 1973 and $6,322 in 1978. In constant 1972 dollars, "at place" personal income for the coastal region was $880.7 million in 1969 and $1.3 billion in 1978, a real income increase of 53% (Table 30). Employment increased 31% in the same period, and there was a 17% increase in real income per worker.

The sectors generating the greatest income in 1978 were manufacturing 25%, services 16%, and government 13%. Due to its higher wage structure, the manufacturing sector generated 25% of the income but only 18% of the employment (Table 25).

The manufacturing sector is relatively more important in Mobile County than in Baldwin County, contributing 25% of the income in Mobile County in 1978, compared to 20% in Baldwin County (Table 31). Farming is more important in Baldwin County, accounting for 10% of its 1978 income, compared to 1% in Mobile County.

In the future, real personal income is projected to continue increasing on an aggregate and per worker basis. By 2000, "at place" income should total $3.0 billion (in 1972 dollars), a real increase of 125% from 1978 (Table 30).

PUBLIC UTILITIES AND SERVICES

ELECTRICITY

GENERAL

Alabama's large deposits of coal, its extensive and modern system of navigable waterways, and its abundance of water and natural water power create conditions especially favorable for the economical production of electric power. Because of abundant electric power, Alabama's power rates are among the lowest in the Nation. Alabama Power Company, a subsidiary of the Southern Company, operates an electric utility system in coastal Alabama and most of the State.

ELECTRIC SYSTEM

Electricity is delivered to customers by a transmission and distribution network. Electricity originates at the generating plant and is dispersed to given geographical areas by transmission lines and substations and is further distributed through subtransmission lines, distribution substations, and distribution lines.

The Alabama Power Company operates two coal-fired generating plants in Mobile County. These plants are the Barry Steam Plant, located in the community of Bucks, and the Chickasaw Steam Plant, located in the Chickasaw area (Figure 10). The Barry Steam Plant has a capacity of 1,583,000 kilowatts and the Chickasaw Steam Plant has a capacity of 40,000 kilowatts. Because of its inefficiency, the Chickasaw Plant is maintained only for peak power demand and is not operated on a day-to-day basis (Alabama Power Company 1981).

In addition to Alabama Power's generating capacity, some of the larger industrial concerns generate electricity in privately owned plants.

Bulk power ties between the Mobile area and other parts of the Gulf coast are provided by 115,000- and 230,000-volt transmission lines. There is also an extensive 115,000-volt transmission network in the metropolitan area. The capacities of these lines vary from 120,000 to 210,000 kilowatts each. In south Mobile County, the Alabama Power Company maintains a 392,000-kilowatt transmission substation to complement the large generating capacity of the Barry Steam Plant (Figure 10).

Most of the industrial, commercial, residential, and other developments in coastal Alabama are serviced by the Alabama Power Company, which serves all of Mobile County and sections of Baldwin County. Local electric power distributors in Baldwin County who receive their supply from the Alabama Power Company are the Riviera Utilities of Foley, which serves Foley, Spanish Fort, Robertsdale, and the Loxley area; the city of Fairhope, which serves the Fairhope area; and the Baldwin County Electric Membership Cooperative, located in Summerdale, which serves Baldwin County's rural area and the city of Gulf Shores.

CONSUMPTION

In 1980, the Alabama Power Company's electric sales in Mobile and Baldwin Counties were 4.2 billion kilowatt hours, about 14% of the State total (Table 32). The Company expects the demand to grow at an average annual rate of 3.2% to 5.8 billion kilowatt hours by 1990. This projected rate of increase in consumption is somewhat lower than that which has occurred over the last ten years, reflecting the effect of future energy conservation efforts (Alabama Power Company 1981).

Industrial users account for the largest portion of electric consumption. In 1980, approximately 43% was for industrial use, 36% for residential use, and 22% for commercial use (Alabama Power Company 1981).

FUTURE CAPACITY

Based on the Alabama Power Company's forecast demand, no new electric generating facilities will be required in Mobile and Baldwin Counties within the next 10 years. New generating facilities constructed by Alabama Power Company in other counties will supply future demand increases in the coastal counties through the company's statewide integrated network.

NATURAL GAS

Natural gas is furnished to coastal Alabama primarily by United Gas Pipeline Company. Its pipeline system is connected to the major reserves of natural gas on the Gulf Coast. This company uses four transmission lines (see Figure 19 in the chapter on Mineral Production) to distribute gas to the following local companies and municipalities: Mobile Gas Service Corporation, which services most of Mobile County; and Riviera Utilities, the City of Fairhope, and the City of Bay Minette, which serve Baldwin County.

The United Gas Pipeline Company furnished over 90% of the natural gas for the coastal counties and, in 1980, its sales totaled 1,080.0 million m^3 (38.2 billion ft^3) (United Gas Pipeline Company 1981). Industrial users accounted for well over one-half of the consumption (Table 33). In 1972-80, the company periodically curtailed the supply to industrial users. Although there is no current curtailment on gas for any use, new industrial hookups may be made only on an "interruptible" basis (whereby the user might be required to temporarily shift to another form of energy).

Because of recent oil and gas discoveries in Alabama, new industrial customers are in a more favorable position to obtain gas supplies. Over the last several years, Mobile Gas Service Corporation has received a portion of its gas supply (about 20%) directly from production of the Big Escambia Creek field in nearby Escambia County, Alabama (Rehm, pers. comm. 1981). Some industries have contracted directly with producers for supply.

WATER

Surface water is the primary water supply in coastal Alabama. In 1975, 6.1 billion liters/day (1.6 billion gal/d) of water was used (Table 34), 96% of which was surface water and 4% ground water (Mettee et al. 1978).

Thermoelectric plants are the principal users of water in the coastal counties. In 1975, these users consumed 4.9 billion liters/day (1.3 billion gal/d), which was 81% of the total supply used. Self-supplied industry is the second largest user (10%); public supply, third (8%); and rural last (1%). Mobile County accounts for nearly all (99%) of the water usage (Mettee et al. 1978).

Mobile County, which gets almost all of its water from surface waters, uses most of its water for industrial purposes. Baldwin County, which gets most of its water from underground, uses most of its water for agricultural and residential purposes (Mettee et al. 1978).

In Mobile County, thermoelectric plants in 1975 accounted for 82% of the water demand, self-supplied industry accounted for 10%, the public supply was 8%, and rural use was less than 1%. The Mobile River is the supplier of water for thermoelectric plants. Public water comes from Mobile River, Big Creek Lake, and Eight Mile Creek (Mettee et al. 1978).

In Baldwin County in 1975, rural areas used 50% of the water supply, domestic use was 27%, and self-supplied industry used about 14%. Nearly one-half of Baldwin County's rural use water is from groundwater sources. The county's public water supplies are from groundwater sources (Mettee et al. 1978).

SOCIAL SERVICES

EDUCATION

An area's economic development is heavily dependent upon educated and skilled labor. Although the level of education is discussed in the chapter on Social and Demographic Characteristics, educational expenditures and facilities are described here.

EDUCATIONAL EXPENDITURES BY LOCAL GOVERNMENTS

Local governmental expenditures on education in coastal Alabama are well below the national average (Table 35). In 1977, local governments in the coastal counties spent $80.0 million on educational services (Table 36). The per capita expenditure of $198 was only about one-half of the U.S. metropolitan area average of $370. In 1967 it was 62% of the national average (U.S. Department of Commerce, Bureau of the Census 1969a, 1979a).

ELEMENTARY AND SECONDARY SCHOOLS

Because of declining birth rates, elementary and secondary school enrollment (grades 1-12) in coastal Alabama has decreased since 1965 (Table 37). Enrollment in grades 1-12 was 104,300 in the 1965-66 school year but was only 98,700 in 1977-78 (Alabama Department of Education 1967, 1979). About 83% of the enrollment in 1977-78 was in Mobile County and 17% in Baldwin County. Private, denominational, and parochial schools accounted for 15% of the two-county enrollment (Alabama Department of Education 1979).

UNIVERSITIES, COLLEGES, AND STATE VOCATIONAL SCHOOLS

The three major colleges and universities in coastal Alabama are the University of South Alabama, Mobile College, and Springhill College (Table 38). Springhill College was established in 1830 and the University of South Alabama and Mobile College were established in 1963. Undergraduate enrollment at the three institutions was 8,800 in 1980. The University of South Alabama is by far the largest of the three (South Alabama Regional Planning Commission 1981).

There are two vocational technical schools and a state junior college in Mobile County and one state junior college in Baldwin County.

HEALTH

Coastal Alabama had 9 general hospitals in 1977 (6 in Mobile County and 3 in Baldwin County). Of the combined capacity of 1,900 beds, 89% were in Mobile County (Table 39) and average daily occupancy was 74% (Southwest Alabama Health Planning Council 1977). Most of the funds for these hospitals were either self earned or from state sources. Local governments spent about $7.9 million on hospitals and health care services in Mobile and Baldwin Counties in 1977 (Table 36).

RESIDENTIAL HOUSING

In 1980, coastal Alabama supported 164,767 residential housing units of which 131,701 (80%) was in Mobile County, and 33,066 (20%) was in Baldwin County (Table 40). In 1960-80, the number of residential units increased 52%. The percentage increase was greater in Baldwin County (99%) than in Mobile County (44%).

In 1975, single-family units made up 79% of the area's total housing units, multifamily units made up 15%, and mobile homes 6%. Mobile County has a larger proportion of multi-family housing units and Baldwin County has a larger proportion of mobile and single-family housing units (Table 40).

In 1970, 99% of the residences were year-round units (Table 41) of which 62%

were owner occupied, 29% were renter occupied, and 8% were unoccupied (U.S. Department of Commerce, Bureau of the Census 1972b).

The CZM Coastal Area (up to 3.0 m or 10.0 ft above sea level) contained 11,500 housing units in 1974, of which 63% were in Mobile County and 37% were in Baldwin County (Table 42). More recent data regarding the CZM Coastal Area housing supply are not available. New housing construction and housing value in the Coastal Area have risen substantially (Tables 43 and 44) from past levels particularly in coastal Baldwin County where the total number of permits issued increased from 912 (1970-74) to 1,503 (1975-79). The total number of permits for the coastal areas of both counties also showed a substantial gain for the same time periods, from 973 during 1970-74 to 1,587 during 1975-79.

IMPACT OF GROWTH

From 1969-78, coastal Alabama experienced substantial economic growth as evidenced by the employment of 40,637 new people in the area (Table 25). Although non-farm employment is expected to increase in the future, it will occur at a slower pace. Farm employment is projected to steadily decline through 2020.

Population increased by 60,500 in the coastal region during 1969-78 (Table 1). Steady but lower average annual percent growth rates are expected for the periods of 1980-90 (0.9%) and 1990 to 2000 (0.6%). The relatively moderate growth projections are valuable to planners, particularly since they follow a period of rapid growth. The population and employment gains will increase the need for more transportation facilities, community facilities, services, and housing. In 1975 to 2000, about 25,080 ha (61,930 acres) will be converted to urban and suburban use.

Projections of industrial growth indicate a need for an additional 1,660 ha (4,100 acres) by 2000. Of this amount, about 1,320 ha (3,250 acres) will require access to navigable water. Much of the future industrial expansion will depend upon facilities that receive raw materials and ship finished products via barges and ocean-going vessels (South Alabama Regional Planning Commission 1975).

The access of industrial sites to navigable waters is a problem in Mobile County because of existing coastal ownership patterns and the lack of deep water channels to inland areas. By 2000, Mobile County will require 1,430 ha (3,540 acres) of additional industrial land area. Of this, 1,260 ha (3,100 acres) will probably be on the waterfront. Baldwin County's industrial land needs will be 230 ha (560 acres), of which 60 ha (140 acres) will require access to navigable waters. The Theodore Ship Channel (see the chapter on Transportation) in Mobile County may provide access to an additional 810 ha (2,000 acres) of potential industrial sites.

SUMMARY

Basic industries are those sectors of the local economy that produce export goods and services and thereby generate non-local income upon which other local industries depend. Growth in basic industries is necessary for an area's continued economic growth.

The eight basic industries of coastal Alabama are (1) paper and allied products, (2) shipbuilding and repair, (3) chemicals and allied products, (4) construction, (5) transportation, communication, and utilities, (6) lumber and wood products, (7) services, and (8) wholesale and retail trade.

Although basic industries support other economic components in an area, they do not necessarily generate proportionately large levels of employment. Yet, in aggregate, coastal Alabama's basic industries account for most of its employment. In 1978, at-place employment in the two-county area was 172,300 persons. Of this total, services contributed 22%; manufacturing 18% (primarily paper, shipbuilding, chemical, lumber, and wood); retail trade 17%; government 15%; construction 8%; transportation, communication, and utilities 6%; wholesale trade 6%; finance, insurance, and real estate 4%; farming 2%; agriculture, forestry, and fisheries 2%; and mining less than 1%.

In 1969-78, coastal Alabama had a period of exceptional economic growth, which for the most part resulted from the expansion of the area's chemical industry. In the future, the rate of growth for this industry is expected to decline. Most of the new economic impetus will be provided by the region's emerging petroleum industry. The opening of the Tennessee-Tombigbee Waterway in 1986 should add substantial economic gain.

In 1969-78, employment in coastal Alabama increased from 131,600 to 172,300 (an annual rate of 3.0%). Population increased from 375,000 to 435,000 during this period (an annual rate of 1.7%). Future rates of growth will be lower, however. During 1978-2000, employment should increase from 172,300 to 233,400, indicating an annual increase of 1.4% or about one-half the 1969-78 rate. Population is projected to increase from 435,300 in 1978 to 512,600 in 2000 at an annual rate of 0.7% or about 40% of the 1969-78 rate.

Land use within coastal Alabama is primarily non-urban. In 1975, land use was as follows: forestry, 48%; undeveloped land, 25%; agriculture, 19%; transportation, communications, and utilities, 3%; residential, 2%; public, 1%; and industrial and commercial, 1%. Residential development is concentrated in the City of Mobile. Most industrial development is in eastern Mobile County, both along the Mobile River and in the Theodore area, which is just south of the urban area. To support future growth, extensive areas of forestry, agricultural, and undeveloped lands will be converted to urban uses.

Over the last 10 years, industrial and residential development in the Coastal Area has been more intensive than in the inland areas. This pattern will probably continue in the future.

RECOMMENDATIONS

The socioeconomic growth of the barrier lands and other islands of coastal Alabama should be monitored and reported periodically, especially because of the scarcity of freshwater for human consumption.

Authority is needed for overall planning of waterfront land areas, particularly those with industrial potential. Water-dependent industries should have priority over other industries for waterfront sites. The impact of proposed new industries and land development on the local economy should be assessed periodically.

County and local governments should coordinate their attempts for planning public services and facilities to meet projected increases in employment and population. Such coordination will help to eliminate, or at least reduce, overlapping facilities and duplicated services.

DATA GAPS

Principal data gaps revealed in this chapter are as follows:

1. Lack of current land use estimates and projections for the CZM Coastal Area.

2. Insufficient periodic estimates of the number and types of housing units. The 1980 *Census of Housing* should temporarily alleviate this problem when it is released in 1982.

3. Lack of an assessment of the economic benefits in the two-county area that will be realized from the Tennessee-Tombigbee Waterway. Recent studies have focused only on benefits accrued by shippers rather than the economic impacts of increased navigation in specific areas along the waterway.

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AGRICULTURE AND FORESTRY PRODUCTION

INTRODUCTION

This chapter characterizes the agricultural and forestry sectors of coastal Alabama and their contribution to the local economy. Agriculture (SIC 01, 02) includes the production of crops, plants, and livestock. Forestry (SIC 08) includes logging, lumbering, and forest nurseries.

Agricultural and forestry resources are relatively extensive in coastal Alabama and contribute substantially to the economy. Their production provides a base for many associated industries (i.e., suppliers, distributors, and processors) which, in aggregate, constitute a major component of the economy. Although the scope of this chapter excludes discussions of industries dependent upon agricultural and forestry activities, the full significance of agriculture and forestry cannot be assessed without considering these associated industries. Reference may be made to the chapter on Industrial and Residential Development for data relevant to farm- and timber-dependent industries.

BACKGROUND

Forestry and agriculture are the predominant land uses in coastal Alabama. In 1975, nearly 70% of the land area was forested or in agriculture (South Alabama Regional Planning Commission 1977). Because of its more urban character, Mobile County is not as important an agricultural or timber area as Baldwin County.

AGRICULTURE

The soil, climate, and topography of coastal Alabama are favorable for agriculture, particularly in the southern portion of the area. Rainfall is usually sufficient for plant growth but, during dry periods, irrigation sometimes is used. The growing period is long—up to 320 days a year. Soils are somewhat low in natural fertility and organic matter and usually require application of fertilizer and lime to be productive. With adequate fertilization, two crops a year usually can be grown and permanent pastures maintained. The topography generally is level or slightly rolling except for hilly areas in the northern portions of the two counties.

Throughout most of the 20th century, soybeans, livestock, nursery products, cotton, corn, potatoes, pecans, and fruits have been the major agricultural crops. Production of cotton and some fruits has fallen over the last 20 years, however.

Since the 1950's, the number of farms in Mobile and Baldwin Counties has declined but productivity and the average farm size have increased. Technological developments have made larger farms more profitable. Improvements, such as more efficient farm machinery, pesticides, and fertilizers, have increased farm productivity and reduced labor requirements. Increased productivity has permitted greater production from smaller total acreages and much farm land has been converted to other uses.

The importance of farming to coastal Alabama's economy has gradually declined and is now relatively insignificant in terms of direct employment and income. Agriculture is far more important to Baldwin County than to Mobile County, however, and several small communities in south Baldwin County are dependent upon agriculture.

FORESTRY

Forestry has contributed substantially to the economic development of coastal Alabama. Extensive forests have attracted lumber and paper manufacturers to the area, and these industries are major components of the local economy.

At the turn of the century, Alabama (including the coastal counties) contained numerous logging and sawmill operations. The State's lumber production was sizeable and the Port of Mobile served as an export center for much of the State's timber trade.

The paper and pulp industry developed in 1910-30. Gulf Paper Mill (1917) was the first paper mill in Alabama and was located in the Three Mile Creek area. The paper and pulp industry grew rapidly in 1930-50 and now represents a major source of income and employment.

The lumber, paper, and pulp industries are discussed in the chapter on Industrial and Residential Development.

ECONOMIC IMPORTANCE OF THE AGRICULTURE AND FOREST INDUSTRIES

AGRICULTURE

The employment and personal income of an industry is a measure of its economic importance. In the following subsections, farm employment and personal income data are provided and trends discussed.

EMPLOYMENT

As a result of mechanization, farming has become decreasingly labor intensive. In coastal Alabama, farm employment has declined over the last ten years and is expected to continue to decline in the future.

The agricultural labor force (SIC 01, 02) was 3,988 in 1969 and 3,300 in 1978, a decrease of 17%. By 2030, farm employment is expected to decline to 2,194, a decrease of 34% (Table 45).

Farming is not a major source of direct employment in coastal Alabama. In 1969, farms supported only 3.0% of the region's total employment and, by 1978, farm employment had fallen to 1.9% (Table 45). Employment (as used in Table 45) is based on "place of work" rather than "place of residence." Because the farm industry employs some migrant Mexican laborers, the relative importance of agriculture would be even less if expressed on a place of residence basis.

PERSONAL INCOME

Farm income (the sum of farm wages, supplementary farm labor income, and net profits of farm operation) is a measure of personal farm income rather than receipts from sales of farm products. In constant 1972 dollars, coastal Alabama farm income was $14.2 million in 1969 and $30.0 million in 1978 (Table 46), a real increase of 112%.

Since farm employment declined during this period, the increase in farm income on a per worker basis was even more apparent. In constant 1972 dollars, farm income per worker was $3,560 in 1969 and $9,100 in 1978, a real increase of 156%.

In terms of direct income, the importance of the farm industry to the area's economy is small. Farms contributed only about 1.6% of coastal Alabama's income in 1969 and about 2.2% in 1978.

In 1978, farm income was about 10% of the total income in Baldwin County and 1% in Mobile County (U.S. Department of Commerce, Bureau of Economic Analysis 1980). If expressed on a place of residence basis, farm income in Baldwin County would be a smaller percentage because many Baldwin County residents have non-farm jobs in Mobile County.

Farm income in coastal Alabama is expected to increase from $30.0 million in 1978 to $52.2 million in 2030 (using constant 1972 dollars). Since projected increases in farm income are not as large as projected increases in non-farm income, the relative importance of farming in the economy will decline (Table 46).

MULTIPLIER EFFECTS

A high degree of interdependence exists among sectors of an area's economy. The agricultural sector indirectly generates employment and income for many other industries (e.g., wholesalers and retailers, manufacturers of agribusiness products, transportation) and thereby exerts a multiplier effect on the area economy.

A recent study indicates that every \$10,000 of agricultural sales creates about 1.7 jobs and \$14,000 in household income (Nelson and Hardy 1980). Based on these relationships, coastal Alabama's 1978 agricultural sales of \$108.1 million directly and indirectly generated about 18,600 jobs and \$151.6 million in household income, or about 11% of the employment and personal income.

In summary, farming is a valuable component of the economy if both the direct and indirect benefits are considered. Farming directly contributed only 2% of the employment and personal income in 1978 but indirectly generated about 11%.

FORESTRY

Limited data are available for forestry (SIC 08) in coastal Alabama. In 1978, 500-800 persons were employed by the forest industry in Mobile County (U.S. Department of Commerce, Bureau of the Census 1979). There are no data for Baldwin County.

In 1978, the raw stumpage receipts to land owners from sales of timber were \$13.1 million (Alabama Crop and Livestock Reporting Service 1980).

About \$13.1 million sales of forest products in 1978 would have directly and indirectly generated about 1,700 jobs and \$20.2 million in household income, or about 1% of coastal Alabama's total employment and personal income (Nelson and Hardy 1980). Even when its indirect benefits are considered, forestry does not constitute an important component of the coastal economy.

The primary economic significance of coastal Alabama's forest resources is that they have attracted wood-product manufacturers—e.g., lumber and wood (SIC 24) and paper (SIC 26)—to locate in the area. These timber-dependent industries constituted a major component of the local economy and are discussed in more detail in the chapter on Industrial and Residential Development.

AGRICULTURAL AND FORESTRY LAND USE

EXISTING LAND USE

Forestry and agriculture are the predominant coastal land uses. In 1975, forestry lands made up about 48% of total land area, and agricultural lands made up about 19% (South Alabama Regional Planning Commission 1977).

In coastal Alabama, there are approximately 496,200 ha (1.2 million acres) of commercial forest lands of which 211,800 ha (0.5 million acres) are in Mobile County and 284,400 ha (0.7 million acres) are in Baldwin County (Table 47). Most of these lands are privately owned by either individuals or the forest industry. Paper companies own or lease vast acreages of these forest lands, particularly in Baldwin County.

Forests are common throughout coastal Alabama but the commercially significant forests are concentrated in the northern portions of the two counties (Figure 11). The dense, commercially important stands of loblolly and shortleaf pine are the backbone of the area's forest industry. Other forested lands are bottomland hardwoods throughout much of the Mobile Delta and longleaf and slash pine in the southern portions (Moser and Chermock 1977).

The area of farms in the region is about 157,830 ha (389,700 acres) of which 53,740 ha (132,700 acres) is in Mobile County and 104,090 ha (257,000 acres) is in Baldwin County (Table 48). About 68% of the farm land is cultivated, 22% is woodlands, and 10% is used for other purposes. Farm land is mostly in or adjacent to the coastal area in southern Baldwin County and in western and southern Mobile County (Figure 11).

In 1959-78, substantial areas of coastal Alabama's agricultural and forested lands were converted to residential, commercial, and industrial uses. The area of farm lands declined by nearly one-fourth from 1959 to

1978 and a further decline of about 4% in the amount of land used for agriculture and forestry is expected by 2000 (South Alabama Regional Planning Commission 1977).

PREFERRED LAND USE BASED ON SOIL ASSOCIATIONS AND FINANCIAL RETURNS

A soil association is a natural landscape unit that has a distinctive pattern of soils and drainage features. It is comprised of one or more soils of major extent and one or more soils of minor extent and is named for the major soils. Soil associations for Mobile and Baldwin Counties are shown in Figure 12 and are described in the accompanying key.

Knowledge of soil characteristics, together with potential financial return, usually helps determine optimum agricultural land use. In general, crops produce the greatest immediate financial return, pastures second, and forests third. Preferred agricultural uses according to soil type in coastal Alabama are given in Figure 13. Some forested areas in central Baldwin County and northern Mobile County have potential for being converted to pasture and, with clearing and drainage, some of the hardwood bottom lands along the rivers in the northern part of the two-county area could be used for soybean production (Moser and Chermock 1977). These recommended uses of land for agriculture (Figure 13) are based solely on suitability of soil type, without regard for overall resource values or habitat considerations.

AGRICULTURAL PRODUCTION

DATA SOURCES

The principal data sources for agriculture in counties of Alabama are the U.S. Department of Commerce, Bureau of the Census' *Census of Agriculture* (conducted nationally every five years) and the Alabama Crop and Livestock Reporting Service's *Alabama Agricultural Statistics* (compiled annually in cooperation with the U.S. Department of Agriculture). The census publication provides detail on farm characteristics, and the state publication reports extensively on production. Because the data obtained from the census publication are comparable to the census data for all other areas of the Nation, it is the primary data source for this chapter.

FARM CHARACTERISTICS

The number of farms in Mobile and Baldwin Counties has gradually declined since 1959 (Table 48). Part of the apparent decline was caused by a change in the definition of a farm. The Bureau of the Census, prior to its 1974 *Census of Agriculture*, changed the definition of a farm to any place selling $1,000 or more of agricultural products (crops; greenhouse and nursery products; livestock and livestock products) annually. The previous definition counted as a farm any place with less than 10 acres that sold $250 or more of agricultural products annually, or any place of 10 acres or more that sold $50 or more agricultural products annually. Using the old definition for comparative purposes, the number of farms in the two counties was 3,557 in 1959 and 2,354 in 1969, a decrease of about 35% (Table 48).

Most of the area's farms are located in Baldwin County, south of Interstate 10, and in Mobile County, southwest of the Mobile urban area (Figure 14). In 1978, Baldwin County contained about 57% of the farms in the two-county area (Table 48).

The average size of farms in coastal Alabama increased by 43% in 1959-69, from 58 ha (142 acres) to 82 ha (203 acres) (Table 48). This trend to larger farms began in 1940 but has gradually moderated or reversed somewhat since 1970. The average size of farms declined from 82 ha (203 acres) in 1969 to 75 ha (184 acres) in 1978, a change of about 9% (Table 48). This decline in average farm size is attributed primarily to the conversion of many large Mobile County farms or parts of farms to urban use. In 1978, Baldwin County farms were about 45% larger than Mobile County farms.

The average value of farms in coastal Alabama has increased substantially since 1959. The average farm (land and buildings) was valued at $25,800 in 1959 and $223,600 in 1978. Machinery and equipment also constitute a major investment. In 1978, the average value of machinery and equipment per farm was $30,500 (Table 49) (U.S. Department of Commerce, Bureau of the Census 1980a, 1980b).

Principal production expenses for farmers in coastal Alabama in 1978 were $9.3 million for fertilizer; $8.6 million for hired labor; $6.5 million for animal feed; $5.4 million for livestock and poultry purchased; $5.0 million for gasoline and other petroleum products; $4.2 million for agricultural chemicals, excluding fertilizer; and $3.9 million for seeds, bulbs, plants, and trees (Table 50) (U.S. Department of Commerce, Bureau of the Census 1980a, 1980b).

PRODUCTION TRENDS

Cash receipts from the sale of farm products in Mobile and Baldwin Counties are given in Tables 51, 52 and 53. Cash receipts in Tables 51 and 52 were obtained from the Alabama Crop and Livestock Reporting Service's annual publication, *Alabama Agricultural Statistics*. Total farm receipts indicated by this publication are slightly higher than those by the *Census of Agriculture* in Table 53 because *Alabama Agricultural Statistics* sales estimates are based on units of production that are consistently higher than those reported in the *Census of Agriculture*. Although the *Census of Agriculture* is the primary source of data for this chapter, data from the state publication, *Alabama Agricultural Statistics*, are used for production trends because it is more current and provides greater detail.

Although the total agricultural acreage and number of farms has declined in recent years, production and cash receipts from farm marketings have increased. Technological improvements have increased productivity and labor efficiency and gained greater production from less acreage and fewer workers.

Cash receipts from farm marketing increased (mostly from inflation) from $75.6 million in 1974 to $106.9 million in 1978, an increase of 41% (Table 51). Between 1978 and 1979, sales dropped slightly, reflecting the damage of Hurricane Frederic (12 September 1979) to area farms.

The principal agricultural products in coastal Alabama are soybeans, nursery products, vegetables, cattle, and calves. In 1978, soybeans accounted for 32% of total farm receipts; fruits and vegetables, nuts, and greenhouse and nursery products accounted for 37%; and cattle and calves accounted for 14% (Table 52). Most of the soybean production is exported abroad.

Since 1969, the annual production of soybeans, corn, and hay has increased, and the annual production of wheat and cotton has declined (Table 54) The largest increase in soybean production was in 1969-75, but it has leveled off since then (U.S. Department of Commerce, Bureau of the Census 1972, 1977, 1980a, 1980b).

Although Alabama farmers have made substantial progress in improving yields, their average yields are generally lower than national averages (Table 55). For its major agricultural products, yields for Mobile and Baldwin Counties are slightly higher than State averages (Alabama Crop and Livestock Reporting Service 1960, 1962, 1974, 1977, 1979, 1980).

FUTURE OF AGRICULTURE IN COASTAL ALABAMA

Agriculture is a declining industry in coastal Alabama and is expected to continue to decline but at a slower rate. On the other hand, the volume of most farm products and farm sales should increase. Improvements in technology and greater labor efficiency should permit increased production of agricultural products with fewer workers and less farm acreage.

Because of increased farm productivity, real farm income in the coastal counties is expected to increase by 75% in 1978-2030 (Table 46). Farm employment is expected to decline as much as 34% in 1978-2030 (Table 45).

Soybeans will probably remain the principal crop in coastal Alabama and production should gradually increase. Nursery operations have grown in number and size in Mobile County in recent years and probably will expand in the future (Alabama Development Office 1978).

FORESTRY PRODUCTION

Forest resources in coastal Alabama are extensive (Table 56). In 1975, there were about 33.5 million m^3 (1,182.8 million ft^3) of growing stock, of which 21.8 million m^3 (771.3 million ft^3) was in Baldwin County (Beltz 1975). Of the 1975 growing stock, approximately 62% was softwood and 38% hardwood (Beltz 1975). Growth in 1975 exceeded the volume of timber being logged, which may indicate that the area's forests are not necessarily being excessively exploited (Moser and Chermock 1977).

Most timber production is concentrated in the northern one-third of the two counties, but there also is some timber production in south Baldwin County, particularly in the area between the Styx and Perdido Rivers.

In 1978, cash receipts from sales of raw stumpage products in the Alabama Coastal region were $15.7 million, or 13% of the State total. Sales were $3.2 million in Mobile County and $12.5 million in Baldwin County (Table 57).

Pulpwood used in the manufacture of paper uses most of the timber harvest (Table 58). Saw timber ranks second in importance, and veneer logs for the manufacture of plywood is third. Other forest products are poles, posts, cooperage, furniture stock, pilings, and turpentine (Moser and Chermock 1977). The production of pine lumber and logs is greater than hardwood production (Table 59).

Most of the industrial plants that process forest products are multi-purpose facilities that manufacture several products at a single location. For example, logs of all diameters are hauled to the plant and, depending on their quality and size, they are converted into paper pulp, chips, lumber, or plywood.

Modern forestry management practices are increasing the production per acre. Undesirable tree species are destroyed, usually by chemical spraying; clearcutting and replanting with "super trees," which have better growth characteristics; and increased use of fertilizers and insecticides (Moser and Chermock 1977).

WATER QUALITY RELATIONSHIPS

COASTAL DRAINAGE PATTERNS

The Mobile, Tensaw, and other rivers that flow through the delta area in the north-central portion of coastal Alabama discharge into Mobile Bay (Figure 15). The Mobile-Tensaw drainage basin is affected by tidal fluctuations except during high freshwater inflow. There are intervals when the tidal effect causes the Mobile and Tensaw Rivers to flow upstream, at least on the surface (South Alabama Regional Planning Commission 1977).

The Perdido River drains the east half of Baldwin County and flows southward until it and several other small tributaries discharge into Perdido Bay, a tributary to the Gulf of Mexico (South Alabama Regional Planning Commission 1977).

The Escatawpa River drains the western area of Mobile County and flows southward generally along the Alabama-Mississippi State line, crossing into Mississippi and flowing into the Pascagoula River a short distance upstream from the Gulf of Mexico (South Alabama Regional Planning Commission 1977).

RUNOFF FROM AGRICULTURAL AND FORESTED LANDS

Runoff from agricultural and forested lands constitutes non-point sources of water pollution. Agricultural non-point sources are crop and animal wastes in runoff, seepage, or the percolation of nutrients, pesticides, and herbicides into surface and ground waters. Clear-cut logging practices in forests often cause excessive erosion and high turbidity and sedimentation in rivers and estuaries. Based on drainage patterns, areas with the greatest potential for agricultural runoff problems (usually an excess of nutrients or toxic substances) are Fish River, Weeks Bay, Wolf Bay, Perdido Bay, Fowl River, and Mobile Bay. Areas with greatest potential for improper logging and runoff problems (usually turbidity and silt deposition) are the Mobile Delta, Chickasaw Creek, Eight Mile Creek, Mobile Bay, and Perdido River.

In 1974, farmers in Mobile and Baldwin Counties spent $11.0 million on the purchase of agricultural chemicals, primarily fertilizers and insecticides (Table 60). In 1974-77, an annual average of 105,280 tons of fertilizers were sold in coastal Alabama. The composition was 81,300 tons of mixed grade fertilizers; 23,980 tons of material fertilizers (17,490 tons nitrogen based, 1,030 tons potassium based, 730 tons phosphorus based, and 4,730 tons miscellaneous) according to the Alabama Water Improvement Commission (1978). These figures include some purchases actually applied in other counties.

In coastal Alabama, virtually all fertilizer is applied by ground equipment. About one-third of the pesticide application is by air and the remainder from the ground (Killpatrick; County Agent's office; Mobile, AL; 23 April 1981; personal communication). No data relative to the actual quantities of fertilizers and pesticides applied in the coastal counties are available.

Agricultural runoff, heavy in nutrients, sometimes causes excessive eutrophication and oxygen depletion in the receiving waters. Pesticides in runoff weaken or kill many aquatic organisms, and cultivation may cause erosion, turbidity, and sedimentation. Fecal coliform from pastureland enters nearby streams and, because it is used as an indicator of pollution, may cause areas to be closed to fishing.

Pesticides are of particular concern in estuarine environments. Pesticides may be washed into streams from agricultural and forested lands and eventually enter estuaries. Pesticides then may accumulate in the bodies of estuarine animals and enter the human food cycle. Pesticides such as phorate, malathion, DDT, DDD, DDE, dieldrin, endrin, aldrin, chlordane, BHC-lindane, and heptachloride have all been detected in oyster, water, and sediment samples. Levels of DDT, DDD, and DDE are expected to gradually decline as a result of the current ban on the use of DDT (Alabama Coastal Area Board 1980).

During rainy periods and under various conditions of site preparation and crop maturity, soils are subject to erosion. Clear-cut forest lands and tilled agricultural lands are a major source of sediments in runoff. Although pasture acreage is not as susceptible to erosion, serious erosion may occur if the grass is grazed too heavily. In 1978, coastal Alabama had 320,920 ha (792,400 acres) of agricultural and silvicultural lands that were subject to erosion (Table 61). About 85% was forest lands, 10% cropland and hayland, and 5% pasture land (South Alabama Regional Planning Commission 1978).

Effective agricultural and forest land non-point pollution control programs have been implemented in coastal Alabama. The U.S. Soil Conservation Service recommends soil erosion preventive practices, and the Alabama Forestry Commission administers a similar erosion control program in connection with logging practices. Water quality monitoring in coastal Alabama waters has revealed no serious public health or biological problems directly attributable to agriculture or logging practices (South Alabama Regional Planning Commission 1978).

SUMMARY

In 1975, nearly 70% of the land area of coastal Alabama was in agriculture or forested. In Mobile and Baldwin Counties, agricultural production is concentrated in the south and commercial timber production in concentrated in the north.

Land used for agriculture and forestry has declined over the last 20 years. In 1959-78, farm land decreased nearly one-fourth. In 1978-2000, the area of farm and forested lands should continue to decline but at a slower rate.

The economic significance of agriculture in the two-county area has decreased over the last 10 years and may continue to decline in the future. In 1969-78, total farm employment declined 17% and is projected to decline even further (34%) by 2030. Farm income as a proportion of total personal income increased slightly in 1969-78 but is expected to decline in the future (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

Direct employment and personal income in agriculture and forestry are not significant components of coastal Alabama's economy. In 1978, farm employment and income were only about 2% of the total, and forestry was less than 1% (U.S. Department of Commerce, Bureau of the Census 1979).

When indirect economic implications of the agricultural and forestry sectors are considered, agriculture emerges as a relatively important part of the economy, although forestry does not. In 1978, agriculture directly and indirectly generated 11% of employment and income, and forestry only 1% (Nelson and Hardy 1980). The primary value of the forest resources is that they attracted lumber and paper manufacturers to the area.

Because of technological developments, the number of farms in coastal Alabama declined in 1959-78, while average farm size and productivity increased. Currently, trends toward a decrease in the number of farms and an increase in average farm size have leveled off, and the increase in unit productivity continues. Principal agricultural products are soybeans, nursery products, vegetables, cattle, and calves. These products will probably remain major components of coastal Alabama's agriculture during the foreseeable future.

The timber harvest is primarily for the production of pulpwood, which is used in the manufacture of paper. Large quantities of saw timber and veneer logs also are produced.

Runoff from agricultural and commercial forest areas constitutes a non-point source of water pollution. In coastal Alabama, approximately 44,440 ha (119,620 acres) of agricultural lands and 272,470 ha (672,770 acres) of forestry land are subject to erosion (South Alabama Regional Planning Commission 1978). The State Soil and Water Conservation Committee and the Alabama Forestry Commission with technical or financial assistance from the U.S. Environmental Protection Agency, U.S. Soil Conservation Service, U.S. Forest Service, U.S. Agricultural Stabilization and Conservation Service, Alabama Cooperative Extension Service, Alabama Water Improvement Commission, and various State and local agencies currently administer effective non-point source control programs under the provisions of Section 208 of the Clean Water Act.

DEFINITION OF TERMS

AGRICULTURE

Agricultural production (SIC 01, 02) - includes any establishment primarily engaged in the production of crops, plants, vines, or trees (excluding forestry operations); and the keeping, grazing, or feeding of livestock for the sale of livestock or livestock products, for livestock increase, or for value increase.

Farm - any place selling $1,000 or more of agricultural products (crops, plants, livestock, livestock products) annually.

FORESTRY

Forestry production (SIC 08) - includes any establishment primarily engaged in the operation of timber tracts, tree farms, forest nurseries, or the gathering of forest products. (Logging contractors are classified under SIC 24.)

Commercial forest land - forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization.

TREE SPECIES

Hardwoods - dicotyledonous trees, usually broadleaved and deciduous.

Softwoods - coniferous trees, usually evergreen, having needle or scale-like leaves.

FOREST TYPE

Longleaf-slash pine - forests in which longleaf or slash pine, singly or in combination, comprise a plurality of the stocking. Common associates include other southern pines, oak, and gum.

Loblolly-shortleaf pine - forests in which southern pine and eastern redcedar except longleaf or slash pine, singly or in combination, comprise a plurality of the stocking. Common associates include oak, hickory, and gum.

CLASS OF TIMBER

Growing stock trees - sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except rough and rotten trees.

Sawtimber trees - live trees of commercial species, 9.0 inches and larger in diameter at breast height for softwoods and 11.0 inches and larger for hardwoods, and containing at least one 12-foot saw log.

Poletimber trees - live trees of commercial species 5.0 to 9.0 inches in diameter at breast height for softwoods and 5.0 to 11.0 inches for hardwoods, and of good form and vigor.

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MINERAL PRODUCTION

INTRODUCTION

Adequate supplies of mineral resources, particularly energy resources, in the future is a major problem in the United States. In recent years, the United States has imported increasingly large volumes of foreign oil and natural gas because domestic production has not kept pace with demand.

Staggering increases in the price of imported petroleum from Organization of Petroleum Exporting Countries (OPEC) cartel members since 1973 have resulted in a national effort to combat domestic energy shortages. As a part of this national effort, the United States government has recently implemented policies that give incentive for accelerating petroleum exploration and development. These policies limit the amount of foreign imports to 1977 levels, deregulate prices of domestic products, and place emphasis on timely processing and evaluation of energy-related permit applications.

As a result of these policies, oil and gas exploration has increased in many areas of the Nation including coastal Alabama. The production of other minerals in the two-county area has also increased but not nearly to the extent of oil and gas.

The purpose of this study is to characterize the mineral industry of Alabama for planning and emphasize oil and gas exploration and production. This chapter includes discussions on the history of exploration and development in the coastal area, production trends, industrial infrastructure, the economic importance of the industry, estimated reserves, and future prospects.

BACKGROUND

Alabama currently ranks among the top 20 mineral producing states in the Nation (Hubbard 1979), primarily because of coal, oil, and gas production. Coastal Alabama does not produce coal, but it does make a sizeable contribution to the State's production of oil and natural gas. Other minerals produced in the coastal counties are sand, gravel, clay, and oyster shells.

Oil and gas has dominated the mineral industry in coastal Alabama for the last 20 years, and recent State territorial and Federal outer continental shelf (OCS) discoveries should lead to greater production. The State controls production onshore and in State territorial waters, and the Federal government controls production in the outer continental shelf. In comparison to oil and gas, the value of the inorganic minerals is small.

Although coastal Alabama makes a sizeable contribution to the State's production of oil and natural gas, the State's annual production is relatively small compared to some other states. For example, Louisiana's oil production in 1979 was 18 times greater than that of Alabama and its natural gas production was about 30 times greater.

OIL AND GAS

Oil and gas are produced onshore and in State territorial waters and Federal OCS waters. The State territorial waters extend from the coastline out 5.6 km (3.0 nautical mi) and include Mobile Bay and portions of the Mississippi Sound and the Gulf of Mexico. The OCS offshore area incorporates all submerged lands outside the 3-mi limit.

Exploration for oil and gas in coastal Alabama began in 1902 (Moser and Chermock 1977) and was confined to onshore areas until the late 1960's. In 1945-79, the State of Alabama Oil and Gas Board issued about 700 permits to drill in coastal Alabama. About 69% of the wells were productive (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Onshore discoveries in coastal Alabama include the South Carlton and Tensaw Lake oil fields in Baldwin County, and the Citronelle oil field and Chunchula and Hatter's Pond gas fields in Mobile County (Figure 16).

The only discovery in State territorial waters was near the mouth of Mobile Bay. This well has yet to be established as a field, however, and only after further wells are drilled will the full significance of the discovery be known.

MAJOR DISCOVERIES

ONSHORE

The South Carlton field, discovered in 1950, is located in Baldwin and Clarke Counties. South Carlton was the second oil field discovered in Alabama and in 1979 contained 47 producing wells. This field produces from the Lower Tuscaloosa horizon (Table 62) and, by the end of 1979, cumulative production was 4.4 million bbl of crude oil (Table 63). Additional wells in the South Carlton field are being drilled, especially in Clarke County, to help develop reserves and delineate the productive limits of the reservoir. Although the oil supply is being depleted, additional wells in the South Carlton field enabled annual production to reach peak levels in 1979 (Masingill and McAnnally 1980).

In 1955, the Citronelle oil field, discovered in northern Mobile County, initiated Alabama's first boom in oil production. Oil was discovered in a series of sands in the Upper and Lower Devonian (Table 62) at depths ranging from 3,052 to 3,299 m (10,014 to 10,824 ft). In 1979, the Citronelle field contained 447 wells, including enhanced recovery wells. By the end of 1979 (Table 63), the field had produced a cumulative total of 129.4 million bbl of oil (two-thirds of the State's cumulative oil production) and 331.1 million m^3 or 11.7 billion ft^3 of gas (3% of the State's cumulative gas production). Since the early 1960's, the field has undergone a complex secondary water-flood recovery program (Masingill and McAnnally 1980).

After 10 years without an oil discovery in Alabama, the Tensaw Lake field was discovered in Baldwin County in 1965. From 1965 until abandonment in 1972, four wells produced 164,786 bbl of oil (Table 63). Production was from a sand in the Lower Cretaceous horizon (Table 62) at a depth of approximately 2,562 m (8,400 ft) (Masingill and McAnnally 1980).

The Chunchula gas field, about 3.2 km (2 mi) northeast of Chunchula in Mobile County, was discovered in 1973. This field produces from the Smackover Formation (Table 62) at a depth of approximately 5,490 m (18,000 ft). Because of association of hydrogen sulfide with the hydrocarbons, production from this field was delayed until construction of a sulfide cleansing plant in 1976. The field had 34 producing wells in 1979 and a cumulative production of 6.0 million bbl of condensate and 356.6 million m^3 (12.6 billion ft^3) of gas (Table 63). Condensate is a liquid hydrocarbon that is formed from condensation of petroleum existing initially in a gaseous form in the underground deposits. Condensate is recovered at the surface and is the result of reduced pressure or temperature. Condensate is used for the same purposes as oil.

In 1974, discovery of the Hatter's Pond gas field increased the importance of Mobile County as a gas-producing area. Hatter's Pond is located about 9.7 km (6 mi) southeast of the Chunchula field. In the Hatter's Pond field, hydrogen sulfide is associated with the hydrocarbons, and production was delayed until a sulfide cleansing plant was constructed in 1976. The field had 11 producing wells in 1979 and a cumulative production of 5.2 million bbl of condensate and 566.0 million m^3 (20.0 billion ft^3) of gas (Table 63). Production from this field is from the Smackover-Norphlet Formation (Table 62) at a depth of approximately 5,486 m (18,000 ft) (Masingill and McAnnally 1980).

The Chunchula and Hatter's Pond fields were the most important oil and gas discoveries in the continental United States in 1973 and 1974. With these discoveries, Mobile County became one of Alabama's major gas-producing areas (Moser and Chermock 1977).

Onshore exploration is currently concentrated in south Baldwin County. This surge in exploration is attributed to a 1979 gas discovery near the city of Foley. The discovery well produced gas at a rate of 26.9 thousand m^3/day (950 thousand ft^3/day) from a Miocene sand at a depth of 509 m (1,670 ft) (Masingill and McAnnally 1980). Over the next several years, onshore explorations will probably continue to be concentrated in southern Baldwin County (Figure 16).

STATE TERRITORIAL WATERS

In 1969, the Mobil Oil Corporation leased four 2,025-ha (5,000-acre) tracts in Mobile Bay (Figure 17). Drilling of the first well in tract 76 began in November 1978. In October 1979, gas was discovered flowing at a rate of approximately 345.3 thousand m^3/day (12.2 million ft^3/day) from the Norphlet Formation at a depth of 6,293 m to 6,369 m (20,634 ft to 20,883 ft). Because Mobil's drilling permit excluded production, the well was "capped" in December 1979 (Mobil Oil Corporation 1980b).

Since 1979, the Mobil Oil Corporation has requested and been granted permits to drill four additional appraisal wells within its leased blocks. Two of these wells, numbers 2-94 (directionally drilled from well number 1-76) and 1-95 are now being drilled. Production from these wells will require further permits.

OUTER CONTINENTAL SHELF

Several exploratory wells currently are being drilled in the outer continental shelf (Figure 18). These include one well in tract 973 (Pensacola Area), which is leased by Mobil Oil; three wells in tract 863 (Viosca Knoll Area), which is leased by Arco; and one well in tract 864 (Viosca Knoll Area), which is leased by Conoco. None of these wells is producing yet.

PRODUCTION TRENDS

Alabama was ranked 17th nationally in the production of oil and condensate in 1979 and 20th in the production of natural gas (Hubbard 1979). Coastal Alabama contributed 29% of the State's oil production, 45% of the condensate production, and 12% of the natural gas production.

Coastal oil production was 3.0 million bbl in 1979, a 50% decline from 1970 (Table 63). This decline is attributed to the depletion of the Citronelle oil field which, since its discovery in 1955, has accounted for nearly all of coastal Alabama's cumulative oil production, and roughly two-thirds of the State production.

Condensate production in coastal Alabama was 3.8 million bbl in 1979 (Table 63). The Chunchula and Hatter's Pond fields, which were discovered in 1973 and 1974, respectively, have accounted for all of the area's condensate production.

Alabama's coastal gas production was 319.8 million m^3 (11.3 billion ft^3) in 1979 (Table 63). Nearly all of the gas produced was from the Chunchula and Hatter's Pond fields.

Cumulative production of oil in the coastal counties was 134.1 million bbl by the end of 1979 or about two-thirds of the State's cumulative oil production (Table 63). Cumulative condensate production was 11.5 million bbl in 1979, or about one-third of State condensate production. Cumulative gas production was 1,253.7 million m^3 (44.3 billion ft^3) in 1979 or about one-tenth of cumulative State gas production.

Oil and gas production in coastal Alabama counties has been limited to production from onshore wells. Although gas was found in Mobile Bay in 1979, the discovery well was "capped" pending drilling of additional appraisal wells in the bay. If production is proven technologically and economically feasible, a new and separate permit action and environmental analysis would be required before production would be permitted.

INFRASTRUCTURE

Production of oil and gas requires a complex infrastructure consisting of refineries, petrochemical plants, storage facilities, and pipelines. The locations of oil refineries, gas processing plants, and oil and gas pipeline systems of coastal Alabama are shown in Figure 19.

PETROLEUM REFINERIES AND STORAGE FACILITIES

The four petroleum refineries now located in coastal Alabama (Table 64) are operated by Louisiana Land and Exploration Company, Marion Corporation, Mobile Bay Refining Company, and Chevron, all located in Mobile County (Figure 19).

In 1977, the Louisiana Land and Exploration Company's refinery, coastal Alabama's largest, had a production design capacity of 40,000 bbl/day and an average daily production of 34,200 bbl. The four refineries had a combined capacity of over 80,000 bbl/day and an average daily production of over 65,000 bbl (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

In 1977, coastal Alabama supported 16 petroleum storage facilities (Table 65). Combined, these facilities had 163 tanks and a primary capacity of 6.1 million bbl (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

NATURAL GAS PROCESSING AND TREATMENT PLANTS

Three gas processing and treatment plants are now located in coastal Alabama (Figure 19). The Citronelle plant is a liquid extraction plant serving the Citronelle field. Natural gas liquids produced by the plant in 1979 were 7,596 bbl of gasoline and 10,301 bbl of a butane-propane mixture (Table 66).

The Chunchula plant is a liquid extraction and gas cleansing facility serving the Chunchula field. This plant was expanded recently and now has a designed inlet capacity of 1,132.0 thousand m^3 (40.0 million ft^3) of gas per day and a daily sales volume of 764.1 thousand m^3 (27.0 million ft^3) of gas and 14.0 thousand bbl of condensate. Natural gas liquids produced by the plant in 1979 were 7,159 bbl of gasoline, 15,619 bbl of butane, 29,241 bbl of propane, and 71.1 thousand kg (69 long t) of sulphur (Table 66).

The Hatter's Pond liquid extraction and gas cleansing plant has a designed inlet capacity of 424.5 thousand m^3 (15.0 million ft^3). In 1979, the plant produced 133,106 bbl of butane and 163,773 bbl of propane (Table 66).

OIL AND GAS PIPELINES

In 1977, the five oil pipeline systems (Table 67) were fed by about 275 km (172 mi) of pipelines (Alabama Coastal Area Board and the U.S. Department of Commerce 1979). These systems were operated by Hess, Exxon, Western Crude, Citmoco, and Miller Purchasing Companies (Figure 19).

In 1977 there were about 3,862 total km (2,384 mi 3-inch main equivalent) of gas pipeline (Table 68) in the two coastal counties. This total includes the four major transmission lines operated by United Gas Pipeline and the distribution lines operated by the local utility companies served by it.

BRINE DISCHARGES

Oil generally is found in brine-saturated porous rocks that were deposited in a marine environment. When crude oil is pumped to the surface, large amounts of brine are produced with the oil. Producers that separate the crude oil from the brine must somehow dispose of the brine.

Disposal of brine into deep wells has been a method used for many years in the United States and Alabama. Deep-well disposal is the process whereby brine wastes are injected under pressure into a permeable zone that is confined above and below by an impermeable zone. This permits the injected wastes to migrate laterally but not vertically so as to prevent contamination of fresh ground water or interference with the production of other natural resources. Disposal techniques are required to meet the following criteria to help eliminate pollution: (1) the receiving strata should contain water of such poor quality as to preclude its future use for any domestic or commercial purpose; (2) the rock should not chemically react adversely with the injected waste; (3) the structure and stratigraphy of the area should confine the injected waste so that other natural resources are protected; (4) the porosity, permeability, and area extent of the receiving strata should be sufficient to accommodate the injected waste for several years; and (5) there should be no apparent adverse biological or seismic effects (Moser and Chermock 1977).

The Oil and Gas Board of Alabama is the principal regulatory agency for brine disposal in the coastal counties. Since about 1950, when oil production began in coastal Alabama, brine contamination has been a problem only at the Citronelle field. Prior to 1970, the Citronelle freshwater supply was contaminated, but the problem has since been eliminated (South Alabama Regional Planning Commission 1978).

In 1979, 11 brine disposal wells were in operation in the Citronelle, Hatter's Pond, and Chunchula fields in Mobile County and two in the South Carlton field in Baldwin County (Alabama Coastal Area Board and U.S. Department of Commerce 1979). In 1977, approximately 19,000 bbl of brine were disposed of daily into the subsurface (Moser and Chermock 1977).

Coastal Alabama, which is in the Coastal Plain physiographic province, is considered the most important ground-water producing area in Alabama. The same parameters of permeability and porosity that permit abundant yields of ground water also provide a virtually unlimited depository at greater depths for brine or other liquid waste disposal (Moser and Chermock 1977).

FUTURE POTENTIAL

ONSHORE

Although estimates of coastal Alabama's onshore oil and gas reserves are not available, estimates relative to the future potential of several existing fields do exist. The Citronelle field (discovered in 1955) has undergone extensive secondary recovery since 1961. About 50 million more barrels of oil can be extracted through continued use of secondary recovery methods (Moser and Chermock 1977).

The Chunchula field was discovered in 1973 and has an expected life extending past 2010. Estimated reserves for the Chunchula field are as follows: 9,293.7 million m^3 (328.4 billion ft^3) of reservoir gas, 102.1 million bbl of condensate; 4,426.1 million m^3 (156.4 billion ft^3) of sales gas; 1,884.9 million liters (498.0 million gal) of propane; 1,402.1 million liters (370.4 million gal) of butane; 238.8 million liters (63.1 million gal) of natural gasoline; and 86.1 million kg (84.7 thousand long t) of sulphur (Hellmich 1981, personal communication).

The Hatter's Pond field was discovered in 1974. It is anticipated that the reserves will be depleted in about 20 years (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Onshore explorations in coastal Alabama over the next several years will probably be concentrated in south Baldwin County. Gas was discovered there in 1979 when Amoco Production Company tested a shallow Miocene sand near the city of Foley (Figure 16). The discovery well flowed gas at a rate of 26.9 thousand m^3 (950 thousand ft^3) per day from a depth of about 509 m (1,670 ft). Since this discovery, six additional wells are being drilled (Masingill and McAnnally 1980, Poe 1981). The volume of gas reserves in this area has not been estimated.

STATE TERRITORIAL WATERS AND FEDERAL OFFSHORE

EXPLORATION AND PRODUCTION

The focus of oil and gas exploration in coastal Alabama over the next decade probably will be in Alabama territorial waters and in the OCS area. Interest in exploration in State waters was stimulated by Mobil Oil Corporation's 1979 discovery of gas in the mouth of Mobile Bay approximately 3.2 km (2.0 mi) east of Dauphin Island. Although Mobil is drilling additional wells to assess the importance of this discovery, gas reserves are now estimated to be from 5,660 to 16,980 million m^3 (200 to 600 billion ft^3) according to the Mobil Oil Corporation (1980a).

Since 1969, Mobil Oil Corporation's four tracts in the mouth of Mobile Bay were the only tracts under active lease in State waters. In 1981, however, the Alabama Department of Conservation and Natural Resources offered an additional 64 tracts for lease sale. Bids on 13 tracts totalling 22,297 ha (55,054 acres) were accepted (Table 69), and the State received $449 million in cash bonuses from this lease sale. The average bonus paid for the tracts was $20,145 per ha ($8,159 per acre). Drilling activity in these newly leased tracts will probably begin in a few years.

Several tracts in the OCS are currently under active lease and exploratory wells are being drilled. As shown in Figure 18, many additional tracts will be offered for competitive bid in the near future under proposed Outer Continental Shelf Sales 66 (October 1981), 67 (March 1982), and 69 (August 1982).

INFRASTRUCTURE

If extensive oil and gas reserves are discovered in Alabama territorial waters and production is proven economically and technologically feasible, various support facilities would be required. These include offshore utility and production platforms, underwater pipeline systems, and onshore processing plants and support facilities. Depending upon the nature and magnitude of the finds, much of the production could be transported to and processed in the existing facilities and logistic services in Louisiana.

The Mobil Oil Corporation is the only oil company to drill in the Alabama waters. It has exploration platforms in Mobile Bay and an onshore support facility in Bayou La Batre. Should production prove feasible, Mobil plans to request authorization to install six production platforms in Mobile Bay, a buried pipeline system (consisting of two or more lines to transport the well-stream to shore), and an onshore processing and treatment plant to be located in an area southwest of Mobile (Mobil Oil Corporation 1980b).

ECONOMIC AND ENVIRONMENTAL IMPACTS

Extensive oil and gas exploration and development in Alabama waters will exert positive and negative economic and environmental impacts. The planning process will require a careful assessment of the direct and indirect aspects of these impacts. Lease bonuses and royalties paid to state and federal governments (Table 70) would be substantial (as in the 31 March 1981 State lease sale) and a portion of these economic benefits undoubtedly would flow to Mobile and Baldwin Counties. Offshore drilling would also provide additional jobs in the area.

Despite direct economic benefits, extensive new oil and gas finds and development could indirectly exert negative impacts on the coastal economy. Extensive oil and gas exploration and development in Alabama waters might degrade the aesthetic quality and recreational benefits of the coastal area and cause a loss of income and employment in the recreational/tourist sector and a decrease in waterfront property values.

Environmental impacts of oil and gas development are well known and discussed in detail in the "Environmental Issues and Regulations" section of this study. Oil spills and blowouts are the major environmental hazards associated with drilling, and proper planning to minimize these potential hazards is requisite. Development of spill cleanup plans and blowout prevention and emergency action procedures is recommended.

SAND, GRAVEL AND CLAY
AVAILABLE RESOURCES

Sand and gravel products are used by the construction industry, which has rigid specifications depending on how they are used. General requirements for sand and gravel are as follows: (1) sand used as aggregate in asphalt, concrete, mortar, and plaster should be clean, siliceous, angular, and free from salts and organic matter; (2) gravel used as aggregate in concrete, road beds, fill material, or ballast should consist of material that is tough, durable, and chemically stable; and (3) sand and gravel having a silica content of more than 95% may be used as glass sand, foundry sand, engine sand, abrasive sand, filter sand, flux in smelting metal ores, and in manufacturing silicones (Moser and Chermock 1977).

Sand suitable for construction aggregate, foundry purposes, and other uses is found in the Citronelle Formation, in beach deposits, and in terrace and alluvial deposits along streams. Terrace deposits composed of poorly sorted clay, silt, sand, and pebbles are in areas adjacent to the Mobile River, and, for the most part, the clay and silt content of these deposits is too great for them to be of much commercial value. Alluvial deposits of fine-to medium-grain quartz sand occur along several creeks and areas adjacent to the Mobile River. These high quality sand deposits are generally suitable for a variety of uses (Moser and Chermock 1977).

Sand and gravel are excavated by hydraulic dredge, by drag line, and by front-end loaders. A majority of miners use hydraulic dredges. Virtually all the sand and gravel produced is washed (Simpson and Smith 1968).

Sand has been dredged from the channel of the Styx River near its confluence with Hollinger Creek in Baldwin County, and an open pit mine with washing and screening facilities for sand has been operating near Three Notches in Mobile County. The locations of all active mines and quarries are shown in Figure 20. Heavy mineral sands are in the nearshore waters off Dauphin Island, but they have not yet been exploited (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Deposits of clay suitable for manufacturing of low-heat duty products occur in small beds (geologically referred to as lenses) within the Miocene age sediments and in the Citronelle Formation of the Pliocene age. Much of the clay, concealed by vegetation and a thick soil cover, is difficult to locate.

Clays that crop out on Fish River, east of Fairhope in Baldwin County, have been mined from shallow open pits for use in the manufacture of brick tile and sewer pipe (Figure 20). Other significant deposits of clay are found in the northern portion of the coastal counties and in the major streams of Mobile County (Moser and Chermock 1977).

PRODUCTION TRENDS

The annual quantity of sand, gravel, and clay produced in Mobile and Baldwin Counties has varied considerably over the past ten years, but the trend shows a general increase (Table 71). In 1971, approximately 208,610 mt (230,000 short t) of sand, gravel, and clay were produced. By 1979, coastal production of these minerals was 1,541,900 mt (1,700,000 short t) or about seven times the 1971 production.

Alabama's production of sand, gravel, and clay was 10.8 million mt (11.9 million short t) in 1979 (Alabama Department of Industrial Relations, Division of Safety and Inspection 1979). The 1979 coastal production of 1.5 million mt (1.7 million short t) was about 14% of the State total.

About 217.7 million mt (240.0 million short t) of sand are available for commercial use in Mobile County and about 9.1 billion mt (10.0 million short t) of sand are available in Baldwin County (Moser and Chermock 1977).

OYSTER SHELLS

Oyster shell deposits are located in Mobile Bay, Bon Secour Bay, and Mississippi Sound. Dredging began in 1946 and has been confined to upper Mobile Bay and its tributaries where living oyster reefs do not now exist (May 1971). The Alabama Department of Conservation is responsible for authorizing and regulating dredging and for collecting royalties from dredging.

Oyster shells are mined hydraulically with suction dredges, primarily for use in the manufacture of cement, masonry block, poultry feed supplements, chemicals, metals, and road materials. Alabama is currently ranked third nationally in the production of oyster shells (Hubbard 1979).

Oyster shell production averaged about 1.5 million m^3 (2.0 million yd^3) annually in 1950-70. Because of depletion in leased areas, annual production has gradually declined since 1970 and was only 1.1 million m^3 (1.4 million yd^3) in 1978 (Table 72).

Radcliff Materials, Inc., is the principal producer of oyster shells in coastal Alabama and, in 1980, sold 60 to 70% of its annual production locally to the Ideal Cement Company for the manufacture of cement (Garrett 1981). Radcliff Materials, Inc., has recently requested renewal of its current lease as well as an additional lease that would grant the company rights to dredge oyster shells from another area of upper Mobile Bay.

In 1970, about 35.3 million m^3 (46.2 million yd^3) of oyster shells were available for commercial dredging in Alabama waters. Assuming that average annual production has been about 1.1 million m^3 (1.5 million yd^3) since 1970, the 1980 shell inventory should approximate 23.9 million m^3 (31.2 million yd^3).

ECONOMIC IMPORTANCE OF THE MINERAL INDUSTRY IN COASTAL ALABAMA

Data pertaining to the economic value of minerals produced in Alabama are compiled by the U.S. Department of the Interior, Bureau of Mines, and are given in Table 73. Due to disclosure rules, however, data for Mobile and Baldwin Counties have not been reported.

Average prices per unit of minerals produced in Alabama are as follows: $10.00 per barrel of crude petroleum (1977); $1.50 per thousand ft^3 of natural gas (1977); $2.30 per short ton of sand and gravel (1979); and $13.20 per short ton of clay (1979). Since the value of a mineral varies according to chemical composition and use, average State prices may not be representative or useful for determining regional production values.

Several reliable estimates of the value of minerals produced in coastal Alabama are available. In 1972, the value of oil and gas shipments for Mobile County alone was $26.0 million (U.S. Department of Commerce, Bureau of the Census 1975). Values for Baldwin County or more recent estimates for Mobile County are not available. Sand production in Mobile and Baldwin Counties was about 320,851 mt (353,705 short t), valued at $187,000; clay production in 1974 was 77,340 mt (85,270 short t), valued at $20,950 (Moser and Chermock 1977). Oyster shell production was 1.3 million m^3 (1.7 million yd^3) in 1968, valued at $2.6 million (May 1971).

Actual (1969 and 1978) and projected (2030) employment in the mining industry (SIC 10-14) and the percentage of the two-county total employment was 184 (0.1%) in 1969; 797 (0.5%) in 1978; and 2,660 (1.0%) in 2030 (Table 25), according to the U.S. Department of Commerce, Bureau of Economic Analysis (1981). Of the employees in specific mining industries, most work was within wholesale trading of petroleum and petroleum products (Table 74).

Although mining constitutes a small proportion of total employment in coastal Alabama, it is one of the most rapidly growing sectors of the coastal economy. In 1969-78, mining employment increased 344%, the largest percentage increase in any of the major industries.

For coastal Alabama, estimated capital investment for expansion by oil and gas companies in 1978-80 was $85.4 million. Expansion investment for the production of other minerals was $11.2 million in 1978-80 (Alabama Development Office 1978, 1979, 1980).

SUMMARY

The principal mineral products of coastal Alabama are oil, gas, sand, gravel, clay, and oyster shells. In terms of economic importance, oil and gas production are by far the most valuable components of the mining industry.

Although exploration for oil and gas in coastal Alabama began as early as 1902, major discoveries were not made until 1950. These onshore discoveries were the South Carlton (1950) and Tensaw Lake (1965) oil fields in Baldwin County; and the Citronelle (1955) oil field and the Chunchula (1973) and Hatter's Pond (1974) gas fields in Mobile County. Oil and gas production to date has essentially been limited to these fields.

In 1979, Alabama was ranked 17th nationally in the production of oil and condensate, and 20th in the production of natural gas. In 1979, coastal Alabama produced about 29% of the State's total oil production, 45% of the State's total condensate production, and 12% of the State's total natural gas production.

The focus of explorations in the next decade probably will be in Alabama coastal waters and in the federal offshore area. Interest there was stimulated by Mobil Oil Corporation's 1979 discovery of gas in the mouth of Mobile Bay. Mobil estimates reserves of 5,660 to 16,980 million m^3 (200-600 billion ft^3). In response to interest by oil companies and the need to provide adequate energy supplies, the State recently offered a substantial amount of offshore area for lease and the federal government plans to do the same in the outer continental shelf in the near future. Explorations in Alabama coastal waters should be relatively intense over the next decade.

Future onshore exploration probably will be concentrated in southern Baldwin County. Gas was discovered in this area in 1979, and current explorations are aimed at estimating the extent of gas reserves in the area.

In terms of economic value, oil and gas production dominates the coastal mineral industry. In 1980, the value of oil and gas produced in Alabama was $522.8 million and the coastal counties contribution to the State production was substantial. Severance tax receipts from oil and gas production in the coastal counties were more than $8 million in 1979-80. Employment generated by the mining industry is relatively small.

In addition to oil and gas, coastal Alabama produces sand, gravel, clay, and oyster shells. Sand, gravel, and clay are mined in scattered locations throughout the area primarily for use by the construction industry. Oyster shells are dredged from Mobile Bay principally for the local manufacture of cement.

RECOMMENDATIONS

As oil and gas companies are becoming increasingly interested in oil and gas exploration in coastal Alabama, planners will be expected to evaluate the economic and environmental impacts of oil and gas development. Careful planning should be exercised in accommodating oil and gas exploration so that the balance of nature is not unnecessarily disturbed. Planners should consider both the direct and indirect aspects of economic and environmental impacts.

DATA GAPS

Major data deficiencies are prevalent concerning: (1) onshore and offshore oil and gas reserves for coastal Alabama (2) oil and gas production projections; (3) planned onshore facilities and logistics relating to oil and gas production; and (4) economic impacts of offshore oil and gas activities.

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COMMERCIAL FISHING

INTRODUCTION

The commerical fishery is an historically important part of the coastal Alabama economy. In 1976, the dockside value of the fishery was $33.6 million; the processed value of fishery products was $73.1 million; boats and vessels numbered 1,031; the number of fishermen totaled 1,923; and the 3,435 seasonal and full-time employees in the processing and wholesaling sector worked in 63 plants. The many other industries and businesses are directly or indirectly dependent upon the industry range from boat builders, net makers, and fuel suppliers to retailers and restaurant operators. The economies of Bon Secour and Bayou La Batre center entirely around commercial fishing. In 1976, the Bon Secour-Gulf Shores and Bayou La Batre ports ranked 19th and 11th, respectively, among U.S. ports in value of landings. Historically, fishing was the first industry of the coast, arising to meet local food needs when the coast was first settled. Later, the fishing industry expanded to reach far inland and, more recently, to other countries.

By whatever measure applied, the local value of the commercial fishery is overshadowed by the value of the resources upon which the fishery depends. Alabama's coastline is small, a tiny fraction of the Gulf states' total, yet it includes Mobile Bay, one of the Nation's major estuaries. Mobile Bay is fed by the fourth largest river system in the United States. The flow from the Mobile River supplies the Mobile River Delta and Bay with a rich supply of nutrients and minerals.

The estuaries of Alabama are protected by barrier islands. The islands combined with a favorable warm climate and nutrients from inland and sea, make Mobile Bay an outstanding fish and shellfish nursery area.

The importance of estuaries is demonstrated by the number of commercial and sport species that depend upon them. About two-thirds of the fish species of the coastal United States are estuarine dependent. Gunter (1967) reported that 97.5% of the total Gulf commercial catch was composed of estuarine-dependent species. Only 2% were marine species and 0.5% were freshwater species. Swingle (1971) reported that 96% of the value and 93.7% of the landings were composed of estuarine-dependent species.

About 2.8 million ha (7.0 million acres) of the Nation's 8.1 million ha (20.1 million acres) of estuaries are in the Gulf region (Gulf South Research Institute 1976). Alabama contributes 174,815 ha (431,967 acres) of estuaries, which is 6.2% of the Gulf total and 2.1% of the national total.

This paper briefly describes the history of Alabama's commercial fishery and related socioeconomic trends. Whenever possible, the current status of a species is compared with that of 1955. Mariculture programs and fishery management problems and programs also are described, as well as identifying problems such as foreign imports and escalating fuel costs that are troubling the industry.

HISTORICAL BACKGROUND

OYSTERS

Over 3,500 years ago, prehistoric Indians gathered oysters from the Mississippi Sound and Mobile Bay. Oysters, readily available and easily taken from shallow waters, provided an excellent food source. From the earliest French and Spanish explorers to today, oysters have been a valuable source of food and a vital local industry. Indian shell middens are a physical record of early exploitation of Gulf fishery resources. In coastal Alabama, these middens date back several thousand years. Coastal middens such as those on Dauphin Island are composed mostly of oyster shells intermixed with some pottery sherds and fish bones. Inland middens usually contain large quantities of brackish water clams. An abundance of oyster shells in middens 64.4 km (40 miles) inland indicates early commerce (Swingle 1979).

French and Spanish explorers and early settlers also used oysters, and in 1723, the French had named Cedar Point "Pointe aux Huitres" or Oyster Point (May 1971). Oysters were a familiar food source to the French. In the 1600's, King Louis XI had admonished his advisors to regularly eat the tasty oyster as "brain food."

The highly perishable oysters, crabs, shrimp, and fish of the Gulf coast delayed the development of a seafood industry until advances in preservation and transportation were made. In 1880, the first Alabama oyster cannery was built at Bayou La Batre (Swingle and Hughes 1976). In the 1920's through the 1950's, several canneries in coastal Alabama used the bulk of the State oyster catch (Swingle and Hughes 1976). Some of these canneries also processed shrimp, crabs, and vegetables, but there are no canneries today. Their loss is attributed to the destruction of many of the oyster reefs in Portersville Bay and unsteady supplies caused by periodic reef closures, and regulations governing commercial catch (Swingle and Hughes 1976).

Statistics on oyster landings and management date back 100 years. The catch characteristically fluctuated from year to year, apparently because of short-term natural environmental changes. On the other hand, production from decade to decade has been relatively uniform. The modern oyster fisherman is little different from his counterpart of a century ago. Long-handled scissor rakes have been the major oyster gear since colonial times. The addition of power motors to the oyster fisherman's characteristic skiff is the principal change. Bon Secour Bay and Mississippi Sound were the sites of extensive riparian bottom plantings in the 1880's. In recent years, they have contributed little to the oyster yield.

SHRIMP

In contrast to the oyster fishery, shrimping has changed dramatically over the years. Since the early part of the century, the shrimp industry has incorporated many changes in fishing methods and vessels. Even the species exploited are different. Prior to introduction of the otter trawl in 1917, Gulf shrimp were caught from open skiffs and haul seines largely in estuaries or nearshore Gulf waters. Haul seines still were commonly used in Alabama until 1948 (Swingle 1971).

White shrimp, which were caught within 10 km (6 mi) from shore, was the principal shrimp species caught until the 1940's. By the 1950's, new markets and fishing methods for brown shrimp, which are found in deeper waters than white shrimp, triggered a rapid expansion of the offshore shrimp fishery. This expansion to offshore waters dictated the need for larger steel-hulled vessels. In recent years, catch efficiency was further enhanced with the introduction of double-rig trawling. A more recent development has been deep-water trawling for royal red shrimp, but the catch is small and undependable.

The 1981 Alabama inshore or bay boat shrimp fleet was composed of boats less than 4.5 mt (5 t). Most fishing is in April and from June to October. The fleet landed only 7% of the Alabama shrimp catch in 1972, compared with 30% of the landings in 1964; but by 1972, shrimp landings for Alabama more than doubled. This increase illustrates the rise in prominence of the new offshore shrimp fleet. Since 1972, the offshore fleet has continued to dominate the fishery, but rising fuel, labor, equipment, and interest costs and competition from abroad have caused serious economic problems.

CRABS

The crab fishery has early origins in Alabama because, like oysters, crabs were accessible and easily caught. The major innovation in the industry came about 1950 when crab traps or pots replaced the trot line. Among Alabama fisheries, the crab fishery has been the least studied; consequently, knowledge of commercial and recreational involvement is limited.

FISH

The earliest Gulf commerce in finfish was limited to estuarine and nearshore marine species which were preserved for transport by salting, smoking, or drying. Barrels of salted mullet were shipped some distance inland in the early 1800's. The search for red snapper led to the development of an offshore fishery in the Gulf and the New England fishermen brought their schooners to the Florida panhandle to fish for snapper (Gulf South Research Institute 1976). Snapper was a prominent commercial species in Alabama until 1966 when the snapper fleet was sold to a Pascagoula firm and was transferred to Mississippi. In the late 1970's, Alabama's share of the Gulf reef fish harvest (dominated by the red snapper) was only about 4% (Gulf of Mexico Fishery Management Council 1980a).

The Atlantic croaker (*Micropogonias undulatus*) in Alabama became a major commercial fish in the early 1970's because of the rise in market demand on the Atlantic coast. The croaker fishery is an Alabama "specialty," because it developed here and not in other Gulf states.

The commercial production of mullet historically has been high, but the dockside value has been low (Swingle 1977). From early times, mullet has been sought commercially, but the low return on the investment has depressed this fishery (Swingle 1977).

Many offshore finfish are now landed incidentally by shrimp fishermen. Shrimp trawls catch Spanish mackerel, black and red drums, sand and silver (speckled) seatrouts, sheepshead, flounders, and spot. From 1955 to 1981, the catch of finfish rose 68% and the market value increased 173%.

The catch and value of major fish and shellfish landed by commercial fishermen in coastal Alabama for selected years since 1955 are given in Tables 75 and 76 and the common and scientific names of species most frequently landed at Alabama ports are given in Table 77.

The number of commercial fishermen and employees in wholesale and processing plants has not increased proportionately to the dockside and processed value of seafood landed in Alabama (Swingle 1979). From 1955 to 1976, the value of landings and processed seafood increased about 800%, yet the number of fishermen and wholesale and processing employees increased only 48% and 78%, respectively.

COASTAL FISHERY AREAS AND RESOURCE OWNERSHIP

Alabama's coastal aquatic habitats are nearshore marine waters, estuaries, and inland rivers and streams. The commercial freshwater fishery is centered in the Mobile Delta, and major estuaries are Mobile Bay and the Mississippi Sound. Less important estuaries are Perdido Bay and Little Lagoon. Alabama estuaries and their acreages are given in Table 78. The physical and biological features of the estuaries are described by Crance (1971) and Swingle (1971).

The territorial waters of Alabama extend three miles seaward from shore. Federal jurisdiction seaward was established through the Fishery Conservation and Management Act of 1976. This act gives the United States exclusive management authority over domestic and foreign fisheries from State territorial waters to 370.4 km (200 nautical mi) from the U.S. coastline.

The ownership of fishery resources in Alabama is more accurately described as a custodianship (Swingle 1977). The State has the power to manage and regulate fishing in the best interests of the State's citizens. Creel limits, seasonal restrictions, and equipment regulations are examples of regulatory measures.

The ownership of oyster beds is different. Since the oyster is immobile, it has been considered as specific property, subject for lease or ownership. At one time, the State leased oyster beds for private production. No areas are presently leased, and all oyster beds (except riparian beds) are now open to all licensed oyster fishermen. The Department of Conservation and Natural Resources still has the authority to lease oyster beds, however. Riparian oyster beds are owned by shoreline property owners who have a claim to oyster beds from low mean tide to a point 546 m (600 yd) seaward.

FISHERIES

In 1978, 22 species (or groups of species) of finfish and 4 species of shellfish comprised the major commercial landings at coastal Alabama ports (Table 76). The 1978 catch totalled 13.5 million kg (29.7 million lb), an increase of 122% over the 1955 catch (Table 75). Dockside value was $35.4 million, an increase of over 1,439% since 1955. The highest catch (36.7 million lb) was in 1973 when there was a record croaker catch, and the highest dockside value ($36.8 million) was attained in 1977 when shrimp were landed in record numbers (Table 76).

The number of licensed commercial fishermen was 1,923 in 1976, a 48% increase over 1955. The number of small boats declined the same period while the number of vessels over 4.5 mt (5 t) increased from 139 to 521 (Table 79). In 1955-78, wholesale volume and processing of seafood increased and the value of processed products increased. Product value was $4.4 million in 1955 and $73.1 million in 1976. Employment, plant numbers, and value of processed fish and shellfish products are summarized in Table 80.

SHELLFISH

SHRIMP

Since 1955, shrimp have consistently ranked number one in volume and value in the Alabama commercial fishery (Figure 21). Shrimp have regularly accounted for one-third to one-half of the commercial catch and between 80% and 85% of dockside value (Swingle 1976). In 1978, shrimp accounted for 71% of the volume and 92% of the landed value. Preliminary totals for 1980 are 6.8 million kg (15.0 million lb) worth $29.3 million, which is a sharp decline from 1978. This decline was caused by heavy floods and cold spring temperatures.

In 1976, Alabama contributed 9% of the volume and 11% of the value to the Gulf shrimp fishery. Total landings for the Gulf States were 91.4 million kg (201.1 million lb) with a value of $275.2 million. Alabama landings were 8.5 million kg (18.7 million lb) with a value of $30.4 million. Gulf production accounted for 52% of total U.S. landings (183.0 million kg; 403.6 million lb). From 1964 through 1977, Gulf shrimp contributed 83% of the cumulative U.S. shrimp landings (Gulf of Mexico Fishery Management Council 1980b).

The five species of shrimp landed in Alabama are brown shrimp (*Penaeus aztecus*), white shrimp (*P. setiferus*), pink shrimp (*P. duorarum*), royal red shrimp (*Hymenopenoeus robustus*), and seabob (*Xiphopeneus kroyeri*). Brown and white shrimp are the most abundant species. Pink shrimp, royal red shrimp, and seabobs are caught in small quantities. Seabobs are incidental to the white shrimp fishery. Between 1959 and 1975, penaeid (brown, white, and pink) shrimp accounted for 98% of the total Gulf catch (Gulf of Mexico Fishery Management Council 1980b).

The shrimping industry in Alabama and elsewhere along the Gulf began with the harvest of white shrimp in relatively shallow waters. Changes in the fishing intensity from inside waters to mainly offshore waters characterized Gulf and Alabama shrimping in the 1950's and 1960's. In Alabama, these changes were reflected by a decline in nearshore marine catches, a greater share of brown shrimp in the catch, and fewer small boats in the fishery. In 1964 and 1972, shrimp catches in Mobile Bay and the Mississippi Sound declined from 544,000 kg (1.2 million lb) to 327,000 kg (722,000 lb), while nearshore marine catches increased from 2.4 million kg (5.2 million lb) to 7.4 million kg (16.2 million lb). A summary of Swingle's (1976) analysis of the shrimp catch for Mobile Bay and other estuaries in 1964 through 1972 is given in Table 81.

The change in shrimping from nearshore to offshore waters has caused a change in species composition of the catch. Brown shrimp are far more abundant in offshore waters than white shrimp. Shrimp landings from National Marine Fisheries Service (NMFS) Statistical Zone 11 (Figure 22) for 1964-72 are given in Table 82. Most (54%) of Alabama's shrimp landings in 1972 were from this statistical zone, and brown shrimp made up 85% of the catch. In earlier years, brown shrimp were rarely sold in fresh seafood markets in Alabama. People preferred white shrimp, but as supplies declined and fishing grounds changed, the brown shrimp won market acceptance. It is reported that one time the Mississippi fishing industry sent several railroad cars of brown shrimp to a northern market to be given away in order to create a market there for this shrimp (J. L. Borom; Faulkner State Junior College; Bay Minette, Alabama; personal communications; 1981).

In 1959-75, brown shrimp contributed 54% of Alabama's shrimp catch, white shrimp contributed 32%, pink shrimp 13%, seabob 1%, and royal red shrimp, less than 1% (Gulf of Mexico Fishery Management Council 1980b).

According to catches reported for the 21 NMFS Statistical Zones in the Gulf of Mexico, Zones 10 and 11, which include Alabama waters, yielded about 1% and 9%, respectively, of the Gulf catch of all commercial shrimp species between 1959 and 1975 (Gulf of Mexico Fishery Management Council 1980b). For the three major species, Zone 10 produced <1% of the landings of each species. For Zone 11, Alabama produced 12% of the brown shrimp, 4% of the white shrimp, and <1% pink shrimp. Statistical Zones 11 and 13, off the coast of Louisiana, are major fishing grounds of the Alabama fleet.

In 1976, the nearshore fleet consisted of 134 boats and 142 shrimp fishermen, and the offshore fleet consisted of 512 vessels and 1,324 fishermen. The number of fishermen with boats under 4.5 mt (5 t) declined in 1955-76, but the number of larger vessels increased 294% and the number of fishermen increased 285% (Table 83).

The abundance of a spawning stock apparently does not necessarily determine the size of the subsequent harvestable population. Environmental conditions seem to be the predominant controlling factor in any one year. The commercial catch does not seem to reduce the size of a spawning stock of shrimp sufficiently to produce a noticeable effect on the size of the resultant population (Heath 1979). Salinity, temperature, and dissolved oxygen are the major environmental factors that affect shrimp abundance. Flooding in Mobile Bay is extremely detrimental to shrimp populations because of low salinity (Heath 1979). Habitat destruction, particularly the marsh areas bordering estuaries, causes a loss in shrimp potential. Marshes provide food and protection for young shrimp except royal red shrimp, which are not estuarine dependent.

OYSTERS

The oyster (*Crassostrea virginica*) ranked fourth in volume and second in value among the commercially landed seafood species in Alabama in 1976. In that year, the oyster yield was 544,000 million kg (1.2 million lb), which is near the annual average of 454,000 kg (1.0 million lb) in 1880 through 1977 (Eckmayer 1979). Catch records date from 1880, but only since 1948 have accurate records been kept on landings and employment in the fishing industry. Based on the 1976 data, Alabama contributed 6% of the Gulf States' oyster landings (9.3 million kg; 20.6 million lb) and 2% of the national catch (24.7 million kg; 54.4 million lb).

The dockside value of Alabama oysters in 1976 was $1.2 million but the estimated total value, considering all related industries, was $4.6 million. The oyster industry's total contribution to the economy is estimated to be four times that of the dockside value (May 1971). Over 75% of the oysters processed in Alabama in 1969 were imported from other states. This additional source of oysters for processing contributes to the overall value of the industry in Alabama.

Oyster production varies greatly from year to year because of changing environmental conditions. Low catches often reflect the closure of oyster reefs because of bacterial contamination. For example, reefs were closed to fishing for six months in 1973, and most of the catch was in September through December. The largest annual catch was in 1967 when undersized oysters were allowed to be taken for the Mississippi canning industry. In that year, Alabama landings totalled over 907,000 kg (2.0 million lb). An unreported quantity, estimated at 590,000 kg (1.3 million lb), was landed in Mississippi from Alabama reefs (Swingle 1977). The record low catch was in 1980 when only 24,836 kg (54,755 lb) were landed largely because 95% of the oyster reefs were covered with sediment during Hurricane Frederic in 1979 and because of unusually heavy spring floods (D. J. Bond; National Marine Fisheries Service; Bayou La Batre, Alabama; personal communication).

The Dauphin Island oyster reef, which was closed to fishing because of bacterial contamination, was the only active reef remaining after the 1979 hurricane. Oysters from this reef were used to restock destroyed beds in other areas. Fishing of these beds was resumed in late 1980. The hurricane flushed Dauphin Island Bay and opened a pass through the road into it, which permitted greater flushing of waters around the oyster reef. Now the oysters meet State Health Department standards. By the spring of 1982, oyster abundance in Alabama should be near normal. The recovery period after disasters that cause high mortality or adversely affect spawning is about 3 years.

Throughout the history of the oyster fishery in Alabama, hand tongs have been the only legal method for taking oysters from public reefs. The exceptions were brief intervals during this century when dredging was permitted. Oyster dredging currently is allowed only for collection of seed oysters for planting and for fishing of private beds.

Because of rather severe fluctuations in oyster abundance, few oyster fishermen rely solely on oysters for their livelihood. Employment records prior to 1948 are lacking; but, between 1948 and 1968, the number of licensed oyster fishermen fluctuated between 478 to 938. In 1980, 557 licensed oyster fishermen and 363 licensed oyster boats were reported (Alabama Department of Conservation and Natural Resources 1981).

Oyster beds in coastal Alabama were first mapped by Ritter in 1896 (May 1971). The total reef area was 1,257 ha (3,105 acres). The number of acres has changed little since then. In 1968, 1,240 ha (3,064 acres) were mapped (Figure 23). Oyster reefs are located in lower Mobile Bay, Bon Secour Bay, eastern Mississippi Sound, and Dauphin Island Bay. Oysters in Mobile Bay are fished south of a line from the mouth of East Fowl River to Great Point Clear on the eastern Bay edge. Cedar Point Reef was a principal oyster reef until Hurricane Frederic. Only 5.3 ha (13.2 acres) of active oyster reefs in May's survey were in the 29,288 ha (72,370 acres) of Mobile Bay permanently closed to oyster and clam fishing. The overall trend has been a shift in production southward and westward in the Bay (Eckmayer 1979). Several public areas formerly were included in a State bottom leasing program, but the most recent productive leases were in Bon Secour Bay in 1967.

The oyster is an estuarine species that attaches to the substrate. Only in the larval stage is it free swimming. Once the larval oyster attaches to a solid substrate, a process known as spat setting, it remains there for the rest of its life; consequently, it cannot escape unfavorable changes in its environment. Oyster abundance therefore reflects natural fluctuations and man-induced modifications of estuaries upon which oysters and other commercially important species depend.

Oysters reach marketable size in 24 to 30 months. Many environmental factors affect the survival of oysters, and socioeconomic as well as environmental problems plague the Alabama oyster industry. A combination of severe spring floods, pollution, low dissolved oxygen, predators, diseases, inefficient management and funding, and indifferent fishermen are factors that limit oyster production. The socioeconomic problems include the State's failure to provide funds for replanting reefs with shells and to claim oyster shells removed from public beds for other uses. The depletion of the more accessible reefs by continuous fishing, the unwillingness of fishermen to return shells to the reefs, and frequent disagreement or opposition by oyster fishermen to State management programs and regulations are other socioeconomic problems.

Heavy freshwater flooding has caused extensive oyster mortality in some years, yet within limits, low salinity is beneficial to the oyster because the chief predator, oyster drills (*Thais haemostoma*) are intolerant of low salinities. On some reefs in some years, drills outnumber oysters and spat combined (May 1971). Low salinities also inhibit a parasitic fungus, *Labyrinthomyxa marina*. In years when salinities were relatively high, high oyster mortality was attributed to infection caused by this fungus. Mud crabs (several species, family Xanthidae) and other predators, may carry this fungus from reef to reef. The mud crabs are abundant and very destructive on the more southern reefs. Blue crabs and black drum are also known as predators.

Closure of reefs due to bacterial contamination from human sewage has become more frequent and of longer duration since the 1950's (Swingle 1977). The oyster, a filter feeder, concentrates bacteria and other pollutants in its body tissues. The reefs are most frequently closed from November through March when fishing and market demands are greatest (May 1971). The proposed Theodore industrial pipeline by its existence will threaten to release treated domestic sewage into Mobile Bay a few miles above the major oyster reefs. EPA has approved a plan to control industrial discharge but it is opposed to combining industrial and domestic waste discharges. Alterations in patterns of currents in Mobile Bay due to deposition of spoil adjacent to the Mobile Ship Channel and saltwater intrusion following channel dredging are important factors affecting salinity and oyster abundance (May 1971). Siltation from dredging operations is less troublesome, but even minor environmental changes can be temporarily disasterous to local oyster populations (May 1971).

BLUE CRAB

The blue crab (*Callinectes sapidus*) accounted for only 7% of the catch and 1% of the value of the 1978 Alabama commercial fishery catch, yet it ranked third in value ($438,148) and volume (900,000 kg; 2.0 million lb). Catches for 1980 are lower (700,000 kg; 1.6 million lb) but of similar value ($464,504) (Bond, personal communication). The 1980 average price per pound of live crab was $0.30. Usually 45.4 kg (100 lb) of crabs will yield 6.8 kg (15 lb) of meat (More 1969).

Compared to the other Gulf states, the Alabama crab fishery is relatively small (only 4% of the Gulf total). In 1976, Alabama landings of 590,000 kg (1.3 million lb) were valued at $281,108, while total Gulf landings of 16.6 million kg (36.6 million lb) were valued at $6.8 million. Total 1976 U.S. production of blue crabs was 52.3 million kg (115.4 million lb) valued at $23 million.

The earliest reported record for Alabama crab landings was 43,600 kg (96,000 lb) in

1880. Since 1963, the catch generally has been stable (about 907,000 kg; 2.0 million lb), although there have been year-to-year fluctuations (Table 76). From 1970 to 1977, 79% of the Alabama blue crab were caught in April through October (Tatum 1979).

In 1978, the 12 crab processing plants in coastal Alabama were operating four to five days a week (U.S. Department of Commerce, National Marine Fisheries Service 1980a). To operate profitably, the plants must process crabs imported from other states. Most crab fishermen and processors prefer to market male crabs because their larger size brings higher prices, and pickers, who are usually paid by picked weight, get less meat from the smaller females. One fisherman-processor, however, has geared his operation to the Heron Bay and Cedar Point area where the catch is 90% females (Tatum 1979).

Before 1950, all commercial crabs were taken by trot line, but by 1966, the trot lines were replaced by the more efficient crab traps (or pots). Trap catches usually decline when water temperatures drop. Most crab trap fishing stops in November and starts again in spring. The trawl fishery helps fill the gap. About 5% of the landed crabs are caught by shrimp trawls, mostly in winter. Commercial trappers usually fish their traps in the same general area in the trapping season. The exceptions are those who fish in lower Mobile Bay for mating crabs in the early spring and later move to the upper Bay for male crabs (Tatum 1979). Traditional fishing grounds usually are respected by other crab fishermen so that there are seldom disputes over fishing areas. The current number of crab fishermen in Alabama is not known because no license is required for either sport or commercial crab fishermen. On the other hand, in 1976 the U.S. Department of Commerce, National Marine Fisheries Service (1980b) estimated that there were 57 full-time and 8 part-time crab fishermen.

OTHER SHELLFISH AND SQUID

In Alabama, there are presently no fisheries for either clams or scallops. Calico scallops (*Aequipecten gibbus*) inhabit near-shore marine waters southwest of Mobile, and the southern quahog (*Mercenaria campechiensis*) is fairly abundant farther offshore (Swingle 1977). The Alabama Department of Conservation tried unsuccessfully in 1954 to establish populations of the northern quahog (*Mercenaria mercenaria*) in Bon Secour Bay and near Cedar Point in Mobile Bay. Although the common rangia (*Rangia cuneata*), a brackish water clam, is relatively abundant, it is found principally in contaminated areas closed to oyster and clam fishing by the State Health Department. Lobsters (*Panulirus argus*) landed in Alabama are almost entirely from the Caribbean Sea (Swingle 1977). Spanish lobsters or bulldozers (*Scyllarides nodifer*) are occasionally taken by shrimp fishermen but are not reported in National Marine Fisheries Service landings. Although they are abundant, only a few thousand pounds of squid (*Lolliguncula brevis*) are landed annually in Alabama. The catch is used entirely for bait.

FINFISH

In 1955, Alabama's finfishery produced 1.6 million kg (3.6 million lb) valued at $497,000. These totals are small compared with 263.5 million kg (581.0 million lb) catch and $16.1 million value for the entire Gulf region. In 1976, Alabama landed 4.8 million kg (10.6 million lb) of fish worth $1.8 million dockside. The U.S. landings for the Gulf region were 680 million kg (1.5 billion lb) valued at $77.1 million. Texas ranked below Alabama in volume, but Alabama was last among the five states in value of landings.

MARINE FISHES

Marine and estuarine commercial fishes usually are caught by trawls, gill nets, trammel nets, and handlines. Most fish are caught in trawls while fishing for shrimp (Swingle 1976). An exception is the Atlantic croaker, which trawlers sometimes fish for specifically. Most of the increase in trawl catches in the 1960's and 1970's reflect the expansion of the croaker fishery. In 1976, 4.0 million kg (8.9 million lb) or 85% of the Alabama marine landings was taken by trawl (U.S. Department of Commerce, National Marine Fisheries Service, 1980b). About 90 fishermen used gill and trammel nets in 1976, a number that has remained stable since the early 1960's. Bluefish, red drum, black drum, Spanish mackerel, spotted seatrout, and striped mullet are the principal species in gill and trammel net catches. Snappers, groupers, and jewfish are the principal species caught with handlines. For Alabama, this fishery has declined since the sale and transfer of the handline fleet to Pascagoula in 1967 (Swingle 1976). Only 100 fishermen used handlines in 1976 compared to 254 in 1966.

Catches of fish from estuaries have come principally from Mobile Bay and Mississippi Sound. The catch from Little Lagoon has recently declined because the lagoon is only periodically open to the sea, and because of restrictive fishing regulations. Catches from Perdido Bay are usually landed in Florida. Catch data for estuaries and nearshore marine waters in 1964-72 are summarized in Table 84. Substantial increases of fish in offshore trawl catches is directly related to the shift in shrimping from relatively shallow to deep waters. Trends from 1955 through 1978 show sharp declines in the catch of reef fish, wide fluctuations in the croaker catch, a steady decline in mullet, and increased yields for other marketable species.

Major commercial reef fishes in Alabama are snappers (*Lutjanus* spp.), groupers (*Epinephelus* spp. and *Mycteroperca* spp.), and jewfish (*Epinephelus itajara*). These fishes, as adults, live near hard rock outcrops, coral reefs, and artificial reef substrates. Most of the fishing is for the snappers. Grouper and jewfish usually are caught incidentally. Catches of snapper, groupers, and jewfish peaked in the mid-1960's just before the sale of the fishing fleet.

In 1965-73, reef fish landings for U.S. Gulf ports dropped from 11.2 million kg (24.7 million lb) to 7.7 million kg (17.0 million lb), but the Gulf catch has remained stable since then. The Alabama catch continues to decline. Snapper landings dropped from 1.1 million kg (2.5 million lb) in 1965 to 181,000 kg (400,000 lb) in 1978, and the combined catch for grouper and jewfish fell from 227,000 kg (500,000 lb) in 1965 to about 33,000 kg (72,000 lb) in 1978.

Croakers are caught primarily in nearshore marine waters of Alabama, Mississippi, and Louisiana by shrimpers (Swingle 1976). Some fishermen trawl almost exclusively for croakers, but most fish for them only when shrimp are scarce. In 1955, about 5,000 kg (11,000 lb) of croakers were landed in Alabama, but by 1971, landings jumped to 3.8 million kg (8.4 million lb), which was 82% of the Gulf croaker catch. This escalation primarily was in response to increased demand for croakers along the east coast due to the depletion of the stocks there. The peak catch was in 1973 when 6 million kg (13.3 million lb) were landed. The Alabama catch (77% of the Gulf total) fell to 2.9 million kg (6.3 million lb) in 1976. Preliminary totals for 1980 are about 2.3 million kg (5 million lb). Price per pound for landed croaker in 1978 was $0.17. Almost all croakers are shipped to the east coast or to midwestern markets.

Sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*) are abundant in the northern Gulf and rank among the top five fish species landed in Alabama (Swingle 1977). Almost all seatrout are caught by shrimp trawls in nearshore marine waters of Alabama and Louisiana. Alabama contributed 76% of the Gulf harvest in 1976, and in 1978, the 354,000 kg (780,000 lb) landed were valued at $126,207 or $0.35/kg ($0.16/lb) dockside.

Most of the catch of kingfish (whiting) in Alabama is gulf kingfish (*Menticirrhus littoralis*) and southern kingfish (*M. americanus*) according to Swingle (1976). From the mid-1960's through 1972, the catch of kingfish usually exceeded 227,000 kg (500,000 lb) annually and constituted over a third of the Gulf catch. In the later 1970's, catches were well under 91,000 kg (200,000 lb) annually, and in 1976 made up 24% of the Gulf catch.

Flounders landed in Alabama are mostly southern flounder (*Paralichthys lethostigma*) and the much less common Gulf flounder (*P. albigutta*). More than 95% of the catch is caught in shrimp trawls. Most of the others are taken with gigs (Swingle 1976). The catches are reported from the NMFS Statistical Zones 10 and 11. The flounder ranked fourth among fish landed in Alabama in 1978 and had a dockside value of $209,647 or $0.55/kg ($0.25/lb).

Landings of sheepshead (*Archosargus probatocephalus*) in Alabama fluctuated from 15,700 kg (34,700 lb) or 5% of the Gulf catch in 1964 to 145,000 kg (320,000 lb) or 82% in 1971. Since 1975, landings have not exceeded 91,000 kg (200,000 lb) yearly, and in 1976 sheepshead contributed only 18% of Gulf landings. This fish is almost exclusively caught in shrimp trawls except in March, April, and May when they congregate near shore and sometimes (when the price is right) are specifically sought by fishermen (Swingle 1977). Sheepshead have a low dockside value and much of the catch by shrimp fishermen is probably dumped at sea (Swingle 1977).

Although catches of red drum (*Sciaenops ocellatus*), commonly known as redfish, began increasing in abundance in the early 1970's, landings have been less than 45,000 kg (100,000 lb) annually. Since then, nearshore marine catches have risen somewhat in proportion to the increase in intensity of shrimp fishing. Some redfish are caught by hook and line.

Striped mullet (*Mugil cephalus*) is the mainstay of the trammel net fishery. Most of the mullet are caught in Mobile Bay and Mississippi Sound. Mullet landings have declined in the 1970's to less than one-third of the volume reached in the late 1960's, yet in 1978, mullet still ranked second in poundage among marine fish landed in Alabama. Mullet landings in Alabama contributed only 5% of the Gulf total, whereas Florida accounted for nearly 50%. The decline in catch in the 1970's was caused largely by low dockside prices. Fishermen received $0.11/kg ($0.05/lb) for mullet in 1964, compared to $0.37/kg ($0.17/lb) in 1978.

A number of other fishes contribute to Alabama landings. All of the following were landed in quantities ranging from 454 kg to 14,500 kg (1,000 to 32,000 lb) in 1978: bluefish (*Pomatomus saltatrix*), cobia (*Rachycentron canadum*), black drum (*Pogonias cromis*), pompano (*Trachinotus carolinus*), spotted seatrout (*Cynoscion nebulosus*), gafftopsail catfish (*Bagre marinus*), Spanish mackerel (*Scomberomorus maculatus*), spot (*Leiostomus xanthurus*), and tripletail (*Lobotes surinamensis*). Gill nets are used to catch Spanish mackerel, trammel nets for spotted seatrout and black drum, and shrimp trawls for the other species.

Neither menhaden (*Brevoortia patronus*) nor other industrial fishes are landed in Alabama, but nearshore marine waters and Mobile Bay and the Mississippi Sound are valuable sources of these fish for processing plants in Mississippi. Menhaden is first among U.S. fisheries in volume. In the 1950's, this traditional east coast fishery was developed in the Gulf of Mexico. Menhaden fishing is prohibited in all Alabama waters except the eastern two-thirds of the Mississippi Sound and in nearshore marine waters east of a line extending south from about the center of Mobile Bay (Swingle 1976).

Industrial groundfish are small croakers, sand and silver seatrout, spot, and longspine porgy (*Stenotomus caprinus*), and several other species which are caught in trawls for pet food plants in Mississippi (Swingle 1977). Croakers constitute 75 to 80% of the catch. Groundfishing is limited to nearshore marine waters of Alabama (Swingle 1977). It is prohibited in Mobile Bay and the Mississippi Sound.

The groundfish industry use fish species normally discarded by the shrimp fleet which employs nearly identical fishing methods (Swingle 1977). Annually, the Gulf shrimp fleet discards an estimated 454 million kg (1 billion lb), most of which could be used by the groundfish industry (Swingle 1977). When the first processing plant was established in Mississippi in 1952, plans were to purchase fish from shrimp fishermen. Uneven supplies and unwillingness on the part of shrimp fishermen to keep "trash fish" when shrimping was good led to the formation of a groundfish fleet (Gulf South Research Institute 1976).

FRESHWATER FISH

The scarcity of data makes it difficult to adequately evaluate the freshwater fishery in coastal Alabama. Landings reported for freshwater species by NMFS are not considered reliable because representative catch statistics are difficult to obtain (Swingle 1977). The only comprehensive study of commercial fishing for freshwater fish was in the Mobile Delta in 1963-64 (Spencer et al. 1966). Fish from the Delta and the Tombigbee and Alabama Rivers are sold in many locations in at least five counties. About 64% of the catch was sold directly to consumers in 1963-64, whereas only 28% was sold to retail and wholesale fish markets. The current status of the fishery is reflected by the number of fishermen. Resident and non-resident freshwater commercial fishermen numbered 152 in 1955 (Baldwin County, 52; Mobile County, 100) and 443 in 1978-79 (Baldwin County, 205; Mobile County, 238), an increase of 191%.

Based on a 1963-64 study, there were 201 fishermen in the Delta (northward to Jackson and Choctaw Bluff) including 42 who were not Alabama residents or were from other counties (Spencer et al. 1966). About 24% were full-time fishermen and 37% were part-time (over 50% of their income came from fishing). The other 39% were part-time fishermen whose income from fishing was less than half of their total income.

The major freshwater commercial fishes are channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), flathead catfish (*Pylodictis olivaris*), smallmouth buffalo (*Ictiobus bubalus*), and freshwater drum (*Aplodinotus grunniens*). Yellow bullhead (*Ictalurus natalis*) and paddlefish (*Polyodon spathula*) are less important. In the 1963-64 study, catfish accounted for 56% of the volume and 85% of income derived from commercial fishing in the Delta.

A new year-long study of commercial and recreational fishing in the Delta was initiated in December 1980, and a final report is expected in June 1982. This study will assess the current fisheries and allow a comparison of the present status with that of 1963-64. This study, funded by the U.S. Corps of Engineers, is being undertaken by investigators at Auburn University as part of an environmental analysis of the proposed Black Warrior-Tombigbee channel modifications.

BAIT INDUSTRY

In a 1968 survey of coastal Alabama, 25 live bait shrimp dealers were listed (Swingle 1972). Most were located near Mobile—nine on the Battleship Parkway. Forty live bait dealers purchased licenses in Alabama in 1977-78, 10 of which operated in Mobile Bay

(Heath 1979). The live bait shrimp industry is active May through November (Swingle 1972). The greatest demand for live bait along the Parkway is in the fall months when the salinity of the Bay increases northward, and spotted seatrout and red drum expand their range into northern Mobile Bay and the Delta.

Brown and white shrimp are the dominant species taken for bait. In 1968, 1,544,000 live shrimp were sold in Alabama at a retail value of $64,500. In addition, 10,000 kg (22,000 lb) of dead shrimp were sold as bait. The Alabama (and Mississippi) bait shrimp landings are small compared with those of Florida (which averaged 74.8 million shrimp annually in 1968-75), Louisiana, and Texas.

In addition to brown and white shrimp, the river shrimp (*Macrobrachium ohione*), and three grass shrimp (*Palaemonetes pugio*, *P. vulgaris*, and *P. paludosus*) are sold for bait. Most of the river shrimp are imported from Mississippi. *Palaemonetes pugio* is taken in submerged grassbeds in Mobile Bay near Battleship Parkway. Other grass shrimp are more common in middle and lower portions of the Bay. Bull minnows (*Fundulus grandis*, *F. similis*, and *Cyprinodon variegatus*), used as bait to catch flounders, are seined or caught in minnow traps in shallow bay waters, tidal pools, and grassbeds. Golden shiners (*Notemigonus crysoleucas*) are commercially raised in and imported from Mississippi as bait for largemouth bass and crappie. Round scad, sometimes called cigar minnows (*Decapterus punctatus*), used as bait for king mackerel, are caught in the Gulf and sold frozen.

MARICULTURE

In the Orient, shellfish and finfish are raised in fenced-off portions of the sea, bays, ponds, and other enclosed areas. Attempts to apply mariculture in the Gulf region have failed because of the high labor costs, high land prices, and because of the difficulty in raising fishes in demand in American markets (Gulf South Research Institute 1976). Despite these problems, experimental mariculture is still underway, particularly for shrimp. According to Gulf South Research Institute (1976), profitable mariculture must raise seafood species that will bring a high market price, do well in confinement (high density culture), do not migrate extensively, and are fast growing. Few species meet these standards.

The first mariculture in Alabama was attempted at the Marine Resources Division Laboratory on Dauphin Island in the late 1960's when cage-rearing experiments were conducted for several species in Dauphin Island Bay. In 1972, 40 acres were donated near Gulf Shores for mariculture ponds for the Claude Peteet Mariculture Center. Studies since then have been conducted in the Center's 35 ponds. Pink, brown, white, and two exotic shrimp species, bull minnows, red drum, spotted seatrout, red snapper, and pompano are among the species successfully raised at the Center. Pompano and shrimp have been reared together (polyculture). Winter culture of rainbow trout has been undertaken, and striped bass are raised to fingerling size to resupply coastal waters.

The Soil Conservation Service has identified suitable mariculture locations in coastal Alabama along the Intracoastal Waterway and other brackish waters. Mariculture offers potential for the future, but the only local success was the bull minnow mariculture facility destroyed by Hurricane Frederic.

FISHING INDUSTRY PROBLEMS AND POTENTIAL

MANAGEMENT PROGRAMS

The Fishery Conservation and Management Act of 1976 (FCMA) provided for conservation and management of all marine fishery resources, except tuna, from the seaward boundaries of the territorial sea (usually 3 nautical mi [5.6 km]) to 200 nautical miles (370 km) from shore. Foreign fishing within the fishery conservation zone (FCZ) is limited to that portion of the optimum yield quota not taken by U.S. fishermen. The Gulf of Mexico Regional Fishery Management Council is one of eight regional councils preparing fishery management plans. The Council is comprised of representatives of all groups of people who use the ocean's living resources. These groups include sport fishermen, commercial fishermen, seafood processors, scientists, and consumers, as well as representatives from each state conservation agency. A shrimp management plan for the Gulf region has received final approval, and management programs for mackerels and reef fishes are being finalized. Other management plans are in preparation. Implementation of these plans will help sustain or enhance populations of sport and commercial fishes and help resolve the problem of competition by foreign fisheries in traditional U.S. fishing waters.

In Alabama waters, regulatory measures are determined and enforced by the Marine Resources Division of the Alabama Department of Conservation and Natural Resources. In October 1980, the Division initiated a long-term research program on population trends and determined management needs. Some of the Division's current economic and management problems concerning the shrimp, crab, oyster, and finfish fisheries are listed in the following paragraphs.

SHRIMP

The shrimp fishery has more serious problems than other fisheries because of sharply rising diesel fuel costs. Many fishermen say that a pound of shrimp requires a gallon of fuel. The shrimp fishery, now largely a nearshore marine fleet, is finding it increasingly difficult to fish profitably. The rising costs of nets, ice, labor, and interest, as well as competition from imports of shrimp, will continue to have a pronounced, unfavorable effect. For example, Mexican shrimp fishermen have lower fuel and labor costs than their American counterparts and are able to sell their catch at lower prices. In the future, it can be expected that marginal operators in Alabama will be eliminated from the fleet, fishing trips will probably be fewer and closer to home ports, and there may be more fishing by smaller boats in Mississippi Sound and Mobile Bay.

BLUE CRAB

Requirements for assessing the management needs of the crab fishery are the determination of the number of crab fishermen, the intensity of the fishery, and seasonal landings. No licenses are currently required, but commercial crab fishermen have gone on record to support licensing and regulations, including trap markers to enable enforcement officers to match fishermen with traps.

Other problems are as follows: heavy die-off of crabs caught in traps during periods of oxygen depletion in Mobile Bay, particularly in July and August; damage to crabs caught in trawls; failure to develop methods to catch or raise soft-shell crabs to meet market demand; diversion of labor from crabs to shrimp processing in years of high shrimp yields; and the inefficiency of presently available mechanical crab meat separators (Tatum 1979). A technique for holding crabs in shedding houses for the soft-shell market is being investigated at the Gulf Coast Research Laboratory.

OYSTERS

Problems of the oyster fishery include overfishing of the more easily accessible reefs with consequent progressive reduction of shell mass available for spat setting; insufficient State funds to plant shells on all bottoms capable of supporting oysters; absence of a regulated bottom leasing program to increase oyster production; and insufficient sources of seed oysters to establish a successful private oyster lease program (Eckmayer 1979).

FINFISH

The finfish fishery is troubled generally by low dockside prices. Declines in mullet landings were caused by low prices, which were accentuated by higher operating costs. Shrimp trawlers will continue to be the principal suppliers of finfish other than croaker. Many of the other species are caught in trawls fishing for shrimp.

Conflicts between sport and commercial fishermen are continually unresolved. Each group blames the other for reducing fish populations. Sport fishermen claim the gear damages small, unmarketable fish. The basis of conflict is always an assumption that there is not a sufficient population of a particular species to supply both interests. Most conflicts have ended in species or gear restrictions for commercial fishermen. These restrictions are seldom, if ever, based upon sound data such as trends in catch, population size, rate of natural and fishing mortality, catch per unit of effort, year-class composition, and other biological considerations (Swingle 1977).

UNDERUTILIZED FISHERY RESOURCES

Many fish and shellfish species in the northern Gulf of Mexico are abundant but are not landed because there is no demand for them (Swingle 1977). For example, squids and sharks are highly prized in other countries but are not usually consumed in the United States. Alligator gar, which is sold in large numbers in Louisiana, is not eaten in Alabama. The exploitation of a number of commercial species by commercial and sport fishermen, as well as the potential that they have for future utilization, is summarized in Table 85.

SUMMARY

Commercial fishing is an historical industry of coastal Alabama. Since 1955, this industry has been characterized by sustained growth in the volume and value of landings, and of processed products. The most valuable species are shrimps. Alabama produces 9% of the volume and 11% of the value of shrimp landed in the Gulf states, which yield 83% of the total U.S. shrimp catch.

The commercial fishery is largely sustained by estuarine-dependent species. To maintain the industry, estuaries must be protected from excessive destruction, modification, and contamination. As the human population increases, there will be more stress on estuaries, yet the need for abundant, high protein food also will increase. Some reasonable balance between human needs and estuary protection must be achieved.

RECOMMENDATIONS

1. Require that sport and commercial fishermen in inland, brackish, and marine waters be licensed annually to provide records and sources of information to help determine the status of the fisheries and help provide sufficient funds for implementing management.
2. Periodically conduct seasonal fishermen counts and creel census surveys and otherwise monitor the freshwater fishery resources in the Delta to analyze socioeconomic effects and change.
3. Improve oyster production through more State shell and seed oyster planting of suitable bottoms or, if adequate sources of seed oysters can be identified, reinstitution of a State leasing of oyster beds with requirements that the leasors maintain the reefs by shell and seed oyster plantings.
4. More cooperation among federal, state, and local governmental agencies to halt additional detrimental changes in Alabama's estuaries, including more thorough consideration of probable effects of commercialism on the fishing industry (e.g., dredge and fill operations, channel dredging and maintenance, agriculture, clear-cut silviculture).

5. Periodically hold symposia similar to that on Mobile Bay in 1979. Such meetings would encourage dissemination of diverse data on natural and physical features and processes. Non-technical collective abstracts of papers presented at these meetings would be made available to decision makers and managers to help them make better environmental and fishery resource decisions.

DATA GAPS

The marine commercial fishery of Alabama has been rather thoroughly studied, and the catch and value of landings have been compiled for many years. In contrast, data on the coastal freshwater fishery generally is incomplete or lacking. The major data gaps are as follows:

1. Lack of reliable data on fishing intensity and catch of freshwater species.
2. Deficiency of data on population trends in estuarine waters.
3. Scarcity of commercial catch statistics in Mobile Bay, Mississippi Sound, and other specific coastal waters after 1975.
4. Lack of precise data on the volume and value of fish and shellfish landings. Reporting is incomplete because many financial transactions are on a cash basis and are unrecorded.
5. Insufficient data on the cumulative impacts of man's activities on estuarine-dependent species of fishes and shellfish in estuaries.

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TRANSPORTATION

INTRODUCTION

Mobile's economic growth, indeed its major reason for existence, has been based on a complex of sea, rail, air, and highway transportation systems and port development (Figure 24). Any planning for future development of coastal Alabama must necessarily consider its transportation facilities.

This chapter is an overview of existing and proposed coastal transportation networks. The major focus is on waterborne transportation and seaport development. Particular emphasis is placed on expansions and improvements at the Alabama State Docks. Of major importance are plans to expand bulk commodity handling facilities. Also of vital interest are several waterway improvement projects. Some, like the Tennessee-Tombigbee (Tenn-Tom) Waterway and the Theodore Ship Channel, are nearing completion. Others, such as the deepening of Mobile's main ship channel, are under consideration.

BACKGROUND

When Bienville founded Mobile in 1702, coastal Alabama already possessed two characteristics vital for a thriving port: a large bay where ships could anchor protected from the open Gulf and a system of inland rivers over which goods could be transported.

In the earliest days, settlers brought their furs and tallow down the rivers to exchange for supplies at the harbor. Later, cotton became the predominant commodity. Passage in Congress of the River and Harbor Act in 1826 authorized the U.S. Army Corps of Engineers to create and maintain navigational channels at Mobile, and, by the time of the Civil War, a 10-foot deep channel had been dredged to aid navigation through the shallows and shoals of the bay. Beginning about 1850, Mobile's port activity began to attract rail lines.

In the 1920's, the State of Alabama built dock facilities that greatly enhanced the port's competitive position. Traffic at the docks increased steadily over the years, and the Alabama State Docks' (ASD) facilities have been enlarged and improved periodically in an attempt to keep pace with increasing tonnage.

Development of several inland port facilities, especially those on the Black Warrior-Tombigbee River system and the Alabama-Coosa River system, have contributed greatly to Mobile's port traffic, as has the construction of the Gulf Intracoastal Waterway (GIWW).

The port at Mobile has extensive intermodal connections with rail and highway carriers. Through these connections, Mobile is linked to various inland destinations not accessible by waterborne traffic.

RAIL TRANSPORTATION

Coastal Alabama has extensive rail transportation facilities for freight traffic but there is no passenger service. Four line-haul companies serve the region; all but one terminate in Mobile. All four lines offer container and piggy-back service in addition to traditional freight handling methods.

The line-haul railways serving Mobile County are: Southern, with four scheduled through trains and one local daily that connect Mobile with the Southeastern states; Illinois Central Gulf (ICG), with four scheduled through trains daily on two tracks that connect Mobile with Kansas City; Louisville and Nashville (L&N), with 20 scheduled trains and two extras daily that join Mobile with the upper South and Midwestern states as well as other Gulf ports; and St. Louis and San Francisco (Frisco), which connects Mobile with the South and Southwest, has four daily trains scheduled (Moore, W. P. and Associates, Inc. 1977).

A fifth line, the local Terminal Railway, is operated by the Alabama State Docks. The

Terminal Railway links the line-haul tracks with coastal marine terminal facilities, and it switches to some 25 industries located in and near the main docks area and at Theodore Industrial Park.

All four of the rail lines serve Mobile County, but only one serves Baldwin County. The L&N line runs from Mobile across the Mobile River and eastward through Baldwin County to the Escambia County line. A spur from this line runs south from Bay Minette to Foley.

TRAFFIC DENSITY

The only available measurement of coastal rail traffic is a generalized railroad traffic density map (Figure 25) for the state of Alabama (Alabama Highway Department, Bureau of State Planning 1980). This map shows traffic moving in each direction from a central point (in this case, the main yards at Mobile) in terms of ton-miles per mile of track. A ton-mile includes the gross weight of the train with freight and empty rolling stock.

Based on traffic densities, the L&N has by far the heaviest traffic. In 1979, that line moved 59 million ton-miles/mi of track in Mobile and Baldwin Counties, one of the highest densities recorded in Alabama.

In 1979, Illinois Central Gulf carried 7.4 million ton-miles, Southern carried 6.9 million, and Frisco 3.7 million (Alabama Highway Department, Bureau of State Planning 1980).

Other than the foregoing traffic density data, little information is available about rail traffic, and there is virtually no comprehensive information available about highway freight traffic. It is difficult to draw conclusions about the relative importance of rail and highway traffic, but there is some indication of the relative importance of rail transportation and port-related traffic from reports showing rail and truck deliveries to Alabama State Docks facilities.

Products are transported overland to and from the various port facilities, both by rail and truck, but because of the high proportion of bulk material, most moves by rail. In 1977, trucks carried 5,016 loads to ASD facilities for a total of 90,990 mt (100,320 gross t). Trains, on the other hand, carried 47,154 car loads that year for a total gross weight of 2.1 million mt or 2.3 million t (Alabama State Docks Department 1978a).

As is discussed in more detail in the water transport section, port activity is expected to increase substantially within the next five years. This gain will be due largely to increased demand for export coal which will be shipped through the port. Although much of the increased coal tonnage will be shipped on the Tenn-Tom Waterway, rail transport will continue to play a major role in coal shipments.

To expedite coal shipments by rail to the port, the use of unit trains is planned for the near future. Unit trains are trains made up of cars assembled at a single location. One example is a large mine site loaded exclusively with one product and bound for a single destination. Although no unit trains currently serve the Alabama coast, Southern Railway already operates unit trains to steam power plants in Alabama. Trains with 90-110 cars and average weights of approximately 8.2 thousand mt (9.0 thousand t) per train are common (John H. Friend, Inc. 1976).

PLANNED AND PROPOSED IMPROVEMENTS

A major advantage in expediting rail shipments and switching cars is the proximity of the four lines' main yards. The yards lie adjacent to one another and just north of the ASD main property.

Primary and secondary tracks radiate from the yards through residential and commercial sections of Mobile with numerous grade crossings and traffic congestion. These conflicts have prompted proposals to relocate and consolidate tracks, but, so far, no action has been taken to do so (South Alabama Regional Planning Commission 1968).

HIGHWAY TRANSPORTATION

Coastal Alabama has an extensive highway network that has evolved over three centuries of human settlement. In fact, the irregular rights-of-way of many of the smaller roads in the area reflect their origins as wildlife and, later, cattle trails. The general configuration of the highway network is indicative of coastal Alabama's historical orientation around Mobile's port facilities and adjacent commercial district. Most of the area's principal arterials radiate north, west, and south from the old waterfront.

Today, coastal Alabama is served by Interstate 10 and Interstate 65, and by U.S. highways 90, 98, 31, 43, and 45. Four of the preceding routes (Interstate 65, U.S. 31, U.S. 43, and U.S. 45) have inland origins and terminate in Mobile. U.S. 98 also originates inland, but it continues into Florida. Both Interstate 10 and U.S. 90 parallel the Gulf coast from Texas through Florida.

HIGHWAY MILEAGE

According to the Alabama Highway Department, the highway mileage of coastal Alabama is 7,704 km (4,787 mi) of which 4,540 km (2,821 mi) are in Mobile County and 3,164 km (1,966 mi) are in Baldwin County (Table 86). Collector (major streets) and local system streets contribute 90% of the highway distance. Such facilities are typically two-lane streets designed to accommodate light traffic (John H. Friend, Inc. 1978).

The remaining 10% consists of arterials, including interstate highways and other expressways, as well as major city streets. Of the 753 km (468 mi) of arterial coastal highways, 489 km (304 mi) are in Mobile County, and 264 km (164 mi) in Baldwin (John H. Friend, Inc. 1978).

TRAFFIC VOLUME

As illustrated in the traffic flow map (Figure 26), the most heavily travelled arteries in coastal Alabama are Interstate 65 and Interstate 10. Peak volumes on both arteries, averaging 50,000 to 60,000 vehicles daily, occur within the city limits of Mobile. The only other artery with traffic averaging over 50,000 daily is Airport Boulevard, the urban area's principal east-west thoroughfare. Although the Interstate 10 "Bayway" in Baldwin County accommodates between 30,000 and 35,000 vehicles daily, none of the arteries on Baldwin County's mainland serves more than 20,000 vehicles daily.

The earliest traffic flow data available from the Alabama Highway Department are for 1965. A comparison of 1965, 1970, and 1979 traffic volumes at selected locations on the fringes of the coastal counties and at Interstate 10 and U.S. 31/90/98 east of Mobile River's mouth are shown in Table 87. In general, traffic at these locations has increased 2 to 3 times since 1965. The sharpest gains were at the Alabama-Florida state line crossings of Interstate 10 and U.S. 90.

PLANNED AND PROPOSED IMPROVEMENTS

Currently, seven major highway projects are either completed, under construction, or planned in Mobile and Baldwin Counties. Those recently completed include the Interstate 65 bridge across the Mobile-Tensaw River Delta and the Dauphin Island Bridge. The Range Line Road is under construction. Planned projects are Interstate 210 and new structures to replace the existing Cochrane, Bayou La Batre, and Dog River bridges. A brief description of each of the above projects follows.

INTERSTATE 65

The 19.3-km (12.0-mi) fixed-span bridge across the Delta was completed in October 1981. Clearance for the bridge is 38.1 m (125 ft). The facility cost $134 million with a federal/state funding ratio of 90-10 (Webb, I., Alabama Highway Department, Mobile, AL, 22 April 1981, personal communication).

DAUPHIN ISLAND BRIDGE

The new facility is a fixed span bridge with a vertical clearance of 25.9 m (85.0 ft). It replaced the vertical lift bridge destroyed by Hurricane Frederic in 1979. The $32 million structure is 100% financed with federal disaster funds. Construction was completed in the summer of 1982.

RANGE LINE ROAD

This partially completed expressway will

vertical-lift Cochrane Bridge across the Mobile River. Assuming an early location selection, construction contracts should be let by September 1983. Cost estimates range from $88 to $100 million. The project will be 100% federally funded (Webb, personal communication).

DOG RIVER BRIDGE REPLACEMENT

Preliminary engineering plans are being prepared for a new fixed-span facility to replace the existing draw bridge on Alabama 163 at Dog River. Cost estimates have not been developed; 75-25 federal/state funding will be used. Construction is tentatively scheduled within 3 to 5 years.

land acquisition. It may be necessary, however, to expand carrier (commercial airline) facilities at Bates Field if traffic increases at projected rates.

FACILITIES

AIR CARRIER

Bates Field is the regional airport serving the Mobile area. The airport (1,133 ha; 2,800 acre) is located about 16.1 km (10.0 mi) west of downtown Mobile. According to Cunningham et al. (1979), "Major facilities include a 4,645 m^2 (50,000 ft^2) terminal building and three active runways: a main runway, 46 m x 2,074 m (150 ft x 6,800 ft); and two secondary runways, one 46 m x 1,522 m (150 ft x 4,989 ft) and the other 46 m x 1,320 m (150 ft x 4,332 ft)."

In addition to scheduled air carrier services, Bates Field has facilities for military (U.S. Coast Guard) and general aviation. The carriers currently flying out of Bates Field are Republic (17 flights daily), Eastern (15), and Pan-American (3) (Lee, K., Mobile Municipal Airport, Mobile, AL, 22 April 1981, personal communication).

The majority of passengers enplaned at Bates Field are coastal county residents (Table 89). In 1973, 70% of all passengers enplaned were from Mobile County, 9% from Baldwin County, 15% from Mississippi, and 2% from Florida (Cunningham, et al. 1979).

Departures and enplanements are expected to increase substantially in the future. The Airport Master Development Plan projections for 1980 expect traffic to double by 1993. Actual enplanements and projected increases from 1962 to 2000 are illustrated in Table 90.

GENERAL AVIATION

Because of its location near the downtown business district and the waterfront, city-owned Brookley Field, located about 3 km (2 mi) west of the Mobile city limits, complements the general aviation facilities at Bates Field.

Facilities at Brookley are more than adequate for general aviation use. It has two concrete runways, one 2,930 m x 61 m (9,600 ft x 200 ft) and one 2,637 m x 46 m (8,652 x 150 ft); numerous hangars, navigation aids and control tower, and a variety of services including major repair and maintenance (Speas, R. D. Associates, Inc. 1970).

PLANNED AND PROPOSED IMPROVEMENTS

MOBILE COUNTY

The City of Mobile has adopted a capital development plan for Bates and Brookley Fields. The plan proposes to further develop Bates Field for air carrier and general aviation traffic. Some aprons, taxiways, and runways already have been modified. The plan calls for construction of a new passenger terminal and rehabilitation of the old one by 1983. Strengthening of existing runways is also proposed by 1983; however, because of financial considerations, it is doubtful that all of these can be accomplished within the time frame allotted. By 1993, the plan calls for construction of a new fire station and the contribution of a new access road and runway on Bates Field.

Proposals for Brookley Field specify no time frame, but reducing runway 18-36 to a more practical length of 1,098 m (3,600 ft), installing an instrument landing system for runway 32, and constructing a new cargo terminal are recommended by the city's development plan.

BALDWIN COUNTY

A small airport (Jack Edwards Airport) in Baldwin County also is undergoing improvement. It is a converted military training field which is being upgraded to primarily serve the tourist traffic at Gulf Shores. Currently, the airport is engaged in a $55,000 capital improvements program involving construction of a field house and facilities to provide aircraft fuel and service.

WATER TRANSPORTATION

Mobile Bay, a large natural harbor, has played a significant role in commerce since colonial days. Until the mid-1800's, when the original ship channel was completed, ocean-going vessels were barred by shoals and shallow water from entering the harbor at Mobile. Instead, these ships were unloaded and loaded by "lighters," large barges that ferried goods to and from the wharves at Mobile. Also, the shallow inland rivers that brought traders and goods to Mobile were often too low for navigation during the dry months of summer and fall.

In this century, the problems with shallow navigation lanes have been resolved largely by dredging channels and building navigation locks to facilitate inland waterborne commerce and traffic from the port to the Gulf of Mexico. The Alabama and Tombigbee Rivers have been dammed and channeled to provide reliable, year-round navigation (2.7 m or 9 ft channels). The Alabama State Docks operates seven inland ports on the Black Warrior-Tombigbee and the Alabama-Coosa River systems that primarily function as intermodal transfer points for freight moving to and from Mobile. In addition, Mobile Bay and a portion of the Mobile River have been dredged for deep-draft navigation (Figure 27). This network of channels, in combination with the inland waterways and the Gulf Intracoastal Waterway, has greatly enhanced Mobile's capacity for waterborne commerce.

The commercial support center for waterborne transport is in downtown Mobile near the waterfront. Nineteen steamship lines maintain agencies in Mobile, and there are 17 barge fleeting and transporting and towing companies.

Waterborne commerce in Baldwin County is currently negligible, and there is little indication it will gain importance in the future. The Baldwin County shore is located about 6.4 km (4.0 mi) from the channel and extensive dredging would be required to make it accessible. Furthermore, there is an absence of rail transportation facilities in the waterfront area and little likelihood of their development.

HARBOR FACILITIES

In the following subsections, coastal Alabama's waterborne transportation facilities are described. Discussion covers existing (public and private) as well as planned and proposed improvements (Table 91).

EXISTING FACILITIES

In discussing the facilities within Mobile Harbor (synonomous with the Port of Mobile), it is important to differentiate between the Port of Mobile, which refers to all waterborne transportation facilities, publicly or privately owned, and the Alabama State Docks (ASD). The ASD is owned and administered by the State of Alabama, the only state that owns and operates its own inland and deep-water port facilities. The State Docks Department annually handles about 50% of all Mobile Bay port traffic.

PUBLIC

The main facilities of ASD are the general cargo and container facilities, the public grain elevator, the dry-bulk handling plant, and McDuffie Coal Terminal. The Survey Report on Mobile Harbor (U.S. Army Corps of Engineers 1980) contains the following descriptions and assessments of the major facilities.

The general cargo facilities consist of 26 berths located on the west bank of Mobile River between Cochrane Bridge and the tunnel crossings. The general cargo berths vary from relatively modern to relatively old (some as old as 50 years). Utilization of these facilities is low, and timely renovation, coupled with new construction, should make these berths adequate for anticipated future needs. Tonnages through these facilities was 1.3 million mt (1.4 million 5) in 1976, or about 50.0 thousand mt (55.0 thousand t) per berth. According to Moore, W. P. and Associates, Inc. (1977), "Cargo Berth No. 2 is the only existing ASD container facility. It has had a container crane in operation since September 1976. The facility is limited by the length of the berth (273 m/895 ft), . . . and by a marshalling area of less than 4.1 ha (10.0 acres). . . . It is estimated that the capacity of this container berth is 272 thousand mt (300 thousand t) per year." In 1980, 10,339 container units were handled, compared with 10,057 in 1979 (Alabama State Docks Department 1979, 1981c).

The public grain elevator is located on the west bank of Mobile River above the I-10 tunnels. Prior to 1975, the elevator had a capacity of 1.1 million bu for an annual throughput capability of 2.3 million mt (2.5 million t). An expansion program begun in 1975 included an annex that added 2.5 million bu of storage capacity, and another expansion is underway which will increase loading efficiency. When completed, the facility's throughput capability will be over 3.2 million mt/yr (3.5 million t/yr).

A dry-bulk handling terminal is located on Three Mile Creek. The original plant was built in 1927 and has been renovated several times. About 5.3 ha (13.0 acres) of storage and berths for two ships are currently available. Annual throughput capacity is 4.5 to 5.4 million mt (5 to 6 million t), and it is being operated at near capacity. The principal commodities handled at Three Mile Creek are bauxite, iron ore, and import coal.

McDuffie Coal Terminal is the port's primary coal-handling facility. It is located at the mouth of the river below the Interstate 10 tunnels and will be accessible for larger vessels if the channel is deepened to 16.8 m or 55 ft (Table 92). The facility opened in 1975 and has a maximum rated throughput of 4.4 million mt (4.8 million t) per year. Equipment at the terminal includes a stacker-reclaimer that moves the coal to storage from barge or rail car, then transfers it from stockpile to ships at a rate of 3.6 thousand mt (4.0 thousand t) per hour. A rotary car dumper unloads up to 30 rail cars per hour, and a high capacity bucket type unloader empties barges at a rate of 2.7 thousand mt (3.0 thousand t) per hour.

The ASD also operates warehouses for dry and cold storage. Warehouses are accessible by rail and arterial highway, and diversified handling is provided (U.S. Army Corps of Engineers 1978a).

The Terminal Railway is also a facility of the ASD. As discussed previously, the function of this rail system is to facilitate and coordinate shipments from ships to commercial carriers.

PRIVATE

Major private docks facilities in Mobile Harbor include the following: Amerada-Hess and Citmoco Terminals, which store and ship crude oil received by pipeline from fields in northwest Florida, central Mississippi, and north Mobile County; Chevron Asphalt Refinery, which receives crude oil by tanker and barge, and ships asphalt by barge; Texaco Terminal, which receives refined petroleum products by small tankers; Pinto Island Metal Docks, which exports scrap iron; Pro Rico Industries, which imports molasses in small tankers; and Argon Terminal, which receives petroleum products and chemicals from small barges (U.S. Army Corps of Engineers 1980).

PLANNED AND PROPOSED IMPROVEMENTS

Several ASD facilities are currently operating at near-capacity, notably the coal and dry bulk plants. To accommodate existing traffic and to prepare for the increased tonnages expected in the 1980's, ASD is undertaking a massive capital improvements program. These improvements are being financed through a series of bond issues authorized by the Alabama legislature.

Projects currently under construction are funded through a bond issue approved in 1977. These projects include a $5.8 million addition at the public grain elevator and a $20.0 million expansion at the McDuffie Coal Terminal.

The grain elevator expansion is in the final stages of completion and entails construction of a new dump truck and scales, and a new shipping system with a 40,000 bu/h elevator leg and cleaning system. All improvements will be linked directly to the existing elevator (U.S. Army Corps of Engineers 1980).

The McDuffie project was completed in September 1981. Essentially, this expansion duplicates the original facilities built in 1975 and will about double throughput capacity. This project also adds a loop rail track to provide more efficient unloading and turnaround for prospective unit trains (Alabama State Docks Department 1981b).

In the spring of 1981, legislative approval was obtained for yet another bond issue. This one, for $100 million, is the largest in the history of the State Docks. The bulk of this money will finance another expansion at McDuffie Coal Terminal, additional facilities at the grain elevator, and upgrading of the bulk materials plant.

The third McDuffie Terminal project will cost $53 million. Improvements will include a third stacker-reclaimer, a third barge unloader, more conveyor systems and storage pads, and additional rail tracks, as well as a second car dump installation, and a second docking pier and ship loader. Additional buildings will also be constructed on this site. Throughput capability for the facility will be boosted to 21.3 million mt (23.5 million t) annually (Alabama State Docks Department 1981a).

Another $15 million will be used to construct a new berth and a loading facility (120,000 bu/h capacity) at the grain elevator. Also, $5 million will fund improvements at the bulk materials handling plant at Three Mile Creek. Three Mile Creek improvements will include construction of concrete-bottom rail car dump pits, and connecting conveyor systems and storage areas. Capacity will be expanded about 1.4 million mt (1.5 million t) per year with these additions (Alabama State Docks Department 1981b).

Other improvements under consideration include a long-range program to provide bulk terminal facilities and ship berths below the Interstate 10 tunnels. The areas under construction for development are located adjacent to the bay side of the old Brookley Field area, and a tract adjacent to Mobile River and McDuffie Island that was recently purchased by the ASD from the ICG railroad, known locally as the Frascati property (U.S. Army Corps of Engineers 1980).

The long-range development plant prepared for the ASD in 1977 recommended creation of new land for future dock expansion adjacent to Brookley Industrial Complex through "the proper use of dredge spoil" (Moore, W. P. and Associates, Inc. 1977). This plan is contingent upon the Mobile ship channel project. As is subsequently noted, the Corps of Engineers' recommended plan calls for new work material dredged from the upper portion of the bay channel and from the turning and anchorage areas to be used to create approximately 424 ha (1,047 acres) of fast land at an elevation of about 5.3 m (17.5 ft) above mean low water (U.S. Army Corps of Engineers 1980).

The Alabama State Docks Department is pledged, as local sponsor of the Theodore ship channel and barge canal extension, to "provide and maintain . . . adequate public terminal and transportation facilities," including a bulk material handling terminal and a terminal for crude oil and other products at the terminus of the barge channel. These facilities are expected to be furnished as required after completion of the Theodore channel project.

CHANNELS AND HARBORS

EXISTING WATERWAYS

The U.S. Army Corps of Engineers has constructed and maintains virtually all the channels and waterways of commercial significance in coastal Alabama (Table 93). The channel network consists of deep-draft channels, barge canals, and anchorage and turning basins.

Materials dredged from the channels are deposited in approved disposal areas. The annual average volume of maintenance bottom materials dredged from the Mobile Harbor system from June 1965 to June 1975 was 3,870,000 m^3 (5,061,000 yd^3) (Table 94).

MOBILE HARBOR

By far the most extensive and complex waterway in coastal Alabama is the Mobile Harbor project. This network is comprised of 67.6 km (42.0 mi) of channels within the bay and river area. Several other smaller channels also are maintained by the Corps of Engineers. Three of these, at Dauphin Island Bay, Bayou La Batre, and Bon Secour Bay, have limited commercial traffic. The others, at Fly Creek, Fowl River, and Bayou Coden, are used for recreation.

GULF INTRACOASTAL WATERWAY (GIWW)

The GIWW is a water route for shallow-draft vessels not suited for navigating long stretches of open Gulf. In Alabama, the waterway traverses Mississippi Sound, lower Mobile Bay, Bon Secour Bay, a land cut near the coast in Baldwin County, and Perdido Bay—a distance of about 96.5 km (60.0 mi) (Figure 27). Barges and other shallow-draft vessels can move through this and a similar succession of bays, sounds, tidal estuaries, and artificial land cuts from Appalachee Bay, Florida, to the Mexican border. Through its connection with the extensive network of rivers that funnels into Mobile, the waterway links Alabama's interior with the entire gulf coast and the Mississippi River system (U.S. Army Corps of Engineers 1977b).

THEODORE SHIP CHANNEL

This channel gives deep-draft vessels access to Theodore Industrial Park, a large tract about 3.2 km (2.0 mi) inland from the Bay on the west side (Figure 28). The area is owned in part by the Alabama State Docks and is being developed by a combination of public and private entities. Total cost of initial construction at 1976 prices was $56.1 million. Benefit to cost ratio at that time was 3.01. Funding of the project was shared by the Federal and State governments (U.S. Army Corps of Engineers 1977a).

The Theodore Ship Channel is 12.2 m deep x 121.9 m wide (40 ft deep x 400 ft wide) and begins at the Main Ship Channel at a point about 4.5 km (2.8 mi) north of Middle Bay Light and extends northwesterly to the shore of the bay. Also being excavated is an anchorage basin adjacent to the channel near the bay shoreline. A land cut 12.2 m (40 ft) deep, 91.4 m (300 ft) wide, and about 3.1 km (1.9 mi) terminates in a turning basin. The barge canal extends westward from the turning basin. Its dimensions are 3.7 m x 30.5 m x 1,829 m (12 ft x 100 ft x 6,000 ft) long.

PROJECTS UNDER CONSTRUCTION

TENNESSEE-TOMBIGBEE WATERWAY

The massive Tennessee-Tombigbee Waterway project has been under construction by the U.S. Army Corps of Engineers since 1972. Although this project is not in the coastal counties, its purpose is to funnel barge traffic southward to Mobile from the Tennessee and Ohio River systems. The 373.5 km (232 mi) long waterway will connect the

Black Warrior-Tombigbee River system in west-central Alabama with the Tennessee River in the extreme northeastern corner of Mississippi. The waterway will, through locks, dams, and channels, make the Tombigbee River navigable year-round for shallow-draft vessels. In addition, it will link the Tennessee River with the Tombigbee by means of a 64.4 km (40 mi) long land cut. In all, the project will connect 25,760 km (16,000 mi) of navigable inland waterways.

The waterway will provide a minimum depth of 2.7 m (9 ft) and an average width of 91.4 km (300 ft). Total cost of the project, 90% of which will be borne by the Federal government, is estimated to be $1.9 billion at 1980 price levels. The benefit/cost ratio is 3.0. Contracts completed and underway now exceed $1 billion, and the project is about 50% complete, according to Corps estimates. Over 188.4 km (117 mi) of the waterway is already open to limited traffic, and the entire system is scheduled to open in 1986.

PLANNED AND PROPOSED IMPROVEMENTS

MOBILE SHIP CHANNEL

In October 1980, the Corps of Engineers submitted a proposal for a major modification of the Mobile Harbor ship channel. The proposal followed a feasibility study that demonstrated need for a deeper, wider channel as well as an anchorage basin near the main harbor and an additional turning basin.

After exploring several possibilities, the report recommends a plan described as "Brookley Expansion Area and Gulf Disposal Plan No. 1 (Modified)" (U.S. Army Corps of Engineers 1980). This plan would provide a channel 17.4 m (57 ft) deep and 213.4 m (700 ft) wide in the entrance channel of Mobile Bay and a channel 16.8 m (55 ft) deep and 167.6 m (550 ft) wide through Mobile Bay (Figure 28). The proposed channel can extend only to the mouth of the river. The Interstate 10 and Highway 90 tunnels cross under the river just north of its mouth and prevent excavation deeper than 12.2 m (40 ft) in that vicinity. The plan also provides for an anchorage basin near the upper limits of the main bay channel and a turning basin opposite McDuffie Island.

The project would cost an estimated $284.6 million in initial construction costs, and an additional $22.0 million annually for maintenance. Benefit to cost ratio is 1.5 indicating net benefits of $11.1 million annually over the 50-year economic life of the plan. The initial deepening and widening project would create 109.3 million m^3 (143 million yd^3) of dredge material and maintenance would add 3.6 million m^3 (4.7 million yd^3) of dredge material annually.

A controversial element of the recommended plan is its provision for use of some of the dredge spoils to create a land expansion adjacent to the Brookley Industrial Complex (U.S. Army Corps of Engineers 1980). This aspect of the plan was discussed in greater detail in the Docks Improvements section.

Steady increases in overall tonnage through the port, as well as significant changes in vessel and commodity trends, have resulted in the current proposal to deepen the main ship channel. As will be discussed in more detail in a following section, traffic levels in the port are expected to increase sharply in the future.

Widening the channel and constructing the turning basin and anchorage area would ease vessel congestion, and deepening the channel would allow larger vessels to enter the harbor. Vessel size is the key factor in attempts to authorize deeper channels because there is a marked trend in the world's bulk commodities fleet toward larger vessels, which have deeper drafts (Table 95). Ninety percent of Mobile's tonnage consists of bulk commodities, yet even now the port can accommodate only 22% of the vessels comprising the world's coal fleet. By 2000, without expanded accommodations, this capability will drop to only 8% as more and more of the larger vessels are put into service (Table 96).

BAYOU LA BATRE CHANNEL

In 1979, the Corps of Engineers developed a proposal to improve the harbor at Bayou La Batre when funds became available. The improvements involved deepening the channel from the presently maintained depth of 3.7 m (12 ft) to 6.1 m (20 ft) and dredging an anchorage and turning basin. Thus far, no funding allocations or project studies have been made; however, there is strong local support for the proposal. The project may receive a higher priority if support facilities for offshore petroleum production are developed in the Bayou La Batre area.

COMMODITIES AND TONNAGES

The waterborne freight tonnages for Mobile Harbor are compiled by both the U.S. Army Corps of Engineers and by ASD personnel (Table 97). Because of differences in methods of compilation, variations ranging from 0.9 to 2.7 million mt/yr (1 to 3 million t/yr) apppeared in overall tonnage figures. For this report, the Corps of Engineers statistics will be used unless otherwise noted.

MOBILE HARBOR

In 1978, Mobile Harbor ranked thirteenth among the Nation's ports by tonnage. New Orleans, the Nation's second-ranked port and the largest port on the Gulf, handled 146.0 million mt (161.0 million short t) in 1978. In contrast, Mobile handled 32.7 million mt (36.3 million short t) (Table 97) (American Association of Port Authorities 1980).

Overall tonnage for 1980 is not yet available from the Corps of Engineers, but Alabama State Docks figures, which generally are slightly lower than Corps of Engineers statistics, record 1980 tonnage at 37.0 million mt (40.8 million short t). The tonnage at Mobile Harbor since 1955 has shown a steady increase (Table 97).

DOMESTIC AND FOREIGN TRAFFIC

Domestic (coastal, internal, and local) traffic was predominant at Mobile Harbor in 1955-78 (Table 98). In foreign trade imports exceeded exports. Even though import tonnage in most categories continues to increase, the percentage of exports is increasing steadily.

In 1978, domestic tonnage accounted for 56% of the port total, foreign imports 30%, and foreign exports 14%. Foreign tonnage in 1978 is listed by major commodity group in Table 99). Of the foreign imports, principal products were metallic ores, primarily iron and bauxite (72%), coal (16%), crude petroleum (7%), and other (5%). Foreign exports primarily consisted of coal (43%), soybeans (28%), other farm products (13%), prepared animal feed (6%), and other (10%).

VESSEL TYPES

For Mobile harbor, barges accounted for 11,962 inbound vessel trips in 1978, and inbound deep-draft vessels accounted for 1,314 trips (Table 100). Since 1955, dry cargo barge trips increased 38%, and tanker barge trips jumped 173%.

Mobile's deep-draft tonnage has shown a healthy growth. Since 1955, the number of trips by deep-draft vessels decreased but the size of deep-draft vessels has increased, with fewer ships carrying more cargo (U.S. Army Corps of Engineers 1980).

COMMODITY TYPES

Of the Mobile port tonnage in 1978, 90% was bulk products. This percentage is expected to remain relatively constant because major emphasis is put on attracting these markets. The primary dry bulk commodities at Mobile are ores, coal, and grains. Major liquid bulk commodities are crude petroleum and refined petroleum products.

In 1978, metallic ore was the commodity with the highest volume of traffic (9.5

million mt; 10.5 million t) (Table 101). This ore is primarily iron ore, which is shipped by barge and rail from Mobile to steel mills in Birmingham and Gadsden, Alabama. Bauxite is the other major metallic ore.

Coal tonnage ranked second in 1978 at 7.3 million mt (8.0 million t). Most of the coal handled by the Port of Mobile is steam coal, a low-sulphur product used to fire stationary power plants. The steam coal currently being exported is mined almost exclusively in northern Alabama. Paradoxically, steam coal is also imported. This coal is being shipped from South Africa through Mobile Harbor to the power plants along the northwest Florida coast, an area that can buy coal and have it shipped over the Atlantic more economically than it can buy domestic coal. Metallurgical coal used in firing steel mills and coking coal comprises a small segment of Mobile's coal exports.

Petroleum products are another important bulk commodity. In 1978, crude oil shipments of 3.4 million mt (3.8 million t) moved through the port. Refined petroleum products amounted to 5.2 million mt (5.7 million t) in 1978. This includes gasoline and asphalt as well as other refined products.

Total grain tonnage in 1978 (handled by the public grain elevator) amounted to 2.6 million mt (2.9 million t). One and one-third million mt (1.5 million t) of marine shells and 1.0 million mt (1.1 million t) of sand and gravel were moved through the port in 1978.

COMMODITY TRENDS

The composition of traffic shipped through Mobile changed considerably in 1955-78, as shown by Corps of Engineers data (Table 101). Two products that were major commodities in 1955 were fishery products, 16% of the tonnage, and primary metals, 20%. In 1978, fishery products accounted for only 4% of total tonnage and primary metals only 1%. Conversely, other products increased in relative importance over the 23-year period. Metallic ores increased from 18 to 29% of the total; petroleum and coal products increased from 11 to 16%; and farm products increased from 4 to 8% (U.S. Army Corps of Engineers 1955, 1978b).

Coal tonnage showed the greatest gain, from 5% of the tonnage in 1955 to 22% in 1978. This trend has great importance for the port because coal and petroleum will be the products of the future at Mobile, according to Corps of Engineers projections.

COMMODITY PROJECTIONS

Future levels of waterborne commerce in Mobile are expected to be influenced by the anticipated opening of the Tennessee-Tombigbee Waterway, and the accelerated international demand for steam coal. Either of these would stimulate traffic through the port, but together they are expected to increase traffic by over 400% in the next 50 years. In 1980, the Corps of Engineers projected major commodity tonnages into the next century. These projections apply only to deep-draft vessels. Barge traffic growth, according to the Corps, can be expected to parallel growth in ocean-going traffic.

Much of the data used for computing the tonnage projections was collected before the recent sharp increase in overseas demand for steam coal. Based on more current knowledge, the Corps of Engineers estimates are probably conservative. Despite conservatism, sharp increases in commerce for the port are expected. By 1986, the impact of traffic from both the Tennessee-Tombigbee Waterway and the Theodore Ship Channel are expected to reflect much higher tonnage.

In 1975-86, deep-draft tonnage through the port of Mobile will more than double (Table 102). In 1975, deep-draft freight was 15.1 million mt (16.7 million t). Projected 1986 tonnage is 34.5 million mt (38 million t), an increase of 19.4 million mt (21.3 million t).

The projections for coal tonnage in 1986 show an increase from 2.8 million mt (3.1 million t) in 1975 to 16.3 million mt (18.0

million t) in 1986. By 2000, coal tonnage is projected to be 19.4 million mt (21.4 million t). These figures reflect the vital role that the Tennessee-Tombigbee Waterway is expected to play in the export of steam coal.

Corps projections also show deep-draft tonnage for the Theodore Ship Channel in 1986. According to their estimates, total tonnage for Theodore Ship Channel in 1986 will be 12.7 million mt (14.0 million t). The principal commodity will be crude oil.

GULF INTRACOASTAL WATERWAY (GIWW)

In 1978, 8.1 million mt (8.9 million short t) moved in the GIWW between Mobile and Pensacola (Table 103). The commodities carried were primarily petroleum products, crude oil, asphalt, coal, chemicals, grain and grain products, and marine shells.

The section of the waterway between Mobile and New Orleans bears almost three times the traffic as the eastern section. In 1978, tonnage was 20.5 million mt (22.6 million t) consisting of petroleum products, basic chemicals, grain, coal, marine shells, limestone and iron and steel manufactures (U.S. Army Corps of Engineers 1978b).

In 1955-1978, Mobile-Pensacola traffic increased by 5.9 million mt (6.5 million t), and Mobile-New Orleans traffic grew by an impressive 14.0 million mt (15.4 million t). Since some of the traffic moves directly from New Orleans to Tampa, for example, the combined tonnage of the two sections does not represent the total.

MINOR HARBORS

The three minor harbors, Bayou La Batre, Bon Secour, and Dauphin Island, accommodate small volumes of commercial traffic (Table 104). Of these, tonnage at Bayou La Batre, a minor port for commercial fishing, has decreased from 22.2 thousand mt (24.5 thousand t) in 1970 to 11.2 thousand mt (12.3 thousand t) in 1978. The tonnage at Bon Secour Harbor, also a commercial fishing port, increased in the 8-year period from 4.7 thousand mt (5.2 thousand t) to almost 9.1 thousand mt (10.0 thousand t). At Dauphin Island Bay, tonnage is up from a mere 298.5 mt (329 t) in 1970 to 11.8 thousand mt (13.0 thousand t) in 1978.

ECONOMIC IMPACT OF THE PORT

GENERAL

Three major studies pertaining to the Port of Mobile's impact on the economy of coastal Alabama have been conducted during the last decade. As described below, one deals with the port's overall impact on all economic sectors, another measures the specific impact of grain exports, and a third analyzes the impact of mining and manufacturing exports.

A general economic impact study (Dunphy and Chang 1974) reports that 41,990 Alabama residents were employed in jobs that directly related to port activity in 1973. These employment categories included marine and inland transportation, marine services, governmental and civic jobs, tidewater and manufacturing industries, and farming. Wages for these employees totalled $441.1 million in 1973 dollars (Dunphy and Chang 1974).

The same study computed the port's indirect impact on the basis of employment and wages in the supply and service industries which support activities that are directly port-related. Indirect employment totaled 83,990 workers in 1973, and wages were $882.2 million. The combined direct and indirect economic impact of the port on the State of Alabama in 1973 involved the employment of about 126,000 workers who earned $1.3 billion in wages (Table 105). This analysis does not contain county-by-county impact estimates (Dunphy and Chang 1974). This economic analysis also computes economic impacts in terms of revenue generated per ton of cargo. Most of this revenue is generated in the Mobile area and involves expenditures for cargo handling, State Docks fees, steamship agency expenses, custom brokerage and forwarding costs, storage, ship supplies, overland freight revenue, and even the ships' crew expenditures in the area. The study indicates that revenue for general cargo is greater per ton than for other kinds of cargo (Table 106).

A study on the public grain elevator of the ASD system identifies the specific impact in 1977 of grain exports on all counties in Alabama (Auburn University, Department of Agricultural Economics 1979). This study also points out that production of Alabama's chief export grain, which is soybeans, is increasing. Grain facility impacts on Baldwin County, Mobile County, and Alabama as a whole are described in Table 107.

The port's relationship to mined and manufactured exports is analyzed in a study prepared at the University of Alabama (Bird 1979). The study concludes that 42,765 Alabamians earned $420.3 million in 1976 in jobs that related directly or indirectly to mining or manufacturing products for export through the Port of Mobile. In 1976, mining and manufacturing products for export generated 555 jobs in Baldwin County and nearly 3,000 in Mobile County.

Bird states that "In 1976, an estimated 2.4 million mt (2.7 million t) of Alabama coal were exported via Mobile. These shipments provided direct and indirect employment for 4,440 Alabama citizens. The U.S. Army Corps of Engineers estimated that 4.8 million mt (10.8 million t) could be exported by 1986. If mined in Alabama, such an increase of coal production would generate 5,900 additional jobs directly and perhaps 17,759 new Alabama jobs indirectly."

TENNESSEE-TOMBIGBEE WATERWAY

The economic impact of the Tenn-Tom project on Mobile currently is a subject of wide discussion and speculation. Although the tonnage estimate (as indicated by Corps projections) is based on sound predictive data, the economic implications of the traffic increase for Mobile are far less certain.

One school of thought contends that the waterway will have a major impact on the port city's economy. According to Hammer, Siler, George Associates (1976), "Mobile . . . stands to gain a relatively heavy share of the waterway's potential impacts. . . . In its potential role as an origin, destination, and transfer point . . . nearly all sectors of the Mobile economy will benefit from the development of the waterway. The impacts will most heavily be felt in the manufacturing sector and port-related trade and services sectors."

Large quantities of bulk traffic may not have much effect on Mobile's economy, according to a study on the economic impact of Tidewater, Virginia, port facilities (which exported 80% of U.S. coal shipments in 1980) on the Commonwealth of Virginia (Silberman and Yochum 1980). The study was based on revenue per ton and payroll per ton at Hampton Roads. The authors state that payroll per ton gives a more accurate, though conservative, estimate of economic impact because wages are most likely to be spent locally, whereas revenue may go to the federal government and to rail companies and other distant industries.

According to Silberman and Yochum (1980), payroll per ton varies by type of cargo, with the direct impact being greatest for break-bulk cargo and least for bulk cargo (Table 108).

Based on evidence given in the Hampton Roads study, the Virginia payroll per ton impacts can be applied to projected Tenn-Tom tonnage to arrive at an estimated impact figure for Mobile. If the Tenn-Tom boosts tonnage at Mobile by 14.9 million mt (16.4 million t) in 1986 (as Corps projections indicate) and if that tonnage consists almost exclusively of bulk materials (as projections indicate it will be), then coastal Alabama payrolls may be expected to increase by roughly $48 million (direct impact only) the first year the Tennessee-Tombigbee Waterway is in operation. That amount ($48 million) should equal about 1% of the ACR's total personal income in 1986.

SUMMARY

Coastal Alabama is served by a well-developed intermodal transportation system and terminal facilities, most of which are concentrated in Mobile County.

The rail system is highly developed and four line-haul railroads perform a key function by carrying freight to and from inland areas not accessible by water.

The area has an extensive network of highways including expressways, major and minor arterials, and collector streets. The Interstate system, except for a proposed connector, is virtually complete. Several major bridge projects are under construction.

The coastal air carrier facility, Bates Field, is served by three major carriers with regularly scheduled flights. An upgrading of facilities and service has been planned to accommodate future needs.

The dominant transportation is waterborne. An extensive system of waterways and channels has been developed to facilitate navigation of ocean-going and inland barges.

Waterborne traffic will increase sharply with the opening of the Tennessee-Tombigbee Waterway in 1986 as commodities, principally coal, are channeled from the inland river systems to Mobile. Increases in waterborne traffic should follow the opening of the Theodore Ship Channel in 1981.

A major project is now under consideration to modify the main harbor channel in Mobile Bay. The proposed modifications provide for widening and deepening the channel for better port accessibility to vessels of greater tonnage. Unless the harbor is modified to accommodate these vessels, Mobile may lose its competitive position among the Nation's seaports.

Most of Mobile's port facilities are owned and administered by the Alabama State Docks Department of the State of Alabama. It maintains facilities to handle all major cargoes. Ongoing improvements at the docks consist for the most part of facilities to handle bulk commodities, primarily grain and coal.

Upon the opening of the Tennessee-Tombigbee Waterway in 1986, tonnage at the port is expected to increase by an estimated 14.9 million mt (16.4 million t). Bulk commodities, which will comprise the majority of the waterways' traffic, will probably generate only moderate direct payroll or employment benefits. As an example, it has been found that relatively little local industrial development has been generated by the large shipments of coal handled by the port of Tidewater, Virginia.

RECOMMENDATIONS

1. Waterborne commerce at the port of Mobile will increase sharply in the foreseeable future. Until a better understanding of the implications of this increase is acquired, however, effective planning will be difficult. To assist planning, studies should be undertaken on the general and specific socioeconomic effects of waterborne commerce growth on the port and on Mobile County.

Questions that need to be answered are which specific facilities will be required for handling increased vessel traffic? How will channel modifications, facility expansions, and land acquisitions for those expansions be managed? What priorities should be made of scarce and valuable waterfront property?

There is also a need to examine the implications of the ASD's continuing emphasis on bulk commodities. Since many major coal ports are planning to expand their export facilities, the possibility of overexpansion exists. How much coal-handling capacity will the port of Mobile need?

Broader implications, too, must be considered. What will be the economic, environmental, and social impacts of increased port traffic?

2. Since the ASD is an arm of the State of Alabama and is therefore responsible to statewide interests, it is recommended that an entity be established to address the broad range of issues and questions pertaining to the port, specifically from the perspective of coastal Alabama's interests.

3. It would be advisable for the ASD to adopt a working long-range development plan that is flexible enough to reflect changing traffic trends and technology in the years ahead.

4. At present there is no comprehensive, long-range highway development plan for coastal Alabama. Although such plans have been prepared in the past, they are now obsolete. A new plan should be developed with the cooperation of interested entities—city and county officials, the South Alabama Regional Planning Commission, and the State Highway Department.

DATA GAPS

1. Although data relating to waterborne traffic are fairly complete, trends and projections by transport mode and commodity are lacking for rail and vehicular traffic.

2. In general, data for waterborne commerce is adequate but projections for waterborne traffic in Mobile Harbor exist only for deep-draft tonnage, which represents only about one-half of total traffic. Planning for construction and modification of port facilities, land uses, and other future activities requires knowledge of the full range of anticipated traffic; therefore, projections ought to be developed for shallow-draft traffic.

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RECREATION AND TOURISM

INTRODUCTION

This chapter is a review of coastal Alabama's recreational attractions (scenery, beaches, historical and archaeological sites, recreation sites and parks, and special events) and their residents and tourists.

For this chapter, a tourist is defined as one who travels 161 km (100 mi) or more away from his county of residence and engages in outdoor or cultural recreation. Residents also are recreationists but their participation requires little travel; consequently, they are less likely to use hotels, rental cars, airlines, or other tourist-related services.

The three types of tourists usually involved with recreation are terminal and transient tourists and business people. The terminal tourist is one already at his destination; transient tourists are those who stop over when traveling to or from their primary destination outside the coastal counties of Alabama; and the third is business people from out of the county who participate in local recreation not directly related to their work (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

Coastal Alabama offers a wide variety of recreation to residents and tourists (Figure 29 and Table 109). Because of the sharp increase in the population and higher disposable income, greater mobility, and more leisure time over the past 35 years, the demand for recreation has risen steadily. The increasing demand for recreation and demands from other interest groups have caused stiff competition for the same resources or facilities. To effectively deal with the demands from various interest groups, planners need an integrated understanding of the relationship between the recreation and tourism industry and the area's socioeconomic and physical environment.

This paper characterizes the recreation and tourism industry and emphasizes outdoor activities that may cause stress to the environment. Included is a description of the major recreational attractions, a discussion of the level of participation in recreation/tourism and its economic importance to the local economy, and a description of past, present, and probable future needs.

Currently, no comprehensive data are available that characterize the recreation/tourism industry in the two-county area; consequently, the data herein presented are obtained from various sources and are somewhat fragmented.

BACKGROUND

Over the past 35 years, the demand for recreation along the Alabama coast has followed the national trend. Major factors contributing to this growth are increased population, income, leisure time, and mobility.

The basic character of the coastal recreation and tourist industry is directly related to the area's geography, climate, and history. Because of the generally warm climate and abundance of public waters in coastal Alabama, swimming, fishing, boating, and hunting are traditional forms of recreation.

Most of Mobile and Baldwin Counties' major recreational attractions are located in the area defined by Coastal Zone Management regulations as the Coastal Area (Figure 29). As recreation in the Coastal Area has increased in recent years, so have the demands on its natural resources. Some incompatible uses have destroyed resources by displacing them (like a suburban development), and others, located next to a recreational area (like a chemical factory), have made some areas unfit for recreation (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

In September 1979, Hurricane Frederic devastated much of south Alabama, particularly the coastal area. Although total economic losses attributable to the hurricane have not been estimated, the recreation/tourism income of coastal Alabama was sharply reduced (Blunt Associates, Inc. 1980). Recovery efforts are now progressing rapidly and the industry should return to normal by 1985 (Table 110).

Many private beach homes were destroyed by the storm but most are gradually being rebuilt. Many tourist attractions (e.g., Bellingrath Gardens, Battleship USS Alabama) and commercial establishments serving tourists (e.g., hotels, motels) were also damaged and forced to close temporarily, but most have either been rebuilt and reopened.

MAJOR ATTRACTIONS

The following subsections provide a description of coastal Alabama's major recreational attractions. A discussion of the hurricane's impact on each attraction also is provided.

CLIMATE

In general, coastal Alabama has a humid, nearly subtropical climate suitable for a variety of outdoor recreational/tourist activities. The average annual temperature is 20°C (68°F) and average annual rainfall is 173 cm (68 inches). In comparison, Miami, Florida's average temperature is 24°C (75°F) and its average rainfall is 152 cm (60 inches) (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

WATER AND BEACHES

Inland, estuarine, and marine water resources are relatively plentiful. The Tombigbee and Alabama Rivers converge near the northern boundary of the coastal counties to form a system of rivers, marshes, and hardwood bottomlands, usually referred to as the delta. Other freshwater inflows are Big Creek Lake and Escatawpa River in Mobile County and Shelby Lake and the Styx and Perdido Rivers in Baldwin County. Estuaries are Mobile Bay, Mississippi Sound, Perdido Bay, Little Lagoon, and the lower portion of the Mobile Delta (Auburn University, Department of Agricultural Economics and Rural Sociology 1974). The Gulf of Mexico up to the barrier lands is the only marine area.

Coastal Alabama has about 80 km (50 mi) of beach fronting the Gulf of Mexico, and about 103 km (64 mi) fronting Mobile, Wolf, Weeks, and Perdido Bays, and eastern Mississippi Sound. In comparison, Florida has approximately 1,735 km (1,078 mi) of beaches (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

Numerous vacation homes are located along the water and beach front areas. The demand for and cost of these homes have grown sharply over the last 10 years. In 1970, there were about 625 seasonal homes (homes not intended for year-round occupancy) in Mobile County and 970 in Baldwin County (U.S. Department of Commerce, Bureau of the Census 1972). Building permits issued since 1970 indicate that many more second homes have been built. Most of these homes are owned by local residents, and many, particularly those on the gulf beaches and Mobile Bay, are rented to other residents and tourists during the spring and summer seasons.

The gulf beaches are wide, white sandy beaches and are more popular with beachgoers than the estuarine beaches. Swimming, sunbathing, fishing, boating, and surfing are the main forms of recreation.

Alabama's gulf beaches are located along the southern shorelines of Baldwin County and Dauphin Island in Mobile County. The Baldwin County gulf beach is a 51-km (32-mi) stretch of white beach land, located about 97 km (60 mi) southeast of the city of Mobile. Dauphin Island is one of a string of barrier islands that lie just off the gulf coasts of Mississippi, Alabama, and Florida. Located at the mouth of Mobile Bay, about 48 km (30 mi) south of the city of Mobile, Dauphin Island is normally accessible from the mainland by a toll-free bridge. The island is approximately 24 km (15 mi) long, and its southern shoreline is composed of a white, sandy expanse of beach fronting the gulf.

Hurricane Frederic had a substantial effect on these gulf beaches. In the Gulf Shores area, approximately 1,200 homes and buildings were badly damaged or destroyed by the hurricane (Blunt Associates, Inc. 1980), and on Dauphin Island, the storm destroyed or severely damaged about 1,000 such structures (Rhodes 1980). Most of these homes and commercial establishments either have been or will be rebuilt in the near future. Some sand dunes were leveled by the hurricane, leaving houses and buildings more vulnerable to future storms. Recovery of the Gulf Shores area is progressing rapidly. A survey conducted in February 1980 shows that 62% of the recreation/tourism facilities in the area would reopen by the summer of 1980, only 9 months after the storm (Table 110) (Blunt Associates, Inc. 1980). The hurricane destroyed the Dauphin Island bridge (built in 1953); consequently, recovery on Dauphin Island is slower than at Gulf Shores. Construction of a new bridge was completed in 1982.

Most of the gulf shorefront land is privately owned. In Baldwin County, however, the State operates a 5-km (3-mi) stretch of public beach, and the city of Gulf Shores operates a small 458 m (1,500 ft) beach frontage public beach. At Dauphin Island, 0.8 km (0.5 mi) of beach is available to the public.

Primary recreation in bays and estuaries is sailing, power boating, waterskiing, and fishing.

DEEP SEA FISHING IN CHARTER BOATS

Deep sea fishing in charter boats is an attraction for tourists as well as local residents. A discussion of charter boat usage, including some fish catch data, is given in the section on "Sport Fishing" later in this chapter.

In 1978, there were 36 charter boat operators in coastal Alabama (Table 111). Of these, about two-thirds were in Baldwin County, all at Orange Beach, and the remainder in Mobile County, primarily on Dauphin Island. Because of the hurricane's destruction of the Dauphin Island bridge, 90% of the charter boats in 1981 are in Baldwin County (Alabama Sea Grant Advisory Service 1978).

FLOWERS

Due to the semi-tropical climate, spring arrives early, usually in the beginning of March, bringing with it an unusual display of blooming azaleas, dogwood, wisteria, and various spring flowers. This floral exhibit is celebrated by several local promotional events such as the Azalea Trail Festival and the Dogwood Festival. The springtime flowers together with the area's stately, moss-laden oaks and old homes and buildings, have given Mobile the reputation as one of the Nation's most beautiful cities (Mobile Area Chamber of Commerce 1981).

Hurricane Frederic destroyed some of the area's oldest oak trees, and these, of course, will require over 100 years to replace. Smaller shrubs and trees, including azaleas and dogwoods, sustained less damage from the storm.

HISTORICAL SITES

Mobile, one of the oldest cities in the Nation, contains many historical structures and other historical remnants such as street names, cemetaries, social customs, and indigenous cuisine, that give the city a special character. Restoration of historical structures gives part of the city a 19th century look (John H. Friend, Inc. 1974).

Three National Register Historic Districts in downtown Mobile (Table 112) have a total of 248 historical structures. Oakleigh Garden District is primarily a Victorian neighborhood with restored residences comprising the majority of the 125 buildings. The other two historical districts, Church Street (70 structures) and De Tonti Square (53 structures), display a variety of architectural styles, including Federal, Greek Revival, Rennaissance and Baroque Revival, Gothic Revival, Victorian, and "Gulf Coast" raised cottage.

In addition to the 248 National Register structures contained in these three historical districts, there are 34 other National Register sites in Mobile County and 8 in Baldwin County (Alabama Historical Commission 1981).

ARCHAEOLOGICAL SITES

About 2,000 archaeological sites are located in coastal Alabama (Table 112), a fact not surprising considering its rich and varied past (Alabama Coastal Area Board 1978). These sites are concentrated along the coast but they attract few visitors.

In pre-Columbian times, coastal Alabama was inhabited by Indians of the Muscogee family, a part of the Choctaw tribe. Evidence of their activities can be found in the coastal shell mounds and burial sites located at Bayou La Batre, Bayou Coden, Shell Bank Bayou, Dauphin Island, and the Fort Morgan Peninsula. Other sites are located in the Mobile-Tensaw River Delta and Tombigbee River floodplain and include the Bottle Creek Indian Mounds, D'Olive Creek shell mounds, Grand Bay village site, and Dead Lake shell mounds and midden. A complex chronology of Indian habitation based on artifacts found at these and other sites has been documented. Although the earliest dated artifacts are about 4,000 years old, Indians in coastal Alabama probably date back 10,500 years (Alabama Coastal Area Board 1978).

FEDERAL- AND STATE-OPERATED RECREATIONAL SITES

Although there are no national parks, national seashores, or marine sanctuaries located in coastal Alabama, a 10,000-acre refuge (Bon Secour National Wildlife Refuge) has recently been authorized (Figure 29; Tables 109 and 112). When funds are available, the refuge area will include Little Point Clear, Perdue, Little Dauphin Island, and Skunk Bayou tracts. These tracts are considered to be the best undisturbed coast beaches between Pensacola and New Orleans.

The area's two State parks (Gulf State Park and Meaher State Park) are both located in Baldwin County (Figure 29; Tables 109 and 112). Gulf State Park, located just east of the City of Gulf Shores, is the only Alabama park located on the Gulf of Mexico. This park contains 2,495 ha (6,160 acres) and contributes heavily to the recreational needs of the entire State (Auburn University, Department of Agricultural Economics and Rural Sociology 1980). Facilities include a campground area, fishing pier, pavilion, public beach, cafeteria, and convention center. Swimming, camping, saltwater fishing, and boating are the principal forms of outdoor recreation.

Facilities at Gulf State Park received substantial damage from the hurricane. The Federal Emergency Management Agency's preliminary damage survey reported $4 million in damages (Blunt Associates, Inc. 1980). The park and convention center were closed for only a short period following the storm.

Meaher State Park is located on the Tensaw River and Mobile Bay and contains 537 ha or 1,327 acres (Auburn University, Department of Agricultural Economics and Rural Sociology 1980). The basic facilities are boat launching ramps and piers for boating and fishing.

Several rivers in coastal Alabama are being considered for inclusion in the National Wild and Scenic River System. Congress has authorized feasibility studies to determine the suitability of the Escatawpa River and Soldier's Creek for inclusion in this system and, in addition, has recommended the Styx, Perdido, and Blackwater Rivers for study. The State of Alabama currently has no State Wild and Scenic River System, although several bills have been proposed to establish one.

SPECIAL TOURIST ATTRACTIONS AND EVENTS

BELLINGRATH GARDENS

Bellingrath Gardens and home is a major tourist attraction. The 28-ha (70-acre) estate, located at Theodore (Figure 29 and Table 109) on a bluff overlooking the Isle-aux-Oies River, consists of beautifully landscaped gardens, planted to provide year-round exotic foliage.

Hurricane Frederic almost totally destroyed the gardens. Estimated damages were in excess of $6.5 million (Blunt Associates, Inc. 1980) and, as a result, the gardens were closed until 1 March 1980.

BATTLESHIP USS ALABAMA MEMORIAL PARK

The Battleship USS Alabama Memorial Park is located on Battleship Parkway (Figure 29 and Table 109) and is a major tourist attraction. The 30-ha (75-acre) park's main feature is the USS Alabama, a World War II battleship. The ship was acquired from the Navy in 1964 and was enshrined in its present location in 1965. Children, as well as adults, find the ship's galleys, guns, and various other features fascinating. Displayed next to the battleship is a World War II submarine, the USS Drum.

FORT CONDE

Fort Conde is a partially reconstructed 1725-35 French fort, which treats visitors with an example of an architectural style rarely found in the United States. The fort was opened in 1976 and is located in downtown Mobile at Church and Royal Streets (Figure 29 and Table 109).

South of the fort are four square blocks known as Fort Conde Village, which contain retail shops, restaurants, and other attractions. The basic concept behind the entire development is that of an outdoor museum of Mobile architecture.

FORT MORGAN AND FORT GAINES

Fort Morgan and Fort Gaines are located on opposite sides of the entrance to Mobile Bay, Fort Morgan at Gulf Shores and Fort Gaines on Dauphin Island (Figure 29 and Table 109). Both forts were built in the early to mid-1800's and served as co-guardians of Mobile Bay and harbor during the Civil War.

MOBILE GREYHOUND PARK

Mobile Greyhound Park is a large dog racing facility which offers viewing from a clubhouse or grandstand, along with pari-mutuel wagering. The park is popular with local residents, as well as tourists, and is located in the Theodore area (Figure 29 and Table 109).

MARDI GRAS

Although more famous in New Orleans, Mardi Gras is a celebration that originated in Mobile. Held annually during the ten days prior to Ash Wednesday, the festival consists of a series of gala parades and balls. On Mardi Gras Day, the final day of revelry (the Tuesday before Ash Wednesday), the celebration culminates with all day and night parades and festivities.

SENIOR BOWL

The Senior Bowl football game, where the Nation's outstanding college players turn pro for the first time, is held annually in Mobile. The game is held in mid-January at Ladd Stadium and is televised nationally.

JUNIOR MISS PAGEANT

The Junior Miss Pageant Finals is a week-long contest among high school senior girls from 50 states for the title of America's Junior Miss. The pageant is held annually in May at the Mobile Municipal Auditorium.

DEEP-SEA FISHING RODEOS

The Alabama Deep-Sea Fishing Rodeo is a weekend of deep-sea fishing competition which has been held annually since 1948 at Dauphin Island. The rodeo is held in July, and prizes are awarded for the largest fish caught among various species.

The Alabama International Billfish Tournament is held annually at Orange Beach during Labor Day weekend. This tournament is relatively new, and the competition is limited to billfishing.

RECREATIONAL PARTICIPATION

DATA SOURCES

The three major sources of data relevant to recreation and tourism in coastal Alabama are as follows: (1) *Tourist Development: A Summary Program*, by the South Alabama Regional Planning Commission; John H. Friend, Inc. 1971; (2) *Alabama Statewide Comprehensive Outdoor Recreation Plan (SCORP): 1981 Plan*, by Auburn University, Department of Agricultural Economics and Rural Sociology 1980; and (3) *Travel in Alabama—1979: A Study of Traveler Characteristics and Their Economic Impact*, by Auburn University, Department of Marketing and Transportation 1979. In addition, miscellaneous sources provide data pertaining to attendance at specific recreational and tourist attractions.

The 1971 study by the South Alabama Regional Planning Commission and John H. Friend, Inc. is the only comprehensive study available relevant to coastal Alabama's tourism and is the principal source of data on tourism for this paper. The study estimates (1) the number of tourists traveling to Mobile, Baldwin, and Escambia Counties by automobile, and (2) tourist expenditures in the tri-county area. The principal source of data for the 1971 study was the *Mobile Area Transportation Study* conducted by the Alabama Highway Department (1966). In the 1971 study, the number of tourists is estimated for 1980. The projections were based on national income, leisure time, mobility, and population for specific origins and destinations of recreational travel in the three-county area. Although the 1971 study includes data for Escambia County, that area has limited recreational attractions and its share of tourism in the three-county area is small. Therefore, the study is reasonably representative for Mobile and Baldwin Counties. The 1981 SCORP Plan presents data on demand and supply for outdoor recreational activities in Mobile, Baldwin, and Escambia Counties.

Because of sampling deficiencies and study area differences, Auburn University, Department of Marketing and Transportation's 1979 travel and tourism study is not used extensively for this report.

NUMBER OF TOURIST TRIPS AND TOURISTS

About 1.6 million tourist trips by automobile to or through Mobile, Baldwin, and Escambia Counties were reported in 1970 (Table 113) . Approximately 2.4 million tourist trips were projected for 1980, an increase of 50%. Of these trips, approximately 14% were terminal (or trips whose primary destination was within the three-county area); 60% were transient (trips to or from a primary destination); and 26% were business-related trips. Although the number of tourist trips reported are limited to those by automobile, most (90%) tourist travel in Alabama is by automobile so the data are fairly representative (Auburn University, Department of Marketing and Transportation 1979).

The number of tourists visiting the three-county area was estimated at 2.5 million in 1970 and 4.4 million in 1980 (an increase of 76%) (Table 113). This increase was estimated, based on the assumptions that the 50% increase in the number of tourist trips in 1970-80 was because of increased leisure time, income, mobility, and population, and that the 17% increase in the average party size in 1970-80 reflected attempts by travelers to economize because of sharp increases in fuel costs.

These estimates of the number of tourists stopping in Mobile, Baldwin, and Escambia Counties include transient tourists making brief stops (30 minutes on the average) to purchase food or gas. If these transient tourists are excluded, the total number of tourists visiting the three-county area was only 1.1 million in 1970 and 2.0 million in 1980.

The Mobile Chamber of Commerce estimates that 950,000 tourists visited the city of Mobile in 1979, which represents almost one-half of the 2.0 million estimate for the three counties. This proportion, however, would actually be lower because the Chamber of Commerce defines a tourist, in broader terms, as anyone traveling more than 80 km (50 mi) away from home for any reason other than commuting to work.

ATTENDANCE AT MAJOR TOURIST ATTRACTIONS AND CONVENTIONS

Actual attendance at the major recreational attractions indicates that the estimated rate of growth (76%) in the number of tourists in 1970-80 was realistic (Table 114). The combined attendance at Gulf State Park, Battleship USS Alabama, and Bellingrath Gardens was about 2.0 million in 1970, and about 4.0 million in 1977. Between 1977 and 1978, attendance at these attractions dropped about 3% and the 1979-80 attendance declined sharply. The decline reflected the temporary closing of many of these attractions because of Hurricane Frederic, as well as curtailed travel because of high gas prices. Attendance is expected to increase again in 1980-81.

Estimates of attendance at Gulf State Park are probably high (Alabama Department of Conservation and Natural Resources, Parks Division 1981). Analysis of the traffic volume on major highways to the Gulf Shores area shows a total of about 2.0 million recreational visitors (residents and tourists) to the area in 1978 (Gulf Research Associates, Inc. 1981a), which is well below the 3.4 million visitors (Table 114) in 1978, estimated by the Alabama Department of Conservation and Natural Resources, Parks Division.

The number of persons attending conventions in coastal Alabama has also increased (Table 115). In 1970-76, the number of convention delegates increased 120%, and then dropped 19% in 1976-78 (Mobile Area Chamber of Commerce 1981).

Analysis of attendance at major tourist attractions and conventions is reasonably sound evidence that the level of tourist activity generally doubled from 1970 to 1980. The largest increases were in 1970-77, before the recent gasoline price increases and prior to Hurricane Frederic.

HIGHWAY TRAFFIC

The daily average traffic volume on highways leading to the gulf beaches is given in Table 116. Average daily traffic volume increased substantially from 1970 to 1978, particularly in the Baldwin County gulf beach area. On Highway 59, 2.7 km (1.7 mi) north of the city of Gulf Shores, average daily traffic volume increased 79% between 1970 and 1978. On Highway 182 or the Gulf Shores Beach road, just west of the Florida state line, average daily traffic volume increased 169% during the same period. In comparison to the Baldwin County gulf beach area, Dauphin Island (Table 117) has not had much traffic increase. During 1970-78, average daily traffic volume on Highway 163, just north of the Dauphin Island bridge, increased by only 32%.

Based on the assumption that average daily traffic volume during January and December of each year closely approximates annual average nonrecreational traffic and that the remaining traffic volume constitutes recreational traffic, an estimated 1 million recreational visitors went to Dauphin Island in 1978 (Table 117) and 2.0 million to Baldwin

County gulf beaches (Gulf Research Associates, Inc. 1981a). This analysis of traffic volume in the Baldwin County gulf beach area indicates that Gulf State Park attendance estimates are too high (Table 114).

OUTDOOR RECREATION

DEMAND

Projected participation (Table 118) in outdoor recreation for coastal Alabama is 51.4 million days of recreation in 1980, 61.4 million in 1990, and 66.2 million in 2000 (Auburn University, Department of Agricultural Economics and Rural Sociology 1980). These data include participation by both local residents and tourists.

In 1980, the primary forms of outdoor recreation in coastal Alabama were sightseeing by motor vehicle (36%), swimming (19%), games and sports (13%), fishing (12%), and picnicking (8%) (Table 118). Projections show no significant changes in the relative demand.

Recreation concentrated in Alabama's Coastal Zone Management coastal area are camping, fishing, water skiing, boating, picnicking, beach swimming, and waterfowl hunting. In 1980, the demand for these forms of recreation made up about 41% of the total demand for recreation in coastal Alabama.

SUPPLY

If the demand for an outdoor recreational resource exceeds the available supply, a deficit exists. In 1980, major deficits (Table 119) in the supply of recreational resources in coastal Alabama were as follows: primitive campgrounds (1,007 ha or 2,486 acres); freshwater fishing (21,430 ha or 52,914 acres); pedestrian trails (64 km or 40 miles); swimming pools (8,158 m^2 or 87,810 ft^2); bicycling trails (42 km or 26 miles); sightseeing roads (101 km or 63 mi); baseball fields (56 fields); and hunting areas (39,914 ha or 98,555 acres big game area; 19,702 ha or 48,648 acres waterfowl area). By 1990, these needs are expected to reach critical levels (Auburn University, Department of Agricultural Economics and Rural Sociology 1980).

TOURIST PROMOTIONAL AGENCIES

The principal promoters of tourism in coastal Alabama are the Mobile Area Chamber of Commerce, the State of Alabama Travel Office, the Alabama Travel Council, and the Mobile Innkeepers Association. Various smaller city governments and chambers of commerce (i.e., Fairhope, Gulf Shores) also provide promotional services (Mobile Area Chamber of Commerce 1981).

SUMMARY

Various reports support the view that tourism in coastal Alabama doubled in 1970-80. Over 2 million tourists visited the area by automobile in 1970 and 4.4 million in 1980 (Table 113). Annual attendance levels at area recreational attractions and conventions showed that the largest increase in tourism was in 1970-77, prior to Hurricane Frederic. Increases should continue in the future, provided that there are no drastic increases in the price of gasoline.

Almost one-half (41%) of resident and tourist outdoor recreation (fishing, swimming, boating, picnicking, camping and waterfowl, and hunting) in Mobile and Baldwin Counties in 1980 was in the CZM Coastal Area. Other major outdoor recreation was sightseeing by motor vehicle (36%) and games and sports (13%) according to Auburn University, Department of Agricultural Economics and Rural Sociology (1980).

Saltwater beaches constitute an important recreational resource in coastal Alabama. In 1970-80, visitors at Baldwin County gulf beaches increased 120% or about four times the rate at Dauphin Island. Baldwin County gulf beach used has grown faster than at Dauphin Island largely because of greater development of facilities for recreation there. In 1978, there were 2.0 million recreational visitors to Gulf Shores and 1.0 million to Dauphin Island (Gulf Research Associates 1981a).

TOURISM

Spring and summer are the primary tourist seasons in coastal Alabama (Table 120). Average seasonal participation is as follows: January-March, 20%; April-June, 32%; July-September, 30%; and October-December, 18% (Alabama Highway Department 1966, Mobile Area Chamber of Commerce 1981; Battleship USS Alabama 1981; Fort Conde 1981). Nationally, coastal Alabama has more tourists in the spring, possibly reflecting that tourists are attracted to the area to view the spring flowers.

TOURIST TRAVEL PATTERNS

The 1971 study by the South Alabama Regional Planning Commission and John H. Friend, Inc., presents trip origin and destination data obtained from a study conducted by the Alabama Highway Department in 1966. In the 1966 study, automobile drivers were surveyed as they traveled along major highways leading to and from the Mobile urban area. Some trips with destinations in Mobile and Baldwin Counties, however, did not pass through the Mobile urban area and were not monitored in the survey (e.g., tourists from Montgomery, Alabama, traveling to Gulf Shores in Baldwin County). As a result, the tourist trip origin and destination data (Table 121) may understate the number of destinations in Baldwin County.

Of the tourist trips by automobile through the Mobile urban area, 41% were destined for Florida; 22% in local counties (Mobile County 17%, Baldwin County 5%); 12% for Louisiana; 9% for Mississippi; 8% for western states; and 3% for other areas in Alabama (Table 121).

Analyzed by origin, 26% came from western states; 20% from Louisiana; 13% from Florida; 11% from Alabama; 10% from north-central states; 6% from Mississippi; 5% from Georgia; and 4% from other southeastern states.

Tourist trips with destinations outside of Mobile and Baldwin Counties had the following origins: western states, 30%; Louisiana, 20%; Florida, 19%; north-central states, 9%; and Georgia, 6%.

Tourist trips with destinations in Mobile and Baldwin Counties originated as follows: western states, 23%; Louisiana, 19%; Alabama, 17%; north-central states, 12%; Mississippi, 9%; Florida, 8%; and Georgia, 4%.

ECONOMIC IMPORTANCE

A study of the economic importance of the recreation/tourism industry in coastal Alabama has never been conducted and represents a significant data gap for planners. The 1971 tourism study, by South Alabama Regional Planning Commission and John H. Friend, Inc., provides estimates and projections of tourist expenditures in the area, but these estimates exclude resident recreational expenditures which are substantial.

TOURIST EXPENDITURES

Tourist expenditures in Mobile, Baldwin, and Escambia Counties were about \$32.1 million in 1970 and increased to about \$117.8 million in 1980 (Table 122). This 267% increase was attributed to a 76% increase in the number of tourists visiting the three-county area, and 112% inflation, as indicated by the 1970-80 change in the consumer price index.

About \$2.2 billion in expenditures by travelers was reported for Alabama in 1979 (Auburn University, Department of Marketing and Transportation 1979). The 1980 estimate of \$117.8 million (Table 122) in tourist expenditures in Mobile, Baldwin, and Escambia Counties represents about 5% of the statewide estimate, a share which would have been larger had the state expenditure figure excluded business and local travel expenditures. The Auburn University travel study for the state should be used with caution because the results are based on a survey that may not be representative.

The contribution of the tourism industry to the income of the three counties is far greater than the $117.8 million in direct expenditures. Direct expenditures in a region exert a "multiplier effect." Spending by tourists goes to local business establishments that pay employees and suppliers who, in turn, engage in further spending. The spending continues through successive cycles, ultimately resulting in a volume of expenditures several times the size of the initial expenditure, thus creating a "multiplier effect." Estimates of multiplier factors for tourist expenditures typically range from 2.0 to 5.0 (Auburn University, Department of Marketing and Transportation 1979). Using the conservative multiplier of 2.0, it is estimated that the $117.8 million in direct tourist expenditures ultimately generated about $235.6 million of income for the three-county economy.

EMPLOYMENT

No comprehensive source of data is available on the number of jobs generated by the recreation/tourism industry in coastal Alabama. Several indirect measures of tourist employment, however, are available. Approximately 1,600 persons were employed in 1977 by local hotels and motels (Table 123). About 30% were employed by Baldwin County hotels/motels, and about 70% by Mobile County hotels/motels (U.S. Department of Commerce, Bureau of the Census 1980b). Employment by hotels/motels represents total travel employment rather than just tourist employment. The Mobile Area Chamber of Commerce estimates that approximately 6,000 jobs were generated by the tourism industry in the city of Mobile in 1979. This estimate is a very "rough approximation" of tourist employment, and includes direct employment such as that by hotels/motels and tourist attractions as well as indirect employment by supportive service establishments (e.g., restaurants) only to the extent that they serve the tourist industry.

PROPOSED RECREATIONAL ATTRACTIONS

BON SECOUR NATIONAL WILDLIFE REFUGE

A $25 million authorization bill to create Bon Secour National Wildlife Refuge near the mouth of Mobile Bay was approved by Congress in 1981. The refuge, in four parcels, would consist of up to 4,050 ha (10,000 acres) in Little Dauphin Island in Mobile County; and Little Point Clear, Skunk Bayou, and the Perdue Tract in Baldwin County (Figure 30). Although management of the refuge would focus on preservation of various wildlife habitats, it would also provide wildlife observation, photography, hiking, fishing, and swimming.

The annual funding for the $25 million would be $7.5 million in 1981, $8 million in 1982, and $9.5 million in 1984. Although the $25 million appropriation has been authorized by Congress, approval must be granted in the annual budget for each year of the outlay. The 1981 funding has made possible the purchase of a portion of the Perdue Tract (527 ha or 1,300 acres) from the Nature Conservancy.

REDEVELOPMENT OF BATTLESHIP PARKWAY

Development along Battleship Parkway was almost completely destroyed by Hurricane Frederic. The Alabama Coastal Area Board currently is planning its redevelopment. The Board's plans include low intensity development for the area east of Battleship Memorial Park, and moderate intensity development for the Battleship Memorial Park and the area to its west.

The eastern segment would be developed for natural outdoor activities such as boating and fishing. At the Battleship Memorial Park, new attractions and facilities would be added which are described in the following section. The western segment would be developed with restaurants and shops.

EXPANSION OF THE USS ALABAMA BATTLESHIP MEMORIAL PARK

In February 1981, the USS Alabama Battleship Commission approved a long-range development plan that would add a number of new facilities and attractions to the Battleship Memorial Park. These additions would cost $76 million and include a museum, observation tower, field house, deep water marina, and a recreational vehicle park. The expansion would be phased over three to five years. At present, the expansion has not been funded.

REDEVELOPMENT OF DAUPHIN ISLAND

In 1980, the Alabama Coastal Area Board commissioned a study, "Development Plan for Dauphin Island, Alabama" by Jordan, Jones, and Goulding, Inc. (1980), which outlines development recommendations for Dauphin Island. Recommendations presented in this study include the establishment of camping facilities, public beach areas, picnic facilities, a public marina, and improvements to the existing water system and the wastewater treatment plant. The total cost for these capital improvements was estimated at $11.6 million.

In 1980, the plan showed little progress. Incorporation of Dauphin Island was recommended in the study as one means of providing management and a source of funds. In a 1979 election by Dauphin Island residents, however, the motion for incorporation was defeated, and, since then, the issue has not been voted upon again. Another proposed means of implementing the plan was to establish an Island Development Authority, but action relative to this suggestion has not been taken either.

Some recent attempts have been made to acquire additional public beach area on the island. From 1969 to 1978, the uninhabited, and undevelopable, western end of the island (13 km or 8 mi) had been leased by Mobile County from a private concern for public use. This lease expired in 1978, and, since then, several unsuccessful attempts have been made by local citizens to obtain public funds to purchase this area. A plan for the acquisition and development of the area for public use was prepared in 1980 but funding for the project is not yet available (South Alabama Regional Planning Commission 1980).

MOBILE-TENSAW RIVER BOTTOMLANDS

The Mobile-Tensaw River Bottomlands area was named a national natural landmark by the Secretary of Interior in 1974. Subsequently, in 1977, the National Park Service listed the landmark as "threatened" and, in 1978, conducted a study to explore methods of preserving its resources. The various alternatives assessed in the study were management by State regulation; administration as a State Park, Area of National Concern, or U.S. Fish and Wildlife Service Refuge; joint management by the National Park Service and the U.S. Fish and Wildlife Service; single agency management by the National Park Service; or preservation of the status-quo (U.S. Department of the Interior, National Park Service 1979). Congressional action has yet to be taken in response to the study's assessment of each of these alternatives.

TOWN OF BLAKELY

Blakely is a 1,539-ha (3,800-acre) historical site listed in the National Register of Historic Places. The site is located at a point where the Tensaw and Apalachee Rivers converge, a few miles west of Alabama Highway 225.

The site includes the formerly commercial and residential areas of the now "dead"

Town of Blakely, which was at its peak of development in the 1820's. The former commercial section of the Town of Blakely was donated to the Historic Blakely Foundation in the mid-1970's. Current development plans for the Blakely site by the Foundation include an outdoor recreational area, reconstruction of identifiable buildings from the 1820's town, nature trails and observer positions with access by foot to swamp areas for wildlife observation, preservation of archaeological sites, restoration of an early church building, and long-range plans for construction of a center for the performing arts to serve Baldwin County. Funds necessary for this restoration have not yet been obtained (Public Relations Council, Inc. 1981).

SPORT FISHING

The relative decline in world status of the United States' commercial fishing has been paralleled by extraordinary growth of the sport fishery. In some coastal states, sport catch now equals or exceeds commercial harvest for some species. Marine sport fishing has been an American tradition, and this Nation is unique among others in the magnitude of sport fishery (Gulf South Research Institute 1976). The coastal sport fishery has grown rapidly since World War II, particularly from the 1960's. Indeed, the value of this fishery may soon, if not now, exceed commercial fishery contributions to the economy in some coastal areas (Gulf South Research Institute, 1976). In Alabama, the coastal sport fish landings for 1975 (Table 124) were 53% of the commercial landings (Wade 1977).

Alabama coastal waters support a varied and extensive sport and commercial fishery. Aquatic habitats include 28,998 ha (72,496 acres) of freshwater rivers and streams; 9,120 ha (22,800 acres) of privately owned ponds; 155,947 ha (389,868 acres) of brackish bays, sounds, and rivers; and 43,000 ha (107,500 acres) of marine (offshore) waters extending from the 74.2 km (46 mi) of Gulf beaches (Alabama Department of Conservation and Natural Resources 1975). The acreage of ponds in 1971 for Mobile County (4,000 ha; 10,000 acres) and Baldwin County (5,120 ha; 12,900 acres) far exceeded all other counties in Alabama (Auburn University, Department of Economics and Rural Sociology 1973a).

In 1978-79, Alabama issued 545,002 fishing licenses to residents and 76,859 to non-residents. About 22% of the State's licenses were issued in coastal Alabama; of these, 8% were issued to residents and 14% to non-residents. Revenue from the sale of resident and non-resident licenses was $314,425. A summary of fishing license data for selected years from 1955-79 is in Table 125.

Although population growth between 1960 and 1980 was 59% in Baldwin County and 14% in Mobile County, the number of resident fishing licenses sold annually from 1955 to 1979 increased only 4% in Baldwin County and 2% in Mobile County.

In 1978-79, total license sales in the two counties were similar, yet the population of Mobile County is about five times that of Baldwin County. About 21% of Baldwin County residents purchased licenses, but only 7% bought licenses in the more urbanized Mobile County. Fishing license sales to non-residents have risen 132% in each county since 1955. About ten times more non-resident licenses were sold in Baldwin County than in Mobile County.

Ownership of Class I and Class II boats increased 91% in coastal Alabama from 1955-80 (Table 126). In 1955, 10,477 Class I boat (less than 16 ft long) were registered and in 1980 16,572 were registered. Registrations for Class II boats (at least 16 ft long but less than 26 ft long) increased more than two-fold (2,294 in 1955 to 7,811 in 1980). The increase in registrations of larger boats was slight. All motorized and sail boats are required to register. The percentage of boat owners who fish is not known, but it probably is high. In 1975, about 76% of the man hours of fishing and 86% of the landings by weight of the saltwater sport catch was by private boat (Wade 1977).

Data on fish species composition, numbers and weight of fish caught, and fishing intensity (number of fishing trips times hours fished) were reported by Swingle et al. (1966), Swingle et al. (1976), Wade (1977), Auburn University, Department of Economic and Rural Sociology (1973a), and the U.S. Department of Commerce, National Marine Fisheries Service (1980). The National Marine Fisheries Service (NMFS) saltwater angling surveys of 1960, 1965, and 1970, have proved to be inaccurate and are not referenced here.

The number of sport fishing trips and catch in the Mobile Delta (Table 127) were surveyed in 1963-64 (Swingle et al. 1966; Spencer et al. 1966). About half the study area extended north of Mobile and Baldwin Counties into Washington and Clarke Counties. The most fishing was near the city of Mobile and the Battleship Parkway. Based on a 12-month survey, Swingle et al. (1966) estimated 49,922 fishing trips or 0.64 trips/ha (1.6 fishing trips/acre). The catch was 50,145 kg (112,325 lb) or 1.0 kg/trip (2.3 lb/trip). In 1964, expenditures during these trips contributed $170,234 to the local economy. Of the 3,644 fishermen interviewed, 82% percent used boats, 18% were bank fishermen, and less than 1% were waders.

According to a statewide survey of sport fishing (Auburn University, Department of Economics and Rural Sociology 1973a), the number of fishing trips on creeks and rivers by State Planning District Eight (Mobile, Baldwin, and Escambia Counties) increased from 0.64 trips/ha (1.6 trips/acre) in 1964 to 1.8 trips/ha (4.5 trips/acre) in 1971. Based on these and other data, Swingle (1977) estimated that 140,893 kg (315,000 lb) of fish were taken in 1971 in the Delta area. The 1971 study also projected a fishing intensity of 2 to 3 trips/ha (5 to 7 trips/acre) on freshwater creeks and rivers by 1980. Based on six fishing trips per acre (2.4/ha), the number of pounds of fish caught in 1979 was near 568,000 (253,571 kg).

A year-long study of the sport and commercial fisheries of the Delta and the Black Warrior and Tombigbee Rivers to Demopolis began in December 1980, and the final report is expected in June 1982. This study is being conducted by the Fisheries Department, Auburn University, as part of the environmental quality plan being developed for the proposed navigational improvements of the Black Warrior and Tombigbee Rivers. Results of this study will establish trends in fishing since the 1963-64 study and determine whether the projections for fishing intensity and catch were accurate.

A survey of sport fishing in marine and brackish waters of Alabama was conducted in 1975 by Wade (1977). Based on interviews during creel censuses and a mail survey, the estimated man days of fishing in 1975 was 765,117 (Table 128). Based on 11 man days of fishing per boat, privately owned boats made 247,858 trips south of Battleship Parkway. Much of the fishing in Baldwin County was by tourists, but nearly all of the fishing in Mobile County was by Mobile County residents.

Sport fishermen landed about 3,612,501 kg (8,027,779 lb) of fish in 1975 (Table 128), whereas commercial finfish landings in Alabama were 5,100,636 kg (11,221,400 lb). Based upon expenditures for each man day of fishing, the value of the fishery was estimated to be $4.9 million (Table 128).

The annual National Marine Fisheries Service's marine sport survey (U.S. Department of Commerce, National Marine Fisheries Service 1980) began in 1979. This survey estimated that 204,000 fishermen made about 958,000 fishing trips in Alabama marine and estuarine waters. About 70% of the participants were coastal residents, 13% were from other areas of Alabama, and 17% were from other states. The number of trips estimated by NMFS may be too high. Because of a decline in populations of king mackerel between 1976 and 1979, there has been less fishing than in 1975 and before (C. W. Wade, Alabama Department of Conservation and Natural Resources, Marine Resources Division, Dauphin Island, Alabama; 1981; personal communication). An upturn in fishing in 1980 corresponded well with an increase in mackerel.

Three hundred species of fish have been reported for coastal Alabama (Swingle 1975). The distribution of these fish are known through the work of Boschung (1957), Boschung and Hemphill (1960), Hemphill (1960), Smith-Vaniz (1968), Swingle (1971), Swingle and Bland (1973, 1974), and Swingle (1975). A current study for the Alabama Coastal Area Board by Robert Shipp will better determine the distribution and relative abundance of commercial and sport species in Mississippi Sound and in Mobile and Perdido Bays. The number of species of fish in Alabama marine coastal waters declines progressively shoreward from the high, stable salinity waters of the Gulf (Swingle 1971).

Based on spawning locations, fishes are classified as freshwater, estuarine, or marine. The last two categories are not precise because some species use both brackish water and marine habitat at sometime in their life cycle. In this section, estuarine-dependent and marine species are collectively discussed as saltwater fishes. Descriptions of the freshwater and saltwater fisheries are given in the following subsections.

FRESHWATER FISHING

Numerous farm ponds, Big Creek Lake (Mobile County), Lake Shelby (Baldwin County), and many streams in the Mobile Delta provide abundant freshwater fishing. Of these, the Mobile Delta is most important. Fishing here is regarded as outstanding, and it is subject to the most intensive sport fishing in southwestern Alabama (Tucker 1979). Rivers draining 112,820 km^2 (43,560 mi^2) with an average annual discharge of 73,077 ft^3/sec (Chermock 1974) feed the Delta. Predominant factors in making the Delta an excellent fishing ground are high fertility, fresh and saltwater mixing, and tidal fluctuations (Tucker 1975). The Delta, which is an important nursery ground for many fish and crustaceans, provides ideal feeding conditions for sport fish (Tucker 1975). Tidal movements distribute nutrients and food organisms into and around Delta waters. A total of 115 finfish species have been identified in the Delta (Tucker 1979).

The most important freshwater species in the Delta are largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish or shellcracker (*L. microlophus*), black and white crappies (*Poxomis nigromaculatus* and *P. annularis*), warmouth (*Lepomis gulosus*), blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), flathead catfish (*Pylodictis olivaris*), striped bass (*Morone saxatilis*), and alligator gar (*Lepisosteus spatula*). Species less common are spotted sunfish (*Lepomis punctatus*), green sunfish (*L. cyanellus*), yellow bass (*Morone mississippiensis*), spotted bass (*Micropterus punctulatus*), and bowfin (*Amia calva*).

Largemouth bass are abundant in the Delta (19% of the catch in a 1963-64 survey) and are common in Big Creek Lake, Lake Shelby and coastal streams. Delta bass fishing is best in the spring after the annual floods begin (Tucker and Johnson 1978). In the lower reaches of the Delta, shallow bays and bayous are good bass fishing grounds, and wade fishing is popular along the Battleship Parkway. In the upper Delta, bass inhabit deep lakes and river cutoffs. Most weigh from 0.5 to 1.5 kg (1 to 3 lb). The small size is perhaps due to overcrowding (Swingle and Bland 1974), but its abundance makes it attractive to anglers. The Delta has been the site of several tournaments and, to accommodate bass fishermen seeking trophy-sized fish, bass clubs have been supplied with Florida largemouth bass (*Micropterus salmoides floridanus*) for release in public waters (Tucker

1979). Some have been stocked in Big Creek Lake and Lake Shelby.

Bream, which consists of several species of sunfish, and crappie made up 45% of the sport catch in the Delta in 1964 (Swingle et al. 1966). The shallow, grassy beds of the lower Delta and deeper oxbows of the northern portion yield redear sunfish, bluegill, crappie, and warmouth (Tucker and Johnson 1978). An area between the mouths of Blakely and Apalachee Rivers is especially known for its redear sunfish.

Catfish fishing is good in all parts of the Delta and in other streams and ponds. Blue, channel, and flathead catfish are major contributors to the commercial and sport catch and, according to Swingle (1977), they are probably at or near maximum utilization. Catfish contributed 8% of the Delta sport catch in 1963-64.

The striped bass was once a common riverine species in the Perdido River system, the tidal rivers flowing into Mobile Bay, and the Mobile Delta. Only a vestige of the natural population remains because impoundments have blocked passage of fish to their upriver spawning grounds (Tucker 1979). The striped bass, an anadromous species, spawns in freshwater but spends most of its life in brackish waters. Intensive stocking to support a put-and-take sport fishery has been carried out in the coastal waters of Alabama since 1967. Over 4,200,000 fingerlings have been introduced into coastal waters including Mobile Bay, the Mobile Delta, and Big Creek Lake (Minton 1979). Continued stocking is necessary to maintain the population.

The largest fish (up to 45 kg or 100 lb) of the Delta is the alligator gar. It is commonly found at river mouths to bays and estuaries (Tucker and Johnson 1978). It is known sometimes as the "poor man's tarpon," but it is little utilized for sport or food.

The future of the fishery resources of the Mobile Delta is directly tied to the maintenance of its biological characteristics. Habitat alteration and water pollution are major threats. Although the waterways are public and some lands are owned by the State, most of the land ownership is private; therefore, protecting the fish and wildlife resources there is difficult.

Current threats to aquatic stability are the abundance of the exotic Eurasian water milfoil (*Myriophyllum spicatum*) in bays and backwaters, and the exotic hydrilla (*Hydrilla verticillata*), which is now entrenched in the Coffeeville Reservoir on the Tombigbee River.

Five species of fish in the Delta are on the State list of endangered and threatened species, and their populations have been reduced because of habitat modifications, including alteration of main river channel habitats by impoundments, siltation, eutrophication, and navigation (Tucker 1979). These five species are the shovelnose sturgeon (*Scaphirhynchus* sp.), Atlantic sturgeon (*Acipenser oxyrhynchus*), blue sucker (*Cycleptus elongatus*), crystal darter (*Ammocrypta asprella*), and the freckled darter (*Percina lenticula*).

SALTWATER FISHING

An extensive area is available for saltwater (and brackish water) fishing, including Mobile and Perdido Bays, smaller bays such as Bon Secour and Wolf, Little Lagoon, Mississippi Sound, and the Gulf of Mexico. When salinity concentrations increase in the fall in the Mobile Delta when freshwater inflow is near minimum, saltwater species often are caught there.

Saltwater fishing is common in private and commercial piers, along beaches, and from smaller craft. Larger craft and charter boats usually fish deeper, offshore waters. In 1975, the preferred method of fishing in the Gulf (offshore) was trolling, and the principal species caught were Spanish and king mackerels and bluefish (Wade 1979). Baldwin County fishermen use artificial marine reefs more extensively than their counterparts in Mobile County. For coastal Alabama, bay and estuarine fishing intensity was greater than offshore intensity. Highest catches were spotted seatrout (speckled trout), sand seatrout, and bluefish.

At public fishing piers, bottom fishing was the preferred method of fishing in 1975. Kingfish (ground mullet) and sea catfish were the species most frequently caught at piers. Public fishing piers (Figure 31) on the Alabama gulf coast are at Gulf State Park (1) and Young's-by-the-Sea (2) (Gulf Shores) in Baldwin County and at Bienville Beach on Dauphin Island (3) in Mobile County. The Fairhope Municipal Pier (4), May Day Pier (5) in Daphne, and Autrey's Pier (6) (Battleship Parkway) give access to Mobile Bay. Over half the anglers that fished in Baldwin County were from out of state.

Anglers fishing from shore most frequently caught croaker and red drum according to Wade (1977). Catches of croaker and sea catfish were probably much higher than reported; most were discarded because of their small size or poor quality of flesh.

About 36 charter boats operated in Alabama coastal waters in 1978-81. Thirty-three boats were based at the Orange Beach area of Baldwin County, one was based at Bayou La Batre, and two were based at Fowl River in Mobile County. Only one boat now operates at Dauphin Island because of the current limited access to the island. Many other boats are chartered but only seasonally or for short periods of time. Offshore charter boats are 28 ft to 58 ft long (Alabama Sea Grant Advisory Service 1978) and account for a large proportion of sport fishing trips in coastal Alabama (Table 129).

Much of the charter boat fishing centers around reefs in offshore waters, particularly at artifical reef sites (Figure 31 and Table 130). Reef fishes spend most of their adult lives in and around limestone outcroppings, coral reefs, or man-made reefs, In 1975, amberjack and red snapper were taken in greatest abundance at reefs. Many of the snappers were not reported in the sport catch because they were sold (Wade 1977). Major non-reef fishes caught from charter boats are Spanish and king mackerel and jack crevalle. Non-reef fishes made up 43% of the charter boat catch in 1975. Of the sport catch (reef and non-reef fish combined) taken by charter boats, more than 75% of the catch consisted of amberjack, king mackerel, little tunny and snapper (Table 131).

The main charter season is from mid-May to early September. Local residents usually fish from charter boats in the fall, whereas most tourists charter boats from January through April. The average Alabama charter boat in 1975 grossed $147.50 for each trip of 183 trips for an average annual gross revenue of $26,992 (Wade 1977). The gross for 22 boats was about $593,835. Prochaska and Cato (1977) estimated in 1975 that the average party boat on the Florida northwest coast grossed $142,529. Tourist levels are much higher on the northwest Florida coast, however, and more weekday trips could be expected in comparison with Alabama charter boat operations.

Since 1953, reef fishing has been enhanced by the establishment of artificial reefs. These reefs, built by the Alabama Department of Conservation and Natural Resources, were made of automobile bodies placed in small groups at depths of 20 to 30 m (60 to 90 ft) in the Gulf south of Baldwin County. An assortment of culverts, cars, old boats, and other materials also are used by the Department and by charter boat operators to make reef habitat. In the early 1970's, the Department sank five Liberty ships to serve as fishing reefs and more recently used concrete spans from the old Lillian Bridge as reef materials.

The most important saltwater sport fish are greater amberjack (*Seriola dumerili*), blue runner (*Caranx crysos*), sea catfish (*Arius felis*), cobia (*Rachycentron canadum*), jack crevalle (*Caranx hippos*), Spanish mackerel (*Scomberomorus maculatus*), king mackerel (*S. cavalla*), little tunny or bonito (*Euthymus alletteratus*), southern flounder (*Paralichythus lethostigma*), gulf flounder (*P. albigutta*), gulf kingfish (*Menticirrhus littoralis*), southern kingfish or ground mullet (*M. ameri-*

canus), northern kingfish (*M. saxatilis*), ladyfish (*Elops saurus*), bluefish (*Pomatomus saltatrix*), striped mullet (*Mugil cephalus*), red drum (*Sciaenops ocellata*), sheepshead (*Archosargus probatocephalus*), Atlantic croaker (*Micropogonias undulatus*), sand seatrout (*Cynoscion arenarius*), silver seatrout (*C. nothus*), and red snapper (*Lutjanus campechanus*).

Spotted seatrout (*Cynoscion nebulosus*) is perhaps the leading sport fish in Mobile Bay (Table 132) (Wade 1979) and is caught in the Mobile Delta, the Battleship Parkway area, and Mobile Bay tributaries.

Angling for flounder is highly popular throughout the summer and early fall in lower portions of bays. Some fishermen catch the flounder at night with gigs or around jetties with gill nets. Spearfishing for flounders and sheepshead also is sometimes practiced in bay waters.

Spanish and king mackerel and jack crevalle are important sport fish that are readily accessible to pier and small boat fishermen. King mackerel is one of a few species prized by sport fishermen that is not caught commercially in Alabama.

New license fees have been proposed by the Alabama Marine Resources Division for gill netters. Currently, a gill netter with a sport fishing license can legally use large nets. The proposed higher license fee will help restrict the number of fishermen. Many sport fishermen are concerned about the effect of large-scale gill netting on spotted seatrout and other sport fish.

SHRIMPING

Shrimping is an important sport fishery in Alabama estuarine waters. Shrimp may be taken by sport fishermen throughout the year except in areas permanently closed to shrimping. During the closed commercial season, the daily limit for sport fishermen is 2.5 kg (5 lb) per person or a maximum of 6.8 kg (15 lb) per boat. In the open commercial season, a daily sport limit of 11.3 kg (25 lb) per person is imposed. No license is required for 16-foot trawl users as long as the catches are not sold. For larger trawls, a commercial license is necessary, and commercial laws must be observed.

In late spring and early summer, brown shrimp (*Penaeus aztecus*) concentrate in the lower portions of estuaries such as lower Mobile Bay where they are taken by sport shrimpers. The fall and early winter fishing is in the upper estuaries where white shrimp (*P. setiferus*) comprises most of the catch. Peak shrimping is in late June through August when the shrimp are most abundant and widely distributed (Swingle et al. 1976).

Although some sport shrimpers use cast nets, a huge majority of the shrimp are caught in 16-foot trawls. On fall mornings before sunrise, cast netters on Mobile Bay's eastern shore piers often are rewarded with good catches of white shrimp. Speckled trout and green trout (largemouth bass) fishermen also seine for small shrimp for bait. Minnow seines once were used in the submerged grassbeds along the eastern shore to catch shrimp but now most of the grassbeds have disappeared.

The actual number of sport trawls in use is not known because there are no license requirements. However, Swingle et al. (1976) conducted a survey of the 16-foot trawl fishery of Alabama between 1972 and 1974. The data, derived from both a mail survey and creel censuses, established some of the sport/commercial relationships (Table 133). Commercial catch data from the NMFS statistical zones were modified by Swingle et al. (1976) so that comparison could be made with Alabama data. The adjusted commercial catches were then compared with the 16-foot trawl sport catch data (Table 134). It was revealed that the catch by 16-foot trawls was between 15% and 25% of the total shrimp catch from Mobile Bay and other Alabama estuaries.

The composition of the 1973 commercial catch in Mobile Bay was 54% brown shrimp, 45% white shrimp, and 1% pink shrimp (*P. duorarum*). Composition of the 16-foot sport trawl catch was 71% brown shrimp, 28% white shrimp, and 1% pink shrimp. The species composition of the sport and commercial catch is different largely because sport trawling is relatively uncommon in early spring and late fall when white shrimp are most abundant. Pink shrimp is of little importance to sport fishermen except in Perdido Bay where it constitutes 5% of the shrimp catch (Swingle et al. 1976).

Recent surveys of sport shrimping in Gulf states have been made by the Gulf States Marine Fisheries Commission (Human Sciences Research 1980, 1981). Based on the May-October 1979 survey, 20,423 shrimp fishermen made 54,895 trips and caught 356,180 kg (785,242 lb). In 1980, 29,194 sport shrimp fishermen made 88,556 trips and caught 332,274 kg (710,482 lb) of shrimp.

There is an ongoing controversy between commercial and sport fishermen concerning the size and amount of shrimp that can be taken by the commercially unlicensed sport shrimper during the closed commercial season. In one study, Swingle et al. (1976) failed to determine the percentage of shrimp taken under the commercial size limit (68 shrimp/lb or smaller) because, in many instances, some of the shrimp had been used for fishing or were culled before docking. The study did disclose that a large percentage of the sport shrimpers in Baldwin County used their catch for food (82%) rather than for bait. Mobile County shrimpers used only 58% of their catch for food. Most of the people contacted in the census favored a closed season that corresponded with the commercial season. Because the commercial shrimp season coincides with peak spotted seatrout fishing in the lower bays and along beaches, most shrimpers that catch shrimp and small fish for bait were opposed to a closed season. A license required for sport trawling as a basis for estimating fishing pressure on shrimp stocks and to fund management and research programs was recommended by Heath (1979).

CRABBING

Blue crab (*Callinectes sapidus*) is a favored delicacy sought by commercial and sport fishermen. Most of the commercial catch is with crab traps (pots), but most sport fishermen use 16-foot trawls, lift nets, and hand lines in addition to traps. Still another method used in shallow waters is scooping crabs up with dip nets at night after locating them with torch lights. From May through August, soft shell crabs are particularly sought by sport crabbers since the molted crabs are delicious when eaten whole, and the need for picking crab meat is eliminated. The crab population and fishery is relatively stable. The catch for personal consumption was recently calculated to be about 20% of the commercial catch or 125,000 kg or 280,000 lb (Tatum 1977). Legal minimum harvest size is a 10-cm (4-inch) width at spine tips or about the size of a year-old crab.

JUBILEES

Jubilees are a phenomenon peculiar to Mobile Bay. The right combination of environmental conditions produces a concentration of flounders, crabs, and shrimp in stress at the water's edge. Jubilees usually occur in late July and August, mostly along Mobile Bay's eastern shore from Daphne south about 19.3 km (12 miles) to just below Point Clear. They correspond with periods of unusually low dissolved oxygen in the bottom waters of the bay. The phenomena causes bottom dwelling finfish, crabs, and shrimp to helplessly crowd near shore in a seemingly dazed condition apparently in an attempt to find higher concentrations of dissolved oxygen (Borom 1975).

A jubilee is caused by a rising tide combined with gentle, northeasterly winds that move surface waters offshore which are replaced with oxygen-deficient water from deeper water in upper Mobile Bay (Borom 1975). Low oxygen concentrations apparently arise when more saline waters in this part of the bay remain stationary and when decaying organic debris deposited by the Tensaw River gradually reduces the oxygen supply (Borom 1975). Jubilees peak just before high tide and quickly stop when the tide begins to ebb. The exact location of a jubilee is unpredictable; it may extend along the beach for miles but at different locations from year to year. Most often, the time is in the quiet, early morning hours just before daylight. Occasionally it occurs during daytime. One study of jubilee records for 23 years showed that the phenomenon tends to occur within a few days of a full and new moon (Gudac 1980).

The animals that concentrate near shore seldom die and revive quickly when the tide changes. Many people report seeing crabs, flounders, and eels near the surface, not necessarily near shore, immediately before a jubilee (Gudac 1980), and some residents can accurately predict an oncoming jubilee by observing environmental conditions, but they cannot predict the exact time and place in advance. For some years there are a dozen jubilees and in others none; the average is five per year and a maximum of 15 was reported in 1959. The recorded history dates to 1812, but there are indications that residents then were already familiar with them (Gudac 1980).

Southern flounder, Atlantic stingray (*Dasyatis sabina*), sea catfish, eels (*Anguilla rostrata* and *Myrophis punctatus*), blue crab, and brown and white shrimp as well as numerous small aquatic animals are regular jubilee "participants." Species composition variations are the rule, however, because of species distribution and environmental conditions. Spotted seatrout, black drum, and striped mullet are occasionally caught in jubilees.

The fish and shellfish in a jubilee are easily caught with nets or buckets at the shoreline. There are no catch or participation records for jubilees because they are infrequent events and locations are variable. They are highly popular events, however, that provide seafood in abundance (in bucket and tub-sized quantities) to those persons fortunate enough to be present. A jubilee has been described as an outbreak of "controlled pandemonium" (Gudac 1980). It is peculiar to Mobile Bay. Similar occurrences are almost unknown, although in 1978, one was thought to have occurred near Biloxi, Mississippi (Gudac 1980).

HUNTING

Although there are about twice as many fishermen as hunters in Alabama, hunting is still a major sport. Hunting seasons are relatively long, about 200 days, beginning in mid-September and continuing to late April. Generous bag limits on most species attract both out-of-state hunters and residents. Large populations of game live in the State because of the extensive and variable habitat. Among the habitats there are about 8 million ha (20 million acres) of habitat for turkey; 10 million ha (25 million acres) for deer; and 12 million ha (30 million acres) for quail and squirrel (Davis, personal communication). Statewide hunting data, based on a sample from 340,608 licensed hunters in 1964-65 and 317,204 licensed in 1979-80, are given in Table 135. The number of hunters for all game species except squirrel, rabbit, and opossum increased in 1964-80. Deer replaced squirrels as the principal species hunted, probably because of their great abundance. In the 1978-79 survey, 86% of the licensed hunters actually hunted.

In 1971, 16% of the State population purchased hunting licenses (Auburn University, Department of Agricultural Economics and Rural Sociology 1973b). In 1979-80, 317,204 hunting licenses were issued for Alabama. About 37,631 licenses, or 12% of the State total, were issued in Mobile and Baldwin Counties. Sales of hunting licenses there since 1955 have risen steadily (Table

136). The increase from 1955 to 1979 was about 47% in each county. Much of this increase is related to a sharp rise in the purchase of non-resident licenses, particularly in Baldwin County, where license sales more than tripled. Although both counties attract out-of-state hunters, there is no way to quantify the number of State residents from other counties who hunt in the coastal counties.

WATERFOWL

Coastal Alabama, which is located on the eastern fringe of the Mississippi flyway, is a resting and feeding place for thousands of waterfowl. Although ducks inhabit many of the ponds, creeks, rivers, and bays of the area, the Mobile Delta is by far the most important wintering waterfowl habitat. About 95% of the wintering population and bagged game is in the shallow bays and marshes of the lower 25% of the Delta (Beshears 1979).

Since 1952, the Alabama Department of Conservation and Natural Resources has conducted an annual waterfowl inventory and habitat survey in the Mobile Delta. Estimates based on reliable observations indicate that during the three decades prior to 1952, populations of 50,000 to 70,000 ducks were common in the lower Delta, but since then, the highest count was about 37,000 (Figure 32). In 1970-79, the ducks numbered over 20,000 only once, and most counts were near 11,000 birds (Table 137).

The decline in the duck populations (Figure 32) in the last several decades has corresponded with a similar reduction in the continental duck population, which apparently was brought about by large-scale drainage of marshes since the turn of the century. By the 1950's, drainage had reduced the area of the Nation's wetlands from 317.5 million ha (127 million acres) to 205 million ha (82 million acres). More than 2.5 million ha (1 million acres) of prairie pothole land in the North Central states were drained and tilled between 1943 and 1961. The destruction of these breeding grounds has permanently reduced the duck populations (Linduska 1964).

Duck populations in the Mobile Delta also have been affected by long-term changes in the abundance and composition of submerged aquatic plants. In 1956, submerged aquatic plant areas in the Delta were described as the finest south of Virginia and North Carolina (Beshears 1979). In the 1960's, pollution and other man-induced factors wiped out some of the most desirable food plants, and none of the once plentiful five principal plant species used by ducks were abundant in 1978 (Beshears 1980). One major contributing factor to the decline is the phenomenal increase of Eurasian watermilfoil, an exotic plant that first appeared in 1970. By 1978, it occupied 75% of the Delta's shallow areas where more desirable species once grew (Beshears 1980). Ducks will eat milfoil, but it is not a preferred food, and it remains to be seen whether this exotic plant will continue to encroach on native plants.

In addition to these permanent and long-term changes, weather-related factors affect the abundance of waterfowl in coastal Alabama in any given year. Foremost among these factors is droughts, which are disastrous for ducks in the breeding grounds in the north-central United States and Canada. Wet years such as those occurring in the mid-1950's resulted in high continental populations. Winter temperatures also may alter the number of ducks reaching the Delta. During mild winters, fewer ducks move far southward. Even in severe winters, some ducks, including mallards and pintails, will remain at northern localities if grain is plentiful.

In 1955-78 in Alabama, the average daily bag per hunter was 1.6 ducks and 2.3 coots (Table 138). These figures compare favorably with the Mississippi flyway average, which, according to the U.S. Fish and Wildlife Service, is less than 1.0 duck per day per hunter (Beshears 1979). In the Delta, 90% of the waterfowl hunters are from Mobile County, 5% from Baldwin County, and the remainder from other counties or out of state (Beshears 1979).

Twenty-seven duck species have been recorded in the Delta (Beshears 1979). The dabbling ducks are blue-winged teal (*Anas discors*), green-winged teal (*A. crecca*), common pintail (*A. acuta*), mallard (*A. platyrhynchos*), American black duck (*A. rubripes*), northern shoveller (*A. clypeata*), gadwall (*A. strepera*), and American wigeon (*A. americana*). Blue-winged teal numbers peak about the first of October, move southward, then return in mid-February to mid-March. Other duck species arrive later and stay all winter. The mallard, a hunter's favorite in Alabama, once led the harvest, but it has been relatively infrequent since the establishment of the Noxubee National Wildlife Refuge in Mississippi where the mallards now concentrate (Beshears 1979). Gadwall and green-winged teal have been the most abundant species in hunter bags for several years.

Diving ducks of the coastal wintering population are redhead (*Aythya americana*), canvasback (*A. valisineria*), lesser scaup (*A. affinis*), ring-necked duck (*A. collaris*), ruddy duck (*Oxyura jamaicensis*), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), oldsquaw (*Clangula hyemalis*), and greater scaup (*Aythya marila*). Ring-necked ducks and lesser scaup make up the bulk of the Delta wintering population, and in many years, the ring-necked duck was most frequently bagged.

The wood duck (*Aix sponsa*), the only common breeding duck in the State, is a coastal resident. On the verge of extinction in the early 1900's, it is now found in all Alabama counties and accounts for 20 to 25% of the total ducks killed in the State. The annual harvest now is about 20,000 to 25,000 birds (Beshears 1974). In the coastal area, resident wood ducks are joined by northern migrants in the fall. Wood ducks do not concentrate in the lower Delta but are hunted in hardwood swamps and forest-bordered ponds.

The American coot (*Fulica americana*) is a major component of the wintering waterfowl population and is taken in greater numbers by hunters than any other species. The highest recorded number of coots bagged was 44,000 in 1944, and the lowest was 6,000 in 1941. Some hunters apparently never hunt anything but coots and consider them a delicacy (Beshears 1980).

There is a considerable controversy between the traditional duck hunter and those who utilize airboats in hunting and boating. The traditional hunter contends that airboats are in part responsible for the failure of the Delta to retain an abundance of waterfowl throughout the winter. They also believe that the airboat destroys important plant foods and that the noise levels generated by these boats are disturbing to all wildlife. Several attempts have been made through State legislation to ban airboats for 30 days prior to and during the duck season in the Delta. To date, no law has been enacted, but undoubtedly there will be more restrictions. Some contend, however, that if legislation is enacted, it would be declared unconstitutional.

GAME SPECIES

The Florida coastal race of the white-tailed deer (*Odocoileus virginianus osceola*) is widely distributed and abundant in coastal Alabama. Some areas are overpopulated, as evidenced by reports of agricultural crop damage, pine seedling damage, and poor body weights (Davis, personal communication). The deer population in Mobile and Baldwin Counties peaked during the late 1950's. Data on weights and measurements collected from several hunting clubs show a decline in all measurements (weight, antlers, etc.) since 1958. Harvest data on deer for the State show a marked increase in number since 1964-65 (Table 135). Davis (1979) conservatively estimated that the population of 1,200,000 deer in Alabama in 1979 exceeded carrying capacity. By contrast, at the turn of the century, deer had completely disappeared from many counties. Restocking was initiated in 1925, and by 1940 14,000 deer were counted of which 12,050 were in southwestern Alabama (Linzey and Linzey 1972).

Deer and other game killed are not reported by counties but Davis (personal communication) made some estimates by comparing kills from hunting clubs located in soil provinces that corresponded well with those of Mobile County. Based upon soil province similarities, Mobile County would have yielded about 1,800 of the 141,000 deer killed in Alabama in 1979-80. This estimate assumes an average of about 2.3 bucks taken per square mile (0.9/km^2). The estimated kill for Baldwin County was about 4,650 deer (bucks and does), based on a deer range of 1,160 square miles (720/km^2) that yielded 4.0 deer per square mile (2.5/km^2). Coastal Alabama's kill of 6,450 deer was about 5% of the State total.

The range of wild turkey (*Meleagris gallapavo*) in coastal Alabama is more restricted than that of deer. At the turn of the century, turkey abundance in Alabama was critically low, but restrictive hunting regulations, restocking, and habitat improvement brought the turkeys back (Linzey and Linzey 1972). Turkey releases made in Mobile and Baldwin Counties in 1970-80 have re-established turkeys on about 8,100 ha (20,000 acres) in Mobile County (Davis, personal communication). No range expansion occurred in Baldwin County. Davis estimates that 200 turkeys are now taken annually in Mobile County and 600 in Baldwin County (about 3% of the State total). There is a spring hunting season for gobblers; there is no hunting season for hens.

Quail (*Colinus virginianus*), grey squirrel (*Sciurus carolinensis*), and mourning dove (*Zenaida macroura*) are popular game animals in coastal Alabama, and extensive private acreages are managed for hunting. Common snipe (*Capella gallinago*), cottontail (*Sylvilagus floridanus mallarus*), opossum (*Didelphis marsupialis pigra*), and American woodcock (*Philohela minor*) are not ordinarily sought by many hunters (Davis, personal communication). Raccoon (*Procyon lotor varius*) supports moderate hunting and hunting for snipe is restricted to coastal marshes and wetlands, particularly in the Delta. Most woodcock are taken incidentally to quail hunting, so the number of woodcock hunters shown in Table 135 is probably an overestimate. An inventory of woodcock habitat and a study of the bird's potential as a game bird in Alabama is being conducted by Auburn University.

Although game in coastal Alabama generally is abundant, many are under stress from man's activities. The destruction of game habitat is caused by urbanization, highway construction, industrialization, forestry and logging practices, clearing of forests for agriculture, and other types of land development (Davis, personal communication). Small game abundance will continue to decline as more natural habitat is lost (Davis, personal communication). Deer and dove in coastal Alabama are currently subject to intensive hunting.

TRAPPING

Little is known about the trapping of fur-bearing animals in coastal Alabama. A three-year study of trapping in the State will be reported in 1981 (final report available through James Keeler, Alabama Department of Conservation and Natural Resources, Montgomery, AL). This study concerns the problems and needs of Alabama's fur resources and is being prepared by researchers at Auburn University under the direction of Edward P. Hill. It will include harvest data from licensed trappers who have completed annual reports on their trapping.

Fewer than one hundred trappers were licensed in coastal Alabama in 1955-76 (Table 139). In 1975-79, the number in Mobile and Baldwin Counties rose from a low of 36 to a high of 109 (Alabama Department of Conservation and Natural Resources, Game and Fish Division, License Section

1981). This increase probably reflects better markets rather than increased availability, especially with the embargo on Russian furs. In 1978-79, 3,707 licenses were issued in Alabama. Based on an estimated $2,200 annual income for part-time trappers, the total income in 1979 for fur trappers in coastal Alabama could have been as high as $239,800 (Davis, personal communication).

The trapping season extends from November through mid-February, except for beaver, which has no closed season. In the 1930's, the beaver population in Alabama was down to 500 animals as a result of excessive trapping, but they are now plentiful, primarily on the large river systems in the southern half of the State (Hill 1974). According to Holliman (1979), coastal trappers seek raccoon on land and coastal marshes where it is an abundant predator, opossum on land except beaches and salt marshes, bobcat in swampy, heavily wooded river edges and farm perimeters, beaver in the northern part of the delta, Louisiana muskrat in marshlands and river deltas, nutria in marshlands and river deltas, red fox in saltbush-salt marsh areas, savannahs, and timbered areas, and the grey fox, which is more common than the red fox, particularly north of the delta. Demand for furs of different species fluctuates considerably from year to year so fur yields are not necessarily related to abundance.

SUMMARY

Because of the warm climate and abundance of water resources, recreation for the residents of coastal Alabama consists largely of swimming, games and sports, fishing, picnicking, and hunting. Tourist recreation centers around more sightseeing. Examples are structures such as old homes, forts, public buildings, and beaches and flower gardens.

About 2.5 million tourists in automobiles visited Mobile and Baldwin Counties in 1970 and 4.4 million in 1980 (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971). Most of the increase was prior to the sharp increase in the price of gasoline in 1978 and before Hurricane Frederic in 1979. Because a majority of the area's recreational and tourist attractions are located along the coast, this substantial increase in demand for recreation over the last 10 years has exerted increasing pressure on coastal resources.

In 1980, outdoor recreation in the two counties supported over 51 million days of resident and tourist participation, which was about 15% of the statewide total. About 41% of the participation involved fishing, camping, waterskiing, boating, picnicking, beach swimming, and waterfowl hunting. Other major outdoor recreation was sightseeing by motor vehicle (36%) and games and sports such as football and baseball (13%) according to a report by Auburn University, Department of Agricultural Economics and Rural Sociology (1980).

Saltwater beaches probably are the most important recreational resource in Alabama. In 1978, there were about 2.0 million visitors to the Baldwin County gulf beach area and about 1.0 million to Dauphin Island (Gulf Research Associates 1981a). In 1970-80, the number of visitors using Baldwin County gulf beaches increased faster than at Dauphin Island, primarily because recreation was in greater demand there and facilities were more rapidly developed.

Because it is exceedingly difficult and costly to measure the value of the recreation/tourism industry, a study attempting to do this in coastal Alabama has yet to be conducted. Tourist expenditures for coastal Alabama were estimated at $32.1 million in 1970 and $117.8 million in 1980 (an increase of 267%) (Table 122). In comparison, total retail and service industry receipts were $904.6 million in 1972 and $1.6 billion (an increase of 77%) in 1977 (U.S. Department of Commerce, Bureau of the Census 1975a, 1975b, 1980a, 1980b). About 60% of the recreation and tourism is in the spring and summer.

The only projections available relative to the future of the recreation/ tourism industry in coastal Alabama are the studies on outdoor recreation by Auburn University's Department of Agricultural Economics and Rural Sociology. As projected in their 1980 study, the demand for outdoor recreational opportunities in Mobile and Baldwin Counties should increase about 30% in 1980-2000.

RECOMMENDATIONS

The following recommendations are made to help improve the quality of decisions that will be made by land-use and resource planners.

1. Increase public access to water and beach areas and still maintain the integrity of coastal resources and rights of property owners. To help alleviate the public access problem, the following actions are recommended: acquire additional saltwater beach area; develop better access within the urban waterfront; provide greater boat access to coastal waters; develop facilities supporting recreational boating; and guarantee public access rights to tidelands, submerged lands, and navigable waters.
2. Monitor the socioeconomic aspects of coastal Alabama's recreation/tourism industry.
3. Use baseline data prepared for the Alabama Coastal Area Board on fish species composition, abundance, and catch in estuaries to assess man's alteration of these areas and means of mitigation.
4. Continue and expand surveys of the sport fishery including its contributions to the local economy such as those for saltwater fishing by Wade (1977) in 1975 and freshwater fishing by Swingle et al. (1966) in 1964.

DATA GAPS

Of all the topics covered in the coastal Alabama socioeconomic characterization study, data gaps are most troublesome in the recreation/tourism industry. So far, an adequate study outline and funds are not available for this task. The most significant data gap is the summation of the economic value of the recreation and tourist industries.

The continuing controversy over the value of the recreational/tourism industry versus other demands (i.e., industrial, commercial, or residential development) is difficult to resolve without a better estimate of the economic value of recreation and tourism. In coastal Alabama, there are no available estimates of the aggregate value of the recreation/tourism industry, much less any comparable estimates of the economic value of individual activities (e.g., swimming, fishing, hunting). Also, there is no estimate of the number of employees supported by the recreation/tourism industry and their economic effects on small coastal communities.

As discussed in the body of this paper, a 1971 study by the South Alabama Regional Planning Commission and John H. Friend, Inc. is the only comprehensive study available pertaining to tourism in coastal Alabama. This study provides 1970 and 1980 estimates of tourist expenditures, and 1966 trip origins and destinations by season. Seasonal tourist expenditures were not given in the 1971 study.

Future studies of the tourist industry of coastal Alabama should include the following:

1. Annual number of tourists traveling to the area by transportation mode, season, and type tourist (terminal, transient, business).
2. Average tourist expenditures per day, by type, season, and type tourist.
3. Trip origins and destinations.
4. Other tourist trip characteristics, including average party size, and reasons for selecting coastal Alabama as a destination.
5. Overall economic importance of tourist industry.
6. Projections of demand (by type activity and locality) including the impact of future gasoline price increases.

Current data on sport fishing and hunting are very limited, and trends are not well documented. Specific data gaps are as follows:

1. No data by county for fishing intensity or catch are available on an annual basis.
2. Several studies for individual years are available, and a current study of the Mobile Delta will be valuable. The annual marine recreational fishing surveys by the National Marine Fisheries Service will eventually provide useful data for fishery management programs since the recreational catch is locally and nationally significant. This catch now represents about 40% of the total U.S. commercial catch.
3. No data are available for harvest of game species except for waterfowl species wintering in the lower Mobile Delta.
4. Only limited information is currently available on trapping. The results of a three-year study by Auburn University researchers will be reported in 1981 and will provide a basis for determining harvest by species and potential as a small industry.

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MULTIPLE USE CONFLICTS

INTRODUCTION

A multiple use conflict is herein defined as an activity by man that is incompatible with, or at variance with, other life forms (including man).

The social and economic activities discussed in previous papers depend, for the most part, on the utilization or consumption of natural resources. Because these activities often compete for the same resources, conflicts as well as benefits result. Multiple use conflicts in turn generate social, economic, political, and environmental issues.

The rapid industrial expansion, port development, and population growth now characteristic of coastal Alabama cause pressures that demand effective planning and management of industrial and environmental resources. Knowledge of the functions and ecological values of coastal ecosystems is essential for decision makers to properly manage them. The purpose of this paper is to provide planners and decision makers with data about specific multiple use conflicts.

This paper discusses five major topics, identifies the activities that produce environmental issues, and analyzes multiple use conflicts in the major geographic areas of coastal Alabama (Figure 33). The Environmental Issues and Regulations paper, which follows this paper, describes in detail the issues which are generated by the multiple use conflicts identified in the following sections.

WATER POLLUTION

Coastal Alabama is subject to a wide variety of uses, many of which are detrimental to the environment. Several studies have shown that the lower Mobile River and its tributaries and the northern part of Mobile Bay adjacent to the metropolitan and industrial areas of Mobile are severely polluted (Chermock 1974; South Alabama Regional Planning Commission 1979; U.S. Army Corps of Engineers 1979a; Brady 1979; Alabama Coastal Area Board 1980). Other areas including Bayou La Batre, Bayou Coden, Dauphin Island Bay, Styx River, Bon Secour River, and Little Lagoon are polluted to a lesser degree (Brady 1979; St. Amant 1981a and b).

Industrial, municipal, and agricultural water pollution in combination are particularly harmful, but each is discussed separately in their respective sections.

POINT SOURCES

INDUSTRIAL WASTES

Point source wastes pollute natural waters with toxicants, nutrients, and heated effluents. A clear example of their destructiveness were the fish kills in Mobile and Baldwin Counties in the 1970's. These fish kills are strong indications of stress caused by industrial discharges, sewage wastes, and sometimes natural phenomena. Of the 49 reported fish kills from 1969 to 1972 in Mobile Bay and its tributaries, 44 apparently were caused by the direct or indirect effects of industrial and municipal pollution. Only 5 were due solely to natural causes (Alabama Coastal Area Board 1980).

Most industry in Mobile County is located in a band from Theodore to Mount Vernon. Shore facilities of the fishing industry are located in the Bayou La Batre area. It is expected that future industrial growth will continue near navigable waters. Currently, the industries in Baldwin County are rather widely scattered. Most major industries are in the Bay Minette area, but the fishing industry is in the Bon Secour area (Alabama Coastal Area Board 1980).

TOXICANTS

Chemical pollution of both surface and ground waters usually is caused by improper disposal of industrial and chemical wastes. Some industrial wastes are neutralized or disposed of properly by the industry, some are carried away by surface runoff, but far too much seeps through the subsoil into ground water. Since the alluvial aquifer in Alabama is interconnected with the Mobile and Tombigbee Rivers, toxicant waste disposal in these areas may contaminate both surface and ground waters (Alabama Coastal Area Board 1980).

Most industry in upper Mobile County is concentrated along the western bank of the Mobile River. Evidence of toxic industrial wastes is greatest in the southwestern portion of the Delta and the northwestern portion of Mobile Bay. At least 26 documented fish kills caused by industrial and municipal discharges were reported for this area. Because of tidal influence and poor flushing action, fish kills from pollution sometimes extend upstream from point sources on Chickasaw Creek (Tucker 1979).

The lower Mobile River, Chickasaw Creek, Three Mile Creek, and portions of Mobile Bay are most subject to toxic wastes in coastal Alabama (Alabama Coastal Area Board 1979a). Mobile Bay immediately south of the Mobile River mouth is badly polluted because of contaminated inflow from Three Mile Creek and Chickasaw Creek, and because of tidal influence that pushes or holds pollutants in a given area (Brady 1979).

Various toxic chemical and industrial wastes that combine with salt water tend to "burn out" aquatic vegetation in the Delta (Beshears 1979). If this condition worsens, it will be only a matter of time before the submerged vegetation in the lower river and upper bay areas will be severely reduced or destroyed. The dispersal of toxic wastes from point sources also is thought to be at least partly responsible for the recent severe loss of valuable submerged aquatic plants in eastern Mobile Bay (Borom 1979).

NUTRIENTS

Excess nutrients often contribute to oxygen depletion (high biochemical oxygen demand, BOD) in the relatively shallow and sometimes stagnant waters of coastal Alabama, especially in Mobile Bay. High BOD is a function of eutrophication. Although most organic nutrients discharged into coastal waters are from municipal sewage and agricultural runoff (feed lots and chemical fertilizers) nutrients, usually inorganic, in industrial wastes add to the unusually high nutrient concentration in the Delta and upper bay. Major nutrients sources are the inflow of the Alabama-Tombigbee River system and industrial waste discharges from metropolitan Mobile. That high nutrient concentrations probably extend throughout northern Mobile Bay (Alabama Coastal Area Board 1980) was demonstrated by a study conducted by Bault (1972) who determined that highest concentrations of nitrate-nitrogen, nitrite-nitrogen, and total phosphorous were in the Delta waters. Concentrations steadily declined southward in Mobile Bay and out into the Mississippi Sound.

Bayou Coden, Bayou La Batre, and Bon Secour are polluted largely by fish processing wastes from seafood industries (Brady 1979).

HEATED EFFLUENTS

Aquatic organisms sometimes are directly or indirectly affected by thermal pollution. Steam power plants use large quantities of cooling water and discharge heated water. All organisms have limited tolerance to heat; however, lethal water temperatures are rarely reached because of dilution by cooler waters, and the tendency for at least some of the larger organisms to swim away. In natural waters the effects of severe thermal pollution may alter such vital functions as migration, reproduction (eggs and larvae), and basic metabolic rate. Under heat stress, fish sometimes are more vulnerable to predators, more susceptible to disease, and more sensitive to reductions in salinity (Horwitz 1978).

Fish larvae and other tiny aquatic creatures are drawn into plant pumps (usually known as entrainment) and condensers despite filters to keep out the larger organisms. The entrained organisms may be killed by mechanical action, high temperatures, changes in water pressure, and by the use of chlorine and other biocides used to clean the condenser systems (Horwitz 1978).

Thermal pollution is a problem in the upper reaches of the Mobile River where large volumes of cooling water are discharged from the Barry Steam Plant (Brady 1979). This steam plant is the largest single source of wastewater in Mobile County. It uses about 1,200 Mgal/day, of which about 1,170 Mgal/day is cooling water discharged into Mobile River (U.S. Department of the Interior, National Park Service 1979).

Thermal pollution from the discharge of heated cooling water is a product of thermoelectric power generation. The critical factor is the degree of temperature differential between the effluent and the receiving waters. No comprehensive data on these parameters of thermal discharge are available for coastal Alabama (Alabama Coastal Area Board 1980).

MUNICIPAL WASTES

Effluents from municipal waste plants and disposal facilities are among the major polluters of Mobile Bay and Alabama's coastal waters. These plants discharge suspended solids, nutrients, organic materials, hydrocarbons, and microorganisms into natural systems. In some waters, these effluents cause accelerated eutrophication and potential oxygen depletion. Worse, seafoods can become contaminated resulting in little or no use of that resource. Coastal Alabama has 19 municipal waste plants, 12 in Mobile County and 7 in Baldwin County. Nine are located in the Mobile metropolitan area and account for a combined design flow of 37.35 Mgal/day (81%) out of the two-county total of 43.25 Mgal/day (Alabama Coastal Area Board 1980).

Other than the municipal waste plants, there are 49 semipublic and private dischargers of domestic wastewater, of which 28 are located along Battleship Parkway. Most of these use an activated sludge process to treat unsanitary wastes. The major characteristics of these effluents are high BOD, high suspended solids, and coliform bacteria (Alabama Coastal Area Board 1980).

Municipal wastes are decomposable organic material, discharged from toilet, kitchen, and laundry facilities and carried in sewer lines. This material consists of carbohydrates from plants and paper, proteins from animal matter, and miscellaneous fats and oils. Organic material as a source of nutrients alone is not necessarily detrimental; in fact, it is necessary to sustain life in natural habitats. In excess, however, it exerts a secondary effect by reducing the level of dissolved oxygen in the water and the development of new flora and fauna, particularly objectionable algae. The lower portion of Mobile River is heavily polluted by organic material primarily from domestic sewage. Large fish kills in Eslava Creek have been attributed to low dissolved oxygen concentrations resulting from increased domestic waste discharge. Sections of Three Mile Creek, Hog Bayou, Eslava Creek, Chickasaw Creek, Mobile River and other areas have very low levels of dissolved oxygen caused by organics from industrial, municipal, and agricultural wastes and are so polluted that they often are unsightly and malodorous (Alabama Coastal Area Board 1980).

NUTRIENTS

Little data are available on nutrient concentrations in Mobile Bay and adjacent coastal waters in Alabama. Concentrations of several nutrients were measured monthly in Mobile Bay from January 1968 through March 1969 (Bault 1972). Values for total phosphorus ranged from 0.01 mg/l to 0.125 mg/l, and averaged 0.078 mg/l. Concentrations in bottom waters were somewhat greater than surface waters. Nitrate-nitrogen values ranged from about 0.13 mg/l to undetectable amounts, averaging 0.067 mg/l. Surface water values were greater, averaging about 0.027 mg/l more than bottom water. These values fall within the range of concentrations found in other Atlantic and Gulf coast estuaries (U.S. Army Corps of Engineers 1979a).

COLIFORM BACTERIA

Concentrations of fecal coliform bacteria, which usually are reliable indicators of municipal wastes, are greatest in Mobile Bay near Mobile and rapidly decrease seaward. Discharge of the Mobile River has a strong effect on the distribution of coliform bacteria throughout the Bay. The water quality classification of Mobile Bay shows that during low flow in summer and fall, excessively high concentrations of fecal coliforms are usually limited to the northwest portion of the Bay near Mobile. During high river flow in the spring, concentrations of fecal coliform bacteria in the bay usually are greater than the maximum allowable for the shellfish harvest standard of 14 MPN/100 ml (MPN = most probable number). Concentrations during high flows in 1969 varied from about 25 MPN/100 ml in Bon Secour Bay to over 1,000 MPN/100 ml at the mouth of the Mobile River (U.S. Army Corps of Engineers 1979a).

Runoff and sewage treatment plants in the Mobile area contribute about 60 to 85% of the fecal coliforms entering the bay. A direct correlation has been observed between coliform concentrations in Mobile Bay and the discharge of the Mobile River above Mobile. Because of this, it is likely that during periods of high flow, the shellfish harvest standards would be violated in all of Mobile Bay even if all wastewater inputs from the Mobile area were removed (U.S. Army Corps of Engineers 1979a).

In the early 1950's, violations of water quality standards for bacteria in many coastal areas ended with the closure of about 29,300 ha (72,370 acres) of shellfishing grounds. Oysters in particular were heavily contaminated with coliform bacteria.

CHLORINATED EFFLUENTS

The ecological impact of chlorine and its by-products on aquatic environments has not been adequately measured or evaluated largely because diagnostic techniques for chlorine are undependable. At relatively high chlorine concentrations, the growth of most phytoplanktors decreases and mortality increases largely because of the impairment of photosynthesis (Stevenson and Confer 1978).

In Mobile Bay, much of the chlorine comes from sewage treatment plants, but some is transported in pesticides and industrial effluents. There is some indication that chlorine may be a factor causing the decline of large areas of submerged grassbeds in Mobile Bay, but it seems certain that chlorine is damaging in areas directly receiving municipal and industrial effluents (Borom 1979).

OIL SPILLS

Oil and gas related spills are unfortunate consequences of oil and gas production. Marine organisms can be affected by oil in several ways. Highly toxic fractions are usually lethal at relatively low concentrations (as low as 0.1 ppm), especially for larval and juvenile fish species. Sublethal effects on fish are the disruption of behavioral patterns and spawning, feeding, and sensing habits. The habitats of marine life, especially of burrowing organisms that depend upon particular substrates, can be severely disrupted. Eventually, the impacts on marine life can be felt by humans if hydrocarbons are incorporated and concentrated in the food chain, tainting edible organisms (e.g., oysters) or causing health hazards that are not well understood (Liebow et al. 1980).

A major cause of pollution is improper handling of crude oil. Accidental pollution is generally in the form of oil spills caused by tanker and barge accidents, leaks from pipelines and offshore drilling operations, and illegal tanker bilge washings (Alabama Coastal Area Board 1980).

Heavy use of watercraft can cause chronic oil pollution. Specific problems of oil pollution from watercraft operations have been reported in Terry Cove, Bay La Launch, and Arnica Bay (Alabama Coastal Area Board 1980).

Oil spills are not yet a major problem in coastal Alabama but, as more wells are put into production, the severity of the problem will increase.

HAZARDOUS WASTES

Waterborne transportation will play a key role in the future growth and development of coastal Alabama; consequently, the risk of hazardous materials from delivery systems is likely to increase. Highly concentrated toxic chemicals in estuaries can directly affect public health and fish composition and abundance. There is no known deliberate dumping of toxic substances into Alabama's coastal waters.

The U.S. Environmental Protection Agency has issued a special ocean dumping permit to Chemical Waste Management, Inc., Oak Brook, Illinois, and Ocean Combustion Service, B. V. Rotterdam, the Netherlands. The applicants are transporting and incinerating at sea a mixture of various liquid halogenated/chlorinated organic compounds. It is anticipated that they will also request permits to incinerate at sea wastes which contain other toxic compounds such as PCB (U.S. Environmental Protection Agency 1981).

The Alabama Water Improvement Commission monitors heavy metal concentrations in estuaries biannually. The metals measured are arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Food with mercury levels of 0.5 ppm or less are considered safe for human consumption. In coastal Alabama, mercury levels as high as 2.5 ppm have been reported in fish caught in the Delta. Although fishing was banned after this disclosure, the restriction was lifted in 1972. Elevated mercury levels are still reported periodically (Alabama Coastal Area Board 1980).

Pollution by heavy metals in coastal Alabama apparently is not too serious. Sediments in Mobile Bay are relatively uncontaminated with trace and heavy metals when compared with other areas in the United States and the United Kingdom (U.S. Army Corps of Engineers 1979a).

Although the levels of some chemicals in solution may be below those considered dangerous to humans, accumulated doses may be extremely dangerous to aquatic organisms; and, when heavily concentrated in the tissues of fish and estuarine shellfish, they are a potential public health problem.

NONPOINT SOURCES

AGRICULTURAL RUNOFF

Surface runoff from agricultural lands contributes to water pollution by transporting biocides (insecticides and herbicides), by increasing erosion of disturbed soil and associated sedimentation, and by pathogenic bacteria and viruses from feed lots and pastureland. The area of agricultural lands in coastal Alabama is about 157,830 ha (389,700 acres) of which 53,740 ha (132,700 acres) is in Mobile County, and 104,090 ha (257,000 acres) is in Baldwin County. About 68% of the farm land is cropland, 22% is woodlands, and 10% is used for other purposes (South Alabama Regional Planning Commission 1979). Usually individual farms do not substantially contribute to downstream pollution but collectively they do.

BIOCIDES

Herbicides are used to control unwanted weeds, and pesticides are used to control insects. When biocides are used extensively in a given area, relatively large quantities of these chemicals are carried by runoff into nearby tributaries (Wagner 1974).

The plankton of estuaries are extremely sensitive to some commercial herbicides, especially substitute urea compounds such as Monuron, Diuron, and Neburon. Most plankton cannot tolerate these compounds in concentrations as low as 0.5 ppb (McConnaughey 1978).

Submerged vegetation in the Mobile Delta and northern portions of Mobile Bay for wildlife and waterfowl management planning were assessed by Baldwin (1957) and Lueth (1963). A comparison of their works showed that tape grass (*Vallisneria americana*) beds appeared about one mile farther south in the 1950's than in the 1940's. Baldwin predicted a continuing increase in the southerly range of this species because natural shoaling has created more favorable water depths to the south. On the other hand, Borom (1975) found a great reduction in the area of tape grass and other submergents along the eastern shore of the bay. Once extensive submerged grassbeds are now only small patches (Stout and Lelong 1981). The decline in submerged vegetation has coincided with declines in sport and commercial fish and invertebrates usually associated with aquatic vegetation. Pesticides are absorbed and accumulated in estuarine animals, sometimes seriously affecting their health and reproductive capacities. Pesticide residuals in fish and shellfish are transmitted to man and other animals that feed on them.

About 1,105 ha (2,753 acres) of submerged grassbeds are located in the bay waters south of Battleship Parkway. Although a decline in the abundance of grassbeds is apparent, it is not possible to quantify the loss due to a lack of historical data (Stout and Lelong 1981).

Local residents have observed an increase in the use of herbicides in the Mobile Bay area in recent years. Herbicides, after spraying, are transported into nearby waters by leaching or in runoff (Stevenson and Confer 1978).

Submerged aquatic plants are known to be highly sensitive to relatively low concentrations of herbicides. The following herbicides have been used experimentally to eradicate tape grass: Silvex, Diquat dibromide, Diquat dichloride, Paraquat dichloride, 2,4-D IOE, 2,4-D D,E, Acrolein, and Endothall DDS (Stevenson and Confer 1978). Some of these are commonly used in coastal Alabama. The full extent that herbicides affect submerged aquatic plants in Mobile Bay is unknown.

A study on fish in an estuary on the Texas coast showed that accumulations of about 4 ppm of DDT in fish eggs caused complete egg mortality (Jackson 1971). The accumulation of DDT in body tissues of aquatic animals in coastal Alabama has been a problem. For example, until 1957, the brown pelican (*Pelecanus occidentalis*) was abundant along the Alabama Gulf Coast; but since then the Alabama population has been almost decimated by the widespread use of chlorinated hydrocarbon pesticides. The population declined from about 1,800 birds in 1956 to about 60 birds in 1971 (Boschung 1976). Since the banning of the use of DDT, the brown pelicans are beginning to increase in abundance. The population is still very low, and the birds do not breed in the State.

Pesticides in Mobile Bay were studied by Casper (1969). He found DDT, DDD, DDE, dieldrin, endrin, aldrin, chlordane, BHC-lindate, and heptachlor-epoxides in oysters, bay waters, and sediments. With the exception of DDT and its metabolites, pesticide concentrations were low. The median measure of total DDT (DDT, DDD, and DDE) was 0.33 ppm in oyster samples and 0.001 ppm in water samples. May (1971) also reported low concentrations of DDT, DDD, DDE, and dieldrin in oysters and sediments from Mobile Bay (Chermock 1974).

Mobile Bay bears the brunt of the load of biocides washed out of fields and woods into the streams of the Mobile Basin. The Mississippi River now carries an estimated

10,000 kg of pesticides into the Gulf of Mexico annually (McConnaughey 1978). Other river systems that empty into Mobile Bay also transport large quantities of these agro-chemicals. Although proof is largely circumstantial, it is clear that biocides are among the many pollutants that threaten the aquatic environments in the Mobile Bay area.

DOMESTIC MANURES

The Alabama State Soil and Water Conservation Service (1978) reported that animal wastes were pollutants in southwest Alabama. In 1981, St. Amant (1981a and b) announced that swimming in Styx River and Hollinger Creek was a health hazard because of bacteria contamination (fecal coliform) from warm-blooded animals. Hog and cattle farms are a major source of bacterial contamination. Coastal zone planning for recreation in or near farm lands should consider the threat of domestic manure pollution.

COMMERCIAL FERTILIZERS

Nearly all farmers use inorganic fertilizers on their cropland. According to a report from Washington University, as much as 60% of the nitrates in lakes come from inorganic fertilizers used on the surrounding farmlands (Wagner 1974). In agricultural areas, fertilizers add nutrients to streams, ponds, and lakes, which increases their fertility, but, in cases of excess, added nutrients may accelerate eutrophication, stimulate objectionable algal blooms, and cause oxygen depletion.

In 1974, farmers in coastal Alabama spent about $10.1 million for agricultural chemicals, primarily fertilizers (U.S. Department of Commerce, Bureau of the Census 1980). In 1974-77, an annual average of 105,280 tons of fertilizer were sold in coastal Alabama. The composition was 81,300 tons of mixed grade fertilizers, 23,980 tons of material fertilizers, 17,490 tons of nitrogen based fertilizers, 1,030 tons of potassium based fertilizers, 730 tons of phosphorus based fertilizers, and 4,730 tons of miscellaneous fertilizers (Alabama Water Improvement Commission 1978).

Considering the flushing action of the tides and major rivers in coastal Alabama, environmental alteration caused by fertilizers in runoff probably is restricted to localized areas in the Fish and Fowl Rivers and in Weeks Bay, Wolf Bay, Perdido Bay, and Mobile Bay (Alabama Coastal Area Board 1979b). In any case, recognition of the effects of commercial fertilizer on nearby waters may help explain some changes in aquatic environments that were previously unknown or unexpected.

EROSION

Recent studies show that of 806.2 km (503.9 mi) of estuarine and Gulf shorelines in coastal Alabama, about 353.4 km (220.9 mi; or 94%) are subject to erosion. These erosion prone areas and rates of erosion are identified and mapped by the U.S. Army Corps of Engineers (1971) in their national shoreline inventory.

Although annual rates of erosion along the Gulf are generally less than 1.5 m (5 ft), erosion greater than 3.0 m (10 ft) have been reported for Perdido Pass in Baldwin County. In Mobile County, Dauphin Island's western shoreline has receded due to heavy beach erosion (Alabama Coastal Area Board 1980).

About 33% of Alabama's estuarine shoreline (Mobile Bay, Mobile Delta, Mississippi Sound, and Bon Secour Bay) also is subject to erosion. The most eroded areas are Little Point Clear, and the St. Andrews Bay shoreline, the southeastern area of the Mobile Delta, and the islands and northern shore of the Mississippi Sound (Alabama Coastal Area Board 1980).

TURBIDITY AND SEDIMENTATION

Runoff from agricultural and commercial forest areas constitutes a major nonpoint source of water pollution. Clear-cut forest land and tilled agricultural lands can cause excessive turbidity and sedimentation in Mobile Bay. In 1978, 320,920 ha (792,400 acres) of agricultural and silvicultural land in coastal Alabama was subject to erosion. Of this total, approximately 85% was forested, 10% was cropland or in hay, and 5% was in pasture (South Alabama Regional Planning Commission 1979).

Logging in coastal Alabama is confined largely to pine trees and hardwoods from uplands and river bottoms in the northern portion of the delta in Mobile and Baldwin Counties. Logging is extensive in some areas, and large areas of bare soil are exposed. Sheet and gully erosion often causes excessive deposition of sediment that may smother infauna and submerged plants, and reduce fishing success.

The Mobile River carries an estimated annual average 4.3 million mt (4.7 million tons) of suspended solids into Mobile Bay. The effect of this sedimentation on fishing is unknown, but it is known as an essential part of the building of estuaries and maintaining their fertility (Wade 1979). Heavy logging in the delta may excessively increase the rate of erosion of sediments into Mobile Bay. In severe cases, sediments may drastically reduce submerged aquatic plant density because of shading which reduces photosynthesis. Submerged aquatic plants tend to collect organic and inorganic material by slowing down currents and stabilizing the sediments. When plants are eliminated from estuaries, increased shore and bottom erosion is likely (Zieman 1981). The effects of logging practices in the northern portion of the delta on the submerged aquatic plants in the southern portion of the delta is unknown.

Based on drainage patterns and land use in coastal Alabama, waters with the greatest potential for agricultural pollution are Fish River, Weeks Bay, Wolf Bay, Perdido Bay, Fowl River, and Mobile Bay. Waters with the greatest potential for sediment pollution from logging are the Mobile Delta, Chickasaw Creek, Eight Mile Creek, Mobile Bay, and Perdido River.

Although water quality monitoring has revealed no significant problems directly attributable to agriculture and logging in coastal Alabama (South Alabama Regional Planning Commission 1979), there is a data gap concerning the effects of erosion on submerged aquatic plants in Alabama estuaries.

CONSTRUCTION

Continuing development of extensive condominiums, summer homes, resorts, and highways along the shoreline undoubtedly will lead to further modification of the shoreline and increase the rate of erosion (Alabama Coastal Area Board 1979c).

Erosion caused by poor road grade and building construction practices is apparent in the Lake Forest area of Baldwin County. Large amounts of red clay have washed into D'Olive Creek and D'Olive Bay and smothered submerged aquatic plants there, but the extent of environmental damage is unknown.

SALTWATER INTRUSION

Saltwater intrusion is the landward movement of sea water into freshwater coastal aquifers. Currently, saltwater intrusion is taking place on Dauphin Island, in the Gulf Shores area, and on the Fort Morgan Peninsula. With increased groundwater use in these resorts, saltwater encroachment probably will become a serious problem. The construction of canals extending inland from Mobile Bay (such as the Theodore Industrial Complex ship channel) and construction site dewatering also have a potential for increasing saltwater encroachment (Alabama Coastal Area Board 1980).

SEWAGE DISPOSAL

The problem of suitable waste disposal facilities for single- and multiple-family dwellings has become increasingly important in coastal Alabama. Large rural portions of the coastal area use septic tanks. Health problems and ground water contamination have been caused by seepage from septic tank systems or by flooding at Gulf Shores and Dauphin Island. *Salmonella* organisms were found in waters used for swimming and fecal coliform bacteria were found in wells used for drinking water (Alabama Coastal Area Board 1980) .

In 1981, the Baldwin County health officer announced that swimming in Bon Secour River was a health hazard because of contamination from fecal coliform bacteria. Inadequate septic tank systems are thought to be the cause of the problem.

Many of the numerous pleasure and commercial craft dump raw sewage directly into the Bon Secour River (St. Amant 1981a and b) and other rivers.

In addition to sanitary wastes, the waters are strewn with litter (1 lb of paper, cans, and bottles, and 0.5 lb of garbage per capita per day of boating) and receive bilge water containing lubricating oil (Wagner 1974).

Groundwater on the Fort Morgan Peninsula was tested by the Baldwin County health officer in 1981. About 75% of the wells were contaminated with bacteria from animal wastes. All wells tested there contained water that was declared unsafe to drink (St. Amant 1981a and b).

MULTIPLE USE CONFLICT ANALYSIS

The following sections outline the potential environmental conflicts for coastal Alabama and should be considered in coastal zone planning and water control projects.

INDUSTRIAL WASTES

Conflicts: public health, aesthetics, commercial and sport fishing.

Direct effects: toxicants (localized plant and animal mortality); heated effluents (localized plant and animal mortality and alteration of immediate aquatic habitat).

Indirect effects: toxicants (depletion of algae and submerged aquatic plants—loss of productivity and nursery areas); nutrients (enrichment of aquatic habitats—changes in plant and animal composition); heated effluents (alteration of migration, spawning and metabolism of aquatic organisms—reduction of coastal commercial and sport fishing success).

Major species affected: toxicants (tape grass, *Vallisneria americana*; brown shrimp, *Penaeus aztecus*; white shrimp, *Penaeus setiferus*; Gulf menhaden, *Brevoortia patronus*); heated effluents (brown shrimp; white shrimp; blue crab, *Callinectes sapidus*; largemouth bass, *Micropterus salmoides*).

Level of conflict: toxicants (substantial, long term); nutrients (usually considered long term, local or general); heated effluents (moderate, short term).

Major sources: toxicants (Mobile River, Chickasaw Creek, Three Mile Creek); nutrients (Alabama-Tombigbee River system, metropolitan Mobile); heated effluents (Barry Steam Generating Plant).

Major areas affected: toxicants (Mobile Bay, Mobile River delta); nutrients (Mobile River delta, Mobile Bay, Mississippi Sound); heated effluents (Mobile River).

MUNICIPAL WASTES

Conflicts: public health, aesthetics, and commercial and sport fishing.

Direct effects: odors, algal blooms, contamination of oysters, possible loss of submerged aquatic plants, contamination of swimming beaches and waters.

Indirect effects: contamination of seafood, increased eutrophication, mortality caused by oxygen depletion.

Major species affected: eastern oyster (*Crassostrea virginica*), clam (*Rangia cuneata*); possibly tape grass; man (public health).

Level of conflict: substantial, long term.

Major sources: Metropolitan Mobile, Lake Forest, Daphne, Fairhope, Bayou La Batre, Battleship Parkway, Bon Secour, Dauphin Island, Gulf Shores.

Major areas affected: Three Mile Creek, Hog Bayou, Eslava Creek, Chickasaw Creek, Mobile River, Mobile Bay, Mississippi Sound.

OIL SPILLS

Conflicts: public health, aesthetics, commercial and sport fishing, coastal birds and mammals.

Direct effects: destruction of larval and juvenile fish; contamination of shellfish; death of marine birds and mammals.

Indirect effects: disruption of behavioral activities of marine organisms; possible contamination of food chains; loss of seafood resources; contamination of swimming and surf fishing areas.

Major species affected: eastern oyster, blue crab, brown shrimp, white shrimp, and birds that tend to feed and rest on the water; e.g., magnificent frigatebird (*Fregata magnificens*), black skimmer (*Rynchops niger*), least tern (*Sterna albifrons*), double crested cormorant (*Phalacrocorax auritus*), herring gull (*Laurus argentatus*); and a number of fish species that utilize the surf zone, e.g., Gulf kingfish (*Menticirrhus littoralis*), rough silverside (*Membras martinica*).

Level of conflict: substantial, localized, long term.

Major sources: oil tankers and other ships, pipelines, marinas, and refinery and petroleum storage areas.

Major areas affected: Mobile River, Mobile Bay, Terry Cove, Bay La Launch, Arnica Bay, Bon Secour River, Bayou La Batre.

HAZARDOUS WASTES

Conflicts: public health, commercial and sport fishing.

Direct effects: contamination of food chains for fish and wildlife (potential public health hazard).

Indirect effects: restrictions on the harvest of commercial and sportfish and waterfowl.

Level of conflict: potentially substantial, currently localized.

Major sources: transportation, industrial, and municipal effluents.

Major areas affected: Mobile Bay, Mobile River Delta, Mississippi Sound.

BIOCIDES

Conflicts: commercial and sport fishing.

Direct effects: localized aquatic plant and animal mortality.

Indirect effects: depletion of algae (loss of primary productivity); depletion of submerged aquatic plants (loss of estuarine nursery areas); decline in fish abundance; and reduction in commercial and sport fishing success (e.g., oyster, shrimp).

Major species involved: tape grass, eastern oyster, brown shrimp, white shrimp, spotted sea trout (*Cynoscion nebulosus*), largemouth bass.

Level of conflict: substantial, long term.

Major sources: Mobile River, Tensaw River, Fish River.

Major areas affected: Mobile Bay, Weeks Bay, Wolf Bay, Perdido Bay.

DOMESTIC MANURES

Conflicts: commercial and sport fishing and swimming.

Direct effects: odors, algal blooms (swimming, aesthetics).

Indirect effects: increased nutrients, habitat alteration (low oxygen, realignment of food chain, decline in abundance of preferred fishes, decline in commercial and sport fishing success).

Major species involved: undeterminable.

Level of conflict: short term, local.

Major sources: farm ponds and smaller tributaries to Mobile Bay.

Major areas affected: Local, usually within small freshwater drainage systems (e.g., Styx River and Hollinger Creek).

COMMERCIAL FERTILIZERS

Conflicts: water quality.

Direct effects: enrichment of aquatic habitats.

Indirect effects: accelerated eutrophication, changes in plant and animal composition.

Major species affected: a broad range of aquatic plants and animals. Depending upon the level of enrichment, effects may be beneficial or harmful.

Level of conflict: usually considered long term, local and general.

Major sources: Mobile River, Tensaw River, Fish River.

Major areas affected: freshwater and brackish estuaries and flats of Mobile Bay.

EROSION

Conflicts: aesthetics, swimming, hunting, commerical and sport fishing.

Direct effects: turbid waters, siltation.

Indirect effects: loss of surface soils, change in tilled and untilled habitats (loss of wildlife feeding, breeding, and nursery areas); siltation of fish habitats (decline in fishing success).

Major habitats involved: uplands and bottomlands; streams and rivers, intertidal zone.

Major species affected: nearly all freshwater and estuarine-dependent fish species.

Level of conflict: substantial, long term. A major coastal environmental problem.

Major sources: agricultural and logging practices, coastal zone construction and alteration.

Major areas affected: freshwater estuaries and Mobile Bay tidal flats.

SALTWATER INTRUSION

Conflicts: public health.

Direct effects: contamination of freshwater coastal aquifers with seawater.

Major species affected: man, population distribution.

Level of conflict: substantial, long term.

Major sources: residential development on barrier islands.

Major areas affected: Dauphin Island, Gulf Shores, Fort Morgan Peninsula.

SEWAGE DISPOSAL

Conflicts: commerical and sport fishing, swimming, and public health.

Direct effects: odors, algal blooms (swimming, aesthetics).

Indirect effects: increased nutrients, bacterial contamination of oysters.

Major species affected: eastern oyster, clam.

Level of conflict: substantial, long term.

Major source: septic tank systems.

Major areas affected: Oyster Bay, Little Lagoon, Dauphin Island Bay, Bon Secour River, Styx River, Hollinger Creek, Bayou La Batre.

AIR POLLUTION

Although the land-sea breeze pattern in coastal Alabama readily diffuses airborne pollutants, violations of both primary and secondary ambient air quality standards for total suspended particulates are common in Mobile County. Polluted air may cause human illness, damage wildlife and vegetation and contribute to water pollution (Alabama Coastal Area Board 1979b). Mobile's atmosphere, compared to most urbanized areas in the United States, has relatively low concentrations of gaseous pollutants such as carbon monoxide, oxides of nitrogen, and sulfur dioxide; however high particulate and dust levels have been reported for coastal Alabama. Among cities in the southeast, only Birmingham has recorded higher levels (Alabama Coastal Area Board 1980).

Because of the Clean Air Act Amendments of 1977, portions of coastal Alabama were designated as nonattainment areas for National Ambient Air Quality Standards. The term "nonattainment area" means an area that is known to exceed any national ambient air quality standard for a particular air pollutant. Portions of eastern Mobile County have been identified as areas of primary nonattainment and secondary nonattainment for particulates. The entire county has been designated as a primary nonattainment area for photochemical oxidants (Alabama Coastal Area Board 1980). Even though air pollution standards in parts of coastal Alabama are now being exceeded, new industries and residents are constantly moving into the two-county area and new attempts are being made to improve air quality (Alabama Coastal Area Board 1979a).

INDUSTRIAL EMISSIONS

Industrial and commercial stack emissions in Mobile County contributed 63,100 mt (70,122 short tons) of particulates and 86,935 metric tons (96,594 short tons) of sulfur oxides in 1976. Three air quality monitoring stations in Mobile County recorded total suspended particulates in excess of $75\mu g/m^3$, the primary ambient air quality standard. Violations were most frequent at the station at the Alabama State Docks (Alabama Coastal Area Board 1979b).

Most emission sources are located in the eastern half of Mobile County between Bayou La Batre and Mount Vernon. This area has the highest ambient levels in the coastal area. Although particulate levels have been steadily decreasing, violations of the primary ambient air quality standards are frequent, particularly in the northeast section of Mobile (Alabama Coastal Area Board 1980). The principal sources of particulate pollution are the electric power generating facilities (Barry Steam Plant) and the Alabama State Docks. Ozone levels are generally highest in the industrial area north of Mobile and at the Theodore Park area to the south (Alabama Air Pollution Control Commission 1981).

Air quality is usually good in western Mobile County and in all of Baldwin but if winds are calm, odor problems from industrial sections of eastern Mobile County may affect other areas (Alabama Coastal Area Board 1979b).

The impacts of harmful levels of air pollution on man's health, crops and forests, and the materials used are well documented and quantified (Wagner 1974; Wallace 1981). Air pollution in Mobile County continues to cause concern. The following industries are major contributors to air pollution in coastal Alabama: Scott Paper Company, International Paper Company, Ideal Cement Company, Barry Steam Plant, Alabama State Docks, Marion Corporation Refinery, Kerr-McGee Chemical Corporation, Courtaulds North America, Inc., Shell Chemical Company, and the GAF Plant. People frequently complain of respiratory problems, but whether air pollution is a cause or not is unknown.

FOREST FIRES

The economic importance of controlled burning of pine forests is well documented (Odom 1971; Wagner 1974); however, smoke from forest fires contributes to air pollution and may affect human health and safety. Smoke in calm air may cause hazardous driving conditions (especially at night and early in the morning). Automobile accidents caused by poor visibility because of smoke were reported for Fairhope and Bay Minette in 1981.

Fires often are deliberately started in the lower Mobile Delta by rabbit and nutria hunters to force the animals in the open for easier capture. These fires usually occur during the winter months when the marsh vegetation is dry. The effects of marsh fires on the ecological balance of the Delta has not been studied.

MULTIPLE USE CONFLICT ANALYSIS

The following is an outlined analysis of potential conflicts in coastal Alabama that should be considered in coastal zone planning.

INDUSTRIAL EMISSIONS

Conflicts: public health and aesthetics.

Direct effects: Four major types of respiratory damage from air pollutants are bronchitis, bronchial asthma, emphysema, and lung cancer (Wagner 1974). Respiratory problems, eye irritation and "bad odors" are frequent complaints in Mobile County. The extent of the public health problem caused by industrial air pollution in coastal Alabama is unknown as is the extent of damage to vegetation and wildlife.

Indirect effects: reduced quality of life (aesthetics).

Major areas involved: the eastern half of Mobile County from Mount Vernon to Theodore.

Major species affected: man (public health).

Level of conflict: substantial, long term. A major coastal environmental problem.

Major sources: Scott Paper Company, International Paper Company, Ideal Cement Company, Barry Steam Plant, Alabama State Docks, Marion Corporation Refinery, Gold Bond Building Products, Degussa Corporation, Kerr-McGee Chemical Corporation, Courtaulds North America, Inc., Shell Chemical Company, and the GAF Plant.

FOREST FIRES

Conflicts: wildlife, public health, and safety.

Direct effects: respiratory problems, hazardous driving conditions, extensive wildlife mortality and habitat destruction.

Indirect effects: increased erosion, temporary loss of wildlife and their habitat.

Major areas involved: the northern portions of Baldwin and Mobile Counties.

Major species affected: man, forest plants and animals.

Level of conflict: short term, local.

NAVIGATION PROJECTS

Estimates by the U.S. Army Corps of Engineers (1979a) reveal that port activities contribute about one-fourth of the employment and over one-half of the wages earned in coastal Alabama. Ports depend upon channels that must be maintained at adequate depths because of continuing deposition of large quantities of sediments from the rivers. The Mobile River system alone is estimated to carry an annual average of 4.3 million metric tons (4.7 million short tons) of suspended sediments. Three million metric tons (3.3 million short tons) are deposited in Mobile Bay, and the other 1.3 million metric tons (1.4 million short tons) are transported to the Mississippi Sound and to the Gulf (U.S. Army Corps of Engineers 1979a).

DREDGING

About 6.9 million cubic yards of sediments have been dredged from Mobile Bay Navigation channels each year over the last eight years (U.S. Army Corps of Engineers 1979a). Future excavation and maintenance dredging is planned. Construction of the Theodore Ship Channel, which is a branch channel from the main ship channel in Mobile Bay, required the removal of approximately 33 million cubic yards of sediments (U.S. Army Corps of Engineers 1979b).

Although the ecological effects of dredging in coastal Alabama are not always clear, it is known that the excavation, deepening, or enlargement of a channel can cause changes in water circulation patterns that may alter tidal and freshwater flushing, salinity, and turbidity regimes (U.S. Army Corps of Engineers 1979a). Sediments from maintenance dredging in Mobile Bay are sometimes heavily polluted by heavy metals and hazardous wastes, whereas sediments from rivers, which are more common in excavation dredging, are often relatively free of contaminants (Hardy 1981).

IMPACTS OF DREDGING

Open water disposal of dredge spoil causes turbidity, which generally is transitory and seldom has lasting effects, except in channels that must be constantly dredged for maintenance. Quantities of iron, manganese, ammonia, and phosphorus are released during dredging into the water column, but dispersion normally renders them harmless (Hardy 1981). Potential water column impacts at the dredging or open water disposal sites include increased turbidity (suspended solids in the water column) and biochemical oxygen demand (by exposing decaying organic debris), and the release of free sulfides, hydrogen sulfide, and ammonia (Allen and Hardy 1980). Sediments in the open water sometimes are resuspended by wave action or currents until they finally are transported by natural forces from the area or become biologically stabilized (Taylor and Saloman 1967). Newly dredged channels trap sediments that are frequently resuspended by boat traffic or maintenance dredging (Allen and Hardy 1980). The net result of new channel construction is increased turbidity (Taylor and Saloman 1967). In contrast, maintenance dredging, although it may produce a temporary increase in turbidity, may decrease long-term turbidity by deepening the channel and decreasing the resuspension of sediments by boat traffic (Allen and Hardy 1980).

CHANNELS

After a ship channel is excavated, it becomes a trap for sediments that often contain large amounts of potential contaminants (e.g., PCB's, mercury). Resuspension or reactivation of these potential contaminants is great when maintenance dredging is conducted or when ships move through the area (Smith 1976).

During channel excavation and maintenance dredging, 75% or more of the benthic organisms are removed from the site (U.S. Army Corps of Engineers 1975). Recolonization of a new channel is often rapid and original biomass is sometimes reached in two weeks to four months, but species composition may be different, at least in the beginning (U.S. Army Corps of Engineers 1974). Organisms in dredge spoil areas may be reestablished in a matter of a few months to two years.

Changes in the bottom topography due to construction of the Mobile Ship Channel have contributed to oxygen depletion in Mobile Bay. Waters depleted of oxygen in the navigation channels sometimes disperse to other areas of the Bay because of wind and wave action (May 1973).

The adverse impact of turbidity on aquatic organisms is well documented (Darnell et al. 1976). Potential impacts usually are very site specific. Dredging and disposal of dredged material constitute habitat displacement which has an immediate and serious effect on the benthos. Abnormally high concentrations of suspended solids from dredging and disposal could also cause abrasion of gills which could result in chronic bacterial coating of the gills (causing anoxia) and decreases in catches of fish (Allen and Hardy 1980). A potential adverse impact of dredging is the entrainment of slow-moving nekton. Large-scale mortality of crabs has been blamed on hydraulic dredges in Grey's Harbor, Washington (Allen and Hardy 1980).

SPOIL DISPOSAL

The proper disposal of dredged material is of real importance to coastal Alabama. Inadvisable disposal procedures could cause severe ecological damage. Current waterway and improvement projects such as the Tennessee-Tombigbee Waterway, in addition to maintenance dredging, contribute vast quantities of spoil materials which, to safeguard the public, requires adoption of a sound disposal plan (U.S. Army Corps of Engineers 1979a).

TERRESTRIAL DISPOSAL

Wetlands, once considered suitable for disposal of dredged spoil material, now are more valuable for fish and wildlife. Owners of areas adjacent to wetlands that have been drained or filled and are potentially suited for urban development, generally are opposed to terrestrial disposal if it complicates the engineering features or aesthetic values of the land to be developed (Boyd et al. 1972).

Areas, sometimes wetlands, contained by dikes often have been used as a dump for dredge material. These areas potentially have little value to wildlife (Allen and Hardy 1980). The trade-off of new habitats (often wetlands) created by dredged material have to be carefully evaluated (Hardy 1981).

If not well located, confined spoil areas can change runoff patterns and replace or alter preferred habitats (Schroeder et al. 1977). Major environmental concerns from terrestrial disposal of dredged material are turbidity and sedimentation in nearby waters from dike construction and from the containment area overflow, and the possible uptake of contaminants by waterfowl or other animals using containment disposal areas (Allen and Hardy 1980).

Nearly 45% of the spoil material from dredging on the Texas coast is polluted (Liebow et al. 1980). The extent to which dredged material in coastal Alabama is polluted is unknown. According to much of the literature, the potential toxicants (e.g., heavy metals, oil, and PCB's) in fine-grained clays and silts are insoluble; consequently, the movement of these potential pollutants is related to the fate of settable solids (Allen and Hardy 1980). Retention of solids through proper design of containment areas and proven engineering practices will reduce the levels of hazardous wastes being discharged (Allen and Hardy 1980). Dense vegetation in confinement areas also increases the removal of solids from elutriate (Chen et al. 1978). Windom (1977) found that overland flow in salt marshes removed nutrients and metals from disposal area effluent.

Adverse impacts of terrestrial placement of dredged material can be mitigated to a great extent by the application of well-established wildlife management and agriculture practices (Hardy 1981). The development or enhancement of wetlands often is warranted but not widely practiced in coastal Alabama.

ESTUARINE AND SEA DISPOSAL

Estuaries in coastal Alabama are highly productive complex ecosystems that are ecologically threatened by improper spoil disposal. The potential for biological damage from aquatic disposal appears to decrease as the distance from shore and diffusion increases (Pequegnat et al. 1978; Hardy 1981).

Estuarine areas most sensitive and most threatened by spoil are submerged grassbeds, oyster reefs, and fish spawning and nursery areas (Allen and Hardy 1980).

Sedimentation is a source of nutrients. An initial reduction in productivity of turtle grass (*Thalassia testudinum*) and shoal grass (*Halodule wrightii*) because of sedimentation from dredging was reported by Odum (1963). However, in the following spring, beds of aquatic vegetation not directly smothered by the dredged material grew more vigorously. Increased productivity was attributed to the release of nutrients from the dredged material.

Submerged grassbeds are very sensitive to dredging operations. A healthy submerged grassbed composed of tape grass was smothered and completely destroyed near Sea Cliff in Baldwin County when Rock Creek was dredged in 1980 (personal observation). Submerged grassbeds composed of shoal grass were observed in Perdido Bay. The healthiest beds are located the greatest distance from dredging operations. The least healthy beds are located near the pass at Alabama Point where maintenance dredging frequently occurs.

Turbidity and siltation from channel dredging is especially harmful to mollusks. Recovery of obliterated populations of mollusk may take up to 10 years (Hardy 1981). Because mollusks are located near natural reefs, extreme care is necessary when conducting maintenance dredging in the Mobile Bay Ship Channel and the Gulf Intracoastal Waterway (Alabama Coastal Area Board 1979a).

Coastal river dredging, whether on new or old channels, often adversely alters the stream bottom, backwaters, wetlands, or riparian vegetation (Hardy 1981). The construction of the Tennessee-Tombigbee Waterway and subsequent maintenance dredging will potentially contribute vast quantities of disposable materials (U.S. Army Corps of Engineers 1979a). Improperly placed dredged material may seriously alter the physical and biological characteristics of the Delta.

MULTIPLE USE CONFLICT ANALYSIS

DREDGING FOR NAVIGATION

Conflicts: fish and wildlife resources, aesthetics, and environmental quality.

Direct effects: Destruction of benthos and the alteration of bottom topography, water current patterns, salinity gradients, and sediment budgets; pollution caused by dredged sediments (biocides, PCB's, heavy metals); release of iron, manganese, ammonia, and phosphorus from the sediments into the water column; fluid mud from dredging and spoil disposal; loss of active oyster reefs; possible disruption of early life stages of shrimp and its post-larval forms; alteration of benthic communities, which serve as a food source for many of the higher forms of animal life; and loss of submerged grassbeds that provide food and cover for fish.

Indirect effects: dredged materials release nutrients and contaminants in the water column some of which is beneficial and some is harmful, and dredging rivers may alter nearby stream bottoms, backwaters, and wetlands.

Major species affected: eastern oyster, blue crab, brown shrimp, white shrimp, tape grass, shoal grass.

Level of conflict: substantial, a major environmental problem, long term.

Major sources: construction of Tennessee-Tombigbee Waterway, construction of Theodore Ship Channel, maintenance dredging of Mobile Bay Ship Channel, Alabama Point Channel, and Gulf Intracoastal Waterway.

Major areas affected: Mobile River, Mobile Bay, eastern Mississippi Sound, Perdido Bay, tidal flats, and oyster reefs.

DREDGED SPOIL MATERIAL

Conflicts: fish and wildlife resources, aesthetics, and environmental quality.

Direct effects: replacement of valuable fish and wildlife habitats by spoil material; changing historical water depths (diposal in nearshore shallow water is a bigger threat than disposal in deep water); release of bottom sediments and hazardous wastes into the water column.

Indirect effects: The benthic composition and biomass may be suppressed for months or in extreme cases, years.

Major species affected: smooth cordgrass (*Spartina alterniflora*), big cordgrass (*Spartina cynosuoides*), needle rush (*Juncus roemerianus*), tape grass.

Level of conflict: Substantial, a major long-term environmental problem.

Major sources: Dredging of the Tennessee-Tombigbee Waterway and the Theodore Ship Channel, and maintenance dredging of the Mobile Bay Ship Channel, Alabama Point Channel, and Gulf Intracoastal Waterway.

Major areas affected: The Mobile River, Mobile Bay and Delta, wetlands along Mobile Bay, and eastern Mississippi Sound.

OIL AND GAS DEVELOPMENT

To meet increasing national demands for energy, it is inevitable that the search for petroleum in coastal Alabama will intensify. The coastal area serves as a habitat for many desirable plants and animals; consequently, it is necessary to pursue oil and gas development with the least possible disruption of natural land formations, water flows, and indigenous wildlife (Longley et al. 1978).

PLATFORMS AND RIGS

A significant nearshore discovery of gas was made by Mobil Oil Corporation in 1979 near the mouth of Mobile Bay. This well has yet to be established as a field, and additional test wells will be necessary to determine the magnitude of the discovery (see Minerals Production paper for more detail). The well is located near the Gulf Intracoastal Waterway and the Mobile Bay Ship Channel where commercial vessel traffic is common. Offshore production platforms have been a cause of vessel collisions and pose a serious continual traffic hazard for nearby barge traffic, shipping lanes, and commercial fishing boats (Liebow et al. 1980). These accidents sometimes cause oil spills. Considering the number of platforms in the Gulf and the intensity of shipping traffic, the number of such accidents is low (U.S. Department of the Interior, Bureau of Land Management 1981).

Mobil's discovery will likely kindle interest in further oil exploration in Outer Continental Shelf (OCS) lands nearby; however, OCS leased lands in the northern Gulf off the coast of Florida, Mississippi, and Alabama have failed to show either oil or gas potential (see Environmental Issues and Regulations paper for further details).

DRILLING

Well drilling requires constant air and waterborne traffic to and from the well site 24 hours per day, and drilling may last from one to several months. Drill cuttings and other wastes must be decontaminated if they are disposed of in adjacent waters (Longley et al. 1978). Drilling in open water could be damaging if located near oyster reefs or other hard bottom habitats.

Drilling sometimes causes high turbidity at the well site. Some wetland erosion could be caused by increased boat traffic, and toxic or noxious substances could be released into the environment. In addition, bottom dwelling and some swimming animals could be displaced or killed; however, most are reestablished shortly after the platforms are constructed (Longley et al. 1978).

Drilling mud, drill cuttings, and brine are by-products of drilling operations. Residents of the Gulf Shores and Fort Morgan areas are concerned about the prospect of these wastes being dumped into the nearby Gulf. The proposed disposal site is 12 miles south of the city of Gulf Shores. They also are concerned about the possibility of wastes and oil spills that might contaminate beaches and swimming areas (see Environmental Issues and Regulations paper for more detail).

Disposal of brine from onshore drilling operations has been a problem in coastal Alabama (see Mineral Production paper). Disposal of brine into deep wells has been the method used for many years. In 1979, there were 13 brine disposal wells in operation in coastal Alabama: 11 in Mobile County in the Citronelle, Hatter's Pond and Chunchula fields; and 2 in Baldwin County, both in the South Carlton field (Alabama Coastal Area Board 1979b). Excessive discharge of hypersaline solutions into freshwater aquifers and fragile freshwater wetlands can kill vegetation, benthic organisms, and fishes, and contaminate well water.

PIPELINES

Gas is most frequently transported locally by pipelines (61 to 91 cm or 24 to 36 inches in diameter). OCS operating regulations now require pipeline burial in water depths less than 60 m (200 ft). Bureau of Land Management (BLM) requirements stipulate burial to a depth of 0.9 m (3 ft) for greater stability during storms (U.S. Department of the Interior, Bureau of Land Management 1981).

During pipeline burial a large volume of bottom sediments are disrupted and suspended in the water for a short period of time (Longley et al. 1978). According to the U.S. Department of the Interior, Bureau of Land Management (1981), dredging pipeline ditches on the bottom in nearshore areas may cause resuspension of many years' accumulation of organic matter, phosphates, and other nutrients, as well as toxic heavy metals and biocides. Dredging for pipelines on hard bottoms could destroy suitable habitat for seaweeds and oysters, and spoil material, often dumped along the pipeline right of way, can temporarily smother the benthos. Increased turbidity also can temporarily clog the respiratory organs of many marine organisms and the filter-feeding mechanisms of others. Pipeline burial in coastal wetlands could displace many species of wildlife during construction and maintenance.

In 1969-79, 19 pipeline breaks or leaks, each with a spillage of 50 barrels or more, were recorded for OCS operations in the Gulf of Mexico (U.S. Department of the Interior, Geological Survey 1980). More oil (about 41,000 barrels) has been spilled into the Gulf of Mexico from pipeline accidents than from all other types of OCS oil and gas related accidents. Four of these spills were directly attributed to anchor dragging. Anchors from relatively large ships can rupture, sink, or split pipelines (U.S. Department of the Interior, Bureau of Land Management 1981).

Other causes of pipeline failure include movement or shear due to wave action, unstable bottom conditions, fouling of trawl gear on subsea valves and taps, and internal corrosion. Trawling gear such as nets, ropes, or tickler chains frequently hang up on pipeline-related obstructions including taps and valves (U.S. Department of the Interior, Bureau of Land Management 1981).

Large oil production related vessels, such as pipelaying barges, require extensive anchoring systems while operating. It is not uncommon for these anchors to bury at depths of 5 to 6 m (16 to 20 ft), whereas commercial vessel anchors bury 0.5 to 3 m (1.5 to 10 ft). Since it is not feasible to install pipelines at depths that give complete protection, pipelines near rigs should be buoyed to prevent anchor damage (U.S. Department of the Interior, Bureau of Land Management 1981).

Generally, pipelines are the most efficient, economical, and the cleanest method for moving bulk liquids. Pipelines transport approximately 98% of the oil produced in the Gulf of Mexico (Shanks 1978).

The recent discovery of natural gas in Mobile Bay, and the recent lease of submerged lands in coastal Alabama increase the potential need for pipelines and threaten the Mobile Bay estuary.

DRILLING BLOWOUTS

It is possible for wells to blow out of control especially during drilling. Nine blowouts that spilled 56,225 barrels of oil and/or gas condensate were reported for northern Gulf of Mexico between January 1969 through December 1979 (U.S. Department of the Interior, Geological Survey 1980). One blowout was reported for every 250 wells drilled (Danenberger 1980).

A blowout (IXTOC) in the southern Gulf of Mexico off the Mexican coast on June 3, 1979 spilled 3.3 million barrels of oil in 295 days of uncontrolled flow (U.S. Department of the Interior, Bureau of Land Management 1981).

From January 1969 through December 1979, 306 explosions and fires were reported in the Gulf of Mexico. The biggest spill was 53,000 barrels and the total was 84,086 barrels (U.S. Department of the Interior, Geological Survey 1980).

Oil pollution is a continuing threat to coastal ecosystems and can affect their biological productivity. Prolonged studies of subtidal organisms that cannot escape oil spills indicate that residues of oil persist far longer than had been thought possible and that their toxic effect on a wide variety of marine organisms may last for years (McConnaughey 1978).

OIL SPILLS

A typical tanker carrying crude oil during World War II held 16,000 tons of oil. By 1965, average capacity had almost doubled. New tankers now carry from 326,000 to 720,000 tons and there is talk of a ship having a 1,000,000 ton capacity (Wagner 1974). Considering their sizes, oil spills from these large ships could be devastating to coastal environments.

Accidental oil spills from tankers and barges, as well as oil spills during normal operations, are the major source of oil spills in the United States (U.S. Department of the Interior, Bureau of Land Management 1981). Tanker and barge accidents accounted for 3,115 oil spills in the Gulf of Mexico in 1974-79. Tanker spill rates are higher than the total of all other OCS spill rates (U.S. Department of the Interior, Bureau of Land Management 1981).

Some pollution is produced by all ships large or small, whatever their cargo. Slop water from routine ship maintenance, which picks up oil from machinery lubrication, bilge water, and oil wastes from engine rooms all find their way into the ocean (Wagner 1974). The great volume of these wastes pumped into the sea is offset by their wide dispersal.

About 10 million tons of oil is spilled into the ocean by man's activities and another 10 million tons reaches the ocean by natural seepage from the ocean floor (Wallace 1981). Partly refined oil may be most harmful to the environment. Short-chain hydrocarbons are known to damage marine larvae, simple ring systems are generally poisonous to living things, and complex ring systems are known to cause cancer (Wallace 1981).

Despite the efforts of local citizens, seabirds covered with spilled oil almost invariably die (Stickel and Dieter 1979). In Alaskan waters, great rafts of oil-covered corpses of birds, sea lions, hair seals, killer whales, and sea otters have been found (Wallace 1981). Researchers found that shortly after a coastal oil spill, 95% of the benthic fauna were killed (Wallace 1981).

Salt marshes and tidal creeks may be contaminated by oil, but after a few days, most of the oil evaporates and some measure of recovery has begun. Yet, after eight months, unaltered oil may still be recovered from bottom sediments, and after 12 months, bacterial degradation of the oil components may have only begun. The least toxic hydrocarbons seem to disappear first (Wagner 1974).

The effects of oil contamination are not always long lasting. For example, barnacles have grown back on oil-slicked rocks with apparently little difficulty. Some tiny isopods and stunted goose barnacles may live within the tar balls that form from oil slicks (Wallace 1981). Certain bacteria are known to digest tar balls, but they do it slowly even under ideal conditions. Hydrocarbon residues are likely to enter the food chain unchanged through another route before the bacteria can decompose the tar ball (Wallace 1981).

If heavy residues from spilled oil reaches the ocean floor where little oxygen exists, it is likely to add to the problem (Wallace 1981). Once on the bottom, the oil has been found to enter the fat and flesh of marine organisms. Some fractions of the oil in an oil spill are highly toxic and in estuaries may kill worms, crustacea, mollusks, and fish for months afterward and given objectionable taste to oysters (Wallace 1981). When contaminated oysters are placed in clean water, they lose their oily taste. Yet, when checked with gas-liquid chromatograph techniques, fuel oil in the body tissues was found in the same concentration and composition as at the beginning of the period of flushing (Wagner 1974). The evidence suggests that the hydrocarbons were not flushed out and may remain intact throughout the lifetime of an oyster. Obviously, taste cannot be trusted as a criterion of contamination.

Other research has indicated that low levels of oil hydrocarbons in water may affect the behavior as well as the physiology of marine organisms (Wagner 1974; McConnaughey 1978). If the oil either blocks or mimics natural stimuli, behavior such as sex attraction, food finding, homing, and escape from predators may be altered. Oil also may concentrate various fat-soluble compounds such as PCB's into the surface film of the water (Wagner 1974).

The local office of the Alabama Water Improvement Commission investigates all reports of spills in the waterways of coastal Alabama; in 1980 24 oil spills were investigated (see Environmental Issues paper for further details).

A major oil spill in Mobile Bay would cause considerable environmental damage. The extent of the damage would depend upon the time of the year as well as the magnitude of the spill. In view of the expanding oil and gas exploration in Mobile Bay, potential environmental impacts are becoming increasingly important to planners.

MULTIPLE USE CONFLICT ANALYSIS

PLATFORMS AND RIGS

Conflicts: vessel traffic and aesthetics.

Direct effects: currently there are no rig problems in coastal Alabama. The Mobil Oil Corporation well in Mobile Bay is located close to the Gulf Intracoastal Waterway and the Mobile Bay Ship Channel. Any increase in the number of wells in this area will create a hazard for nearby barge traffic and a potential for accidents and oil spills.

Indirect effects: Many local citizens feel that platforms and rigs interfere with aesthetics.

Major species affected: man.

Level of conflict: minor.

Major area affected or expected to be affected: the lower portion of Mobile Bay.

DRILLING

Conflict: environmental quality.

Direct effects: high local turbidity; release of toxic or noxious substances into the aquatic environment; temporary destruction of benthos and some nekton, loss of plants and animals on adjacent wetlands. Displacement of sensitive wildlife due to constant noise and activity. Possible erosion of wetlands from increased boat traffic; increase in salinity caused by brine disposal.

Major species affected: man.

Level of conflict: Onshore disposal of brine is a substantial problem. Offshore drilling is a minor problem.

Major areas affected: Citronelle, Hatter's Pond, Chunchula, and South Carlton oil fields. Mobile Bay will be affected.

PIPELINES (IN ESTUARIES)

Conflict: environmental quality.

Direct effects: More oil has been spilled into the Gulf of Mexico from pipelines than from all other types of OCS petroleum production accidents. Displacement of plants and animals along the canal route due to excavation; suffocation of plants and animals at spoil sites; degradation of aquatic habitats due to turbidity, sedimentation, and oxygen depletion; blockage of natural waterflows and alteration of natural drainages; new and less desirable waterfowl habitats (Longley et al. 1978).

Major species affected: man, most wetland plants, fish and wildlife.

Level of conflict: minor in coastal Alabama. The potential conflict is substantial and long term.

Major areas affected: none.

DRILLING BLOWOUTS AND OIL SPILLS

Conflict: environmental quality.

Effects: High mortality of wildlife, waterfowl, and other aquatic organisms because of "oiling"; and loss of emergent and some submergent vegetation in marshes; nutrients and soil characteristics may be altered (Longley et al. 1978).

Indirect effects: Residual toxicants transported to adjacent systems, into water column, and into bottom sediments.

Major species affected: man, many species of plants, fish and wildlife.

Level of conflict: minor in coastal Alabama. The potential conflict is substantial and long term.

Major areas affected: Most minor spills occur in the lower portion of the Mobile River and around marinas. The potential for spills will increase as oil and gas exploration and transportation increase.

HABITAT DESTRUCTION OR DISPLACEMENT

COASTAL

The rate of population and urban growth of Mobile and Baldwin Counties is increasing, especially along the bay and coastal areas. The wetland acreage of coastal Alabama is relatively low, but the value per acre is high. The annual wetland acreage is being reduced piecemeal by dredge and fill of impoundment and bulkhead projects. This destruction of wetlands has a direct effect on seafood production because spawning and nursery grounds of a number of fish and shellfish are destroyed or altered (Alabama Coastal Area Board 1979a).

The area of estuaries is small compared to that of adjacent land masses, and the environmental values peculiar to estuaries are found nowhere else. Coastal wetlands constitute an ecosystem that is easily damaged or destroyed (McConnaughey 1978); however, estuaries must be considered as multiple-use environments that are a compromise among conflicting uses. Since "everybody" (man and organisms) lives downstream from everybody else in an estuary, modification or pollution at one point directly or indirectly affects distant points in both tidal directions (Odum 1971).

Socioeconomic considerations are always a part of determinations of how best to use natural resources. For the owner of property, the decision to convert a marsh into building sites includes an economic choice; however, society has a stake in this choice because wetlands are a part of an aquatic ecosystem which indeterminately affects all people in a given area. When wetlands are voluntarily retained in their natural state, financial returns are low (wetlands often are leased to hunters and trappers), and seafood production usually does bring a significant return to the individual property holder (Horwitz 1978).

Landfill and bulkheading are two major causes of wetland loss. According to Mock (1966), "bulkheading" destroys the most important part of the estuarine nursery ground and encourages the building of housing developments that are vulnerable to hurricanes and other storms. A ten-month intensive sampling of a Texas estuary yielded 2.5 times more brown shrimp and 14 times more white shrimp from a natural area than could be harvested from a bulkheaded area in the same estuary.

LANDFILL AND HUMAN ENCROACHMENT

Because more people are purchasing boats, there is an increasing demand for docks, harbors, and marinas. More than 23,300 boats were registered in Alabama coastal waters in 1975 (Alabama Coastal Area Board 1979a). As recreational opportunities increase, demands on the natural resources that originally caused the attraction also increase. There is little question that the construction of a marina and the disposal of dredged material on wetlands benefits a few individuals directly but the attrition of a valuable fishery may affect many (Horwitz 1978).

According to Holliman (1979), urban expansion caused habitat destruction or displacement for four endangered species of mammals in coastal Alabama. The four are Florida black bear (*Ursus americanus floridanus*), Florida panther (*Felis concolor coryi*), Alabama Gulf beach mouse (*Peromyscus polionotus ammomates*), and the Perdido

Bay beach mouse (*Peromyscus polionotus trissyllepsis*), all endangered because of habitat loss (Dusi 1976; Holliman 1979).

The Florida black bear is limited to the Mobile Delta and the Lillian area. Perhaps 150 bears live in coastal Alabama (Holliman 1979). The Florida panther inhabits large and remote river swamps and large forested areas. The entire Alabama population is thought to be less than 12 individuals. Human disturbance and degradation of bottomland and swamp habitat are prime factors affecting their survival (Dusi 1976; Holliman 1979).

Drainage of marsh and swamplands and human encroachment along coastal areas of Alabama have excessively restricted the habitat of the black-crowned night heron (*Nycticorax nycticorax*). The species is of special concern and is on the state's rare and endangered species list (Keeler 1976; Johnson 1979). The reddish egret (*Dichromanassa rufescens*) and the mottled duck (*Anas fulvigula*) both are threatened because of habitat destruction and human encroachment (Keeler 1976).

The Tennessee-Tombigbee Waterway project will have certain long-term effects upon the Delta. The landfilling effects of building and maintaining a barge and ocean shipping system will be substantial. Long distance barging of dredged spoil may not be economical; therefore, the spoil will probably be deposited along the canal. Future dredging will likely result in accelerated landfilling, industrial site development, and change in the total riverine ecosystem (U.S. Department of the Interior, National Park Service 1979).

Studies prepared by the South Alabama Regional Planning Commission indicate that about 1,600 additional hectares (4,000 acres) more industrial land will be required to satisfy the anticipated industrial requirements by the year 2000 (Alabama Coastal Area Board 1979a).

Resort development, condominiums, motels, numerous summer cottages, and restaurants, many built directly on the dunes and marshes, are intruding on fish and wildlife habitats. Human encroachment is a problem on Dauphin Island, the Fort Morgan Peninsula, Gulf Shores, Ono Island, and Orange Beach. The Atlantic loggerhead turtle (*Caretta c. caretta*) was reported to nest "regularly" on the seaward beaches of Dauphin Island and the Fort Morgan Peninsula in 1970 but now they do not (Mount 1976; personal communication with local citizens). Secluded stretches of beach without artificial lights are apparently required, and it is unlikely that any such habitat will be preserved. The species is endangered in the State of Alabama (Mount 1976).

There are other serious threats of encroachment. Pace Oil Company of Winston-Salem, North Carolina, owns approximately 800 ha (2,000 acres) at Little Point Clear which is authorized for acquisition by the U.S. Fish and Wildlife Service as an addition to the 4,000 ha (10,000 acres) of Bon Secour National Wildlife Refuge. The oil company plans to construct 3,500 condominiums, single-family dwellings, a marina, golf course, and a commercial business area on the tract. U.S. Fish and Wildlife Service is reported not to have made an offer for the land at this time (Mobile Bay Audubon Society 1981).

Lagman Realty and Mortgage, Inc. plans to construct condominiums with 50 units on the west end of the Fort Morgan Peninsula. The applicant proposes to place about 11,000 cubic yards of fill on the tract to raise the elevation to 2.3 m (8 ft) above mean sea level. Placement of this much landfill will destroy much of the immediate wetlands in the area (Mobile Bay Audubon Society 1981).

Alabama's beaches provide breeding grounds and nesting areas for many shorebirds such as the least tern (*Sterna albifrons*), snowy plover (*Charadrius alexandrinus*), and Wilson's plover (*Charadrius wilsonia*). Thoughtless beach development and "dune buggy" traffic interferes with their reproduction (Howell 1928; Imhof 1976). The snowy plover is a State endangered species (Keeler 1976).

PORT DEVELOPMENT

Mobile is the third largest port on the Gulf coast. The Alabama State Docks are located on approximately 1,000 ha (2,500 acres) of land at five separate locations. Three of these are located on the northwestern side of Mobile Bay, and two are located in the southwestern portion of the Delta (Alabama Coastal Area Board 1979c).

In 1974, there were 205.4 km (128.4 mi) of navigational channels with a bottom surface area of 1,368 ha (3,420 acres). The U.S. Army Corps of Engineers, in completing the Theodore Ship Channel, is constructing an additional 28.1 km (17.6 mi) of navigation channel with an area of 182.4 ha (456 acres) (Alabama Coastal Area Board 1980).

One of the products of maintenance dredging and harbor expansion is the tremendous volume of dredge spoil material. The maintenance dredging of the Mobile Bay channel between 1968 and 1973 produced 15 million net cubic yards of spoil material (Alabama Coastal Area Board 1980). Pinto Pass in Mobile County, an excellent habitat for many species of wildlife, has been proposed as a spoil dumping area to the discontent of local conservationists.

MINING

Extraction of oyster shells from coastal waters on a large scale can alter wetland habitats by increasing turbidity and sedimentation and mechanically disrupting productive bottoms. The extraction of shells, which are used for making cement, poultry grit, and a variety of other calcium-based products, is highly damaging environmentally, and some ecologists suggest that the practice can be abandoned because other sources of calcium are available (Horwitz 1978).

Over 46 million cubic yards of oyster shell are available for mining from coastal water bottoms. The removal and washing of mined oyster shells disturbs the benthic habitat (Alabama Coastal Area Board 1979b).

Oyster shell deposits have been dredged in Alabama for commercial use since 1946. The royalty paid to the state of Alabama from these shells has been a major source of revenue to support the program of the Seafoods Division of the Alabama Department of Conservation (May 1971).

Local sport fishermen believe that shell dredging in Mobile Bay is the direct cause of the alarming loss of submerged grassbeds along the eastern shore. Since the submerged grassbeds provide habitat for sport fish such as the spotted sea trout (*Cynoscion nebulosus*), their loss is of great concern. Commercial fishermen claim that live oysters also are being dredged along with the oyster shells.

The extraction of oyster shells changes the bottom of the bay. In some places the depth has increased, and in others the depth has decreased. Sailboats occasionally get stuck in the spoil left by the shell dredge. In addition, pleasure boaters trying to catch shrimp occasionally lose their trawls in deposits of dredged material.

Although the shell dredge operates well away from any swimming area, a plume of suspended material increases turbidity and the rate of sedimentation along beaches.

INLAND

The inland portions of Mobile and Baldwin Counties support the socioeconomic enterprises of forestry and agricultural production, urban and industrial development, oil production, transportation, and recreation. These activities cause habitat modification and a decline in species diversity (see Environmental Issues paper for details).

FORESTRY PRODUCTION

Forestry resources in coastal Alabama are extensive (see Agricultural Production paper). Current forestry practices include monoculture, clear-cutting, and selective and cull cutting. Cull cutting usually includes old pine trees with a dead heart.

The elimination of old large pine trees with a dead heart, usually called "red-heart," is part of the cause of the decline in the red-cockaded woodpecker (*Picoides borealis*), which use red heart trees for their nesting. The species is listed as endangered by the U.S. Department of the Interior and the State of Alabama (Keeler 1976).

The habitat of the flatwoods salamander (*Ambystoma cingulatum*) is being destroyed or rendered unsuitable by clearcutting and intensive mechanical site preparation of forestlands. This species also is listed as endangered in Alabama (Mount 1976).

Between January and October in 1981, 491 forest fires burned 13,871 ha (34,677 acres) in Baldwin County (Alabama Forestry Commission 1981). These fires cause smoke pollution, lowering of water quality by exposing soils to erosion, and the loss of recreational opportunity by destroying wildlife habitat (Alabama Forestry Commission 1981).

Each 40-ha (100-acre) forest fire loss would be equivalent to enough wood for 100 homes, 100 tons of pulp for paper, browse for approximately 3 deer, cover for perhaps 3 coveys of quail, habitat for several squirrels and rabbit, woodlands in which to camp and hike, watershed protection, and scenic beauty (Alabama Forestry Commission 1981).

Although the effects of forest fires are temporary, but devastating at the time, plant regrowth sometimes is of considerable value for many forms of wildlife (e.g., deer). There is no intention here to discuss all the ramifications of forest fires.

AGRICULTURAL PRODUCTION

In 1975, about 19% of the land use in coastal Alabama was in agriculture. The principal crop was soybeans (see Agricultural and Forestry Production paper for details). The importance and uniqueness of wet, acid bogs and pinelands has been discussed (see Environmental Issues and Regulations paper for more detail). These areas contain many beautiful and interesting species of plants, such as the parrot pitcher plant (*Sarracenia psittacina*), trumpet pitcher plant (*S. rubra*), rose orchid (*Cleistes divaricata*), and narrow leaf coreopsis (*Coreopsis gladiata*), which are listed as State threatened species (Thomas et al. 1976).

Many flat, wet, acid pinelands have been drained in southern Baldwin County. The land has been converted to crop production (mostly soybeans). Sandhill cranes (*Grus canadensis*) have been observed in these areas south of Foley; however, drainage and habitat destruction have resulted in less frequent sightings (personal communication with Fairley Chandler Oct. 1980). The population of cranes in southern Baldwin County probably numbers less than 30 (Keeler 1976).

Hillside acid bogs near Stapleton are being cleared for marginal pastureland. These natural and unique habitats are rapidly being lost.

URBAN DEVELOPMENT

Urbanization has been the principal cause of an accelerated loss of wet, acid pineland habitats in Mobile County (see Environmental Issues and Regulations paper). Large areas are in danger of being lost between the Theodore Industrial Complex and Bayou La Batre.

Mesic, ravine woods are being developed for residential areas near Blakeley in Baldwin County. Their scarcity in coastal Alabama has been discussed (see Environmental Issues and Regulations paper).

MULTIPLE USE CONFLICT ANALYSIS LANDFILL AND HUMAN ENCROACHMENT

Conflicts: fish and wildlife, aesthetics, and environmental quality.

Direct effects: Loss of wetlands, marshes, submerged grassbeds, bottomlands, dunes, and beach habitat; reduction of estuarine productivity; disturbance of beach nesting areas; and modification of riverine and bay ecosystems.

Major species affected: brown shrimp, white shrimp, blue crab, Florida black bear, Florida panther, Alabama Gulf beach mouse, Perdido Bay beach mouse, black-crowned night heron, reddish egret, Atlantic loggerhead turtle, snowy plover (*Charadrius alexandrinus*), numerous shorebirds, and many species of plants and animals.

Level of conflict: substantial, a major long-term environmental problem.

Major sources: recreational, industrial and urban development.

Major areas affected: Mobile Delta, all coastal marshes, Chickasaw Creek, Three Mile Creek, D'Olive Bay, Dauphin Island, Fort Morgan Peninsula, Gulf Shores, Orange Beach.

PORT DEVELOPMENT

Conflicts: fish and wildlife, aesthetics.

Effects: Disposal of dredged material destroys valuable fish and wildlife habitats; loss of wetlands; increased pollution.

Major species affected: Marsh flora and fauna especially certain migratory waterfowl.

Level of conflict: substantial, a major environmental problem, long term.

Major sources: Alabama State Docks, Theodore Industrial Complex.

Major areas affected: Mobile Bay, marshes and wetlands in the southwestern portion of the Delta; Theodore Ship Channel.

OYSTER SHELL MINING

Conflicts: environmental quality, aesthetics, and commercial fishing.

Effects: disruption of benthic environments; benthos mortality; alteration of depth of bay bottom; increased turbidity and sedimentation; reduction of seed oysters and spat production; siltation of submerged grassbeds.

Major species affected: eastern oyster, tape grass, and man.

Level of conflict: moderate environmental problem, generally short term.

Major sources: Radcliff Shell Dredge.

Major area affected: Mobile Bay.

FORESTRY AND AGRICULTURAL PRODUCTION AND URBAN DEVELOPMENT

Conflict: wildlife.

Effects: Loss of habitat and terrestrial plants and animals.

Major species affected: red-cockaded woodpecker, flatwoods salamander, parrot pitcher plant, trumpet pitcher plant, rose orchid, narrow-leaf coreopsis, and many others.

Level of conflict: substantial, long term.

Major sources: Forested and cultivated lands.

Major areas affected: Forests in the northern portions of Mobile and Baldwin Counties, and wet, acid pinelands in their southern portions. Hillside acid bogs near Stapleton, and between Bay Minette and Atmore, and mesic, ravine woods between Spanish Fort and Hurricane.

SUMMARY

This paper has reviewed major multiple use conflicts involving water, land, and air resources in coastal Alabama. Many conflicts have been triggered by competition for sharing water resources. Of these, dredging and spoil disposal, industrial wastes, municipal wastes, agricultural runoff, nonpoint sewage disposal, and habitat loss are leading concerns. The habitats most endangered are submerged grassbeds in Mobile Bay, marshes adjacent to Mobile Bay and the Mississippi Sound, and the alluvial flood plains of the lower Mobile River.

Conflicts involving land uses are port development, industrial expansion, urban development in high-risk areas, and human encroachment on wildlife habitat. The habitats most endangered are the dune systems on Dauphin Island, Gulf Shores, Orange Beach, and the Fort Morgan Peninsula.

Air pollution problems, but generally not serious ones, are apparent in Mobile, the Theodore Industrial Complex area, and in Bay

Minette. Air quality conflicts are likely to increase as industrial expansion continues.

Industrial, municipal, and agricultural wastes contribute to water pollution in the lower Mobile River and the northwest portion of Mobile Bay. Water pollution and spoil disposal from channel dredging are potentially serious problems in Mobile Bay.

Oil and gas exploration in coastal waters, the outer continental shelf, and the development of onshore support facilities are in conflict with the natural resources of Mobile Bay.

RECOMMENDATIONS

Multiple use conflicts of significance in coastal Alabama should be better evaluated so that planning land and water use will be more effective for managing fish and wildlife and their habitats.

If coastal Alabama and Mobile Bay are to continue to be important as seafood spawning and nursery grounds, and as habitat for waterfowl and other wildlife, pollution from all sources must be reduced to a level compatible with the basic biological needs of the primary plant, fish, and wildlife species.

An attempt should be made to increase concern among citizens for protecting and preserving the natural heritage of coastal Alabama. Grade school curricula concerning coastal ecology should be a part of basic education. Clear explanations of public laws relating to coastal ecology and fish and wildlife management should be made available to the general public.

DATA GAPS

1. Lacking are monitoring studies and historical reviews on the cumulative impact of man's activities in Mobile Bay, the Delta, Dauphin Island, Gulf Shores, and the Fort Morgan Peninsula.

2. The details of the cause and effects of the drastic decline of submerged grassbeds in Mobile Bay has not been adequately explained.

3. Data deficiencies exist in flora and fauna inventories, and on the extent of habitat displacement.

4. Lacking are site studies of the biological effects of dredging and spoil disposal in Mobile Bay as well as overall cumulative effects of excavation and maintenance dredging.

5. No comprehensive data on the parameters of thermal discharge are available for coastal Alabama.

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ENVIRONMENTAL ISSUES AND REGULATIONS

PREFACE

Insofar as this report is concerned, any apparent problem can be an issue. Probably most argumentive is the scope of magnitude of an issue and its priority in environmental considerations, depending upon the particular interests or views of those that are groping for generic acceptability of their definitions. The major issue here seems to be the striving of a balance between the environment and man's attempts to alter it. Acceptable compromise usually is the condition.

Major environmental issues of coastal Alabama are navigation, water pollution, air quality, land use, and oil and gas exploration and development, and oil spills. Each issue has contributing issues, e.g., dredging is a contributing issue to navigation, bacterial infection of oysters is a contributing issue to water pollution, particulates is a contributing issue to air pollution, sand dunes is a contributing issue to land use, and oil spills is a contributing issue to OCS oil and gas development. The readers of this report would do well to accept these views as a reading guide, recognizing that he or she may have a somewhat different outlook on issues as a subject of concern and discussion.

INTRODUCTION

The Alabama coastal region is subject to its particular environmental stresses and human demands. Although coastal areas are especially valuable for their natural resources, waterborne commerce, desirable living sites, and recreation, man has the tendency to manipulate and sometimes irreversibly change segments of the environment to satisfy immediate needs and make short-term gains. Our economic system has many paradoxes that make environmental decisions difficult. For example, if a marsh is in private ownership, its owner may gain by selling it for urban development. Whether the gain is small or large, it will be profitable, since leaving the area in its natural state earns the owner little if any return. Yet in the aggregate, the value of coastal wetlands to seafood production is great. The dichotomy of interests between value to its owner and value to society becomes an increasingly serious problem with population increase and industrial growth (Gosselink et al. 1974).

The challenge is to find ways to achieve orderly economic growth that respects and takes advantage of renewable, yet ultimately finite, natural resources peculiar to coastal Alabama. One way to meet the challenge is to resolve environmental conflicts, when possible, that lead to polarization of interest groups within the community.

Often in decisionmaking, segments of society that will be directly affected are not considered or consulted. The marsh again is an example. If a decision is made to use a productive marsh for spoil disposal, such use will benefit waterborne commerce by creating or maintaining navigable channels, and eventually the value of the filled land will accrue to individuals or the state. The public bears the cost of such work through expenditure of tax revenue. Some of the taxes paid by commercial fishermen is used for navigation projects that destroy marshes which are nursery grounds for some of the major species sought by the fishermen.

The solution to many conflicts is a land-use plan that delimits the amount and location of naturally productive areas that are necessary to support the optimum level of urban-industrial growth (Gosselink et al. 1974). The best approach likely to be achieved, however, is the establishment of priorities based upon knowledge of natural resources and processes. These priorities would help lessen gross environmental abuse and destruction and at the same time reduce conflicts and the issues that result.

The purpose of this socioeconomic report is to provide planners and decisionmakers with data about the human, cultural, natural, and other resources of coastal Alabama. It attempts to contribute to decision making by outlining major environmental issues that have resulted from competing uses for the water, land, and air resources. This discussion incorporates rules and regulations that control activities affecting the coastal environment. Also included are an historical perspective of coastal development and resource use and a brief delineation of the region's principal environmental characteristics.

Environmental issues are perceptions by the public or the scientific community of activities or proposals that have an environmental impact and cause conflicts or competition for coastal resources.

BACKGROUND

It is believed that Spanish explorers discovered coastal Alabama in the early 1500's. The French were the first settlers, arriving at Dauphin Island in the early 1700's. Successive waves of English, Spanish, and American settlers followed, eventually replacing the native Indians. The Indians were Choctaws whose tribal name, though variously rendered, likely meant either to row or paddle (David Volkert and Associates 1977). The "paddlers" or Mobilians used the coastal watercourses and its many resources.

The French were traders and developed the first port at their settlement on Dauphin Island. Sea-going vessels at anchor were unloaded to shallow-draft vessels that transported goods inland. Other French settlements were founded along Mobile Bay including the city of Mobile.

From these origins arose a waterborne commerce that contributed substantially to colonization and inland development of the State (Chermock 1974). The navigable courses of the Mobile River system brought products of inland agriculture to Mobile for trade through Atlantic and European ports. After Alabama became a state in 1819, the population of its port area increased rapidly.

One major hindrance to the development of water commerce was the shallow depth of Mobile Bay. The port was located miles from the deep water entrance to the Bay. To remedy this problem, a channel was dredged in 1826, and between 1839 and the 1850's, other channel work was completed. With these channel improvements and increased commercial trade, Mobile's population grew at an annual rate of about 62% between 1840 and 1850 (David Volkert and Associates 1977).

After the Civil War and into the early part of this century, commercialism expanded. Channel modifications continued; dams and locks were built on the Tombigbee and Black Warrior Rivers; the State Docks Commission was formed; and the Alabama portion of the Gulf Intracoastal Waterway was completed. Mobile became a major regional and national port. Port development was augmented by a railroad system. Timber production, agricultural development, especially in Baldwin County, and the seafood industry came into prominence.

After World War II, industrial growth was extensive. Paper mills, chemical plants, and other heavy industries characterized the growth. Petroleum became increasingly important following the discovery of oil and gas fields and refineries and storage facilities were located in the region.

In the early history of coastal Alabama, resources were so great that abuses or exploitation did not substantially alter environmental quality. Also, man did not have the capacity to effect major, often irreversible, changes until recent times.

In this century, coastal resources have been used in increasingly diverse and competing ways. Often, what benefited one resource harmed another. The more people, the less resources there were to share. Because of ignorance, convenience, or lack of alternatives, numerous resources were lost or damaged. For example, marshes were used to create land for waterfront housing, industrial development, solid waste disposal, spoil disposal, highways, and an airport. Major habitat losses were inflicted before ecosystem values and functions were recognized and at least partly protected by laws and regulations.

The past two decades have been a period of growing environmental awareness, one of recognizing problems locally as well as nationally and in many cases working toward solutions. The days are past when waterways are viewed as convenient waste disposal sites and belching smokestacks a sign of progress, although locally the equating of progress with development without regard to environmental considerations is sometimes still in evidence.

Today, Mobile remains a major and growing port. Baldwin County is a prime agricultural center and its coast an expanding tourist center. Both counties have thriving timber industries. In Mobile County, industrial growth has outpaced the State as a whole, and the discovery of gas reserves in Mobile Bay may cause extensive, related development onshore. With more growth, more people, and many new demands, environmental issues will continue to arise and ferment.

BIOPHYSICAL SETTING

Coastal Alabama lies within the Gulf Coastal Plain physiographic province. The Southern Pine Hills, a moderately dissected, southward sloping plain, constitutes a major portion of the area. Excellent forestry resources and good agricultural lands, particularly in the lower half of Baldwin County, are found in this section of the province.

Coastal lowlands form a narrow border adjacent to and parallel to the shoreline. This area includes the alluvial-deltaic plains of the Mobile-Tensaw and Perdido fluvial systems and many smaller streams and rivers. Elevations within the lowlands range from sea level to about 9 m (30 ft) and may extend inland to a maximum of approximately 16 km (10 mi) from the shoreline. The lowlands are indented by tidal creeks, rivers, and estuaries which are fringed by tidal marshes (Alabama Coastal Area Board 1980).

The nearshore marine waters less than 7.6 m (25 ft) deep are known as the Mississippi-Alabama section of the Continental Shelf physiographic province (Moser 1977). The landward boundary is the steep shoreface of the barrier island and spit systems of the Mississippi Sound, Dauphin Island, and the Fort Morgan peninsula (Moser 1977).

Mobile Bay and the Delta of the Mobile-Tensaw River system are the principal geographical features of coastal Alabama. Mobile Bay is about 50 km (31 mi) long and 38 km (24 mi) wide at its maximum. It receives the drainage of the Mobile River system, the second largest drainage in the eastern United States. Like the Bay, the delta through which the river system flows is a highly productive area. Extending northward from the Bay, it is a vast swamp and marsh with abundant timber, wildlife, and fishery resources.

MAJOR ENVIRONMENTAL ISSUES

The major environmental issues, based upon water, land, and air quality considerations, are discussed in the following subsections.

NAVIGATION PROJECTS

CHANNEL CONSTRUCTION

Environmental impacts from the construction and maintenance of navigation channels in coastal Alabama are severe and have been compounded by many projects over the years. At issue is the best compromise to provide adequate port facilities and yet maintain a good measure of environmental integrity. Environmentally acceptable, long-range spoil disposal sites contributes to the issue on channel construction and maintenance. As proposed by the U.S. Army Corps of Engineers, the harbor and channel expansion will cause substantial alteration of the benthos, increase saltwater wedge movement upstream and intensify other existing problems. The type of harbor and channel modifications also is part of the issue. There are many alternatives presented in the technical report on the harbor (U.S. Army Corps of Engineers 1979b) that would produce some of the improvements needed for a growing port.

Questions have been raised about whether deepening the channel all the way from the Gulf to Mobile port to accommodate a limited number of deeper draft vessels is a valid trade-off for environmental losses that threaten the Bay. Without deeper channels, sufficient coal and ore handling facilities could be located at the Theodore Industrial Park or at an nearshore marine facility. Since coal and iron ore are the only materials expected to be transported by the deeper draft vessels, the Theodore proposal would lessen the distance of channel modifications needed to handle their transport. A nearshore marine facility for unloading cargo would completely eliminate the need for channel widening and deepening.

The magnitude of dredging and spoil disposal in general was demonstrated in 1978 at a series of workshops sponsored by the U.S. Army Corps of Engineers. The purpose was to determine what leaders of diverse interest groups with particular knowledge of Mobile Bay and the Mississippi Sound felt were the principal environmental concerns. Nearly all participants were principally concerned with the impact that dredging and spoil disposal might have on water quality, natural biological processes, and marine life (Hosking et al. 1978).

DREDGING

The construction and maintenance of navigational channels is a vital part of Alabama's transportation system. Currently, there are 206.7 km (128.4 mi) of navigational channels in coastal Alabama with a surface area of 1,384 ha (3,420 acres) according to Crance (1971). The Theodore Ship Channel will add another 11.6 km (7.2 mi) of 12.2 m (40 ft) depth channel and 1.8 km (1.1 mi) in a more shallow barge canal extension. The major channels are located in the Mobile port area, the Gulf Intracoastal Waterway, and Mobile Bay (see Figure 27 in the chapter on Transportation).

The shallow depth of Mobile Bay, combined with the port's distance of 37 km (23 mi) from deep Gulf waters, has required major dredging projects since about 1830 to accommodate ocean-going vessels. Although these channels greatly benefit water commerce, they may have serious environmental consequences. Channel construction alters the bottom habitat by deepening portions of the estuary and filling or reducing the water depth in other areas. Channelization and spoil deposition from a dredging project may increase saltwater intrusion and turbidity, prolong flushing, alter tidal exchange and water circulation patterns, destroy submerged plants, and alter fish behavior and abundance (Crance 1971). All of these changes have occurred to some degree in Mobile Bay.

In 1847-51, before intensive dredging, Mobile Bay's bottom was relatively flat. Most of the bay was 3 to 4.3 m (10 to 14 ft) deep and sloped gently downward toward its center and the Gulf. Studies 110 years later showed significant change. Although the bay's periphery remained relatively unmodified, sedimentation of the broad, flat bottom decreased the depth in most areas from 0.3 to 0.9 m (1 to 3 ft). Spoil banks with a relief of 1.8 m (6 ft) or more extends on either side of the main ship channel south from Mobile to Great Point Clear (see Figure 28 in the chapter on Transportation). South of there, spoil material on the west side of the channel has a 0.6 to 0.9 m (2 to 3 ft) relief. A series of spoil mounds is located in water depths greater than 4.3 m (14 ft) along the western side of the ship channel in the lower Bay. In addition, segmentation by spoil banks has virtually isolated the northwestern section of the Bay (Chermock 1974).

The bay's water circulatory pattern once was largely determined by river discharges, tides, and wind. Numerous studies, briefly summarized by Loyacano and Busch (1979), have shown, however, that alterations in the bay's bottom contours by channeling and spoil disposal have modified and restricted water circulation patterns. Spoil disposal banks along the western side are a barrier to the flow of bottom waters. Salinity stratification is more pronounced on the eastern side of the channel because the flow of saltwater from the Gulf has been restricted in the western side. In the northern section of the Bay, spoil banks have affected both surface and bottom circulation according to a 1974 study by Story et al. (Loyacano and Busch 1979).

The change in water circulation and increased salinity stratification are believed to be partly responsible for some of the low oxygen concentrations in extensive bottom areas of the bay in summer (Loyacano and Busch 1979). During these periods of low oxygen, fish exhibit severe strees called jubilees (see Recreation and Tourism chapter for further discussion), occasional oyster kills and spat failure are evident, and crabs caught in traps may be dead. Since jubilees happened prior to man-made alterations of the bay and because similar depletions were observed in relatively undisturbed Grand Bay, it is probable that oxygen depletion is not caused by but is abetted by channelization.

The Mobile ship channel has introduced a wedge of saltwater into the bay which, during summer months when freshwater inflow is low, may reach 32 to 48 km (20 to 30 mi) northward from the Gulf opening and estuarine fishes may be farther upstream than usual.

Annual maintenance dredging of the Mobile ship channel and periodic maintenance dredging of other channels increase turibidty in the bay. In addition to reducing light penetration and photosynthesis, resuspension of sediments may release pollutants such as heavy metals and persistent pesticides. When a ship channel is constructed, it becomes a sink for sediments that often contain contaminants. Resuspension or reactivation is a problem during maintenance dredging or when ships move through the area (Allen and Hardy 1980).

Benthos production is often altered by channel construction and maintenance. During initial channel construction and each additional dredging, 75% or more of the benthic (bottom-dwelling) organisms are removed. Although recolonization of a channel is often rapid and the original level of biomass is usually quickly reached, the recolonizing organisms tend to be of less value in the food chain, and the original species diversity is seldom achieved (Allen and Hardy 1980). The direct effect of bottom disturbance on fish population or behavior is unknown.

SPOIL DISPOSAL

With each new navigation channel and the enlargement and maintenance of old channels by dredging, the problems of spoil disposal intensify. For example, dredging of the Theodore Ship Channel has required the disposal of 26.8 million m^3 (33 million yd^3) of bottom material and marsh. This material has been placed in a diked area of about 526 ha (1,300 acres) in Mobile Bay. The spoil island also will be used as a dump for about 1.5 million m^3 (2 million yd^3) of spoil annually during the 50-year life of the project. This disposal is predicted to eventually elevate the island 6 to 9 m (20 to 30 ft) above mean low water.

Some spoil has been dumped in biologically valuable marshlands (Table 140). McDuffie Island and Little Sand Island were formed by spoil disposal that covered 196 ha (485 acres) of marsh.

The proposed harbor and channel improvements would require the filling of an additional 283 ha (700 acres) of bay bottom and 210 ha (520 acres) of nearshore bottom in Mobile Bay. Worse, an additional 44.4 million m^3 (58.7 million yd^3) of spoil from the bay south of Theodore plus an estimated maintenance dredging of 3.1

million m^3 (4.1 million yd^3) annually would be disposed of in the Gulf of Mexico (U.S. Army Corps of Engineers 1979b).

During the past decade, maintenance dredging for the Mobile ship channel and harbor has produced about 3 million m^3 (4 million yd^3) of spoil annually. Channel spoil is deposited along the channel sides, whereas the Mobile River harbor spoil is placed in diked upland areas.

One of the main problems arising from Mobile River harbor dredging is the lack of suitable disposal sites that should be provided by the Alabama State Docks. Existing sites were determined by the Corps of Engineers to be at or near capacity in 1980, and the Corps proposed Pinto Pass as a new disposal site. A study in the mid-1970's found that the Pass was the only acceptable choice of sites surveyed, yet a great deal of controversy resulted. The issue was whether Pinto Pass was the only available spoil site and whether its use would violate new national policies on wetland protection. The proposal was temporarily shelved, and spoil sites for the 1980 maintenance dredging were restricted to the existing Corps sites and one of Alcoa's diked bauxite tailings disposal areas that the company is restoring as wildlife habitat.

Both the Corps of Engineers and Alcoa sites have limited capacities, but perhaps the Corps' sites can be enlarged by new spoil dewatering methods developed at the Corps' Water Experiment Station. The material may best be recycled from existing disposal sites to extend their useful period. Because disposal sites are mostly short-term leases by the State Docks, the Corps has been reluctant to invest in costly new disposal sites.

Open-water nearshore marine disposal sites in the Gulf currently are used only for spoil from maintenance dredging of the Mobile Bay entrance to the Bay. The new Mobile harbor proposal would use the open Gulf for disposal (Figure 34) of all spoil for the 50-year life of the project. Adverse effects in open water from dredged materials apparently are not as severe as they are in estuaries because the deeper waters have greater dilution, mixing, and assimilative capacities (Allen and Hardy 1980); however, because of transportation costs and available equipment constraints, open-water disposal has not been widely used. An exception is the New York Bight where circulation is not adequate for dilution and dispersal of large volumes of waste material.

HABITAT DISPLACEMENT

In this century, there has been a continuing demand to develop the shoreline of Mobile Bay for industrial, port, commercial, recreational, and home sites. The consequence has been extensive shoreline bulkheading and filling of nearby marshes. The central issue is how to prevent further losses of marshes and shallow waters essential to estuarine productivity. In 1910 the population of the coastal counties was 4.6% of the Alabama total, whereas in 1980 it was over 12%. At least 22% of the marsh in the Mobile Bay and Delta estuaries have been altered or lost (Stout 1979). Even if large dredge and fill projects are restricted under Section 404 of the Clean Water Act, numerous small projects such as bulkhead and wharf construction have harmful, accumulative effects on estuaries.

PORT DEVELOPMENT

The greatest loss of marsh in coastal Alabama has been in the Mobile harbor area. Since initiation of the harbor project, 521 ha (1,287 acres) of marsh have been filled adjacent to Blakely and Pinto Islands. An estimated 1,192 ha (2,945 acres) have been filled in Mobile Bay and the Mobile Delta (Stout 1979).

The Tennessee-Tombigbee Waterway will be completed in 1986 if federal funding continues at anticipated levels. The waterway will sharply increase water commerce and port activity. A majority of the increase will be coal, exported principally to Japan. The need for additional harbor facilities by

2000 will cause more water quality problems and requires several thousand acres of wetlands and marshes for waterway and port development.

LANDFILL

Shoreline residential and industrial development, particularly in Mobile Bay, has destroyed large areas of marshes and wetlands. The eastern shore of the bay is a residential area, whereas the western shoreline has been developed intensively for multiple use. The principal remaining undeveloped shoreline in Mobile Bay extends south from Weeks Bay to Bon Secour Bay on the eastern shore. In contrast to Mobile Bay, Perdido Bay is largely undeveloped except for the southern portion where there are residential areas.

What has happened in Mobile Bay has been repeated in many other coastal areas and is a national concern. Because coastlands are usually densely populated, waterfronts have become prime real estate. For example, in the early 1970's, good potential commercial sites built over filled marshes in New Jersey were selling for as much as $80,000 per acre (Gosselink et al. 1974). As a result of intensive shoreline development, some states have lost significant portions of their total marsh acreage. By the early 1970's, California lost 67% of its original marsh area, and Louisiana lost 42.7 km^2 (16.5 mi^2) per year (Gosselink et al. 1974). These figures do not include extensive areas of shallow coastal bays that have been lost. More than 80,939 ha (200,000 acres) had been filled in the Gulf and South Atlantic region (Crance 1971).

Regulation of dredge and fill under Section 404 of the Clean Water Act has protected some of the Nation's most threatened coastal and inland wetlands (Council on Environmental Quality 1980). Provisions of Section 404 authorize the U.S. Army Corps of Engineers to issue or deny permits for dredge and fill operations based upon effects of such work on water supplies, shellfish harvest, fishing areas, wildlife, or recreation. Locally, these requirements have been effective in limiting the fill of valuable areas. In contrast, in the late 1960's and early 1970's permits were issued more routinely and frequently after the work had already been completed.

WATER POLLUTION

Coastal Alabama waters are polluted by sewage and industrial effluents from Mobile industrial areas to the north and south of the city, and localized areas in Mobile and Baldwin Counties. Although some progress in pollution abatement has been made in the past decade, some of the pollution will be difficult to control. For example, waters near Mobile were well known for the abundance of fish kills. Now, fish kills are smaller and less frequent. This reversal has resulted from better control of industrial pollution in certain waterways and from the conversion of the Eslava Wastewater Treatment Plant to a pumping station. The excessive discharge of sewage and organic materials caused repeated dissolved oxygen depletion in the receiving waters.

For the Nation as a whole, the quality of surface waters has not improved much in the past five years. The major accomplishment is that large-scale pollution has not increased despite a growing population (Council on Environmental Quality 1980).

Attempts to control toxic pollutants and non-point sources in the United States have just begun. For example, it has been estimated that over half of the water pollution in the United States is caused by unregulated non-point source discharges (Council on Environmental Quality 1980). Alabama, along with other states, has developed agricultural, silvicultural, and residual waste control plans to help control nonpoint pollution.

In coastal Alabama, pollution problems are greatest in Chickasaw Creek, Three Mile Creek, Mobile River, and Mobile Bay. Major problems are bacterial contamination, dredging of fossil shells on oyster fishing grounds, and saltwater intrusion in the ground water in or near some resort communities along the coast.

One major problem (one-stop permits) has been recently resolved. Delays in issuing National Pollution Discharge Elimination System (NPDES) permits for new industries had been excessive, but in October 1979 the Alabama Water Improvement Commission assumed responsibility for the permit program and eliminated delays that were caused by former state-federal coordination requirements.

POINT AND NONPOINT SOURCES

Through provisions of Section 208 of the 1972 amendments to the Federal Water Pollution Control Act, an assessment of pollution sources and controls needed to meet the goals of this Act was made in 1979 by the South Alabama Regional Planning Commission. The following summary of point and nonpoint pollution is from the Commission's 208 study (Brady 1979) unless indicated otherwise. A water quality management plan was prepared for coastal Alabama based upon the findings of the 208 study.

In 1977 there were 19 municipal wastewater point sources with an aggregate flow of 55 Mgal/d and 38 industrial process wastewater sources with NPDES permits that had an aggregate flow of about 134 Mgal/d. There were also 49 semipublic and private sources of sanitary waste, cooling water, boiler blowdown, rain water runoff, and other non-permit effluents.

Municipal and industrial wastewater point sources in coastal Alabama in 1981 are shown in Figure 35 and indexed in Table 141. Not included in this figure are shoreline commercial establishments such as restaurants along Battleship Parkway that have NPDES permits for small package waste treatment systems and industries with storm runoff or other occasional discharges.

Mobile River and Chickasaw Creek are the receivers of the greatest volume of industrial wastes. Major sources are electric generating plants (mostly cooling water and steam condensate), paper mills, and chemical plants. At the time of the 208 assessment, four industrial plants did not meet the 1977 Best Practical Treatment legal requirements, but these were under compliance schedules for 1978 requirements.

In coastal Alabama, the principal nonpoint pollution is associated with urban storm water runoff carrying sediment loads from construction and new development sites, bacterial contamination of Mobile Bay waters from surface water runoff upstream, and water pollution from septic tank drainfields in low-lying areas, including Gulf Shores-Fort Morgan peninsula and Dauphin Island. The agricultural pollution control plan (Alabama State Soil and Water Conservation Committee 1978) reports that animal wastes, nutrients, and sediments are the major agricultural nonpoint pollutants in southwest Alabama. This study reports that over 36,000 ha (90,000 acres) of agricultural lands in Baldwin County and 24,000 to 36,000 ha (60,000 to 90,000 acres) in Mobile County need extensive erosion control.

The 208 assessment identified the following polluted streams in the two-county area (Brady 1979).

Mobile River, upper reaches: thermal wastes from the Barry Steam Generating Plant and fecal coliform from sewage wastes.

Chickasaw Creek: thermal pollution from the Chickasaw Steam Plant, saltwater wedge intrusion, and heavy biochemical oxygen demand from excessive nutrients.

Three Mile Creek: municipal sewage from treatment plants.

Mobile River, lower reaches: pollutants from Three Mile and Chickasaw Creek (see above).

Deer River: storm water runoff.

Mobile Bay (western shoreline waters): municipal sewage wastes causing bacterial contamination.

Bayou Coden and Bayou La Batre: organic wastes from seafood processing plants.

Norton Creek and Bayou Sara: sewage overflow from the Saraland treatment plant.

Hollinger Creek: sewage from the Bay Minette sewage treatment plant.

Dog River: sediment loads from urban storm water runoff.

In addition to the above, improperly installed and/or operated septic drainfields pollute the Gulf Shores and Dauphin Island areas and the Fish, Magnolia, and Fowl Rivers, which discharge directly into Mobile Bay.

The national assessment of water and related resources (Southeast Basins Interagency Committee 1977) identified the Mobile and Perdido Rivers as seriously polluted. The Mobile River is polluted by high residual waste loads, industrial wastes, nonpoint source pollution, and strip mine wastes. Related land-originated problems include urban and non-urban flooding and disposal of dredged material. In the Perdido River, agricultural and logging practices, dredging, and construction of navigational channels have caused heavy sediment loads. Groundwater withdrawals are now exceeding recharge of aquifers in some areas of this drainage basin.

BACTERIAL CONTAMINATION AND OYSTER SHELL DREDGING IN MOBILE BAY

Water pollution in Mobile Bay has had serious consequences for the oyster industry. The upper portion of Mobile Bay has been closed to oyster fishing (see Figure 23) because of bacterial contamination (fecal coliform). In colder weather, when freshwater enters the Bay in large quantities, the entire bay is frequently closed to oyster fishing. Most of the bacteria (principally septic tank overflow or seepage and agricultural runoff) enter the bay from polluted streams. The city of Mobile is not a major source.

The proposed Theodore Industrial wastewater outfall in Mobile Bay would cause additional reef closures due to bacterial contamination if treated domestic wastewater is allowed in the pipe discharge. The proposed outfall pipe would discharge about two miles north of White House reef. The domestic wastewater release would cause permanent closure of at least 83.2 ha (205.4 acres) of oyster reef (U.S. Army Corps of Engineers 1979a). Even worse conditions are projected by the Alabama Department of Conservation and Natural Resources and the U.S. Food and Drug Administration. They believe that the entire western side of Mobile Bay and portions of eastern Mississippi Sound would be permanently closed to oyster fishing because fecal coliform concentration standards of the National Shellfish Sanitation Program would be exceeded. In this case, 76% of the total Alabama oyster fishing grounds would be closed (U.S. Army Corps of Engineers 1979a). EPA has opposed inclusion of treated domestic wastewater in the pipeline because of these potential drastic impacts on the oyster fishery.

For many years oyster fishermen and others, including many waterfront property owners along the eastern bay of Baldwin County, have vigorously opposed dredging of fossil oyster shell deposits from Mobile Bay. This shell removal began in 1946. Although definite adverse impacts resulting from this type of dredging include destruction of benthic organisms, increased turbidity, creation of mud flows, and formation of depressions, these are generally short-term effects. A suspected long-term effect on productivity has not been demonstrated, but oyster fishermen believe it is harmful to the bay's oyster reefs.

GROUNDWATER

Groundwater supplies in Mobile and Baldwin County are generally excellent and of high quality except along the Gulf coast where withdrawals of groundwater have resulted in saltwater intrusion at Gulf Shores and Dauphin Island. Groundwater pollution from septic tank fields is also an acute problem on the western end of Dauphin Island and on the Fort Morgan peninsula. The Baldwin County Health Officer has reported that all wells tested at Fort Morgan are contaminated with human wastes from septic tank fields (St. Amant 1981). The Mobile County Health Department has placed a moratorium on new building on Dauphin Island's western portion until sewer facilities are built because of a similar problem. Following Hurricane Frederic, the Baldwin County Health Department attempted to ban reconstruction of beach houses destroyed by the storm but yielded to the protests of property owners. Building continues there in spite of the well water test results and the poor prospects of funding for sewage treatment facilities and a potable water supply.

AIR QUALITY

Air quality as an issue in coastal Alabama is characterized by particulate and photochemical oxidant pollution in Mobile County, visual and odor problems in certain areas of eastern Mobile County, and inadequate monitoring of pollutants. The solution undoubtedly will be the maintenance and improvement of air quality in pace with the population, port, and industrial growth in Mobile County.

National Ambient Air Quality Standards (NAAQS) are set by EPA as required by the Clean Air Act of 1970. Each state is required to attain and maintain standards for sulfur oxides, suspended particulates, carbon monoxide, hydrocarbons, nitrogen oxides, and photochemical oxidants. For each pollutant, there is a primary standard intended to protect human health and a secondary standard for public welfare. These standards include allowable short-term and average annual levels of pollutants.

The 1977 amendments to the Clean Air Act requires states to designate attainment and non-attainment areas based upon pollutant levels above or below NAAQS's standards for sulfur oxides, suspended particulates, nitrogen oxides, carbon monoxide, and photochemical oxidants. A portion of Mobile County is designated as a non-attainment area for particulates and the entire county is similarly classed for photochemical oxidants. In non-attainment areas, major new sources of pollution must meet stringent requirements to reach the lowest achievable emissions for these pollutants. States with non-attainment areas have been required to revise their implementation plants for these areas so that NAAQS standards can be met by the end of 1982 or, in some cases, 1987.

Total estimated emission levels published by EPA in 1976 for the Alabama portion of the Interstate Air Quality Control Region incorporating Mobile, Baldwin and Escambia Counties are shown in Table 142. Mobile County, with its concentration of industry and vehicular traffic, accounts for most of the air pollution. Of the criteria pollutants, particulates, sulfur oxides, and nitrogen oxides originate largely from point sources (U.S. Army Corps of Engineers 1979a). In Mobile and Baldwin Counties, there are 31 major stationary air pollution sources (Alabama Air Pollution Control Commission 1981). EPA defines a major source as one with the potential to emit more than 100 tons per year of any pollutant or combination of pollutants while operating at design capacity with no pollution controls (Council on Environmental Quality 1980).

In contrast, nonpoint sources account for about 64% of hydrocarbon emissions and 92% of carbon monoxide emissions (U.S. Army Corps of Engineers 1979a). Hydrocarbons, interacting with pollutants such as nitrogen oxides in the atmosphere, produce photochemical oxidants, including ozone. Major hydrocarbon sources are vehicle exhaust and evaporation from industrial processes and petroleum storage areas. Carbon monoxide arises principally from vehicular emissions.

Declines in particulate pollution in Mobile County were observed in the 1970's in both urban and suburban areas. The consistently highest levels of particulates reported from monitoring sites have been at the State Docks and nearby WKRG tower. Between 1975 and 1979, the annual geometric mean at the latter site declined 32% (114 $\mu g/m^3$ to 77 $\mu g/m^3$) compared with the primary standard of 75 $\mu g/m^3$. At the State Docks monitoring station, the decline was 15% (124 $\mu g/m^3$ to 106 $\mu g/m^3$) between 1975 and 1977 (Alabama Air Pollution Control Commission 1981).

The principal sources of particulate pollution are electric power generating facilities (Barry Steam Plant) and the Alabama State Docks, where bauxite, cement, and grain handling are major activities. Ozone levels are generally highest in the industrial area north of Mobile and at the Theodore Park area to the south. Maximum levels of photochemical oxidants such as ozone are typical some distance from the origin of the hydrocarbon emissions from which they are formed. The percentage of air pollution contributed by selected sources in Mobile, Baldwin and Escambia Counties as reported by EPA in 1976 are given in Table 143.

When Mobile's air quality is compared with that of other metropolitan areas of similar size, gaseous pollutants (carbon monoxide, nitrogen oxides, and sulfur oxides) are relatively low (David Volkert and Associates 1977), but suspended particulates and dustfall (settleable particulates) are high. Only Birmingham among southeastern cities has higher levels (Alabama Coastal Area Board 1979). Compared with the Southeastern Federal Air Quality Region (8 states) as a whole, Mobile has less carbon monoxide emissions, greater particulate violations, and comparable ozone concentrations.

Air quality is continuing to improve nationally in spite of severe problems in some areas. In 1974-78, the number of violations of NAAQS's in 23 combined urban areas decreased 18% (Council on Environmental Quality 1980). Reductions in average annual concentrations of carbon monoxide, sulfur dioxide, and suspended particulates have dropped, but ozone levels remained constant. Estimates of total national manmade emissions of criteria pollutants from 1970 to 1978 show constant or decreasing quantities except for nitrogen oxides, which increased 17%. Sulfur oxides declined 9.4% and suspended particulates 46% (Council on Environmental Quality 1980).

ENVIRONMENTAL CONCERNS

Many problems arise from air pollution and efforts to control it. Some are obvious, such as the high cost to meet attainment standards. The impacts of harmful levels of air pollution on crops, forests, and public health are well documented and quantitied. Because of the high cost, industries that produce pollutants as by-products are reluctant to exercise pollution controls.

Due to a phenomenal expansion of information on environmental consequences of pollution and the public's response during the past two decades, many industries have had to make substantial and costly changes in their operations to meet requirements of the Clean Air Act and its amendments. Closing of plants that could not be economically modified to meet pollution standards contributes to unemployment and local economic depression. Some industrialists believe that they have responded adequately to rectify former hazardous air conditions, as evidenced by the national improvements in air quality. Aside from addressing remaining local problems, further improvements are believed to be excessively costly. Environmentalists believe that although much has been accomplished, it would be unwise to lower pollution standards because of long-term public health problems and costs.

In Mobile County, visual and odor problems from several industrial sites continue to cause concern. One of these sites is the GAF Corporation facility that is in a densely populated area of west-central Mobile. Residents also frequently complain of respiratory problems, but the specific causes are unknown.

In the two-county area, eastern Mobile County from Mount Vernon south to Theodore generates and suffers the greatest impacts of air pollution. Air movement is dominantly north-south, corresponding to the offshore-onshore wind pattern. Air stagnation commonly occurs during periods of calm, usually between 10 p.m. and 8 a.m., and during nocturnal thermal inversions. Pollutant concentration and lowered visibility often accompanies these weather/pollution conditions. Prolonged stagnation for four days or more causes air pollutant concentrations over large areas. In 1963-65, there were 42 extended stagnation periods in coastal Alabama (Mobile County Board of Health 1970; South Alabama Regional Planning Commission 1970). Low level inversions (152.4 m [500 ft] or lower) occur about 30 to 35% of the time.

Inadequate monitoring of air pollution is another local concern. The Mobile County Board of Health, as a unit of the Alabama Air Pollution Control Division, operated a monitoring network for many years. Inadequate funding forced its closure in the mid-1980's. Since then, monitoring has been sporadic. According to the State Air Pollution Control Division, regular monitoring will resume in mid-1981. EPA has recently issued regulations creating a standardized national air quality monitoring system. Nationally, more than 1,200 sites are being chosen from 5,000 existing monitoring sites. The purpose of the changes is to have uniform measurements of air pollutants.

Environmental concern has been raised locally and nationally about hazardous air pollutant levels. In the past, pollutants for which criteria have been set were the focus of monitoring and control. Attention is now being directed to hazardous pollutants under Section 112 of the Clean Air Act. Seven substances including asbestos, beryllium, mercury, vinylchloride, arsenic, benzene, and radionuclides have been listed as hazardous. Of these, proposed or final emissions have been set for the first four. EPA also is considering designation of another group of pollutants as hazardous, and under a proposed new policy it would identify substances that should be considered for regulation as airborne carcinogens (Council on Environmental Quality 1980).

Considering the expected future industrial and population growth of coastal Alabama, air pollution problems could become worse. For example, prospects for short-term improvements in photochemical oxidant levels are not good because vehicular traffic, refineries, petroleum storage facilities, and other sources of hydrocarbons, the precursors of photochemical oxidants, will increase. Some relief is expected eventually when vehicles lacking emission control devices are off the road.

Since Mobile and Baldwin Counties are designated EPA Class II Prevention of Significant Deterioration areas, only moderate, controlled growth of pollutant-producing industry is allowed. For example, in the Theodore Industrial Park, prospects for additional sulfur oxide or particulate-emitting industries are negligible because the existing industries have taken up most of the permitted increments in levels of these two pollutants. Because of its water, transportation, and petroleum resources, Mobile attracts heavy resource users. When new industrial areas, such as the Theodore Park, are developed in relatively unpolluted locations, air pollution may increase even if emissions do not violate NAAQS standards in the area. As a result, a frequent criticism has been made of Mobile's preponderance of high resource users and pollutant-discharging industries.

LAND USE

Land use problems are caused largely by development of unincorporated, high population growth areas in the two counties, and development in flood-prone and other high-hazard locations. Residential development in particular is extensive within the 100-year flood zone, and disastrous flooding occurred three times in one and a half years. Second-home and resort development has increased rapidly since Hurricane Frederic. Because hurricanes historically have struck coastal Alabama (ranging from minor to disastrous results) on the average of about every four years, continued development of barrier lands is of great concern. Federal flood insurance and federal disaster assistance, in effect, subsidize new but vulnerable development. In addition, freshwater supplies and sewage treatment facilities at Dauphin Island and along the Baldwin County coast are inadequate and saltwater intrusion is a serious threat.

GROWTH IN UNINCORPORATED AREAS

During the past decade, the population of non-urban areas of Mobile County has grown 18.5% in the northwestern portion and 72% in the western Tanner-Williams area. From 1970 to 1980, the population of unincorporated Mobile County grew 53.7% (South Alabama Regional Planning Commission 1981). In Baldwin County, the growth rate was 21% between 1960 and 1970, and 32% between 1970 and 1980. Much of this growth has been along the eastern edge of Mobile Bay from Spanish Fort to Point Clear.

Since county governments have no zoning authority, the rapid growth of non-urban areas has been relatively uncontrolled. The Tillman's Corner area south of the city of Mobile and a section of U.S. Highway 98 between Spanish Fort and Fairhope are examples of commercial and housing growth patterns that have developed without zoning restrictions. The characteristics of development in the latter area prompted the formation of a citizen's group called Protect Our Baldwin Environment (PROBE) to find ways of preventing further development of this type in Baldwin County.

Unregulated growth has impacts far beyond the immediate area. For example, Lake Forest is a large residential and second-home community on the eastern shore of Mobile Bay north of Daphne. Diamondhead Corporation intensively developed this complex around D'Olive Creek, which resulted in extreme degradation of the creek. The creek is heavily silted, relatively non-productive, and contributes sediments along the eastern shore of the bay.

Land-use problems will intensify in coastal Alabama in the continuing absence of zoning authority outside incorporated areas. The Coastal Area Board (CAB), through its coastal zone management plan, can assist with planning for appropriate siting of facilities and operations within the coastal zone.

After Hurricane Frederic, the CAB funded studies for the re-development of Battleship Parkway and Dauphin Island. Although the purpose of the Battleship Parkway study was to consider a number of options for development, the plan was highly controversial because it emphasized intensive development of much of the Parkway lands—lands that were generally incompatible with the high hazard nature of the area and would degrade or alter its natural values.

The Dauphin Island redevelopment plan is of concern to local conservationists because it recommended conversion of a portion of the National Audubon Society Sanctuary to a campground. The sanctuary is designated a preservation area in the CAB's approved coastal zone management plan. The policy of the Board is to oppose any changes that adversely affect areas it has designated for preservation.

The South Alabama Regional Planning Commission also serves an advisory role in land utilization for both counties, but without zoning, orderly growth will be difficult to achieve.

DEVELOPMENT IN FLOOD-PRONE AND HIGH-HAZARD ZONES

Flood-prone areas are extensive in coastal Alabama because of the natural features of the terrain. Broad, flat floodplains and tidal influences characterize coastal streams. Flood-prone areas that correspond to natural drainages are shown in Figure 36.

Severe flooding of lowland areas is most likely during hurricanes and heavy rainfall. In the urban area of Mobile County, much of the residential and commercial development is within the 100-year flood zone. Furthermore, the city of Mobile has adopted a concrete, open channel drainage system which, while directing flood waters along defined courses, eliminates the natural assimilative capacity of unmodified drainages. The city does not have standard regulations for erosion and sediment control, and heavy sediment loads often accompany flood waters.

Within the past one and a half years, Hurricane Frederic and two severe storms have had disastrous results in coastal Alabama. Hurricane Frederic was one of the most costly natural diasters in United States history. Wind damage was extensive, and 49,765 ha (122,920 acres) of coastland, marshes, and the Mobile Delta were flooded (U.S. Army Corps of Engineers 1981).

A severe storm in May 1981 caused greater flood damage to residential areas in the city of Mobile than Hurricane Frederic. Almost 3,000 residences and other buildings were flooded, many of which had never been flooded before. Some of the flooding was in the Bel Air-Springdale suburban area, formerly Wragg swamp before it was filled. The floodplain of Three Mile Creek also was the site of much flood damage, as it has been in the past and flood control there has become a heated issue. Since many structures are already in the floodplain, there are no ready solutions.

The development of Alabama's barrier lands is a complex issue. These high hazard zones are subject to full hurricane and storm intensities and are basically dynamic, naturally changing lands. Hurricanes play a pronounced role in shaping coastal shorelines. Between 1901 and 1974, hurricanes of different intensity struck Alabama's coastline on the average of once every 52 months (Hardin et al. 1976). Between 1909 and 1917, Dauphin Island was divided by hurricane wind and waves into two smaller islands separated by 8.5 km (5.3 mi) of open water, shoals, and the scattered remnants of the former island (Hardin et al. 1976). This breach occurred in the western section of the island, which has been the site of extensive residential development since 1950.

Hurricane Frederic destroyed 475 residential and business structures along the Baldwin County coast and damaged many more in 1979. It was a major storm (Class III) with winds of 179 to 209 km/h (111 to 130 mi/h) and a 2.8 to 3.7 m (9 to 12 ft) storm surge. By comparison, Hurricane Camille, which hit the Mississippi coast in 1969, was a great storm (Class V) with winds of over 233 km/h (200 mi/h) and a storm surge in excess of 6 m (20 ft). If a storm like Camille should hit the Alabama coast, the result would be many times more disastrous than Frederic.

Since Hurricane Frederic, Gulf Shores has been rapidly rebuilt as will be Dauphin Island now that the bridge to the island is completed. In part, this rebuilding is possible because the Federal Flood Insurance program insures property in flood-prone areas at very attractive rates. This federal program, which was originally intended to discourage development in high risk areas, actually promotes it. Annual cost of the insurance program has been escalating, and in 1975 totaled about $1 billion according to the General Accounting Office (Mobile Press Register 1977).

New flood insurance requirements for structure heights above sea level were made for the Alabama coast following Hurricane Frederic. These new regulations have generated much controversy, especially in the Bayou La Batre area.

The coastal shoreline of Alabama characteristically is being modified by wind, currents, and tides (Hardin et al. 1976). Shore erosion rates in 1917-74 are shown in Figure 37. This erosion is of great concern to shoreline owners as it affects property values and boundaries. Attempts have been made at Dauphin Island to alter erosional patterns, and shoreline owners along the bay have used bulkheading to arrest erosion rates. Whether to expand controls and, if so, by what methods remains an unresolved issue.

OIL AND GAS DEVELOPMENT AND OIL SPILLS

Environmental issues related to oil and gas development in coastal Alabama began over a decade ago when the State leased submerged lands in Mobile Bay to several petroleum companies for exploration. Drilling for oil and gas in estuarine waters was fought vigorously by environmentalists and property owners on Dauphin Island and along Mobile Bay. Although Mobil Oil Company discovered gas reserves and drilled without serious accidents, drilling for gas and oil in such sensitive areas as Mobile Bay will remain an environmental issue.

As petroleum exploration in both state and federal coastal waters accelerates, there will be many conflicts, especially if oil is found. These conflicts will expand to encompass petroleum-related development such as the location and extent of pipeline corridors, equipment yards, refineries, and storage facilities.

Until recently, oil and gas exploration and development have been largely confined to onshore sites in coastal Alabama. The Citronelle field in Mobile County and the South Carlton field in Baldwin County were discovered in the 1950's. Later, the Hatter's Pond and Chunchula fields were developed in Mobile County. Oil spills and pollution generally have not caused any serious environmental problems. Exceptions are brine disposal problems at the Citronelle field. See the Mineral Production chapter in this report for further details.

In addition to the oil fields in the two counties, petroleum products are processed at four refineries in Mobile County. In 1977, there were 17 petroleum storage facilities and 163 tanks with a capacity of 6.1 million bbl. In 1975, the total volume of crude oil handled at the port was 4.5 million mt (5 million t) and its refined products shipped through the port was 3.1 million mt (3.2 million t). About 84% of the refined products are moved by barge and nearly all is outbound. Refined products handled at the port consist of distillate and residual oil, gasoline, and asphalt. Crude oil traffic is inbound and carried by small tankers (U.S. Army Corps of Engineers 1979b).

The Alabama State Docks plans a deep-water liquid terminal and dock at the Theodore Industrial Park to handle an estimated 8.7 million mt (9.6 t) of imported crude oil and 0.8 million mt (0.9 million t) of refined products for export. The total estimated volume of crude and refined products for the port in 1986 (14.8 million mt; 16.3 million t) will be almost double the total 1975 volume (7.4 million mt; 8.2 million t), according to the U.S. Army Corps of Engineers (1979b).

The production, processing, storage, and transportation of oil and oil products in the coastal counties cause some pollution and always have the potential to do so. The local office of the Alabama Water Improvement Commission investigates all reports of spills in waterways and those with potential for water contamination. In 1980, the Commission investigated approximately 24 oil spills in the coastal counties (the exact total is estimated since the locations of some are not precisely recorded). The total estimated volume (some amounts were not estimated) of investigated spills was 98,000 liters (26,000 gal). Of this total 29% occurred on land and the remainder at the port and in other waterways (Alabama Water Improvement Commission 1981).

Present levels of oil pollution in the coastal waters are minor compared with that in the entire Gulf region where estuarine and nearshore marine spills have become a major problem. In 1976 and 1977, 252,000 bbl of oil and other petroleum substances were reported spilled in U.S. waters of the Gulf of Mexico (Liebow et al. 1980). More than 84% of this volume was spilled in rivers and channels, ports and harbors, on beaches, and in non-navigable waters. Of the oil polluting incidents between 1972 and 1976, about one-third of the United States total was reported from the Gulf of Mexico and represented an annual range of 16% to 37% of the total volume spilled in the United States.

Recent events indicate that extensive oil and gas exploration and perhaps production will occur in Alabama coastal waters and in the Outer Continental Shelf (OCS). This is assumed because (1) the Mobil Oil Company discovered gas potential for commercial gas production at a lease site in Mobile Bay in 1979; (2) there is a resurgence in petroleum exploration and extraction in response to high price increases for imported petroleum since 1973; and (3) exploration has been stimulated by federal price deregulations.

The Mobil Oil Company has two additional exploratory wells and permits for two more at its lower Mobile Bay site. Mobil also has applied for a permit from the Corps of Engineers for five production wells, an auxillary well, and a buried pipeline network. Included in Mobil's plans are a gas processing facility and sulphur depot. A new lease program in State waters was initiated in 1981 by the Alabama Department of Conservation and Natural Resources and leases have been signed for 13 tracts, totalling 22,289 ha (55,054 acres) in lower Mobile Bay, Mississippi Sound, and offshore from Dauphin Island and the Fort Morgan peninsula (see Figure 17 in the Minerals Production chapter).

It took the Mobil Oil Company nine years to get approval for its Mobile Bay test oil well because of environmental issues. The location of the well where Mobil eventually drilled triggered great concern, because it lies in close proximity to the Mobile Ship Channel, prime marshlands, and beaches. Environmentalists argued that any oil or gas reserves beneath Mobile Bay would only increase in value with time and that their extraction should await technological advances to assure less risk of major pollution from a blowout or other accidents.

A new problem has arisen because of the proposed disposal of drilling muds and cores in the Gulf of Mexico by the Mobil Oil Company. As a condition of its original drilling permit, the company is required to transport all drilling materials and products to land disposal sites as one of a number of stipulations set forth by the State of Alabama Attorney General. The proposed ocean dumping from exploratory drilling was opposed by the tourist industry at Gulf Shores. The dump site was opposed by the Alabama Department of Conservation and Natural Resources because it is near an artificial fishing reef.

The Mobil Oil Company's discovery will likely help kindle interest in OCS lands nearby. Lease sales scheduled for next year include 21 tracts from 4.8 km to 32 km (3 mi to 20 mi) off the Alabama and Mississippi coasts. Some of these tracts will adjoin the recently leased state tracts. In 1981, OCS lease sales included 10 tracts south of Alabama waters. Mobil is drilling at one active lease site south of Perdido Pass. To date, however, OCS leased lands in the northern Gulf off the coasts of Florida, Mississippi, and Alabama have not produced either oil or gas. Between 1947 and 1976, 114 tracts in the Gulf have been leased south of these three states (Mumphrey and Carlucci 1978).

Future problems could involve onshore siting for State and OCS oil and gas-related facilities and activities that support offshore drilling and extraction, and the placement of the pipeline transmission network to shore. Often the onshore impacts are more extensive and permanent than those offshore. Commitments of land to pipe and equipment yards, refineries, pipeline transmission systems, and docks can be extensive; facilities of these types sometimes are located in ecologically sensitive areas. Because of existing shore facilities in Louisiana, OCS oil and gas produced in waters near Alabama may be transported to Louisiana ports.

Through provisions of the 1976 amendments to the federal Coastal Zone Management Act, states with approved coastal zone programs receive federal funds to offset onshore impacts of offshore energy development. Alabama is receiving a share of these funds. Coordination of siting of onshore facilities through state coastal zone agencies also is mandated by the 1976 amendments.

CONSERVATION OF HABITATS AND RELATED SPECIES

Another environmental concern in coastal Alabama is conservation of natural habitats. Coastal Alabama is a complex of urban, suburban, industrial, fishing, tourist, agricultural, and forestry activities. When natural areas are irrevocably modified or converted for such activities, habitats essential to certain animals may be diminished or lost entirely. Habitat modifications caused by man may favor certain species, but in most cases the result is a loss of species diversity. For example, current forestry practices for pine include even-aged management of a single species (monoculture) and clear-cut logging. Before these practices became common, the managed forest contained pine of varying ages along with some hardwoods and a variety of shrubs and herbs, and selective cutting was practiced. With the newer management practices, the land is harvested of all trees at one time, replanted with young pine or seeded, and hardwoods are eliminated by chemical spraying. This type of forest supports only a very limited number of wildlife species.

Beyond the desirability of having diverse and abundant wildlife, conservation of natural habitats in coastal areas provides other benefits. Certain areas provide recreational sites, protect man from the full impact of severe storms and hurricanes, provide habitat necessary for seafood species, recharge ground water supplies, and assimilate pollutants.

In the coastal area, there are only two federally owned natural areas. These areas are a portion of the Perdue unit and the Little Dauphin Island unit of the Bon Secour National Wildlife Refuge. These areas and State or locally protected ones are shown in Figure 38 and Table 144. Most areas are small, and in some cases, protection of their natural features is limited or temporary.

Habitat types of coastal Alabama, their degree of sensitivity to alteration, and activities that severely affect them are listed in Table 145. Critical and ecologically valuable habitats and their major attributes are given in Table 146. These habitats comprise about 28% (45,914 ha; 113,453 acres) of the 161,435 ha (398,906 acres) below 15.2 m (50 ft) msl. The following is a discussion of habitats that are threatened or endangered by man's activities or are of special value (for example, endangered species habitats).

ENDANGERED AND THREATENED SPECIES

The Alabama list of endangered and threatened species and species of special concern for Mobile and Baldwin Counties (Boschung 1976; Freeman et al. 1979) include 17 endangered and 11 threatened animals (Table 147) and 7 endangered and 19 threatened plants (Table 148). Some of these species are few in number because they are at the edges of their present ranges. The introduction of large quantities of DDT and related persistent pesticides into the natural environment has caused a serious widespread loss of birds and other animals. Bald eagles, peregrine falcons, brown pelican, and osprey have had poor hatching and survival success because of these pesticides. The loss of suitable nesting and foraging sites because of current agricultural and forestry practices has endangered the red-cockaded woodpecker, once a common bird of mature southern pine forests. Man's direct impact on a species is illustrated by the over-exploitation of the alligator, which eventually reduced this once common species to precariously low population levels.

In general, man has eliminated the larger predators. Alabama's largest remaining Florida black bear population is in the more remote areas of the Mobile Delta. These animals once were widely distributed in the southern portion of the State.

Of the 26 endangered and threatened plants on the Alabama list for coastal counties, 9 are on the Federal list (Table 148). Twelve of the 28 animals contained in the State list also are federally listed (Table 147). Unless a species is on the federal list, there is no practical way to protect the habitats of most other species. Because Alabama does not have a non-game wildlife program such as those of Colorado and Kentucky, or a natural areas acquisition program, there is currently no effective way to preserve the habitats of most plants and animals.

MOBILE DELTA

William Bartram, who visited the Mobile Delta before 1800, was deeply moved by the primeaval magnificence he found: "Opposite this bluff, on the other side of the river, is a district of swamp or low land, the richest I ever saw, or perhaps anywhere to be seen: as for the trees I shall forbear to describe them, because it would appear incredible; let it suffice to mention, that the Cypress, Ash, Plantanus, Populus, Liquidambar, and others are by far the tallest, straightest, and in every way the most enormous that I have seen or heard of" (U.S. Department of the Interior, National Park Service 1979). The forest Bartram knew was radically altered by logging during the subsequent 100 years. In 1880, fcrester Charles Mohr wrote: "The large number of logs harvested shows clearly with what activity the destruction of these treasures of the forest is being pushed; and the reports, as of heavy thunder, caused by the fall of the mighty trees, resounding at short intervals from near and far, speak of its rapid progress" (U.S. Department of the Interior, National Park Service 1979). Yet today, the Mobile Delta is still a valuable natural area (Table 149). In 1974, its natural importance was recognized when the Secretary of the Interior designated 76,500 ha (189,000 acres) as the Mobile-Tensaw River Bottomlands National Natural Landmark. Its size, inaccessibility, and difficulty of conversion to other uses have been instrumental in retaining the Delta's natural integrity.

The Delta is a vast complex of vegetated lands interwoven with many waterways. It is estimated to be composed of 8,225 ha (20,323 acres) of open water, 4,229 ha (10,450 acres) of fresh-mixed marsh, 28,065 ha (69,348 acres) of swamp, and 34,334 ha (84,839 acres) of mixed bottomland forest (Alabama Coastal Area Board and U.S. Department of Commerce 1979). Within the Landmark boundaries, higher lands are occupied by mixed upland forest. The lower 25% of the Delta is a treeless plain, and its marshes are collectively considered among the finest in the Nation (Stout 1979). This portion of the Delta is a prime waterfowl habitat and a center for sport and commercial fishing. Despite ravage of the past, the entire Delta, because of the diversity and quality of its extensive habitats, is still rich in flora and wildlife.

Although the Delta has largely retained its natural characteristics as the Mobile area has grown, the National Park Service classified the Landmark portion as threatened in 1977 and conducted a survey in 1978 to document its significance and to develop preservation alternatives. This study (U.S. Department of the Interior, National Park Service 1979) concluded that major threats to the Delta, if unchecked, would result in loss of many natural values and the integrity upon which the original determination of national significance was made. The major threats identified were as follows: industrial development along the west bank of the Mobile River with further expansion planned northward; cumulative effects of water pollution, particularly silt and agricultural chemicals; potential expansion of timber harvesting; uncontrolled shooting of wildlife; and the cumulative effects of dredging and spoil disposal from the Tennessee-Tombigbee Waterway project. Of these threats, land-use changes, including development in the floodplain, are the greatest dangers.

Current ownership of the Delta Landmark is divided among 150 owners, some of whom have non-contiguous tracts. The southern half is largely owned by land and timber companies and a smaller section of about 1,200 ha (3,000 acres) is held by the State. Nearly one-fourth of the northern Delta is owned by another timber company. Although the Coastal Area Board has designated the Delta as a geographic area of particular concern, it is largely in private ownership and there is no authority to protect its natural resources. The Board's policy will be to prohibit uses of the Delta that degrade its natural functions, but this policy does not extend to regulations or enforcement.

A Park Service survey concluded that a downward trend in the Delta's natural values is strongly evident and that without effective controls, the landmark will lose much of its ecological value. Previous attempts to protect the Delta by federal acquisition have failed. The U.S. Fish and Wildlife Service twice tried to purchase the lower portion for a refuge, but local opposition cancelled these plans. An organized and vocal group of hunters and fishermen are opposed to federal ownership, apparently even if traditional hunting and fishing are to be permitted. Presently, large Delta tracts are leased by hunting clubs. The State has not attempted to acquire additional lands and probably lacks the funds to do so. The degradation of the Delta will be a continuing issue. The means to prevent or lessen the changes through protective ownership do not now exist.

BARRIER LANDS

Barrier lands of coastal Alabama include Dauphin Island, the Fort Morgan peninsula, Little Dauphin Island, and Sand-Pelican Island. The natural appeal of these areas has caused a rapid growth of second homes on Dauphin Island and the Fort Morgan peninsula, and resort facilities east of the peninsula at Gulf Shores. These developments considerably altered or destroyed the natural habitat.

Sand dunes are particularly threatened because there are no zoning regulations requiring setback of structures. The dunes are frequently leveled for development, and then the area is further altered by filling to accommodate septic tanks and field lines in areas not served by treatment plants.

The uncontrolled use of off-road vehicles also is a threat to dune vegetation and helps hasten dune erosion from wind and water. In a heavily used area such as Gulf Shores, foot traffic has somewhat the same effect. Pollution from septic tanks and disturbance of feeding and resting birds are additional negative impacts on the quality and aesthetics of dunes.

The vegetation of the foredunes is limited to several succulent plant species and some salt-tolerant species. Although sparce, their value is great because their extensive root systems and often trailing vine-like vegetation form traps and hold sand. Dunes are an integral part of an everchanging but naturally resilient shoreline environment. Barrier lands, with their dunes are a first line of defense against storms and help shield the mainland and its communities from direct wave, wind, and tidal forces.

Dunes also provide essential habitat for several species of animals. Loss or degradation of dunes has caused the endemic Alabama Gulf beach mouse and the Perdido Bay beach mouse to be placed on the State's list of endangered and threatened species. These species are restricted in distribution to dunes east of Mobile Bay and are dependent upon the seeds of sea oats for food.

Barrier lands also contain various other habitat types many of which can be altered or lost by injudicious development. Inland from the beach and foredunes on the Fort Morgan peninsula are a series of parallel stable dune ridges alternating with wet sloughs. A diversity of habitats is found in this highly compressed area (Stout and Lelong 1981). Habitats include freshwater marshes, swamps with bay and cypress, freshwater ponds covered with water lily and other floating aquatics, oak hammocks, and dry sand and slash pine communities. Some of the best representatives are in the Perdue tract, purchased for the Bon Secour National Wildlife Refuge, and at Little Point Clear, proposed for refuge acquisition.

Sand bars and spits also are valuable wildlife habitat. Colonial nesting birds, including terns, gulls, and shorebirds, use them as nesting and roosting areas, and in some cases, as nesting sites. Residential development on barrier islands has reduced the availability of sites for many colonial nesting species; their population has declined and their vulnerability has risen. In Portnoy's (1977) survey of nesting colonies of seabirds and wading birds along the Louisiana and Mississippi coasts and the Alabama coast west of Mobile Bay, only 18 of 168 colonies were posted or otherwise protected.

Prior to Hurricane Frederic in 1979, Sand-Pelican Island, an emergent bar south of Dauphin Island, was an important nesting area for black skimmers, least terns, and gull-billed terns. Snowy plovers, a State endangered species, were permanent residents, and the island's intertidal pools were a major feeding location for reddish egrets, also a State threatened species. Hurricane Frederic inundated the entire island and washed away about two-thirds of its 2.7 km (1.7 mi) length. The bar is now rebuilding and revegetating and undoubtedly will again become a valuable nesting site. Human interference, however, during nesting times has and will continue to be a problem, as Sand-Pelican Island is frequently visited by boaters and fishermen. This island and its bird life also will be very vulnerable to pollution that may result from oil spills from OCS and nearshore oil and gas development.

TIDAL MARSHES

Vital, highly productive tidal marshes of coastal Alabama are characterized by expanses of emergent aquatic vegetation. They may be extensive meadows, thin margins along shorelines, or isolated patches (Stout and Lelong 1981). Their natural functions are numerous, but foremost is their importance in the estuarine food chain. When marsh plants complete their life cycles and decay takes place, small-sized organic matter (detritus) becomes available to the estuary as a whole through tidal transport. This basic nutrient source is especially important to the larvae and juveniles of most sport and commercially valuable species of fish and shellfish.

The high productivity of these marshes has been illustrated in a number of studies. For example, conservative estimates for net annual production of Gulf and south Atlantic marshes are 8,000 kg/ha (9,000 lb/acre) for higher marshes and 24,000 kg/ha (27,000 lb/acre) for low, regularly flooded marshes (Gosselink et al. 1974). The rate of productivity for such tidal marshes exceeds high-yield crops like corn and rice.

Marsh values also may be derived from seafood yields. A world-wide positive correlation between commercial shrimp yields per unit of intertidal marsh and latitude has been demonstrated (Stout 1979). For coastal Alabama, Chermock (1977) calculated that the value of a unit acre of tidal marsh based on commercial and sport fish landings in 1975 was about $2,155/ha ($872/acre). Moreover, no planting, fertilizing, or cultivation is needed. By comparison, in 1974 the crop value per hectare of cotton in Alabama was $450 ($182/acre) and corn and soybeans was $381 ($154/acre).

In addition to primary food production, tidal marshes offer shelter, breeding or spawning locations for many aquatic organisms, and feeding or breeding areas for a variety of birds, amphibians, reptiles, and mammals. An important function to man is their contribution to waste treatment and water quality. Marshes remove and assimilate nutrients and effectively buffer impacts of large inputs of phosphates and inorganic nitrogen. Marshes also act as buffer zones against severe storms by absorbing the enormous energy of storm waves and by acting as reservoirs for coastal storm waters (Gosselink et al. 1974).

In coastal Alabama, Chermock (1974) estimated that there were 12,225 ha (30,207 acres) of salt, brackish, and fresh-mixed marshes in 1972. Of this total, about half were located in the Mobile Delta. Vittor and Stout (1975) in another survey reported 4,230 ha (10,450 acres) in the Delta. The different totals are partly attributed to inclusion of some swamp acreage in the earlier survey. In addition to the Delta, extensive marshes spread along the northern shore of Mississippi Sound. Chermock (1974) reported that this area in Alabama contained about 4,450 ha (11,000 acres) of marshes.

Most of the marsh south of the Mobile Delta is saltwater or brackish. Saltwater marshes occupy 943 ha (2,330 acres) in the Mississippi Sound, Bon Secour Bay, and the narrow fringes bordering brackish marshes (Vittor and Stout 1975). These marshes are subject to constant flooding (with salinities over 15 ppt at least part of the year) and are dominated by smooth cordgrass. Brackish marshes in Alabama cover 5,468 ha (13,512 acres). Salinities are typically 5 to 15 ppt and the vegetation is composed of several species, largely black needlerush.

Despite a history of man-made alteration of coastal lands, waters, and marshes, the most significant adverse impact on coastal Alabama, and in particular Mobile Bay, has been dredge and fill operations for navigation. Marshes have been destroyed directly by dredging and indirectly by spoil deposition. A minimum of 2,024 ha (5,139 acres) of marsh have been lost by dredging in the Mobile estuary, whereas 888 ha (2,194 acres) have been created by spoil deposition. The net loss is 1,192 ha (2,945 acres) or 22% of natural marshes. Furthermore, the spoil habitats are less valuable than natural marshes.

SUBMERGED GRASSBEDS

Submerged grassbeds flourish in clear, shallow portions of Alabama's coastal estuaries. The beds are highly productive ecologically sensitive plant communities consisting of rooted vegetation that is usually submerged even during low water. Grassbeds contribute considerably to estuarine productivity as well as providing food for waterfowl and some fishes and, in the form of detritus, for a host of other organisms. Grassbeds also are nursery grounds for many estuarine species of fish.

Submerged grassbeds also help purify water by utilizing dissolved inorganic phosphorus and nitrogen, trapping and holding sediments, and controlling shoreline erosion (Borom 1979). Species valuable to man that find protection and food in submerged grassbeds during their maturation are blue crab and white and brown shrimp. Some of the best fishing in Mobile Bay is located around shallow, submerged grassbeds. Three sport fishes that live in or near grassbeds when young are spotted seatrout, red drum, and sheepshead .

The total area of grassbeds in coastal Alabama has seriously declined in recent years. The beds once extended along both shores of Mobile Bay and lower Perdido Bay. Now, the once extensive beds on the eastern shore from Daphne to Little Point Clear are all but gone. Along the western shore, they are absent except for small patches around the mouths of tidal streams (Borom 1979). These losses have been accompanied by reports of declines in sport and commercial fishes and invertebrates in this habitat (Stout and Lelong 1981).

Grassbeds in brackish waters also have undergone a reduction in species diversity. In some sites, beds are now composed largely of the exotic, Eurasian milfoil . It has become the dominant species in over 50% of the beds in upper Mobile Bay.

The date of milfoil's introduction is not known, but it has widely spread in the lower Delta and upper Mobile Bay since 1975 (Borom 1979). The history of this exotic in other estuaries has been rapid spreading followed by equally rapid declines and eventual establishment of an equilibrium with native species (Borom 1979).

Although milfoil is a poor food for ducks, compared with most native species, its presence can affect waterfowl populations. In the late 1950's and early 1960's, following a large but temporary invasion of milfoil in Chesapeake Bay, duck populations on the bay flats fell from an average of 4,900 birds per flat, to an average of 390. Populations returned to previous levels by 1965 when the native tape grass rebounded to about 50% of its former level (Borom 1979).

The first comprehensive inventory of submerged grassbeds in coastal Alabama was part of Stout and Lelong's (1981) recent survey of all types of wetland and marsh habitats south of Battleship Parkway. Limited studies of grassbeds were made by both Lueth and Baldwin (Borom 1979) in the late 1940's and 1950's for the Alabama Department of Conservation and Natural Resources, but these studies were related to waterfowl management. Stout and Lelong (1981) determined that grassbeds south of Battleship Parkway covered 328 ha (820 acres) in Mobile County and 777 ha (1,943 acres) in Baldwin County for a total of 1,105 ha (2,763 acres). Since there are no comparable earlier studies, the extent of grassbed loss cannot be quantified.

Of the 21 grassbed species in coastal Alabama, 19 are found in the freshwater habitats of Mobile and Perdido Bays and their tributaries. One species, widgeon grass, lives in the brackish waters of Mississippi Sound and the mouths of bays and tributaries discharging into these bays. Another species, shoal grass, lives in brackish and salt waters (Stout and Lelong 1981). Shoal grass is found at the south end of Perdido Bay and along the leeward side of the western end of Dauphin Island.

Reasons for the reduction in grassbed size are not well understood. Dredging, which increases water depths and turbidity may be one cause. Heavy turbidity and siltation in spoil areas may shade out grassbeds. Uprooting and mangling of vegetation by boat propellers in very shallow areas also may be factors. Grassbeds sometimes are deliberately removed by waterfront property owners to make swimming there more desirable (Borom 1979).

WET, ACID PINELANDS

Of the major coastal habitats, wet, acid pinelands are the most seriously threatened. These areas, also known as moist savannahs and bogs, support unique plant assemblages. Pinelands are characterized by widely spaced trees and water saturated soils. Pines (*Pinus elliottii* and *P. palustris*) are the common trees. Cypress (*Taxodium distichum*) dominate wetter areas. Open, relatively dry ground cover consists of many species of grasses, sedges, and other herbaceous plants. These open cleared areas are maintained by accidental and intentional recurrent burning. Without frequent burning, this habitat, known as pocosins, would be shrubby.

Pitcher plants (*Sarracenia* spp.), sundews (*Drosera* spp.), and butterworts (*Pinguicula* spp.), which trap and digest insects, live in the wetter areas. Characteristically, these areas support an abundance of other herbaceous plants, including yellow-eyed grasses (*Xyris* spp.), redroot (*Lachnanthes tinctoria*), and meadow beauties (*Rhexia* spp.). Several species of orchids sometimes are conspicuous community components.

About half of the wet, acid pinelands is estimated to have been lost in Mobile County during the past 20 years (M. G. Lelong; Biology Department, University of South Alabama; Mobile, Alabama; 1981; personal communication). Originally, acid pinelands occupied extensive areas, espcially below the 3 m (10 ft) msl elevation contour. Rapid urbanization has been the principal cause of habitat destruction (Lelong, personal communication). Until recently, the Theodore Industrial Park supported a large area of wet, acid pinelands but they are being destroyed by dredging and filling. The site is now in the vicinity of Grand Bay Swamp. Smaller, isolated, pinelands sites also live in transitional zones bordering swamps.

Substantial losses of wet, acid pinelands also are apparent in Baldwin County. Many of the flatter, southerly areas have been drained for conversion to cropland, and small areas just north of Gulf Shores have become residential sites. In other parts of the county, hillside bogs are common, but these too are being cleared for marginal pasturelands.

The extensive reduction of this habitat type in Mobile and Baldwin Counties, as well as other areas of south Alabama, has caused many of its characteristic species to be placed on the State list of endangered and threatened plants. In coastal Alabama, two endangered and ten threatened plants live in wet, acid pinelands (Freeman et al. 1979).

MESIC, RAVINE WOODS

Ravines with streams feeding into the Mobile Delta support plant associations which are common to many areas north of the two coastal counties. Examples of the mesic (moist) ravine habitat are near the old Blakely town site and at Live Oak Fishing Camp on the eastern Delta border. Although once found along the western edge of the Delta, most ravine woods have been eliminated one way or another by industrialization.

Beech (*Fagus grandiflora*), maple (*Acer* spp.), deciduous magnolias (*Magnolia macrophylla* and *M. acuminata*), and hophornbean (*Ostrya virginiana*) are characteristic trees and are generally restricted to ravine woods in coastal Alabama. Continued destruction of ravine habitat is serious and threatens the diversity of plant life in coastal Alabama. Because this habitat type has always been uncommon, further loss could be catastrophic.

ENVIRONMENTAL REGULATIONS

In other sections of this chapter, a number of federal acts and regulations affecting major environmental issues were discussed that did not include certain laws and regulations unique to coastal areas. These particular ones are discussed in this section. In addition, Table 150 lists major federal environmental laws and orders. State laws are listed in Table 151.

Federal coastal zone management legislation was enacted in 1972, and Alabama's original legislation followed the next year. The Coastal Zone Management (CZM) Act and amendments affirmed a national interest in protection and growth of coastal areas through a funding program to encourage individual states to develop and implement approved plans for managing natural coastal areas. Responsibility for CZM rests largely with the states, and management powers are derived from a Federal consistency provision of the Act. This provision requires that determinations be made for consistency with State CZM plans for all developments that require federal permits before such permits are approved. Energy facilities are explicitly included in the federal law, and therefore, siting of energy-related onshore facilities may be effectively influenced by state coastal zone management agencies.

Alabama's original coastal zone legislation was enacted in 1973. Intense controversy over the program arose during deliberations on the official boundaries of the state coastal zone. This act was repealed in 1976, and new legislation enacted in the same year. The Alabama Coastal Area Act of 1976 specified coastal zone boundaries and contained measures to correct deficiencies of the original act. The Coastal Area Board, created by the Act to formulate and implement a CZM program, has received federal approval of its plan.

Controversy has continued after enactment of the 1976 Act and formulation of the management program. There have been several attempts to either repeal the enabling legislation or limit the Board's authority to advisory functions.

The other set of laws and regulations that relate strictly to coastal Alabama concern OCS oil and gas drilling and production in submerged offshore lands. Federal legislation on OCS oil and gas originated in 1953 with passage of the Outer Continental Shelf Lands Act. This Act established federal jurisdiction over the submerged lands of the continental shelf outside of the State boundaries. It empowered the Secretary of the Interior to administer mineral exploration and production in the OCS. The secretary designated the Bureau of Land Management as the agency to conduct a leasing program of OCS waters. The U.S. Geological Survey (USGS) was given authority to supervise exploration and production (Title 30 CFR 250).

In addition to the USGS, other federal agencies are involved in regulation of OCS activities. Constructors of facilities must receive permits from the U.S. Army Corps of Engineers so that these activities do not interfere with navigation. Pipeline regulation, including placement, design, and inspection, are made jointly by the Materials Transportation Bureau of the Department of Commerce, the Bureau of Land Management, Geological Survey, and the Federal Energy Regulation Commission. Discharges into waters from OCS oil and gas exploration and production facilities are regulated by EPA under provisions of the 1972 amendments to the Federal Water Pollution Control Act.

State regulation of oil and gas exploration is vested in the State Oil and Gas Board. The Board prescribes rules and regulations (Freeman et al. 1976), including ones governing drilling, production, and pipeline installation and operation in submerged lands (Code of Alabama 1975, Sections 9-17-1 through 9-17-88 and 40-20-1 through 40-20 37).

Board Rule OS-3 of the submerged lands' regulations concerns pollution and waste disposal. It specifies that if any pollution occurs, it is the responsibility of the operator to control and remove it at his expense. This rule also prohibits any water disposal of oil, drilling muds, cuttings, and other solids, and detergent surfactants, or dispersants. Any spills and their quantities must be reported to the Board's supervisor. Manned facilities are required to be inspected daily and unattended ones at frequent intervals, and standby pollution control equipment is to be maintained and regularly inspected.

SUMMARY

This paper has reviewed major environmental issues that originate from conflicts in the uses of the water, land, and air resources. Water utilization issues are most severe in Mobile Bay. Sharing of the Bay's resources by diverse and competing interests has generated many conflicts. Of these, dredging and fill activities are the leading concern. Water quality problems are serious in both counties, and the resolution of these is a broad issue.

Land use issues are basically those of unregulated growth and development in high-risk areas, such as floodplains and beaches. Frequent flooding, wind damage, and shoreline erosion in areas of urban, industrial, and recreational development often exact a high cost because such developments are supported in part by the taxpayer through insurance subsidy, public works, and disaster relief.

Other land issues are the preservation of endangered and threatened natural habitats, and maintaining abundant and diverse wildlife. The habitat most endangered is the wet, acid pineland with its unique assemblage of herbaceous plants.

Air quality issues involve solutions to existing problems and prevention of future deterioration as coastal Alabama continues its rapid growth and attracts industries that are dependent on natural resources.

One major issue relates to oil and gas activities in Alabama's coastal waters and the Outer Continental Shelf and to development of onshore support facilities. For the past decade, there has been concern about and opposition to mineral exploration and extraction in coastal waters. This issue and others related to mineral production will likely intensify because the coast is subject to major oil and gas exploration. A factor will be whether oil and gas reserves should be developed because of the environmental risks associated with oil extraction.

RECOMMENDATIONS

1. Studies to evaluate economic contributions of the environment to coastal Alabama should be encouraged, and the socioeconomic benefits from high quality environments should be quantified.
2. Encourage development of approaches such as Nelson et al. (1980) in which numerical values are assigned to economic and environmental parameters so that input-output modeling can aid in selecting alternative investment strategies.
3. Require that beneficiaries of developments and activities that substantially alter the environment undertake mitigation or preventive measures to offset the losses. Such measures are particularly needed with large-scale, water-related development in Mobile Bay (dock expansion, channel enlargements) and second home-resort development on barrier lands.
4. Establish a state Natural Heritage Program to inventory generically representative natural lands and acquire those identified as endangered and those that are outstanding representatives of Alabama's natural lands. Alabama is currently one of only two southeastern states without a natural heritage program. The Heritage Conservation and Recreation Service of the Department of the Interior could assist the State with program development. The Nature Conservancy, a private, national land preservation organization, also assists states in conducting systematic inventories. The establishment of a heritage program would stimulate identification of funding possibilities for the acquisition-lease phase of the program (i.e., bond sales, income tax checkoffs, tax incentives for corporations to make land donations, and private owners to preserve land identified in the inventory).
5. Require runoff and erosion control stipulations for permits issued by the city of Mobile for residential, commercial, and industrial development to reduce flood damage and sediment pollution. A state law is needed to address erosion and sediment problems caused by agricultural, silvicultural, and urban activities.
6. Require any company receiving a permit from the Alabama Water Improvement Commission and the State Oil and Gas Board for an exploratory or production oil or gas well in Alabama waters to develop a contingency plan for containment and cleanup of any pollution resulting from its operations. As a condition for issuance of the permit, the company would be required to demonstrate capability for carrying out its plan and include with the pollution cleanup provisions a warning and evacuation arrangement for coastal residents likely to be affected by an accident.

DATA GAPS

An understanding of environmental issues is directly related to the availability of data pertinent to these issues. At present, many issues lack the statistical underpinnings needed to define the nature of the issue. Examples of specific data deficiencies are inventories of flora and fauna and the cumulative impact of man's activities on the Mobile Bay estuary.

On a large scale, the most significant data gap is how much modification of natural systems for man's convenience can be made and yet allow the systems to function. There must be, for example, sufficient aquatic and terrestrial photosynthetic activity, optimum mineral cycling, and sufficient animal habitat. From a local perspective, these needs would include: the estuarine acreage and quality necessary to sustain a profitable seafood industry; the size and frequency of clearcutting that forests are capable of withstanding while retaining the capacity to regenerate these forests; the level of beachfront development beyond which will cause losses in the quality of protection presently afforded to inland areas during hurricanes and other severe storms; the types and quantities of open space and recreation areas necessary for human populations to be physiographically and psychologically healthy; and the size and types of naturally functioning ecosystems required to dilute, detoxify, and process air and water pollutants produced by a rapidly growing industrial complex and population.

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DATA APPENDIX

Figures and tables in sequence with text:
See the List of Figures and Tables in the front material for page numbers.

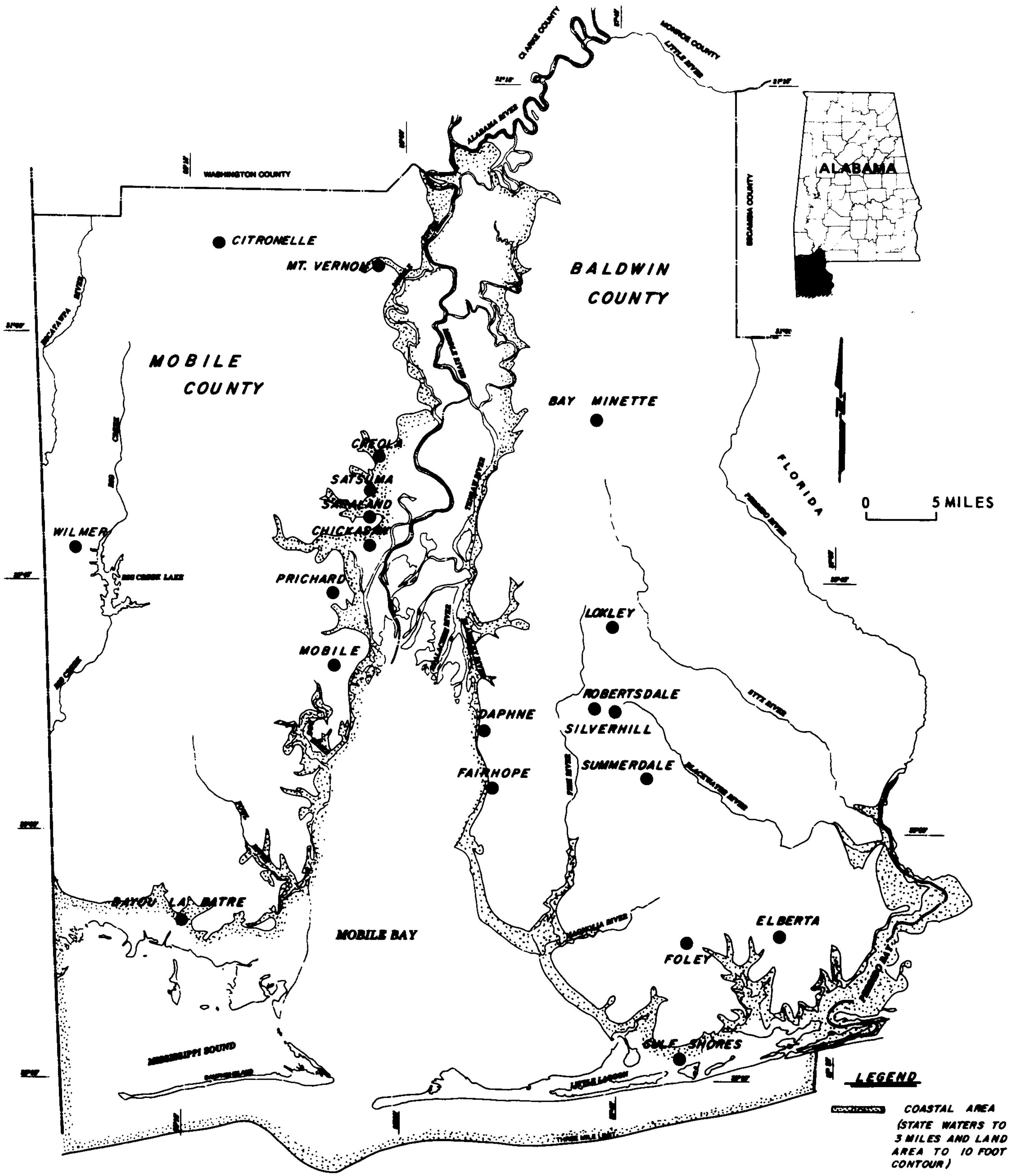


Figure 1. Alabama Coastal Region study area (Mobile and Baldwin Counties) showing the legally defined coastal area, 1981 (South Alabama Regional Planning Commission 1981).

Table 1. Population (1,000's) in the United States, Alabama, and Alabama Coastal Region, selected years 1969-2000 (U.S. Department of Commerce, Bureau of Economic Analysis 1981a, 1981b; U.S. Department of Commerce, Bureau of the Census 1981; South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981).

			Coastal Region		
Year	United States	Alabama	Mobile County	Baldwin County	Total
1969	201,298	3,440	317.8	57.0	374.8
1978	218,051	3,742	361.4	73.9	435.3
1980	226,505	3,890	364.4	78.4	442.8
1990	242,979	4,056	395.0	90.1	485.1
2000	259,845	4,251	412.2	100.4	512.6
Annual average percent growth					
1969-80	1.1	1.1	1.3	2.9	1.5
1980-90	0.7	0.4	0.8	1.4	0.9
1990-2000	0.7	0.4	0.4	1.1	0.6

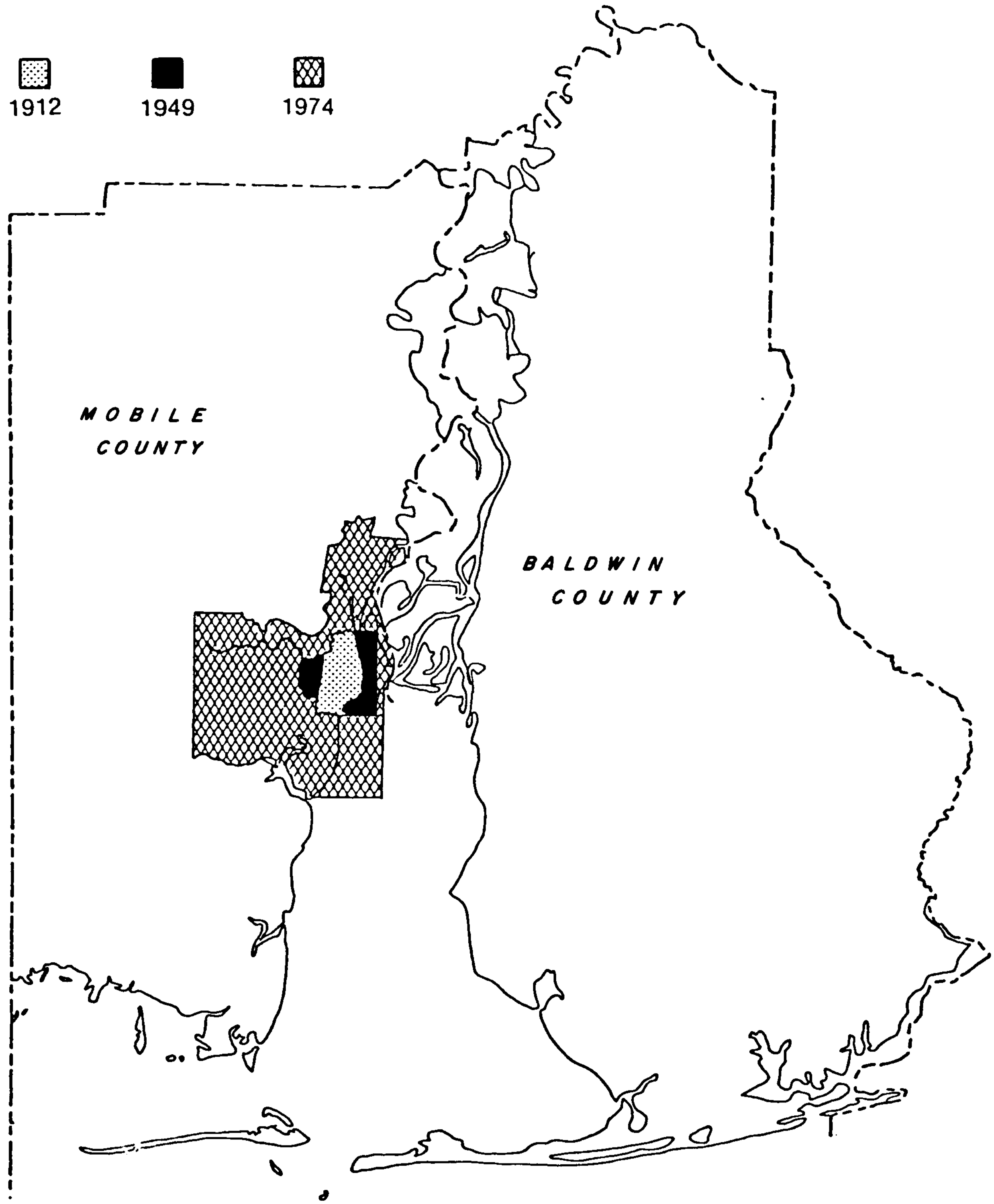


Figure 2. Growth of the Mobile urban area as indicated by corporate limits in 1912, 1949, and 1974 (Moser and Chermock 1977).

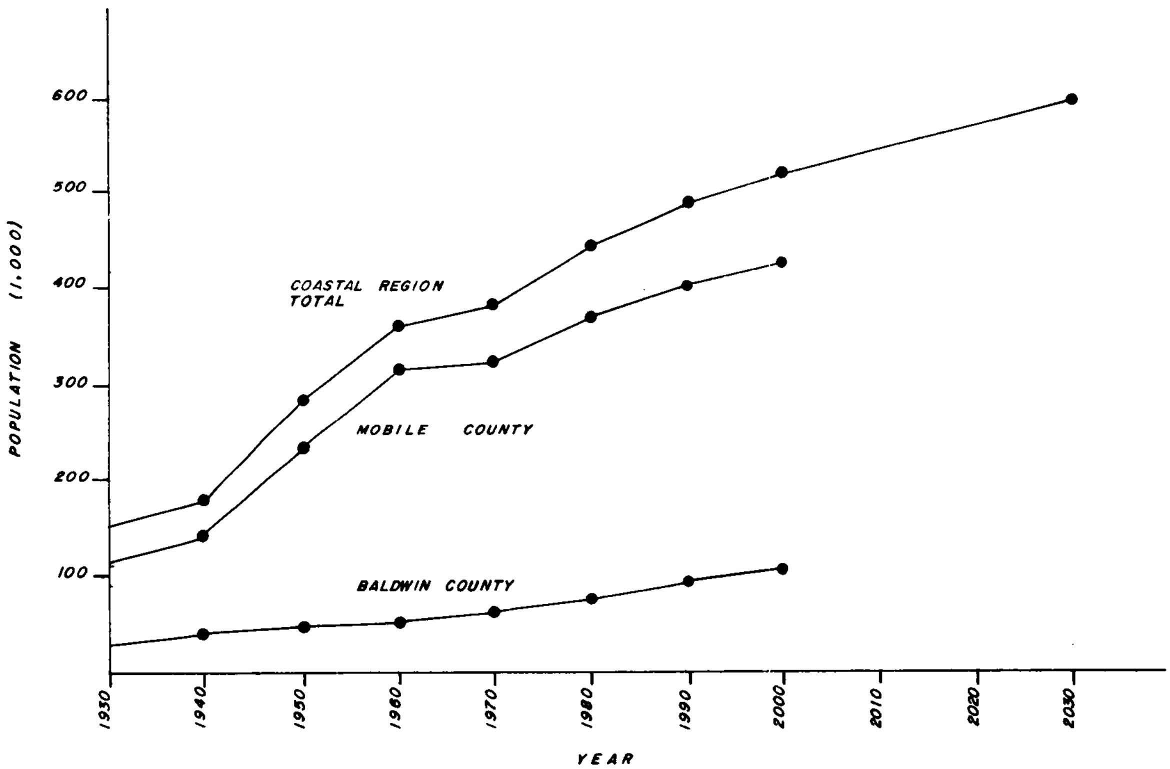


Figure 3. Population trends of Mobile and Baldwin Counties, 1930-2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981; South Alabama Regional Planning Commission and Gulf Research Associates 1981).

Table 2. The population of Mobile and Baldwin Counties, 1940-2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981b; South Alabama Regional Planning Commission and Gulf Research Associates 1981).

	Coastal Region		
Year	Mobile County	Baldwin County	Total
Population			
Actual			
1940	141,974	32,324	174,298
1950	231,105	40,997	272,102
1960	314,301	49,088	363,389
1970	317,308	59,382	376,690
1980	364,379	78,440	442,819
Projected			
1990	394,995	90,146	485,141
2000	412,231	100,369	512,600
Annual average percent change			
Actual			
1940-50	5.0	2.4	4.6
1950-60	3.1	1.8	2.9
1960-70	0.1	1.9	0.4
1970-80	1.4	2.8	1.6
Projected			
1980-90	0.8	1.4	0.9
1990-2000	0.4	1.1	0.6

Table 3. Population of the coastal and inland areas of Mobile and Baldwin Counties, 1970 and 1980 (U.S. Department of Commerce, Bureau of the Census 1972, 1981).

	1970		1980	
County, area	Number	Percent	Number	Percent
Mobile County				
Coastal	72,811	22.9	77,941	21.4
Inland	244,497	77.1	286,438	78.6
Subtotal	317,308	100.0	364,379	100.0
Baldwin County				
Coastal	32,515	54.8	46,096	58.8
Inland	26,867	45.2	32,348	41.2
Subtotal	59,382	100.0	78,440	100.0
Coastal Region				
Coastal	105,326	28.0	124,037	28.0
Inland	271,364	72.0	318,786	72.0
Total	376,690	100.0	442,819	100.0

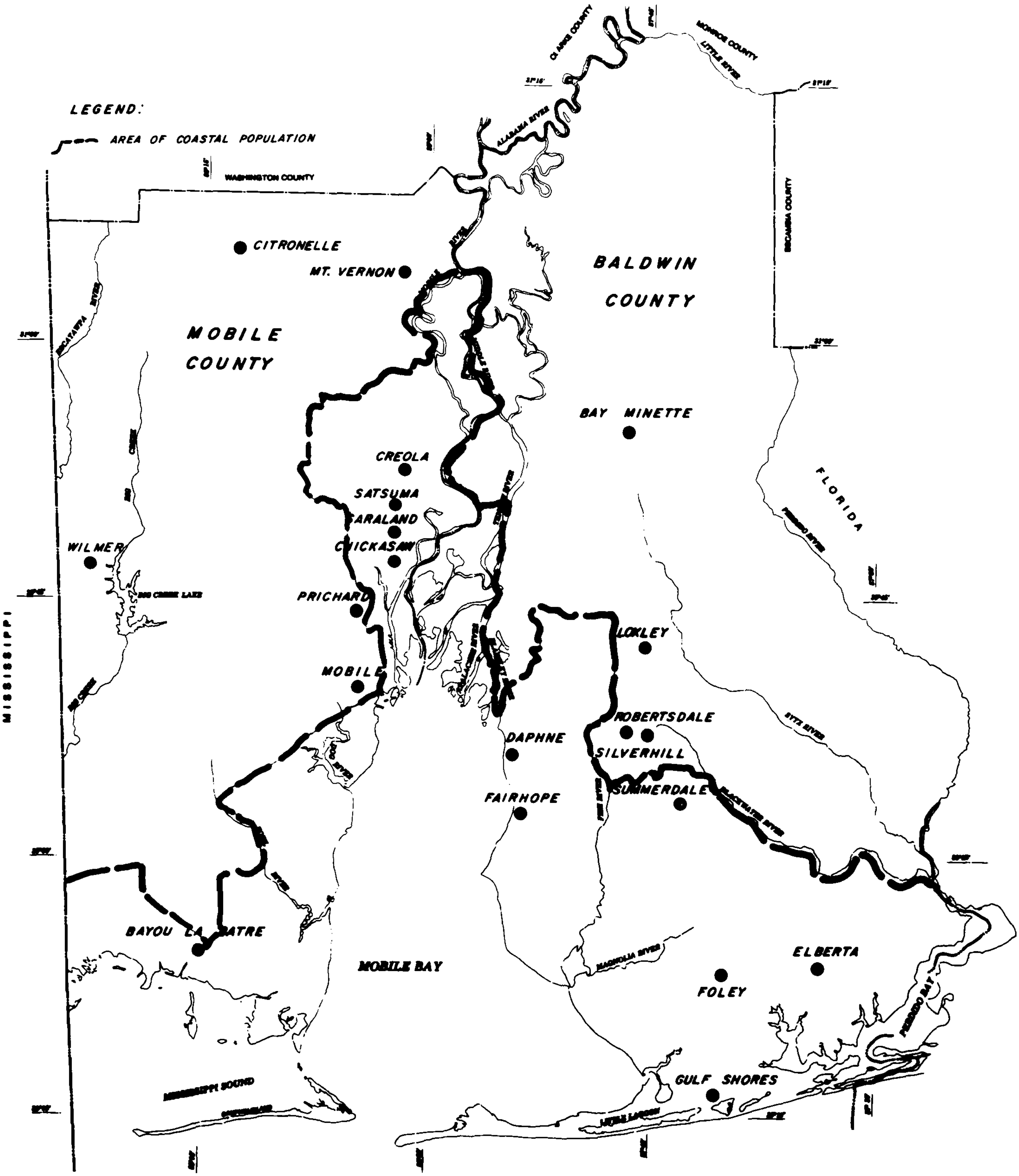


Figure 4. Delineation of the Alabama coastal area as used for population estimates, (Table 3), 1981 (U.S. Department of Commerce, Bureau of the Census 1981.

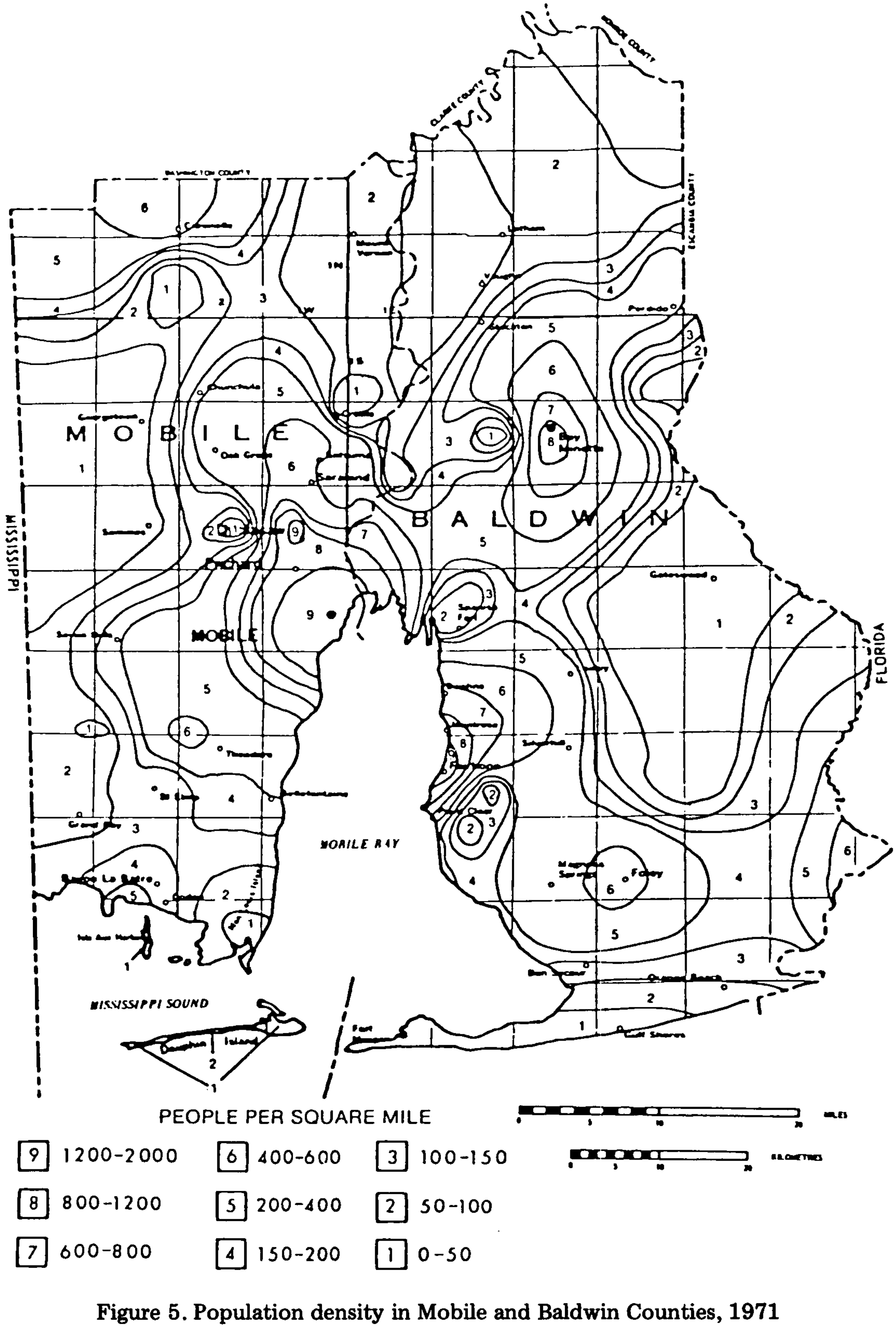


Figure 5. Population density in Mobile and Baldwin Counties, 1971 (Moser and Chermock 1977).

Table 4. Population by urban[a] and rural residence (percentage distribution), United States, Alabama, Alabama Coastal Region, 1950, 1960, 1970 (U.S. Department of Commerce, Bureau of Census 1952, 1963, 1972).

Area	1950	1960	1970
United States			
Urban	64.0	69.9	73.5
Rural	36.0	30.1	26.5
Total	100.0[b]	100.0	100.0
Alabama			
Urban	43.8	55.0	58.4
Rural	56.2	45.0	41.6
Total	100.0	100.0	100.0
Coastal Region			
Urban	69.8	78.1	73.3
Rural	30.2	21.9	26.7
Total	100.0	100.0	100.0
Mobile County			
Urban	79.2	86.1	82.0
Rural	20.8	13.9	18.0
Total	100.0	100.0	100.0
Baldwin County			
Urban	17.3	26.4	26.6
Rural	82.7	73.6	73.4
Total	100.0	100.0	100.0

[a]According to the 1970 census, the urban population comprises all persons in (1) places of 2,500 inhabitants or more, incorporated cities, villages, boroughs, and towns, but excluding persons living in the rural portions of "extended cities" (places with relatively low populations density in one or more large parts of their area; (2) unincorporated places of 2,500 inhabitants or more; and (3) other territory, incorporated or unincorporated included in urbanized areas. With the exception of minor modifications and the introduction of "extended cities" concept in 1970, this definition is consistent with those used in the 1950 and 1960 censuses. In all definitions, the population not classified as urban constitutes the rural population.

[b]Excludes Alaska and Hawaii.

Table 5. Population and households (1,000's) in Mobile and Baldwin Counties, 1960, 1970, and 1980 (U.S. Department of Commerce, Bureau of Census 1963, 1972, and 1981; Gulf Research Associates, Inc. 1981).

County	1960	1970	1980
Mobile County			
Total population	314.3	317.3	364.4
Population in households[a]	307.0	311.5	358.6
Persons per household	3.7	3.4	2.9
Households	83.2	91.8	123.1
Baldwin County			
Total population	49.1	59.4	78.4
Population in households	48.7	58.8	77.7
Persons per household	3.7	3.2	2.9
Households	13.1	17.7	26.7
Coastal Region			
Total population	363.4	376.7	442.8
Population in households	355.7	370.3	436.3
Persons per household	3.7	3.4	2.9
Households	96.3	109.5	149.8

[a]Population in households excludes persons living in group quarters (i.e., institutions, military barracks, college dormitories).

Table 6. Population by race (percentage composition), United States, Alabama, and Alabama Coastal Region, 1950, 1960, 1970, 1980, 1990, 2000 (U.S. Department of Commerce, Bureau of the Census 1952, 1963, 1972, 1981; South Alabama Regional Planning Commission 1975; South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981).

Area	Percent					
	1950	1960	1970	1980	1990	2000
United States						
White	89.5	88.6	87.6	83.2	NA	NA
Black and other	10.5	11.4	12.4	16.8	NA	NA
Total	100.0[a]	100.0	100.0	100.0	NA	NA
Alabama						
White	67.9	69.9	73.6	73.8	NA	NA
Black and other	32.1	30.1	26.4	26.2	NA	NA
Total	100.0	100.0	100.0	100.0	NA	NA
Coastal Region						
White	67.9	69.2	69.7	70.4	71.0	71.6
Black and other	32.1	30.8	30.3	29.6	29.0	28.4
Total	100.0	100.0	100.0	100.0	100.0	100.0
Mobile County						
White	66.2	67.7	67.5	67.6	67.6	67.6
Black and other	33.8	32.3	32.5	32.4	32.4	32.4
Total	100.0	100.0	100.0	100.0	100.0	100.0
Baldwin County						
White	77.5	79.0	81.9	83.8	85.8	87.8
Black and other	22.5	21.0	18.1	16.2	14.2	12.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Excludes Alaska and Hawaii.

Table 7. Population by age group (percentage distribution) United States, Alabama, Alabama Coastal Region, 1950, 1960, 1970, 1980, 1990, 2000 (U.S. Department of Commerce, Bureau of the Census 1952, 1963, 1972; South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981).

Area	Percent					
	1950	1960	1970	1980	1990	2000
United States						
Under 5	10.8	11.3	8.4	7.7	8.2	7.0
5 to 15	17.7	21.2	21.9	17.0	16.8	16.9
16 to 24	13.3	12.0	15.8	16.9	12.9	13.2
25 to 44	29.9	26.2	23.7	27.8	31.7	28.9
45 to 64	20.2	20.0	20.5	19.6	18.6	22.4
65 and over	8.2	9.2	9.8	11.0	11.8	11.6
Total	100.0[a]	100.0	100.0	100.0	100.0	100.0
Alabama						
Under 5	12.4	12.0	8.7	NA	NA	NA
5 to 15	22.1	23.9	23.0	NA	NA	NA
16 to 24	14.8	13.0	15.8	NA	NA	NA
25 to 44	28.0	24.6	23.0	NA	NA	NA
45 to 64	16.1	15.4	20.1	NA	NA	NA
65 and over	6.5	11.2	9.5	NA	NA	NA
Total	100.0	100.0	100.0	NA	NA	NA
Coastal Region						
Under 5	13.1	13.4	9.1	7.7	8.2	7.0
5 to 15	20.6	24.4	23.0	18.3	18.1	18.2
16 to 24	13.3	12.3	17.0	16.7	12.7	13.0
25 to 44	31.4	26.4	23.0	27.7	31.6	28.8
45 to 64	16.0	17.4	19.7	19.5	18.5	22.3
65 and over	5.6	6.1	8.3	10.1	10.9	10.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
Mobile County						
Under 5	13.1	13.5	9.2	7.7	8.2	7.0
5 to 15	20.0	24.3	25.0	18.6	18.4	18.5
16 to 24	13.4	12.3	15.3	16.8	12.8	13.1
25 to 44	32.4	27.0	23.1	27.6	31.6	28.8
45 to 64	15.9	17.1	19.6	19.5	18.5	22.3
65 and over	5.3	5.8	7.8	9.8	10.5	10.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Baldwin County						
Under 5	13.3	12.3	8.6	7.7	8.2	7.0
5 to 15	24.0	25.2	24.3	17.1	16.8	16.9
16 to 24	13.1	12.5	14.0	16.0	12.2	12.5
25 to 44	25.8	22.6	22.0	27.9	31.8	28.9
45 to 64	16.4	18.7	20.4	19.7	18.6	22.5
65 and over	7.4	8.6	10.7	11.6	12.4	12.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Excludes Alaska and Hawaii.

Table 8. Population 25 years old and over, median number of years of school completed, United States, Alabama, Alabama Coastal Region, 1950, 1960, 1970 (U.S. Department of Commerce, Bureau of the Census 1952, 1963, 1972).

Area	Median years of school completed		
	1950	1960	1970
United States	9.3[a]	10.5	12.2
Alabama	7.9	9.1	10.8
Coastal Region	8.8	10.2	11.0
Mobile County	8.9	10.3	11.1
Baldwin County	8.0	9.3	10.7

[a]Excludes Alaska and Hawaii.

Table 9. Population 25 years old and over, by years of school completed (percentage composition), Alabama Coastal Region, selected years, 1950-2000 (U.S. Department of Commerce, Bureau of the Census 1952, 1963, 1972; South Alabama Regional Planning Commission 1975; South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981).

Area	Years of school completed (percentage composition)					
	1950	1960	1970	1980	1990	2000
Coastal Region						
Elementary	53.6	41.5	34.1	23.8	15.5	7.2
High school: 1 to 3 years	18.5	21.6	23.6	23.8	22.8	19.4
High school: 4 years	18.4	24.3	27.2	32.1	35.6	39.3
College: 1 to 3 years	5.8	7.0	7.8	10.1	12.6	16.2
College: 4 years or more	3.7	5.6	7.3	10.2	13.5	17.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Mobile County						
Elementary	52.0	40.4	33.7	23.4	15.2	7.0
High school: 1 to 3 years	19.0	21.7	23.6	23.8	22.7	19.3
High school: 4 years	19.4	25.1	27.2	32.2	35.6	39.2
College: 1 to 3 years	5.9	7.1	7.9	10.2	12.7	16.3
College: 4 years or more	3.8	5.7	7.5	10.4	13.8	18.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Baldwin County						
Elementary	63.2	48.9	36.2	25.6	17.0	7.9
High school: 1 to 3 years	15.8	20.9	23.2	23.8	23.0	19.8
High school: 4 years	12.4	18.8	26.7	31.9	35.7	39.9
College: 1 to 3 years	5.1	6.4	7.4	9.5	12.0	15.8
College: 4 years or more	3.5	5.0	6.5	9.2	12.3	16.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 10. Per capita personal income (1972 constant dollars) by place of residence, United States, Alabama, Alabama Coastal Region, selected years 1969-2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1980, 1981a, 1981b).

			Coastal Region		
Year	United States	Alabama	Mobile County	Baldwin County	Total
1969	4,114	3,046	3,067	2,969	3,052
1978	5,227	4,217	4,240	4,090	4,215
1985	NA	NA	NA	NA	5,362
1990	7,294	6,316	NA	NA	6,273
2000	8,993	8,114	NA	NA	8,083
2030	NA	NA			14,892
Percent of U.S. average					
1969	100.0	73.5	74.6	72.2	73.6
1978	100.0	80.7	81.1	78.2	80.6
1990	100.0	86.6	NA	NA	86.0
2000	100.0	90.6	NA	NA	89.9
Average annual percent change					
1969-78	+2.6	+3.7	3.7	3.6	+3.7
1978-85	NA	NA	NA	NA	+3.5
1985-90	NA	NA	NA	NA	+3.2
1990-2000	+2.1	+2.6	NA	NA	+2.6
2000-2030	NA	NA	NA	NA	+2.1

Table 11. Resident employed persons by occupation (percentage distribution), United States, Alabama, Alabama Coastal Region, 1950, 1960, 1970, 1980, 1990, 2000 (U.S. Department of Commerce, Bureau of the Census 1952, 1963, 1972); South Alabama Regional Planning Commission 1975; South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981).

Area	Percent					
	1950	1960	1970	1980	1990	2000
United States						
White collar	37.3	43.1	48.3	51.5	54.3	55.4
Blue collar	40.3	36.3	35.3	33.1	31.2	29.8
Service	10.3	12.7	12.4	13.3	13.1	13.4
Farm and farm workers	12.1	7.9	4.0	2.1	1.4	1.4
Total	100.0[a]	100.0	100.0	100.0	100.0	100.0
Alabama						
White collar	26.4	34.4	41.1	NA	NA	NA
Blue collar	37.9	41.4	42.5	NA	NA	NA
Service	11.3	9.4	13.2	NA	NA	NA
Farm and farm workers	24.4	14.8	3.2	NA	NA	NA
Total	100.0	100.0	100.0	NA	NA	NA
Coastal Region						
White collar	35.7	41.7	43.7	47.5	50.8	52.4
Blue collar	42.2	40.0	39.9	36.3	33.8	31.9
Service	15.3	15.7	14.5	15.3	14.8	15.1
Farm and farm workers	6.8	2.6	1.9	0.9	0.6	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Mobile County						
White collar	37.4	43.1	44.8	48.1	50.6	51.7
Blue collar	43.0	39.5	39.2	35.8	33.7	32.2
Service	16.3	16.1	14.8	15.7	15.4	15.8
Farm and farm workers	3.3	1.3	1.2	0.4	0.3	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Baldwin County						
White collar	25.1	32.6	36.9	44.3	51.6	55.5
Blue collar	37.7	42.8	44.0	38.9	34.0	30.6
Service	9.3	13.1	13.0	13.7	12.4	12.1
Farm and farm workers	27.9	11.5	6.1	3.1	2.0	1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Excludes Alaska and Hawaii.

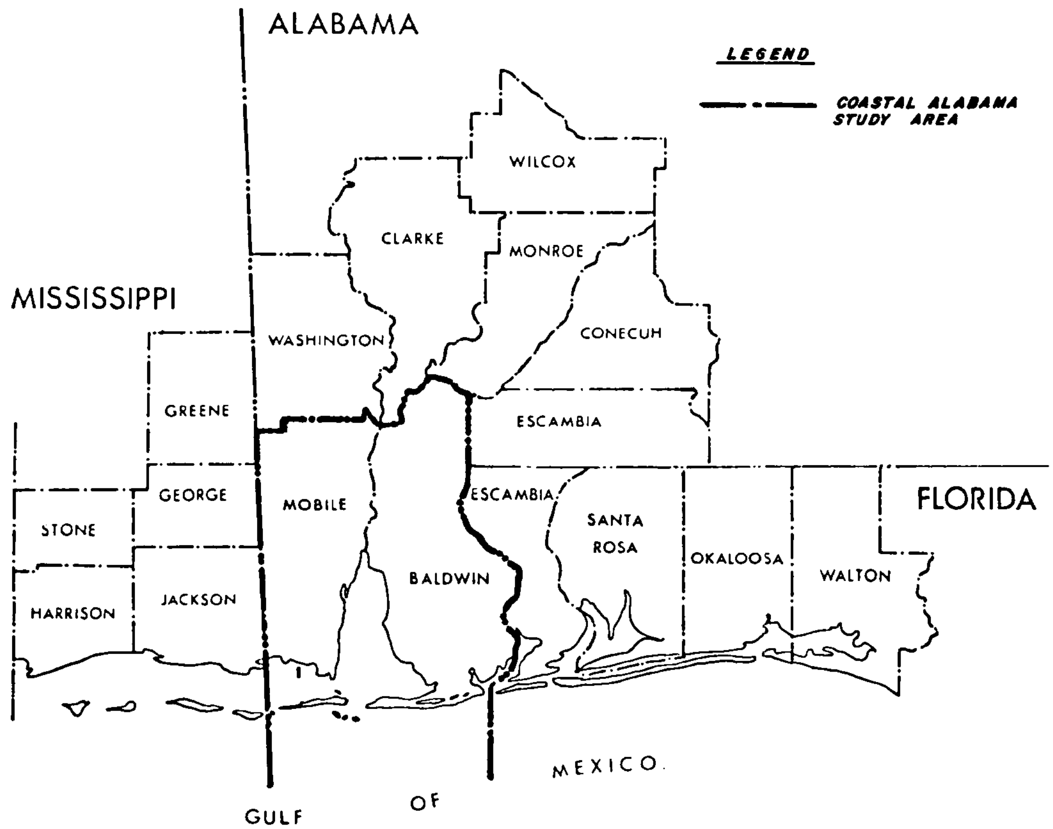


Figure 6. Alabama, Florida and Mississippi counties that comprise the economic region influenced by the coastal Alabama study area (South Alabama Regional Planning Commission 1975).

Table 12. Population in the economic region and the Alabama Coastal Region, 1970 and 1980 (U.S. Department of Commerce, Bureau of the Census 1972a and 1981).

Economic region counties	1970 Number	1970 Percent	1980 Number	1980 Percent	Percent change 1970-80
Alabama					
Coastal Region					
Mobile	317,308	28.6	364,379	27.8	14.8
Baldwin	59,382	5.4	78,440	6.0	32.1
Subtotal	376,690	34.0	442,819	33.8	17.6
Escambia	34,906	3.2	38,392	2.9	10.0
Washington	16,241	1.5	16,821	1.3	3.6
Clarke	26,724	2.4	27,702	2.1	3.7
Wilcox	16,303	1.5	14,755	1.1	- 9.5
Monroe	20,883	1.9	22,651	1.7	8.5
Conecuh	15,645	1.4	15,884	1.2	1.5
Total	507,392	45.9	579,024	44.2	14.1
Florida					
Escambia	205,334	18.5	233,794	17.8	13.9
Santa Rosa	37,741	3.4	55,988	4.3	48.3
Okaloosa	88,187	8.0	109,920	8.4	24.6
Walton	16,087	1.4	21,300	1.6	32.4
Total	347,348	31.3	421,002	32.1	21.2
Mississippi					
Harrison	134,582	12.2	157,665	12.0	17.2
Stone	8,101	0.7	9,716	0.7	19.9
Jackson	87,975	8.0	118,015	9.0	34.1
George	12,549	1.1	15,297	1.2	21.9
Greene	8,545	0.8	9,827	0.7	15.0
Total	251,662	22.8	310,520	23.7	23.4
Economic region	1,106,403	100.0	1,310,546	100.0	18.5

Table 13. Retail sales ($1,000's) by type of business in the Alabama Coastal Region, 1958, 1967, 1977 (U.S. Department of Commerce, Bureau of the Census 1961c, 1970a, 1980b).

SIC code	Type of business	Mobile County 1958	Mobile County 1967	Mobile County 1977	Baldwin County 1958	Baldwin County 1967	Baldwin County 1977	Coastal region 1958	Coastal region 1967	Coastal region 1977
52	Building materials, hardware, garden supply and mobile home dealers	23,513	18,692	66,197	3,993	8,092	16,646	27,506	26,784	82,843
53	General merchandise group stores	34,875	80,507	182,923	2,358	3,297	12,888	37,233	83,804	195,811
54	Food stores	73,826	95,760	233,199	10,431	13,652	51,146	84,257	109,412	284,345
55 (exc. 554)	Automotive dealers	50,598	79,688	251,519	5,465	10,421	41,675	56,063	90,109	293,194
554	Gasoline service stations	21,340	35,021	81,270	5,132	9,807	32,539	26,472	44,828	113,809
56	Apparel and accessory stores	22,489	19,306	49,649	1,713	2,310	5,652	24,202	21,616	55,301
57	Furniture, home furnishings and equipment stores	16,498	22,439	48,385	1,618	2,138	8,070	18,116	24,577	56,455
58	Eating and drinking places	16,338	25,483	81,708	3,106	4,230	14,842	19,444	29,713	96,550
591	Drug and proprietary stores	12,684	(D)	(D)	1,380	(D)	(D)	14,064	18,454	43,029
59 (exc. 591)	Miscellaneous retail stores	26,175	(D)	(D)	4,615	(D)	(D)	30,790	41,333	88,266
	Total	298,336	426,603	1,102,972	39,811	64,027	206,631	338,147	490,630	1,309,603

Table 14. Retail sales ($1,000's) in the economic region and the Alabama Coastal Region, 1967, 1972, 1977 (U.S. Department of Commerce, Bureau of the Census 1970a, 1975a, 1980b).

Economic region counties	1967		1972		1977	
	Amount	Percent	Amount	Percent	Amount	Percent
Alabama						
Coastal Region						
Mobile	426,603	32.1	669,554	29.7	1,102,972	30.6
Baldwin	64,027	4.7	100,421	4.5	206,631	5.7
Subtotal	490,630	36.8	769,975	34.2	1,309,603	36.3
Escambia	43,101	3.3	66,296	2.9	100,403	2.8
Washington	7,500	0.6	11,271	0.5	18,120	0.5
Clarke	30,573	2.3	43,476	1.9	77,449	2.1
Wilcox	8,947	0.7	13,323	0.6	20,216	0.6
Monroe	18,471	1.4	27,920	1.2	47,349	1.3
Conecuh	12,520	0.9	14,597	0.7	24,115	0.7
Total	611,742	46.0	947,158	42.1	1,597,255	44.3
Florida						
Escambia	290,187	21.9	517,133	23.0	771,857	21.4
Santa Rosa	26,413	2.0	48,542	2.2	101,764	2.8
Okaloosa	92,176	6.9	188,093	8.4	314,899	8.7
Walton	15,638	1.2	25,465	1.1	34,773	1.0
Total	424,414	32.0	779,233	34.6	1,223,293	33.9
Mississippi						
Harrison	184,070	13.9	317,825	14.1	449,693	12.5
Stone	9,165	0.7	13,798	0.6	21,501	0.6
Jackson	80,910	6.1	170,828	7.6	278,018	7.7
George	12,922	1.0	16,778	0.8	26,805	0.7
Greene	4,683	0.4	5,873	0.3	9,218	0.3
Total	291,750	22.0	525,102	23.3	785,235	21.8
Economic region	1,327,906	100.0	2,251,493	100.0	3,605,783	100.0

Table 15. Wholesale sales ($1,000's) among types of business in the Alabama Coastal Region, 1958, 1967, 1977 (U.S. Department of Commerce, Bureau of the Census 1961d, 1970b, 1980c).

SIC code	Type of business	Mobile County			Baldwin County			Coastal Region		
		1958	1967	1977	1958	1967	1977	1958	1967	1977
501	Motor vehicles and automotive parts and supplies	9,983	13,399	71,308	NA	1,112	4,650	NA	14,511	75,957
503	Lumber and other construction materials	33,760	(D)	149,477	NA	NA	1,684	NA	34,968	151,161
506	Electrical goods	19,267	(D)	84,832	NA	NA	1,727	NA	35,127	86,559
507	Hardware, plumbing and heating equipment and supplies	24,851	(D)	(D)	NA	NA	NA	NA	25,429	40,104
508	Machinery, equipment and supplies	37,997	(D)	263,757	NA	NA	13,339	NA	86,448	277,096
512, 516	Drugs, chemicals and allied products	20,159	23,087	(D)	NA	--	NA	NA	23,087	(D)
513	Apparel, piece goods	(D)	(D)	(D)	NA	NA	NA	NA	(D)	3,783
514	Groceries, related products	74,413	110,321	198,221	NA	9,026	22,636	NA	119,347	220,857
515	Farm product raw materials	(D)	(D)	(D)	NA	NA	NA	NA	36,924	322,081
517	Petroleum and petroleum products	41,968	62,243	(D)	NA	8,433	NA	NA	70,731	318,407
518	Beer, wines, distilled alcoholic beverages	6,825	(D)	(D)	NA	NA	NA	NA	10,407	30,804
502 504, 505, 509, 511, 519	All other	(D)	(D)	(D)	NA	NA	NA	(D)	(D)	(D)
	Total	323,371	489,396	1,692,319	21,826	38,071	175,524	345,197	527,467	1,867,843

Table 16. Wholesale sales ($1,000's) in the economic region and the Alabama Coastal Region, 1967, 1972, and 1977 (U.S. Department of Commerce, Bureau of the Census 1970b, 1975b, and 1980c).

Economic region counties	1967		1972		1977	
	Amount	Percent	Amount	Percent	Amount	Percent
Alabama						
Coastal Region						
Mobile	489,396	53.0	808,613	50.7	1,692,319	51.1
Baldwin	38,071	4.1	73,156	4.6	175,524	5.3
Subtotal	527,467	57.1	881,769	55.3	1,867,843	56.4
Escambia	20,427	2.2	37,069	2.3	75,891	2.3
Washington	3,689	0.4	7,768	0.5	9,861	0.3
Clarke	9,030	1.0	12,994	0.8	17,040	0.5
Wilcox	5,454	0.6	8,595	0.5	12,508	0.4
Monroe	11,783	1.3	22,141	1.4	40,531	1.2
Conecuh	4,801	0.5	9,167	0.6	16,005	0.5
Total	582,651	63.1	979,503	61.4	2,039,679	61.6
Florida						
Escambia	169,930	18.4	295,759	18.6	553,021	16.7
Santa Rosa	6,437	0.7	32,464	2.0	51,577	1.6
Okaloosa	20,812	2.3	47,615	3.0	89,815	2.7
Walton	21,307	2.3	25,875	1.6	32,656	1.0
Total	218,486	23.7	401,713	25.2	727,069	22.0
Mississippi						
Harrison	83,053	9.0	121,992	7.7	225,657	6.8
Stone	1,859	0.2	2,930	0.2	5,046	0.2
Jackson	30,802	3.3	72,839	4.6	285,026	8.6
George	4,860	0.5	12,740	0.8	26,247	0.8
Greene	2,246	0.2	1,246	0.1	(D)	(D)
Total	122,820	13.2	211,747	13.4	541,976+	16.4
Economic region	923,957	100.0	1,592,963	100.0	3,308,724+	100.0

Table 17. Service industry receipts ($1,000's) in the economic region and the Alabama Coastal Region, 1967, 1972, 1977 (U.S. Department of Commerce, Bureau of the Census 1970c, 1975c, 1980d).

Economic region counties	1967		1972		1977	
	Amount	Percent	Amount	Percent	Amount	Percent
Alabama						
Coastal Region						
Mobile	59,689	30.4	117,686	32.0	219,541	35.0
Baldwin	7,596	3.9	16,962	4.5	27,550	4.4
Subtotal	67,285	34.3	134,648	36.5	247,091	39.4
Escambia	3,318	1.7	7,395	2.0	8,323	1.3
Washington	280	0.1	857	0.2	1,097	0.2
Clarke	1,602	0.8	3,727	1.0	5,200	0.8
Wilcox	646	0.3	998	0.3	3,691	0.6
Monroe	1,017	0.5	2,500	0.7	3,877	0.6
Conecuh	601	0.3	1,749	0.5	2,442	0.4
Total	74,749	38.0	151,874	41.2	271,721	43.3
Florida						
Escambia	37,209	19.0	76,578	20.8	121,541	19.4
Santa Rosa	2,654	1.4	8,099	2.2	10,998	1.8
Okaloosa	34,280	17.5	44,799	12.2	76,464	12.2
Walton	1,963	1.0	2,840	0.8	3,953	0.6
Total	76,106	38.9	132,316	36.0	212,956	34.0
Mississippi						
Harrison	34,325	17.5	57,637	15.6	94,839	15.0
Stone	542	0.3	1,569	0.4	1,830	0.3
Jackson	9,183	4.7	22,441	6.1	42,477	6.8
George	913	0.5	2,072	0.6	2,843	0.5
Greene	264	0.1	319	0.1	447	0.1
Total	45,227	23.1	84,038	22.8	142,436	22.7
Economic region	196,082	100.0	368,228	100.0	627,113	100.0

Table 18. Value added by manufacture ($1,000's) in the economic region and the Alabama Coastal Region, 1967, 1972, 1977 (U.S. Department of Commerce, Bureau of the Census 1971a, 1976a, 1980a).

Economic region counties	1967	1972	1977
Alabama			
Coastal Region			
Mobile	279,900	433,600	829,200
Baldwin	23,300	47,000	74,300
Subtotal	303,200	480,600	903,500
Escambia	42,100	68,100	112,900
Washington	(D)	(D)	(D)
Clarke	26,800	39,800	67,400
Wilcox	3,800	19,600	(D)
Monroe	33,400	24,500	59,400
Conecuh	6,400	11,000	14,800
Total	415,700+	643,600+	1,158,000+
Florida			
Escambia	228,800[a]	266,100	383,300
Santa Rosa		32,100	18,700
Okaloosa	19,100	19,500	31,200
Walton	2,600	4,700	8,300
Total	250,500	322,400	441,500
Mississippi			
Harrison	42,700	65,000	128,600
Stone	4,200	12,900	22,000
Jackson	169,900	357,700	1,417,900
George	2,400	1,500	2,300
Greene	(D)	(D)	2,300
Total	219,200+	437,100+	1,573,100
Economic region	885,400+	1,403,100+	3,172,600+

[a] Combined 1967 total for Escambia and Santa Rosa Counties, Florida.

Table 19. Land use (in acres) in Mobile and Baldwin Counties in 1975 and projected to 2000 (South Alabama Regional Planning Commission 1977a).

	1975			2000			Percent change 1975-2000		
Land Use	Mobile County	Baldwin County	Total	Mobile County	Baldwin County	Total	Mobile County	Baldwin County	Total
Developed									
Residential	35,151	9,651	44,802	52,434	14,667	67,101	+49.2	+52.0	+49.8
Commercial	4,002	1,159	5,161	6,253	3,398	9,651	+56.2	+193.2	+87.0
Industrial	4,808	568	5,376	8,350	1,333	9,483	+73.7	+99.5	+76.4
Roads	30,891	16,786	47,677	47,199	26,140	73,339	+52.8	+55.7	+53.8
Other TCU[a]	7,680	3,141	10,821	8,905	3,793	12,698	+16.0	+10.8	+17.3
Government, education miscellaneous	8,968	3,192	12,160	10,640	3,700	14,340	+18.6	+15.9	+17.9
Cultural, recreational, entertainment	4,336	4,388	8,724	5,286	4,756	10,042	+24.2	+8.4	+15.1
Resource production/ extraction[b]	530,336	722,079	1,252,415	526,563	721,053	1,247,616	-0.7	-0.1	0.4
Subtotal	626,172	760,964	1,387,136	665,630	778,640	1,444,270	+6.3	-2.3	+4.1
Undeveloped									
Vacant	66,887	74,874	141,761	27,429	57,198	84,627	-59.0	-23.6	-40.3
Water	22,343	46,462	68,805	22,343	46,462	68,805	--	--	-
Wetlands	78,198	174,082	252,280	78,198	174,082	252,280	--	--	--
Subtotal	167,428	295,418	462,846	127,970	277,742	405,712	-23.6	-6.0	-12.3
Total	793,600	1,056,382	1,849,982	793,600	1,056,382	1,849,982	--	--	--

[a]Transportation, communication, utilities.

[b]Agriculture, forest, mining.

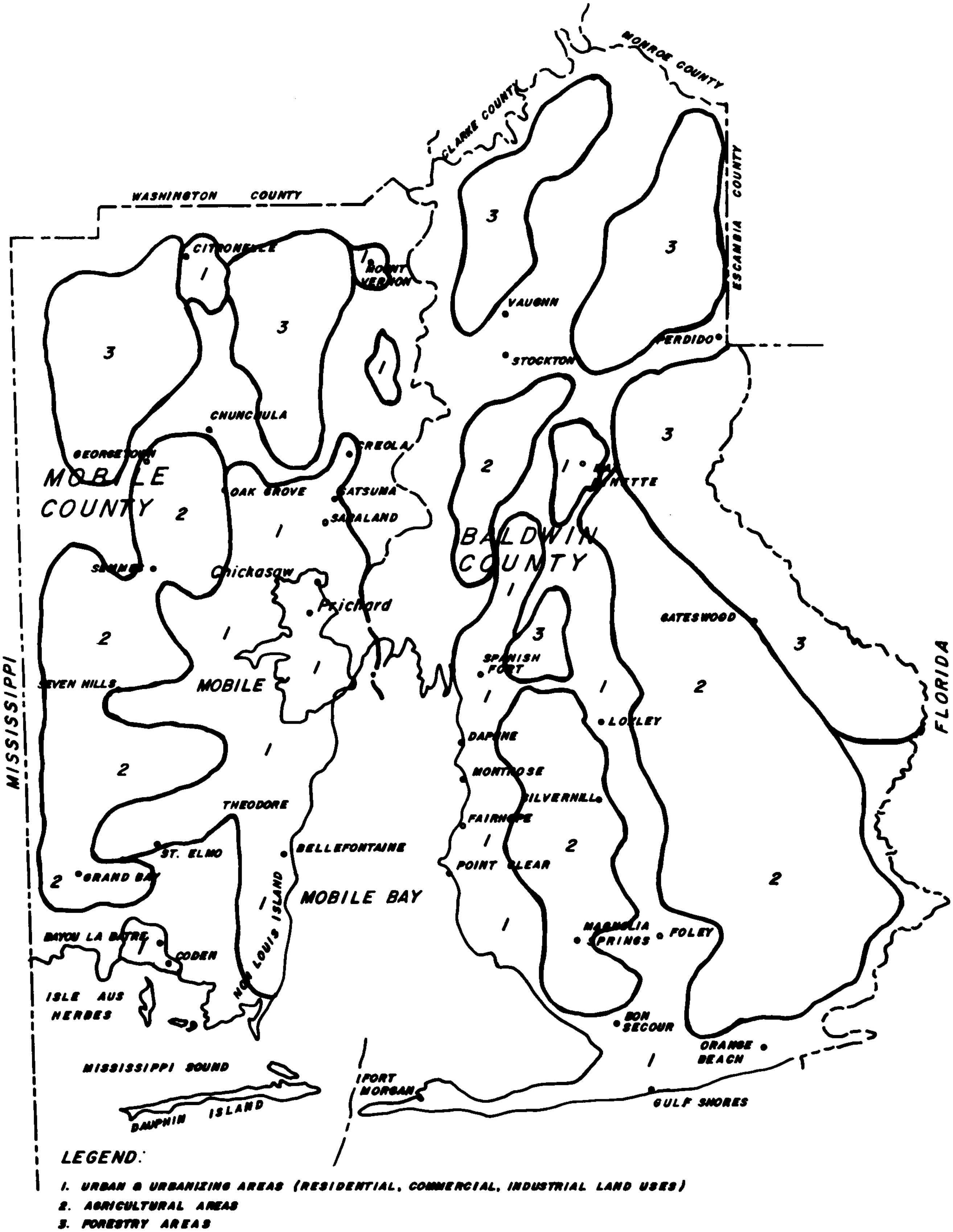


Figure 7. Schematic of existing land use, Mobile and Baldwin Counties, 1975 (South Alabama Regional Planning Commission 1977a).

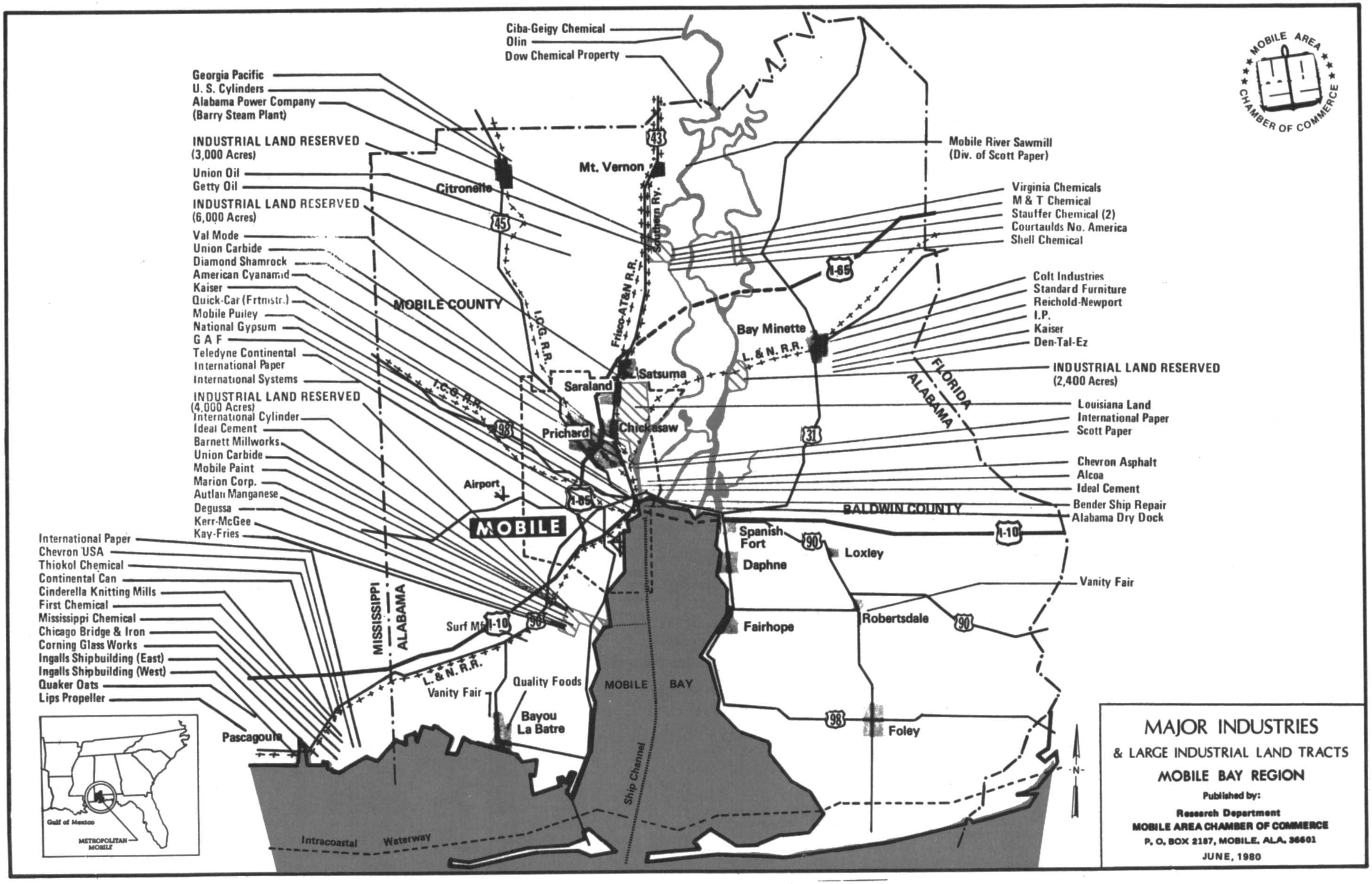


Figure 8. Major industrial facilities in Mobile and Baldwin Counties in 1980 (Mobile Area Chamber of Commerce 1980).

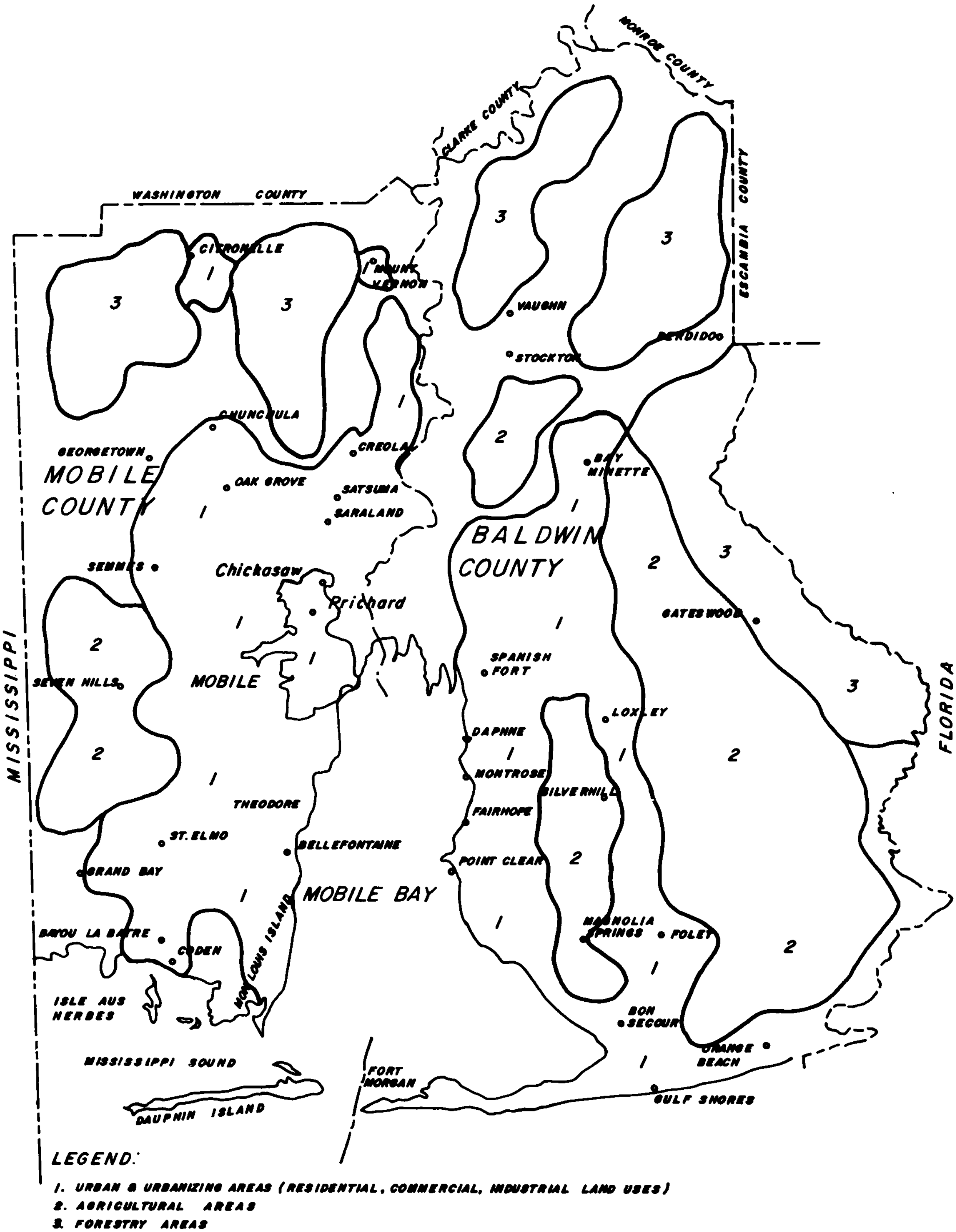


Figure 9. Schematic of projected land use, Mobile and Baldwin Counties, 2000 (South Alabama Regional Planning Commission 1977a).

Table 20. The population of Mobile and Baldwin Counties in 1980 (U.S. Department of Commerce, Bureau of the Census, 1981), the 1980, 1985 and 2000 population projections (South Alabama Regional Planning Commission 1977a), and the 1985 and 2000 population projections (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

Year, County	Actual: U.S. Department of Commerce, Bureau of the Census	Projections: South Alabama Regional Planning Commission[a]	Projections: Bureau of Economic Analysis
1980			
Mobile County	364,379	358,800	NA
Baldwin County	78,440	71,100	NA
Total	442,819	429,900	NA
1985			
Mobile County	NA	379,500	383,270[b]
Baldwin County	NA	76,200	84,030[b]
Total	NA	455,700	467,300
2000			
Mobile County	NA	403,800	412,230[b]
Baldwin County	NA	88,000	100,370[b]
Total	NA	491,800	512,600

[a]Land use projections (Table 19) are based on the South Alabama Regional Planning Commission's population projections.

[b]County disaggregations of BEA projections prepared by the South Alabama Regional Planning Commission and Gulf Research Associates, Inc. 1981.

Table 21. Location quotients[a] by industry in Mobile and Baldwin Counties in 1978 (City of Mobile, Office of Economic Development 1980).

SIC code	Industry	Location quotient
26	Paper and allied	4.811
37[b]	Shipbuilding and repair	4.274
28	Chemical and allied	1.800
15-17	Construction	1.373
40-49	Transportation, communication and utilities	1.296
24	Lumber and wood	1.284
70-89 99	Services and miscellaneous	1.119
50-59	Wholesale and retail trade	1.110
60-67	Finance, insurance and real estate	0.958
91-97	Government	0.859
27	Printing and publishing	0.781
20	Food and kindred	0.765
25, 32, 33 34, 35, 36 37[b], 38, 39	Other durable goods	0.538
21 29-31	Other nondurable	0.351
22-23	Textile and apparel	0.190

[a]Proportion of coastal Alabama employment (at place, civilian, non-agricultural wage and salary) divided by proportion in the Southeast. A quotient greater than 1.0 designates a basic industry. States included in the Southeastern Region are Alabama, Mississippi, Louisiana, Arkansas, Tennessee, North Carolina, South Carolina, Georgia, and Florida.

[b]Portion of classification.

Table 22. New capital expenditures (in millions of dollars) by manufacturing firms in the United States, Alabama, and Alabama Coastal Region in 1958, 1963, 1967, 1972, and 1977 (U.S. Department of Commerce, Bureau of the Census 1961a, 1966a, 1971a, 1976a, 1980a).

			Coastal Region		
Year	United States	Alabama	Mobile County	Baldwin County	Total
1958	9,543.5	164.5	10.1	1.0	11.1
1963	11,370.0	147.4	17.0	1.2	18.2
1967	21,503.0	378.9	26.0	1.5	27.5
1972	24,077.7	355.1	30.8	2.9	33.7
1977	47,459.0	1,318.9	226.0	6.3	232.3

Table 23. Estimated investment ($1,000's) by announced new and expanding industries in the Alabama Coastal Region, 1978-80 (Alabama Development Office 1978, 1979, 1980).

		New industries			Expanding industries			Total		
SIC code	Industry	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region
13	Crude petroleum and natural gas	–	–	–	85,249.6	–	85,429.6	85,429.6	–	85,429.6
14	Mining/quarrying of non-metallic minerals	–	–	–	11,249.8	–	11,249.8	11,249.8	–	11,249.8
20	Food and kindred products	6,000.0	500.0	6,500.0	5,620.8[a]	1,837.0	7,457.8[a]	11,620.8[a]	2,337.0	13,957.8[a]
22	Textile mill products	5,000.0	–	5,000.0	17.8	–	17.8	5,017.8	–	5,017.8
23	Apparel and other finished products	625.0	–	625.0	75.2	67.8	143.0	700.2	67.8	768.0
24	Lumber and wood products	1,000.0	300.0	1,300.0	42,883.1	911.8	43,794.9	43,883.1	1,211.8	45,094.9
25	Furniture and fixtures	–	–[a]	–[a]	–	365.0	365.0	–	365.0[a]	365.0[a]
26	Paper and allied products	–	–	–	68,187.3[a]	–[a]	68,187.3[a]	68,187.3[a]	–[a]	68,187.3[a]
27	Publishing and printing	–	–	–	2,002.0[a]	27.7	2,029.7[a]	2,002.0[a]	27.7	2,029.7[a]
28	Chemicals and allied products	26,000.0[a]	–	26,000.0[a]	157,605.0[a]	2,194.0	159,799.0[a]	183,605.0[a]	2,194.0	185,799.0[a]
29	Petroleum refining and related industries	–	–	–	100,172.0	–	100,172.0	100,172.0	–	100,172.0
30	Rubber and miscellaneous plastic products	–	–	–	1,675.0	–	1,675.0	1,675.0	–	1,675.0
32	Stone, clay, glass and concrete products	–	–	–	43,773.0	515.5[a]	44,288.5[a]	43,773.0	515.5[a]	44,288.5[a]
33	Primary metal industries	8,000.0	–	8,000.0	764.0	4,230.5	4,994.5	8,764.0	4,230.5	12,994.5
34	Fabricated metal products	3,000.0	–	3,000.0	6,065.5	420.9	6,486.4	9,065.5	420.9	9,486.4
35	Machinery, non-electric	–	10,200.0	10,200.0	5,062.5[a]	567.2[a]	5,629.7[a]	5,062.5[a]	10,767.2[a]	15,829.7[a]
36	Electrical machinery, equipment	–	2,450.0[a]	2,450.0[a]	66.4	280.0	346.4	66.4	2,730.0[a]	2,796.4[a]
37	Transportation equipment	525.0	–[a]	525.0[a]	22,750.5	78.9[a]	22,829.4[a]	23,275.5	78.9[a]	23,354.4[a]
38	Instruments and related	–	–	–	155.0	1,110.0[a]	1,265.0[a]	155.0	1,110.0[a]	1,265.0[a]
39	Miscellaneous manufacturing	–	–	–	267.0	–	267.0	267.0	–	267.0
	Total[a]	50,150.0	13,450.0	63,600.0	553,821.6	12,606.4	566,428.0	603,971.6	26,056.4	630,028.0

[a]Incomplete, Data for some companies confidential and thus withheld.

Table 24. Value of shipments ($1,000,000's) for all manufacturing and for selected manufacturing industries in the United States, Alabama, and the Alabama Coastal Region, 1967, 1972, 1977 (U.S. Department of Commerce, Bureau of the Census 1971a, 1976a, 1980a).

SIC code	Area	1967	1972	1977
	United States			
	All manufacturing	557,397.8	756,534.3	NA
20	Food and kindred products	83,975.2	115,060.3	NA
24	Lumber and wood products	11,205.7	23,816.0	NA
26	Paper and allied products	20,969.9	28,261.9	NA
28	Chemicals and allied products	42,148.3	57,349.6	NA
29	Petroleum and coal products	22,043.4	28,694.7	NA
	Alabama			
	All manufacturing	7,442.9	11,241.2	21,010.1
20	Food and kindred products	918.2	1,355.6	2,334.3
24	Lumber and wood products	317.5	874.1	1,219.0
26	Paper and allied products	635.9	962.6	1,981.9
28	Chemicals and allied products	734.0	841.5	2,049.2
29	Petroleum and coal products	58.0	(D)	556.1
	Coastal Region			
	All manufacturing	647.6	1,043.4	2,290.0
20	Food and kindred products	73.3	68.3	136.2
24	Lumber and wood products	30.1	58.8	96.4
26	Paper and allied products	252.8	NA	NA
28	Chemicals and allied products	157.5	237.8	526.9
29	Petroleum and coal products	NA	43.3	309.3
	Mobile County			
	All manufacturing	585.1	917.2	2,076.7
20	Food and kindred products	64.0	52.1	111.7
24	Lumber and wood products	21.1	45.4	77.1
26	Paper and allied products	252.8	NA	NA
28	Chemicals and allied products	NA	NA	507.7
29	Petroleum and coal products	NA	NA	309.3
	Baldwin County			
	All manufacturing	62.6	126.2	213.3
20	Food and kindred products	9.3	16.2	24.5
24	Lumber and wood products	9.1	13.4	19.3
26	Paper and allied products	--	NA	NA
28	Chemicals and allied products	NA	NA	19.2
29	Petroleum and coal products	NA	NA	--

Table 25. "At-place" employment[a] by industry, Alabama Coastal Region, selected years 1969-2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

SIC code	Type industry	1969 Number	1969 Percent	1978 Number	1978 Percent	1985 Number	1985 Percent	1990 Number	1990 Percent	2000 Number	2000 Percent	2030 Number	2030 Percent
01-02	Farm	3,988	3.0	3,300	1.9	3,054	1.5	2,892	1.3	2,662	1.1	2,194	0.9
	Non-farm	127,653	97.0	168,978	98.1	196,883	98.5	211,386	98.7	230,717	98.9	253,521	99.1
	Private	107,170	81.4	143,380	83.2	169,207	84.6	182,765	85.3	200,911	86.1	222,632	87.1
07-09	Agriculture, forestry, fisheries	1,473	1.1	2,585	1.5	3,416	1.7	3,697	1.7	4,057	1.7	4,419	1.7
10-14	Mining	184	0.1	797	0.5	1,748	0.9	2,183	1.0	2,458	1.1	2,660	1.0
15-17	Construction	7,774	5.9	13,512	7.8	16,126	8.1	17,085	8.0	17,920	7.7	18,463	7.2
20-39	Manufacturing	25,427	19.3	31,063	18.0	35,669	17.8	38,041	17.8	41,120	17.6	45,109	17.6
	Nondurable	16,222	12.3	18,136	10.5	19,162	9.6	19,980	9.3	20,887	8.9	22,120	8.7
	Durable	9,205	7.0	12,927	7.5	16,506	8.3	18,061	8.4	20,233	8.7	22,990	9.0
40-49	T.C.U.[b]	10,140	7.7	11,113	6.5	11,862	5.9	12,479	5.8	13,525	5.8	14,862	5.8
50-51	Wholesale trade	7,407	5.6	10,490	6.1	11,907	6.0	12,539	5.9	13,591	5.8	14,811	5.8
52-59	Retail trade	20,867	15.9	28,712	16.7	34,160	17.1	37,201	17.4	41,119	17.6	45,193	17.7
60-67	F.I.R.E.[c]	4,952	3.8	7,504	4.4	9,439	4.7	10,411	4.9	11,714	5.0	13,475	5.3
70-89	Services	28,946	22.0	37,604	21.8	44,880	22.4	49,130	22.9	55,406	23.7	63,640	24.9
91-97	Government	20,483	15.6	25,598	14.9	27,675	13.8	28,622	13.4	29,807	12.8	30,889	12.1
	Federal, civilian	2,468	1.9	2,771	1.6	2,833	1.4	2,858	1.3	2,813	1.2	2,735	1.1
	Federal, military	3,743	2.8	3,127	1.8	3,115	1.6	3,115	1.5	3,115	1.3	3,115	1.2
	State and local	14,272	10.8	19,700	11.4	21,727	10.9	22,649	10.6	23,879	10.2	25,039	9.8
	Total	131,641	100.0	172,278	100.0	199,936	100.0	214,278	100.0	233,380	100.0	255,715	100.0

[a] Employment by place of work. This reflects the number of persons working in coastal Alabama, regardless of their place of residence.

[b] Transportation, communication, utilities.

[c] Finance, insurance, real estate.

Table 26. Nonagricultural wage and salary employment[a] (1,000's) in the Alabama Coastal Region by manufacturing and nonmanufacturing industries, selected years 1960-80 (Alabama Department of Industrial Relations, Alabama State Employment Service 1966-81).

SIC code	Type industry	Annual average 1960	1965	1970	1975	1979	1980
	Manufacturing						
20	Food & kindred products	2.7	2.6	2.6	1.8	2.1	1.9
22,23	Textiles & apparel products	0.7	1.4	1.5	1.5	1.9	1.7
24	Lumber & wood products	2.4	2.3	1.9	2.0	2.7	2.7
26	Paper & allied products	6.2	6.9	7.7	7.2	7.4	6.6
28	Chemical & allied products	1.8	2.2	2.6	3.1	4.3	4.3
373	Shipbuilding & repair	2.8	3.6	4.2	4.1	3.5	4.3
(b)	Other	2.3	2.7	4.4	6.4	7.9	7.2
	Subtotal	18.9	21.7	24.9	26.1	29.8	28.7
	Nonmanufacturing						
15-17	Construction	5.3	6.6	6.7	10.4	10.7	11.7
40-49	T.C.U.[c]	10.4	9.5	10.0	9.9	10.9	10.9
50-59	Trade	21.6	23.3	25.7	30.1	36.3	36.9
60-67	F.I.R.E.[d]	4.3	4.3	4.9	5.8	7.0	7.1
70-89	Service and miscellaneous[e]	11.4	14.7	16.1	23.9	27.8	28.9
91-99	Government	26.7	25.9	16.7	20.1	25.8	26.8
	Subtotal	79.7	84.3	80.1	100.2	118.5	122.3
	Total	98.6	106.0	105.0	126.3	148.3	151.0

[a] Excludes self-employed, unpaid family, and domestic service workers in private households.

[b] 21, 25, 27, 29-39 excluding 373.

[c] Transportation, communication, utilities.

[d] Finance, insurance, real estate.

[e] Includes mining (10-14) and other establishments not classified elsewhere.

Table 27. "At-place" employment[a], Alabama Coastal Region, 1959, 1978 (U.S. Department of Commerce, Bureau of the Census 1961e, 1979b).

		1959						1978					
		Mobile County		Baldwin County		Coastal Region		Mobile County		Baldwin County		Coastal Region	
SIC Code	Type industry	Number	Percent of total	Number	Percent of total	Number	Percent of total	Number	Percent of total	Number	Percent of total	Number	Percent of total
	Agricultural services, forestry, fisheries	519	0.8	(D)	(D)	(D)	(D)	1,481	1.4	[c]	NA	NA	NA
07	Agricultural services	NA	NA	NA	NA	NA	NA	[f]	NA	[c]	NA	NA	NA
08	Forestry	NA	NA	NA	NA	NA	NA	[g]	NA	NA	NA	NA	NA
09	Fishing, hunting, trapping	NA	NA	NA	NA	NA	NA	372	0.3	NA	NA	NA	NA
	Mining	75	0.1	(D)	(D)	(D)	(D)	277	0.3	[b]	NA	NA	NA
13	Oil and gas extraction	NA	NA	NA	NA	NA	NA	[e]	NA	NA	NA	NA	NA
14	Nonmetallic minerals except fuels	NA	NA	NA	NA	NA	NA	[c]	NA	NA	NA	NA	NA
	Contract construction	6,889	10.8	428	7.8	7,317	10.6	10,959	10.1	1,388	9.7	12,297	10.1
15	General contractors and operative builders	3,573	5.6	209	3.8	3,782	5.5	3,046	2.8	573	4.2	3,619	3.0
16	Heavy construction, contractors	1,213	1.9	NA	NA	NA	NA	2,508	2.3	96	0.7	2,604	2.1
17	Special trade contractors	2,101	3.3	163	3.0	2,264	3.3	5,405	5.0	669	4.9	6,074	5.0
	Manufacturing	17,353	27.3	1,719	31.5	19,072	27.7	25,807	23.9	4,092	29.8	29,899	24.5
20	Food and kindred products	2,416	3.8	255	4.7	2,671	3.9	2,274	2.1	186	1.4	2,460	2.0
22	Textile mill products	NA	NA	NA	NA	NA	NA	NA	NA	[f]	NA	NA	NA
23	Apparel and other textile products	280	0.4	(D)	(D)	(D)	(D)	411	0.4	[g]	NA	NA	NA
24	Lumber and wood products	1,364	2.1	898	16.4	2,262	3.3	1,479	1.4	553	4.0	2,032	1.7
25	Furniture and fixtures	NA	NA	NA	NA	NA	NA	56	0.1	[f]	NA	NA	NA
26	Paper and allied products	6,083	9.6	NA	NA	NA	NA	[i]	NA	[e]	NA	NA	NA
27	Printing and publishing	606	1.0	NA	NA	NA	NA	744	0.7	[f]	NA	NA	NA
28	Chemicals and allied products	1,857	2.9	163	3.0	2,020	2.9	3,509	3.2	163	1.2	3,672	3.0
29	Petroleum and coal products	(D)	(D)	NA	NA	NA	NA	511	0.5	NA	NA	NA	NA
30	Rubber and misc. plastic products	NA	NA	NA	NA	NA	NA	346	0.3	NA	NA	NA	NA
32	Stone, clay, glass products	957	1.5	NA	NA	NA	NA	1,589	1.5	97	0.7	1,686	1.4
33	Primary metal industries	NA	NA	NA	NA	NA	NA	[e]	NA	196	1.4	NA	NA
34	Fabricated metal products	282	0.4	NA	NA	NA	NA	1,844	1.7	[c]	NA	NA	NA
35	Machinery, except electrical	216	0.3	NA	NA	NA	NA	700	0.6	54	0.4	754	0.6
37	Transportation equipment	2,797	4.4	NA	NA	NA	NA	4,582	4.2	NA	NA	NA	NA
38	Instruments and related products	NA	NA	NA	NA	NA	NA	104	0.1	[g]	NA	NA	NA
39	Miscellaneous manufacturing industries	NA	NA	NA	NA	NA	NA	185	0.2	[c]	NA	NA	NA

	Transportation and other public utilities	6,829	10.8	189	3.5	7,018	10.2	7,298	6.8	586	4.3	7,884	6.5
41	Local and interurban passenger transit	610	1.0	NA	NA	NA	NA	529	0.5	NA	NA	NA	NA
42	Trucking and warehousing	808	1.3	56	1.0	864	1.3	1,491	1.4	165	1.2	1,656	1.4
44	Water transportation	2,643	4.2	NA	NA	NA	NA	2,734	2.5	75	0.5	2,809	2.3
45	Transportation by air	NA	NA	NA	NA	NA	NA	[e]	NA	NA	NA	NA	NA
47	Transportation services	148	0.2	NA	NA	NA	NA	348	0.3	NA	NA	NA	NA
48	Communication	1,195	1.9	NA	NA	NA	NA	1,450	1.3	[e]	NA	NA	NA
49	Electric, gas, sanitary services	1,085	1.7	NA	NA	NA	NA	[g]	NA	126	0.9	NA	NA
	Wholesale trade	5,377	8.5	277	4.2	5,604	8.1	9,347	8.7	767	5.6	10,114	8.3
50	Wholesale trade durable goods	NA	NA	NA	NA	NA	NA	6,196	5.7	247	1.8	6,443	5.3
51	Wholesale trade nondurable goods	NA	NA	NA	NA	NA	NA	3,151	2.9	520	3.8	3,671	3.0
	Retail trade	12,730	20.0	1,393	25.5	14,123	20.5	22,501	20.8	3,500	25.5	26,001	21.3
52	Building materials and garden supplies	749	1.2	147	2.7	896	1.3	949	0.9	227	1.7	1,176	1.0
53	General merchandise stores	2,037	3.2	134	2.5	2,171	3.1	3,664	3.4	250	1.8	3,914	3.2
54	Food stores	2,045	3.2	245	4.5	2,290	3.3	3,250	3.0	691	5.0	3,941	3.2
55	Automotive dealers and service stations	1,922	3.0	347	6.4	2,269	3.3	3,274	3.0	682	5.0	3,956	3.2
56	Apparel and accessory stores	1,234	1.9	69	1.3	1,303	1.9	[h]	NA	[e]	NA	NA	NA
57	Furniture and home furnishing stores	688	1.1	54	1.0	742	1.1	1,051	1.0	159	1.2	1,210	1.0
58	Eating and drinking places	2,229	3.5	249	4.6	2,478	3.6	5,603	5.2	902	6.6	3,505	2.9
59	Miscellaneous retail	1,384	2.2	148	2.7	1,532	2.2	2,393	2.2	402	2.9	2,795	2.3
	Finance, insurance, real estate	3,960	6.2	208	3.8	4,168	6.0	6,528	6.0	818	6.0	7,346	6.0
60	Banking	958	1.5	NA	NA	NA	NA	2,042	1.9	291	2.1	2,333	1.9
61	Credit agencies other than banks	489	0.8	NA	NA	NA	NA	596	0.6	84	0.6	680	0.6
62	Security, commodity brokers, and services	NA	NA	NA	NA	NA	NA	9.2	0.1	NA	NA	NA	NA
63	Insurance carriers	1,005	1.6	NA	NA	NA	NA	1,475	1.4	108	0.8	1,583	1.3
64	Insurance agents, brokers and service	249	0.4	NA	NA	NA	NA	518	0.5	50	0.4	568	0.5
65	Real estate	873	1.4	34	0.6	907	1.3	1,380	1.3	263	1.9	1,643	1.3
66	Combined real estate, insurance, etc.	280	0.4	NA	NA	NA	NA	181	0.2	NA	NA	NA	NA
67	Holding and other investment offices	NA	NA	NA	NA	NA	NA	[e]	NA	NA	NA	NA	NA
	Services	9,114	14.4	1,024	18.7	10,138	14.7	22,914	21.2	2,375	17.3	25,289	20.8
70	Hotels and other lodging places	861	1.4	502	9.2	1,363	2.0	1,433	1.3	508	3.7	1,941	1.6
72	Personal services	1,773	2.8	103	1.9	1,876	2.7	1,580	1.5	150	1.1	1,730	1.4
73	Business services	775	1.2	NA	NA	NA	NA	3,476	3.2	102	0.7	3,578	2.9
75	Auto repair, services, and garages	498	0.8	29	0.5	527	0.8	830	0.8	104	0.8	934	0.8
76	Miscellaneous repair services	436	0.7	102	1.9	538	0.8	840	0.8	82	0.6	922	0.8
78	Motion pictures	175	0.3	NA	NA	NA	NA	[e]	NA	NA	NA	NA	NA
79	Amusement and recreation services	338	0.5	NA	NA	NA	NA	1,050	1.0	186	1.4	1,236	1.0
80	Health services	2,216	3.5	134	2.5	2,350	3.4	7,592	7.0	633	4.6	8,229	6.8

Table 27. Concluded.

SIC Code	Type industry	1959 Mobile County Number	1959 Mobile County Percent of total	1959 Baldwin County Number	1959 Baldwin County Percent of total	1959 Coastal Region Number	1959 Coastal Region Percent of total	1978 Mobile County Number	1978 Mobile County Percent of total	1978 Baldwin County Number	1978 Baldwin County Percent of total	1978 Coastal Region Number	1978 Coastal Region Percent of total
81	Legal services	205	0.3	23	0.4	228	0.3	619	0.6	NA	NA	NA	NA
82	Educational services	362	0.6	NA	NA	NA	NA	1,084	1.0	116	0.8	1,200	1.0
83	Social services	NA	NA	NA	NA	NA	NA	936	0.9	108	0.8	1,044	0.9
86	Membership organizations	934	1.5	47	0.9	981	1.4	2,197	2.0	199	1.4	2,396	2.0
89	Miscellaneous services	541	0.9	NA	NA	NA	NA	1,092	1.0	118	0.9	1,210	1.0
	Nonclassifiable establishments	665	1.0	142	2.6	807	1.2	935	0.9	166	1.2	1,101	0.9
	Total	63,511	99.9	5,464	100.0	68,975	100.0	108,047	100.1	13,725	100.0	121,799	100.0

[a] Data in the "County Business Patterns" publication represent the following types of employment covered by the Federal Insurance Contributions Act: (1) all covered wage and salary employment of private nonfarm employers and of nonprofit membership organizations under compulsory coverage and (2) all employment of religious, charitable, educational, and other nonprofit organizations covered under the elective provisions of the Federal Insurance Contributions Act. Data for the following types of employment covered in whole or in part by the Social Security Program are excluded: (1) government employees, (2) self-employed persons, (3) farm workers, (4) domestic service workers reported separately, (5) railroad employment subject to the Railroad Retirement Act, and (6) employment on oceanborne vessels. Employment reported as follows: (1) 1959, mid-March pay period, (2) 1978, week including March 12.

[b] 0 - 19 employees.

[c] 20 - 99 employees.

[e] 100 - 249 employees.

[f] 250 - 499 employees.

[g] 500 - 999 employees.

[h] 1,000 - 2,499 employees.

[i] 5,000 and over.

Table 28. Annual average civilian work force employment and unemployment (1,000's) in the Alabama Coastal Region, 1960-80 (Alabama Department of Industrial Relations, Alabama State Employment Service 1966-81).

Year	Total civilian work force[a]	Unemployment		Total employment[b]
		Total	Rate (percent)	
1960	128.8	7.4	5.7	121.4
1961	128.6	8.7	6.8	119.9
1962	128.9	8.1	6.3	120.8
1963	131.9	6.8	5.2	125.1
1964	132.8	6.7	5.0	126.1
1965	133.6	6.0	4.5	127.6
1966	130.8	5.8	4.4	125.0
1967	127.0	6.4	5.0	120.6
1968	127.3	6.1	4.8	121.2
1969	127.9	5.7	4.5	122.2
1970[c]	142.8	8.6	6.0	134.2
1971	145.1	8.6	5.9	136.5
1972	144.6	7.5	5.2	137.1
1973	145.8	7.2	5.0	138.6
1974	151.1	8.3	5.5	142.8
1975	157.6	9.7	6.1	147.9
1976	164.6	10.6	6.5	154.0
1977	172.6	14.2	8.2	158.4
1978	178.0	12.5	7.0	165.5
1979	181.0	14.5	8.0	166.5
1980	183.1	13.8	7.5	169.3

[a] Place of residence basis.

[b] Includes workers involved in labor disputes.

[c] A break in the data series exists between 1969 and 1970 due to a change in methodology in calculating the civilian work force. Unemployment rates (percent), however, are comparable for the entire 1960-80 period.

Table 29. Personal income ($1,000's) by major source and county, Alabama Coastal Region, 1973-78 (U.S. Department of Commerce, Bureau of Economic Analysis 1980).

Item	Personal income by major source					
	1973[a]	1974[a]	1975[b]	1976[b]	1977[b]	1978[b]
MOBILE COUNTY						
Total labor and proprietors income by place of work[c]						
By type						
Wage and salary disbursements	830,121	938,645	1,048,535	1,201,325	1,340,564	1,522,778
Other labor income	59,726	71,651	87,428	106,453	124,878	146,247
Proprietors income[d]	84,706	89,900	97,135	114,579	116,988	136,152
Farm	9,073	10,689	9,012	11,124	11,339	20,034
Non-farm[d]	75,633	79,211	88,123	103,455	105,649	116,118
By industry						
Farm	12,012	13,700	12,430	14,651	15,045	24,581
Non-farm	962,541	1,086,496	1,220,668	1,407,706	1,567,385	1,780,596
Private	827,322	936,389	1,055,736	1,226,520	1,365,443	1,544,926
Ag. serv., for., fish., and other[e]	(D)	13,796	20,597	18,413	18,426	21,620
Mining	(D)	5,426	7,146	10,962	12,603	14,473
Construction	81,079	98,369	130,201	148,470	157,250	162,652
Manufacturing	233,493	267,152	288,780	345,363	392,684	455,988
Non-durable goods	160,145	178,717	188,629	227,490	261,295	291,737
Durable goods	73,348	88,435	100,151	117,873	131,389	164,251
Transportation and public utilities	108,665	116,609	127,222	142,700	161,505	185,454
Wholesale trade	70,695	82,794	92,655	105,133	120,267	130,138
Retail trade	117,084	128,157	138,395	161,573	176,920	198,744
Finance, insurance, and real estate	46,748	49,794	52,904	64,181	76,771	89,509
Services	153,854	174,292	197,836	229,725	249,017	286,348
Government and government enterprises	135,219	150,107	164,932	181,186	201,942	235,670
Federal, civilian	29,893	32,387	35,656	37,634	41,156	46,468
Federal, military	11,461	14,558	8,183	8,647	9,575	10,132
State and local	93,865	103,162	121,093	134,905	151,211	179,070
Derivation of personal income by place of residence						
Total labor and proprietors income by place of work	974,553	1,100,196	1,233,098	1,422,357	1,582,430	1,805,177
Less: personal contributions for social insurance by place or work	52,429	61,735	71,096	82,391	91,255	103,452
Net labor and proprietors income by place of work	922,124	1,038,461	1,162,002	1,339,966	1,491,175	1,701,725
Plus: residence adjustment	11,381	12,356	28,740	33,405	46,798	22,217

Net labor and proprietors income by place of residence	933,505	1,050,817	1,190,742	1,373,371	1,537,973	1,723,942
Plus: dividends, interest, and rent[f]	135,371	152,088	172,906	195,532	224,171	253,972
Plus: transfer payments	161,450	194,202	244,794	274,539	299,165	321,132
Personal income by place of residence	1,230,326	1,397,107	1,608,442	1,843,442	2,061,309	2,299,046
Per capita personal income (dollars)	3,782	4,240	4,798	5,354	5,836	6,361
Total population (thousands)	325.3	329.5	335.3	344.3	353.2	361.5
BALDWIN COUNTY						
Total labor and proprietors income by place of work[c]						
By type						
Wage and salary disbursements	91,025	103,497	113,915	131,717	148,280	157,372
Other labor income	5,996	7,159	8,793	10,871	12,955	13,826
Proprietors income[d]	35,887	35,626	32,564	46,430	30,777	42,882
Farm	18,398	17,709	12,669	23,502	6,990	16,470
Non-farm	17,489	17,917	19,895	22,920	23,787	26,412
By industry						
Farm	20,959	20,377	15,681	26,650	10,247	20,476
Non-farm	111,949	125,905	139,591	162,368	181,765	193,604
Private	94,762	106,683	118,188	138,557	155,066	162,420
Ag. serv., for., fish., and other[e]	(D)	2,903	3,656	4,707	4,018	5,309
Mining	(D)	374	1,115	1,090	699	537
Construction	9,619	12,043	13,143	14,345	15,491	17,851
Manufacturing	29,579	33,043	33,767	42,488	50,212	43,115
Non-durable goods	13,106	13,088	13,613	16,356	18,428	19,336
Durable goods	16,473	19,955	20,154	26,132	31,784	23,779
Transportation and public utilities	6,006	6,718	8,145	9,695	11,443	13,383
Wholesale trade	5,049	6,449	9,137	9,913	10,959	11,660
Retail trade	15,579	17,462	19,359	22,739	25,716	28,883
Finance, insurance, and real estate	5,282	5,259	5,749	7,383	9,442	11,096
Services	20,463	22,432	24,117	26,197	27,086	30,586
Government and government enterprises	17,187	19,222	21,403	23,811	26,699	31,184
Federal, civilian	1,681	1,835	1,876	2,087	2,281	2,401
Federal, military	842	823	850	881	1,013	1,093
State and local	14,664	16,564	18,677	20,843	23,405	27,690

Table 29. Concluded.

Item	Personal income by major source					
	1973[a]	1974[a]	1975[b]	1976[b]	1977[b]	1978[b]
Derivation of personal income by place of residence						
Total labor and proprietors income by place of work	132,908	146,282	155,272	189,018	192,012	214,080
Less: personal contributions for social insurance by place of work	6,045	7,264	8,271	9,906	11,082	11,783
Net labor and proprietors income by place of work	126,863	139,018	147,001	179,112	180,930	202,297
Plus: residence adjustment	51,347	57,530	64,164	73,123	85,403	103,698
Net labor and proprietors income by place of residence	178,210	196,548	211,165	252,235	266,333	305,995
Plus: dividends, interest, and rent[f]	33,541	40,781	46,579	55,000	65,312	74,418
Plus: transfer payments	33,887	41,791	53,296	60,813	66,569	72,924
Personal income by place of residence	245,638	279,120	311,040	368,048	398,214	453,337
Per capita personal income (dollars)	3,839	4,244	4,611	5,286	5,546	6,136
Total population (thousands)	64.0	65.8	67.5	69.6	71.8	73.9
COASTAL REGION						
Total labor and proprietors income by place of work[c]						
By type						
Wage and salary disbursements	921,146	1,042,142	1,162,450	1,333,042	1,488,844	1,680,150
Other labor income	65,722	78,810	96,221	117,324	137,833	160,073
Proprietors income[d]	120,593	125,526	129,699	161,009	147,765	179,034
Farm	27,741	28,398	21,681	34,626	18,329	36,504
Non-farm[d]	93,122	97,128	108,018	126,375	129,436	142,530
By industry						
Farm	32,971	34,077	28,111	41,301	25,292	45,057
Non-farm	1,074,490	1,212,401	1,360,259	1,570,074	1,749,150	1,974,200
Private	922,084	1,043,072	1,173,924	1,360,077	1,520,509	1,707,346
Ag. serv., for., fish., and other[e]	(D)	16,699	24,253	23,120	22,444	26,929
Mining	(D)	5,800	8,261	12,052	13,302	15,010
Construction	90,698	110,412	143,344	162,815	172,741	180,503
Manufacturing	263,072	300,195	322,547	387,851	442,896	499,103
Non-durable goods	173,251	191,805	202,242	243,846	279,723	311,073
Durable goods	89,821	108,390	120,305	144,005	163,173	188,030
Transportation and public utilities	114,671	123,327	135,367	152,395	172,948	198,837

Wholesale trade	75,744	89,243	101,792	115,046	131,226	141,798
Retail trade	132,663	145,619	157,754	184,312	202,636	227,627
Finance, insurance, and real estate	52,030	55,053	58,653	71,564	86,213	100,605
Services	174,317	196,724	221,953	255,922	276,103	316,934
Government and government enterprises	152,406	169,329	186,335	204,997	228,641	266,854
Federal, civilian	31,574	34,222	37,532	39,721	43,437	48,869
Federal, military	12,303	15,381	9,033	9,528	10,588	11,225
State and local	108,529	119,726	139,770	155,748	174,616	206,760
Derivation of personal income by place of residence						
Total labor and proprietors income by place of work	1,107,461	1,246,478	1,388,370	1,611,375	1,774,442	2,019,257
Less: personal contributions for social insurance by place of work	58,474	68,999	79,367	92,297	102,337	115,235
Net labor and proprietors income by place of work	1,048,987	1,177,479	1,309,003	1,519,078	1,672,105	1,904,022
Plus: residence adjustment	62,728	69,886	92,904	106,528	132,201	125,915
Net labor and proprietors income by place of residence	1,111,715	1,247,365	1,401,907	1,625,606	1,804,306	2,029,937
Plus: dividends, interest, and rent[f]	168,912	192,869	219,485	250,532	289,483	328,390
Plus: transfer payments	195,337	235,993	298,090	335,352	365,734	394,056
Personal income by place of residence	1,475,964	1,676,227	1,919,482	2,211,490	2,459,523	2,752,383
Per capita personal income (dollars)	3,791	4,240	4,765	5,343	5,787	6,322
Total population (thousands)	389.3	395.3	402.8	413.9	425.0	435.4

[a] Estimates based on 1967 SIC.

[b] Estimates based on 1972 SIC.

[c] Consists of wage and salary disbursements, other labor income, and proprietor's income. Primary source for private non-farm wages: ES-202 covered wages-Alabama Department of Industrial Relations.

[d] Includes the capital consumption adjustment for non-farm proprietors.

[e] Agricultural services, forestry, fisheries and other.

[f] Includes the capital consumption adjustment for rental income of persons.

Table 30. Labor and proprietors' income[a] (1972 constant $1,000's) by industry, in the Alabama Coastal Region, selected years 1969-2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

SIC		1969		1978		1985		1990		2000		2030	
code	Industry	Income	Percent	Income	Percent	Income	Percent	Income	Percent	Income	Percent	Income	Percent
01-02	Farm	14,192	1.6	30,038	2.2	27,285	1.5	29,139	1.3	33,343	1.1	52,195	0.8
	Non-farm	866,506	98.4	1,316,133	97.8	1,802,635	98.5	2,189,873	98.7	2,995,230	98.9	6,218,373	99.2
	Private	748,923	85.0	1,138,231	84.6	1,580,472	86.4	1,930,826	87.0	2,658,483	87.8	5,569,678	88.8
07-09	Agriculture, forestry, fisheries	6,689	0.8	17,953	1.3	26,774	1.5	32,139	1.4	43,037	1.4	86,166	1.4
10-14	Mining	1,231	0.1	10,007	0.7	26,446	1.4	38,274	1.7	56,211	1.9	122,620	2.0
15-17	Construction	67,828	7.7	120,335	8.9	166,671	9.1	201,494	9.1	271,141	9.0	546,092	8.7
20-39	Manufacturing	225,023	25.6	332,735	24.7	451,274	24.7	544,331	24.5	735,535	24.3	1,500,621	23.9
	Nondurable	149,028	16.9	207,382	15.4	257,638	14.1	303,751	13.7	396,763	13.1	778,358	12.4
	Durable	75,995	8.6	125,353	9.3	193,636	10.6	240,580	10.8	338,771	11.2	772,263	11.5
40-49	T.C.U.[b]	96,974	11.0	132,558	9.8	170,513	9.3	205,408	9.3	282,313	9.3	598,421	9.5
50-51	Wholesale trade	60,462	6.9	94,532	7.0	124,600	6.8	146,281	6.6	193,682	6.4	381,123	6.1
52-59	Retail trade	107,557	12.2	151,751	11.3	204,154	11.2	245,085	11.0	330,764	10.9	670,030	10.7
60-67	F.I.R.E.[c]	43,450	4.9	67,070	5.0	96,041	5.2	118,742	5.4	166,602	5.5	358,942	5.7
70-89	Services	139,709	15.9	211,289	15.7	313,998	17.2	398,532	18.0	579,200	19.1	1,305,663	20.8
91-97	Government	117,583	13.4	177,903	13.2	222,163	12.1	259,047	11.7	336,747	11.1	648,696	10.3
	Federal, civilian	24,030	2.7	32,579	2.4	38,995	2.1	43,706	2.0	52,865	1.7	91,582	1.5
	Federal, military	9,108	1.0	7,483	0.6	8,694	0.5	9,755	0.4	11,899	0.4	22,102	0.4
	State and local	84,445	9.6	137,840	10.2	174,514	9.5	205,586	9.3	271,983	9.0	535,011	8.5
	Total	880,698	100.0	1,346,171	100.0	1,829,919	100.0	2,219,012	100.0	3,028,573	100.0	6,270,569	100.0

[a] By place of work.

[b] Transportation, communication, utilities.

[c] Finance, insurance, and real estate.

Table 31. Personal income[a] ($1,000's) by type industry in Mobile and Baldwin Counties, 1978 (U.S. Department of Commerce, Bureau of Economic Analysis 1980).

SIC code	Industry	Mobile County Income	Mobile County Percent	Baldwin County Income	Baldwin County Percent	Coastal Region Income	Coastal Region Percent
01-02	Farm	24,581	1.4	20,476	9.6	45,057	2.2
	Non-farm	1,780,596	98.6	193,604	90.4	1,974,200	97.8
	Private	1,544,926	85.6	162,420	75.9	1,707,346	84.6
07-09	Agriculture, forestry, fisheries	21,620	1.2	5,309	2.5	26,929	1.3
10-14	Mining	14,473	0.8	537	0.3	15,010	0.7
15-17	Construction	162,652	9.0	17,851	8.3	180,503	8.9
20-39	Manufacturing	455,988	25.3	43,115	20.1	499,103	24.7
	Nondurable	291,737	16.2	19,336	9.0	311,073	15.4
	Durable	164,251	9.1	23,779	11.1	188,030	9.3
40-49	T.C.U.[b]	185,454	10.3	13,383	6.3	198,837	9.8
50-51	Wholesale trade	130,138	7.2	11,660	5.4	141,798	7.0
52-59	Retail trade	198,744	11.0	28,883	13.5	227,627	11.3
60-67	F.I.R.E.[c]	89,509	5.0	11,096	5.2	100,605	5.0
70-89	Services	286,348	15.9	30,586	14.3	316,934	15.7
91-97	Government	235,670	13.1	31,184	14.6	266,854	13.2
	Federal, civilian	46,468	2.6	2,401	1.1	48,869	2.4
	Federal, military	10,132	0.6	1,093	0.5	11,225	0.6
	State and local	179,070	9.9	27,690	12.9	206,760	10.2
	Total	1,805,177	100.0	214,080	100.0	2,019,257	100.0

[a] By place of work.

[b] Transportation, communication, utilities.

[c] Finance, insurance, and real estate.

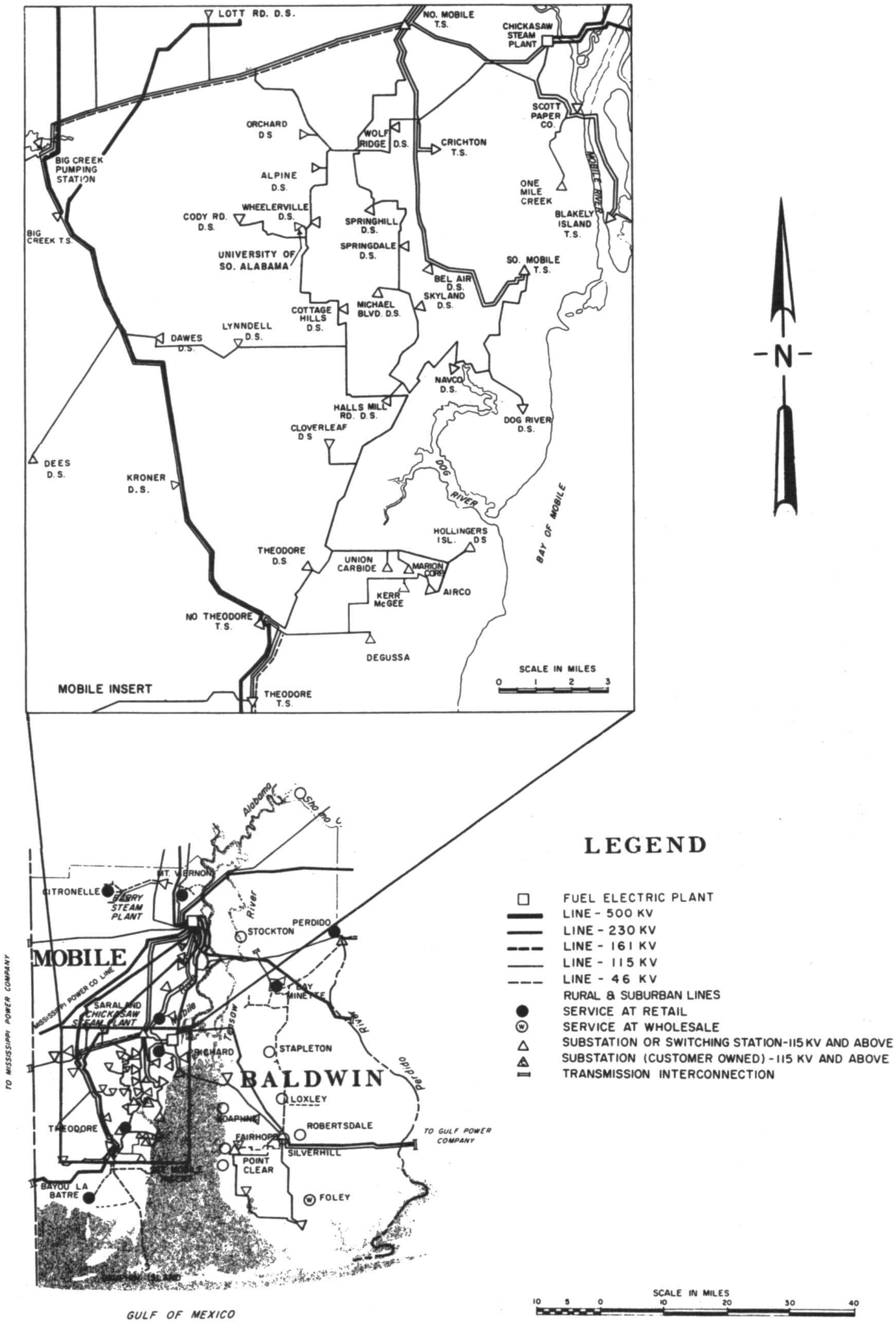


Figure 10. Alabama Power Company electric system in coastal Alabama, 1979 (Alabama Power Company 1971).

Table 32. Sales of electricity (1,000 kilowatt hours) in the Alabama Coastal Region by Alabama Power Company, 1980 (Alabama Power Company 1981).

Type customer	Kilowatt hours	Percent
Industrial		
Heavy	1,800,000	42.7
Light	1,900	--
Subtotal	1,801,900	42.7
Commercial	915,000	21.7
Residential	1,500,000	35.6
Total	4,216,900	100.0

Table 33. Natural gas sales (billion ft^3) by United Gas Pipeline Company[a] in the Alabama Coastal Region 1977, 1980 (Alabama Coastal Area Board and U.S. Department of Commerce 1979; United Gas Pipeline Company 1981).

User type	1977	1980
Jurisdictional[b]	NA	16.649
Industrial	NA	21.512
Total	30.916	38.161

[a] United Gas Pipeline Company furnishes over 90% of the Coastal Region's natural gas.

[b] Includes household, commercial, and some industrial users served by Mobile Gas Corp., Mobile County Gas District, City of Fairhope, Riviera Utilities, Clarke-Mobile Gas, and City of Bay Minette.

Table 34. Withdrawal use of water (Mgal/d) in the Alabama Coastal Region by source and principal use, 1975 (Mettee et al. 1978).

Use	Ground water			Surface water			Total		
	Mobile County	Baldwin County	Total	Mobile County	Baldwin County	Total	Mobile County	Baldwin County	Total
Public supply									
Residential	NA	3.3	NA	NA	--	NA	28.4	3.3	31.7
Commercial and industrial	NA	0.4	NA	NA	--	NA	96.3	0.4	96.7
Subtotal	5.1	3.8	8.9	119.6	--	119.6	124.7	3.8	128.5
Rural									
Domestic	2.7	1.5	4.1	NA	NA	NA	2.7	1.5	4.1
Livestock	0.2	0.3	0.5	0.3	0.5	0.8	0.5	0.8	1.3
Irrigation	0.5	1.5	2.0	1.2	3.5	4.7	1.7	5.0	6.8
Catfish farming	0.4	0.1	0.5	0.4	0.1	0.5	0.8	0.2	1.0
Subtotal	3.8	3.4	7.2	1.9	4.1	6.0	5.7	7.5	13.2
Self-supplied industry	46.8	2.8	49.6	115.2	--	115.2	162.0	2.8	164.8
Thermoelectric power plants	2.0	--	2.0	1,332.7	--	1,332.7	1,334.7	--	1,334.7
Total	57.7	10.0	67.6	1,569.4	4.1	1,573.5	1,627.1	14.1	1,641.2

Table 35. Per capita direct expenditures (dollars) by local governments in United States Standard Metropolitan Statistical Areas and the Alabama Coastal Region, 1966-67 and 1976-77 (U.S. Department of Commerce, Bureau of the Census 1969a, 1979a).

			Coastal Region					
	U.S. (inside SMSAs)		Mobile County		Baldwin County		Total[a]	
Type expenditure	1966-67	1976-77	1966-67	1976-77	1966-67	1976-77	1966-67	1976-77
Education services								
Education	150.35	363.00	94.31	194.35	89.68	191.90	93.66	193.93
Library	2.90	6.55	1.63	5.13	0.36	1.32	1.45	4.49
Total	153.25[b]	369.55	95.94	199.48	90.04	193.22	95.11	198.42
Social services and income maintenance								
Public welfare	24.17	67.85	0.04	0.58	0.04	0.53	0.04	0.57
Hospitals	14.69	41.04	13.32	--	9.06	56.94	12.72	9.61
Health	3.61	15.75	1.92	11.33	0.86	3.89	1.77	10.07
Total	42.47	124.64	15.28	11.91	9.96	61.36	14.53	20.25
Transportation								
Highway	21.14	38.91	13.35	37.21	6.21	11.46	12.34	32.86
Airports	2.73	6.78	0.56	4.68	0.01	0.09	0.49	3.90
Other	2.24	4.58	--	--	--	--	--	--
Total	26.11	50.27	13.91	41.89	6.22	11.55	12.83	36.76
Public safety								
Police	16.73	48.50	10.14	34.53	3.41	16.85	9.19	31.55
Fire	9.77	24.53	8.17	23.18	0.95	3.97	7.15	19.94
Other	2.60	11.55	0.85	8.54	0.06	1.72	0.74	7.39
Total	29.10	84.58	19.16	66.25	4.42	22.54	17.08	58.88
Environment and housing								
Sewerage	10.05	36.30	8.83	74.62	1.57	2.94	7.81	62.52
Sanitation other than sewerage	5.78	12.93	3.91	11.10	1.23	2.91	3.53	9.72
Parks and recreation	8.70	22.07	5.18	19.30	2.89	8.81	4.85	17.53
Housing and urban renewal	9.76	17.93	25.31	10.05	9.66	7.79	23.10	9.67
Total	34.29	89.23	43.23	115.07	15.35	22.45	39.29	99.44
General administration	15.59	43.03	8.61	27.76	4.37	31.65	8.02	28.42

Table 35. Concluded

	U.S. (inside SMSAs)		Coastal Region					
			Mobile County		Baldwin County		Total[a]	
Type expenditure	1966-67	1976-77	1966-67	1976-77	1966-67	1976-77	1966-67	1976-77
Utilities								
Water supply	15.05	32.49	16.09	28.65	5.95	36.65	14.66	30.00
Other	19.33	73.77	2.29	4.34	22.13	133.15	5.08	26.07
Total	34.38	106.26	18.38	32.99	28.09	169.80	19.74	56.08
Liquor store	0.61	0.93	--	--	--	--	--	--
Employee retirement	7.49	17.05	1.22	2.11	--	--	1.04	1.76
Interest on general debt	12.16	34.04	10.81	33.14	2.04	6.07	9.57	28.57
Other and unallocable	17.37	60.22	6.84	22.49	4.30	15.51	6.48	21.31
Total direct expenditures	372.80	984.06	233.36	533.09	164.79	534.15	223.70	549.89

[a] Totals weighted by population size in respective county.

[b] Due to rounding, figures may not exactly equal the total.

Table 36. Direct expenditures ($1,000's) by local governments within the Alabama Coastal Region in 1966-67 and 1976-77 (U.S. Department of Commerce, Bureau of the Census 1969a, 1979a).

Type expenditure	Mobile County 1966-67	Mobile County 1976-77	Baldwin County 1966-67	Baldwin County 1976-77	Coastal Region 1966-67	Coastal Region 1976-77
Education services						
Education	31,140	65,158	4,852	13,063	35,992	78,221
Library	538	1,719	20	90	558	1,809
Total	31,678	66,877	4,872	13,153	36,550	80,030
Social services and income maintenance						
Public welfare	14	194	2	36	16	230
Hospitals	4,397	--	490	3,876	4,887	3,876
Health	635	3,798	47	265	682	4,063
Total	5,046	3,992	539	4,177	5,585	8,169
Transportation						
Highway	4,408	12,475	336	780	4,744	13,255
Airports	186	1,569	1	6	187	1,575
Total	4,594	14,044	337	786	4,931	14,830
Public safety						
Police	3,349	11,577	185	1,147	3,534	12,724
Fire	2,697	7,772	52	270	2,749	8,042
Other	279	2,863	4	117	283	2,980
Total	6,325	22,212	241	1,534	6,283	23,746
Environment and housing						
Sewerage	2,916	25,018	84	200	3,000	25,218
Sanitation and other sewerage	1,290	3,722	66	198	1,356	3,920
Parks and recreation	1,709	6,471	157	600	1,866	7,071
Housing and urban renewal	8,356	3,369	522	530	8,878	3,899
Total	14,271	38,500	829	1,528	15,100	40,108
Governmental administration	2,844	9,307	236	2,155	3,080	11,462
Utilities						
Water supply	5,311	9,607	322	2,495	5,633	12,102
Other	756	1,453	1,198	9,064	1,954	10,517
Total	6,068	11,060	1,519	11,559	7,587	22,619

Table 36. Concluded

Type expenditure	Mobile County		Baldwin County		Coastal Region	
	1966-67	1976-77	1966-67	1976-77	1966-67	1976-77
Employee retirement	401	708	--	--	401	708
Interest on general debt	3,569	11,112	110	413	3,679	11,525
Other and unallocable	2,258	7,540	232	1,056	2,490	8,596
Total direct expenditures	77,054	185,432	8,915	36,361	85,969	221,793

Table 37. School enrollment (grades 1-12) in the Alabama Coastal Region, 1965-66, 1975-76, 1977-78 (Alabama Department of Education 1967, 1977, 1979).

Area, type school	1965-66	1975-76	1977-78
Mobile County			
Public	80,083	67,993	67,983
Private, denominational, parochial[a]	9,167	12,229	14,356
Total	89,250	80,222	82,339
Baldwin County			
Public	14,528	15,323	15,540
Private, denominational, parochial[a]	505	824	773
Total	15,033	16,147	16,313
Coastal Region			
Public	94,611	83,316	83,523
Private, denominational, parochial[a]	9,672	13,053	15,129
Total	104,283	96,369	98,652

[a] Incomplete data due to failure of some schools to report to the State Superintendent of Education.

Table 38. Enrollment in educational institutions of higher learning and state vocational schools in the Alabama Coastal Region, 1965-66, 1969-70, 1971-72, 1973-74, 1975-76, 1977-78 (Alabama Department of Education 1967, 1971, 1973, 1975, 1977, 1979).

	Full time students											
	Regular session (Average per quarter or per semester)						Summer session (Average per quarter or per semester					
Type institution, area	1965-66	1969-70	1971-72	1973-74	1975-76	1977-78	1965-66	1969-70	1971-72	1973-74	1975-76	1977-78
Colleges												
Mobile County												
University of South Alabama	1,243	3,154	3,891	NA	NA	NA	385	1,426	1,683	NA	NA	NA
Springhill College	NA	NA	NA	NA	NA	811	NA	NA	NA	NA	NA	NA
Mobile College	NA	NA	NA	NA	NA	1,250	NA	NA	NA	NA	NA	NA
Baldwin County												
(None)												
Junior Colleges												
Mobile County												
S. D. Bishop	-	770	864	906	1,409	1,231	-	331	318	629	450	359
Baldwin County												
James H. Faulkner	-	930	702	951	1,995	1,169	-	198	169	432	738	292
State Vocational Technical Schools												
Mobile County												
Carver State	355	292	677	751	333	238						
Southwest State	1,033	1,305	1,075	1,519	547	385						
Baldwin County												
(None)												

Table 39. Capacity and occupancy of general hospitals in the Alabama Coastal Region, 1977 (Southwest Alabama Health Planning Council 1977).

Area, hospital	Licensed bed capacity	Average daily occupancy	Projected average daily occupancy 1981	Projected bed need 1981
Mobile County				
Doctor's Hospital	213	174	223	267
University of South Alabama	349	212	229	349
Mobile Infirmary	583	534	612	655
Providence Hospital	378	308	322	398
Springhill Memorial	150	47	47	64
Suburban Hospital	32	25	28	39
Subtotal	1,705	1,300	1,461	1,772
Baldwin County				
Thomas Hospital	66	33	35	51
South Baldwin Hospital	82	57	68	96
Bay Minette Infirmary	55	25	26	39
Subtotal	203	115	129	186
Coastal Region	1,908	1,415	1,590	1,958

Table 40. Residential units in the Alabama Coastal Region in 1960, 1970, 1975, and 1980 (U.S. Department of Commerce, Bureau of the Census 1961b, 1972b, 1981; South Alabama Regional Planning Commission 1977b).

Area, type unit	1960[a]		1970[b]		1975[a]		1980[a]	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Mobile County								
Single family	77,657	84.7	82,887	83.9	86,590	77.8	NA	NA
Multi-family	13,031	14.2	13,825	14.0	19,547	17.6	NA	NA
Mobile home	967	1.1	2,104	2.1	5,152	4.6	NA	NA
Total	91,655	100.0	98,816	100.0	111,289	100.0	131,701	NA
Baldwin County								
Single family	15,889	95.8	19,094	91.6	21,917	85.4	NA	NA
Multi-family	487	2.9	782	3.8	1,298	5.1	NA	NA
Mobile home	217	1.3	959	4.6	2,437	9.5	NA	NA
Total	16,593	100.0	20,835	100.0	25,652	100.0	33,066	NA
Coastal Region								
Single family	93,546	86.4	101,981	85.2	108,507	79.2	NA	NA
Multi-family	13,518	12.5	14,607	12.2	20,845	15.2	NA	NA
Mobile home	1,184	1.1	3,063	2.6	7,589	5.6	NA	NA
Total	108,248	100.0	119,651	100.0	136,941	100.0	164,767	NA

[a] Data include all housing units.

[b] Data represents only year-round housing units; 1970 total housing units were as follows: 99,441 Mobile County; 21,803 Baldwin County; 121,244 Coastal Region total.

Table 41. Tenure, race, vacancy status of housing units in the Alabama Coastal Region, 1950, 1960, 1970 (U.S. Department of Commerce, Bureau of the Census 1952, 1961b, 1972b).

Area, tenure, vacancy	1950	1960	1970
Mobile County			
All housing units	67,048	91,699	99,441
Vacant - seasonal and migratory[a]	593	1,216	625
All year-round housing units	66,455	90,483	98,816
Owner occupied	33,167	52,600	60,952
White	24,140	41,231	47,205
Black	8,968	11,369	13,598
Renter occupied	28,976	30,574	30,817
White	18,008	18,548	18,628
Black	10,936	12,026	12,091
Vacant year-round[a]	4,317	7,309	7,047
For sale only	NA	NA	1,217
For rent	NA	NA	3,392
Other	NA	NA	2,438
Baldwin County			
All housing units	13,046	16,593	21,803
Vacant - seasonal and migratory[a]	922	2,009	967
All year-round housing units	12,124	14,584	20,836
Owner occupied	7,243	9,625	13,793
White	6,013	8,260	12,062
Black	1,230	1,365	1,707
Renter occupied	3,499	3,494	3,928
White	2,589	2,698	3,200
Black	907	796	717
Vacant year-round[a]	1,382	1,465	2,115
For sale only	NA	NA	117
For rent	NA	NA	468
Other	NA	NA	2,530
Coastal Region			
All housing units	80,094	108,292	121,244
Vacant - seasonal and migratory[a]	1,515	3,225	1,592
All year-round housing units	78,579	105,067	119,652
Owner occupied	40,405	62,225	74,745
White	30,153	49,491	59,267
Black	10,198	12,734	15,305
Renter occupied	32,475	34,068	34,745
White	20,597	21,246	21,828
Black	11,843	12,822	12,808
Vacant year-round[a]	5,699	8,774	10,162
For sale only	NA	NA	1,334
For rent	NA	NA	3,860
Other	NA	NA	4,968

[a] Due to modifications in census definitions, data relevant to seasonal and vacant housing units are not comparable from year to year.

Table 42. Housing units by elevation (feet) above mean sea level in the Alabama Coastal Region in 1974 (South Alabama Regional Planning Commission 1974).

County, area	Coastal exposure (nominal miles[a])	Housing units by Elevation above mean sea level 0-10[b]	11-20	21-30	0-30
Mobile County Coastal Area[c]					
Mississippi Sound Coast & Gulf Coast					
Grand Bay-Portersville Bay - including Bayou La Batre & Coden	13	1,500	35	20	1,555
Dauphin Island-Mon Louis Island Fowl River Bay-Heron Bay-Gulf and West Side Mobile Bay, North to mouth of Fowl River	30[d]	850	95	--	945
Hollingers Island					
West Side Mobile Bay From mouth of Fowl River north to Dog River	5	350	350	350	1,050
Mobile Urban Area					
From Dog River north to I-65	15	4,518	16,121	23,540	44,179
Subtotal	67	7,218	16,591	23,910	47,719
Baldwin County Coastal Area[e]					
Gulf Coast - Bon Secour Bay					
Ft. Morgan Peninsula-Oyster Bay. Includes Gulf Shores	23	1,556	--	--	1,556
Gulf State Park-Romar Beach Ono Island	12	656	--	--	656
Bon Secour Bay & River	8	561	217	72	850
Wolf Bay - Perdido Bay	NA	400	222	168	790
Fish River - Mobile Bay					
Fish River-Weeks Bay-Mobile Bay North to County Road 24	5	558	74	72	704
Marlow-Magnolia Air Field-Magnolia Springs	NA	129	85	68	282
Perone Branch-Upper Fish River	NA	13	57	76	146
Elberta-Blackwater River-Seminole-Styx River-Blackwater River	NA	52	22	76	150
Point Clear-Mobile Bay (from County Road 24, North to Fairhope coastal area)	5	338	338	338	1,014
Fairhope-Daphne-Mobile Bay to I-10	10	16	17	17	50
Blakely River-Tensaw River, North of I-10	2	7	7	7	21
Subtotal	65	4,286	1,039	894	6,219
Coastal Region total	132	11,504	17,630	24,804	53,938

[a] Nominal miles are linear exposure which does not include irregularities and uninhabited areas.

[b] 10 ft above mean sea level indicates the upland limit of the "coastal area" as used in this study.

[c] Mississippi Sound, Gulf of Mexico, and Mobile Bay.

[d] Includes 13 miles mainland and 17 miles around Dauphin Island and Little Dauphin Island.

[e] Gulf of Mexico and Mobile Bay.

Table 43. Residential building permits issued in permit issuing places in the Alabama Coastal Region, 1962-64, 1965-69, 1970-74, 1975-79 (U.S. Department of Commerce, Bureau of the Census 1963, 1964, 1965, 1966b, 1967, 1968, 1969b, 1970d, 1971b, 1972c, 1973, 1974, 1975d, 1976b, 1977, 1978, 1979b, 1980e).

	1962-64			1965-69			1970-74			1975-79		
County, municipality	SF	MF	Total	SF	MF	Total	SF	MF	Total	SF	MF	Total
Mobile County (western shore of Mobile Bay)												
Coastal Area												
Bayou La Batre	NA	NA	41	77	–	77	51[a]	10[a]	61[a]	12	72	84
Subtotal	NA	NA	41	77	–	77	51	10	61	12	72	84
Inland												
Chickasaw	NA	NA	396	122	72	194	125	–	125	64	12	76
Citronelle	NA	NA	32	24	–	24	42	–	42	41	74	115
Mobile	NA	NA	4,131	2,385	1,977	4,362	4,151	6,208	10,359	4,245	4,243	8,488
Prichard	NA	NA	267	454	580	1,034	563	44	607	390	119	509
Saraland	NA	NA	356	415	8	423	476	190	666	425	302	727
Satsuma	NA	NA	113	143	6	149	297	11	308	350	2	352
Subtotal	NA	NA	5,295	3,543	2,643	6,186	5,654	6,453	12,107	5,515	4,752	10,267
Total	NA	NA	5,336	3,620	2,643	6,263	5,705	6,463	12,168	5,527	4,824	10,351
Baldwin County (eastern shore of Mobile Bay)												
Coastal Area												
Daphne	NA	NA	57	65	–	65	132[b]	–[b]	132[b]	150	–	150
Elberta	NA	NA	5	9	–	9	10	–	10	6	2	8
Fairhope	NA	NA	141	162	44	206	319	203	522	283	45	328
Foley	NA	NA	65	85	6	91	142	106	248	206	58	264
Gulf Shores	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	753[c]
Subtotal	NA	NA	268	321	50	371	603	309	912	645+	105+	1,503
Inland												
Bay Minette	NA	NA	92	141	68	209	209	109	318	229	88	317
Loxley	NA	NA	16	12	–	12	12	–	12	17	–	17
Robertsdale	NA	NA	68	74	57	131	82[a]	–[a]	82[a]	54	177	231
Silverhill	NA	NA	12	11	2	13	27	–	27	19	–	19
Summerdale	NA	NA	3	7	–	7	8	2	10	18	–	18
Subtotal	NA	NA	191	245	127	372	338	111	449	337	265	602
Total	NA	NA	459	566	177	743	941	420	1,361	982	370	2,105

Coastal Region												
Coastal Area	NA	NA	309	398	50	448	654	319	973	657+	177+	1,587
Inland	NA	NA	5,486	3,788	2,770	6,558	5,992	6,564	12,556	5,852	5,017	10,869
Total	NA	NA	5,795	4,186	2,820	7,006	6,646	6,883	13,529	6,509+	5,194+	12,456

[a] Excludes 1974.

[b] Excludes 1971.

[c] Excludes 1975 and 1976.

Note: Sept.-Dec. 1979 permits were affected by Hurricane Frederic (Sept. 12, 1979).
SF indicates single family units; MF indicates multi-family units.

Table 44. Median value (dollars) of owner occupied housing units and median monthly rent (dollars) of renter occupied housing units in the Alabama Coastal Region, 1950, 1960, 1970 (U.S. Department of Commerce, Bureau of the Census 1952, 1961b, 1972b).

Area, value, rent	1950	1960	1970
Mobile County			
Median value of owner occupied units	4,511	10,700	12,900
Median contract rent of renter occupied units	28	42	53
Baldwin County			
Median value of owner occupied units	3,208	7,500	11,100
Median contract rent of renter occupied units	22	36	52
Coastal Region			
Median value of owner occupied units	4,344	10,303	12,700
Median contract rent of renter occupied units	27	42	53

Table 45. Farm and non-farm employment[a] in the Alabama Coastal Region, 1969, 1978, projected for 2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

Year, type employment	Number	Percent of total
1969		
Farm	3,988	3.0
Non-farm	127,653	97.0
Total	131,641	100.0
1978		
Farm	3,300	1.9
Non-farm	168,978	98.1
Total	172,278	100.0
2030		
Farm	2,194	0.9
Non-farm	253,521	99.1
Total	255,715	100.0
Percent change		
1969-78		
Farm	-17.3	
Non-farm	+32.4	
Total	+30.9	
1978-2030		
Farm	-33.5	
Non-farm	+50.0	
Total	+48.4	
1969-2030		
Farm	-45.0	
Non-farm	+98.6	
Total	+94.3	

[a] By place of work; data not available on a county basis.

Table 46. Labor and proprietors' income (1972 constant $1,000's) by major source in the Alabama Coastal Region, 1969, 1978, 2000, 2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1981).

Major source	1969	1978	2000	2030
Amount				
Farm	14,192	30,038	33,343	52,195
Non-farm	866,506	1,316,133	2,995,230	6,218,373
Total	880,698	1,346,171	3,028,573	6,270,569
Percent of total				
Farm	1.6	2.2	1.1	0.8
Non-farm	98.4	97.8	98.9	99.2
Total	100.0	100.0	100.0	100.0

Table 47. Area (x 1,000 acres) of commercial forest lands[a] by status or ownership in Mobile and Baldwin Counties 1972 (Hedlund and Earles 1972).

Status or ownership	Mobile County		Baldwin County		Coastal Region	
	Area	Percent	Area	Percent	Area	Percent
National forest	--	--	--	--	--	--
Other public	24.4	4.7	5.7	0.8	30.1	2.5
Forest industry	50.4	9.6	286.0	40.7	336.4	27.5
Farmer	92.5	17.7	114.5	16.3	207.0	16.9
Misc. private	355.6	68.0	795.9	42.1	651.5	53.2
Total	522.9	100.0	702.1	99.9	1,225.0	100.0

[a] "Commercial forest lands" are lands either producing or capable of producing crops of wood for various industrial uses.

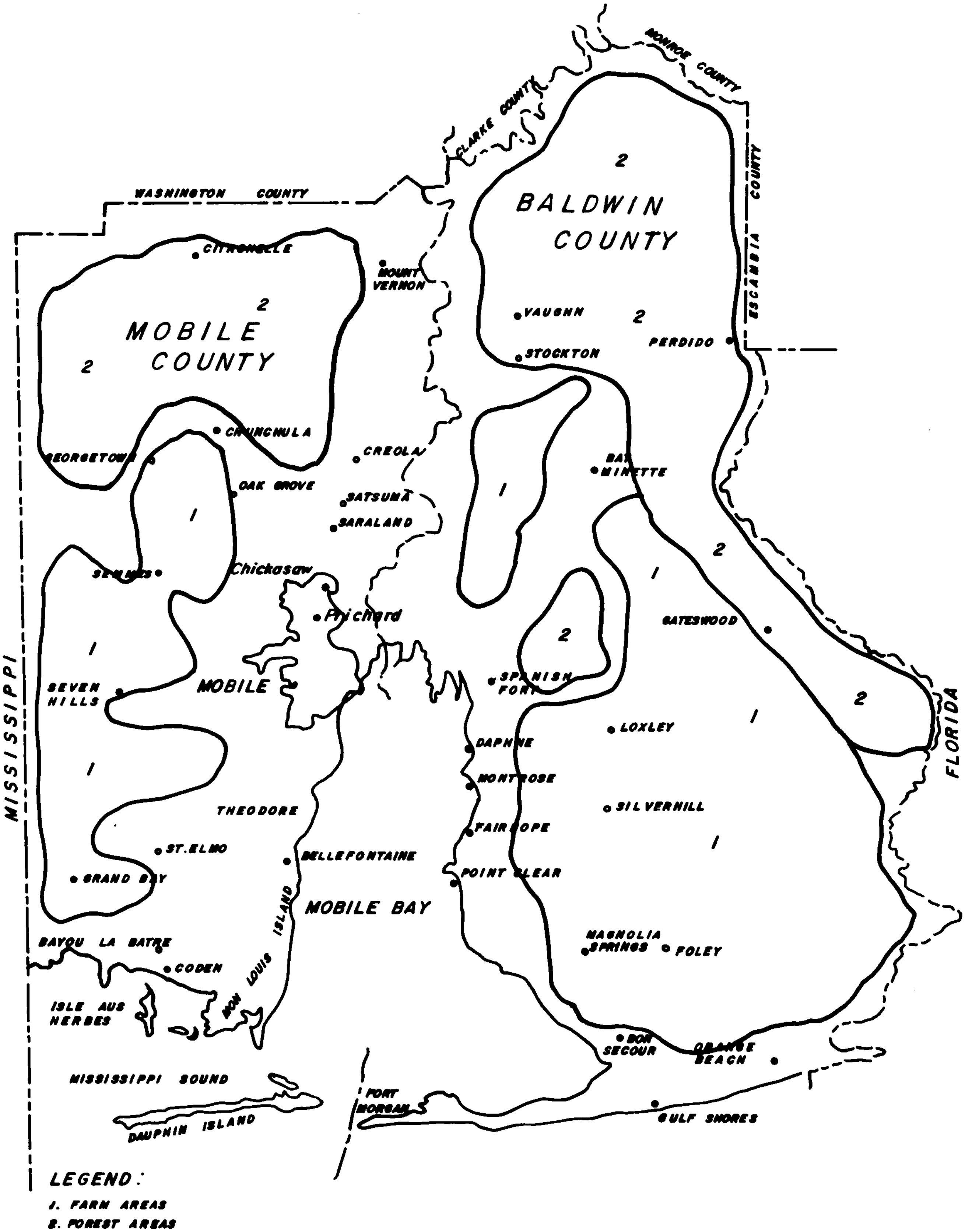
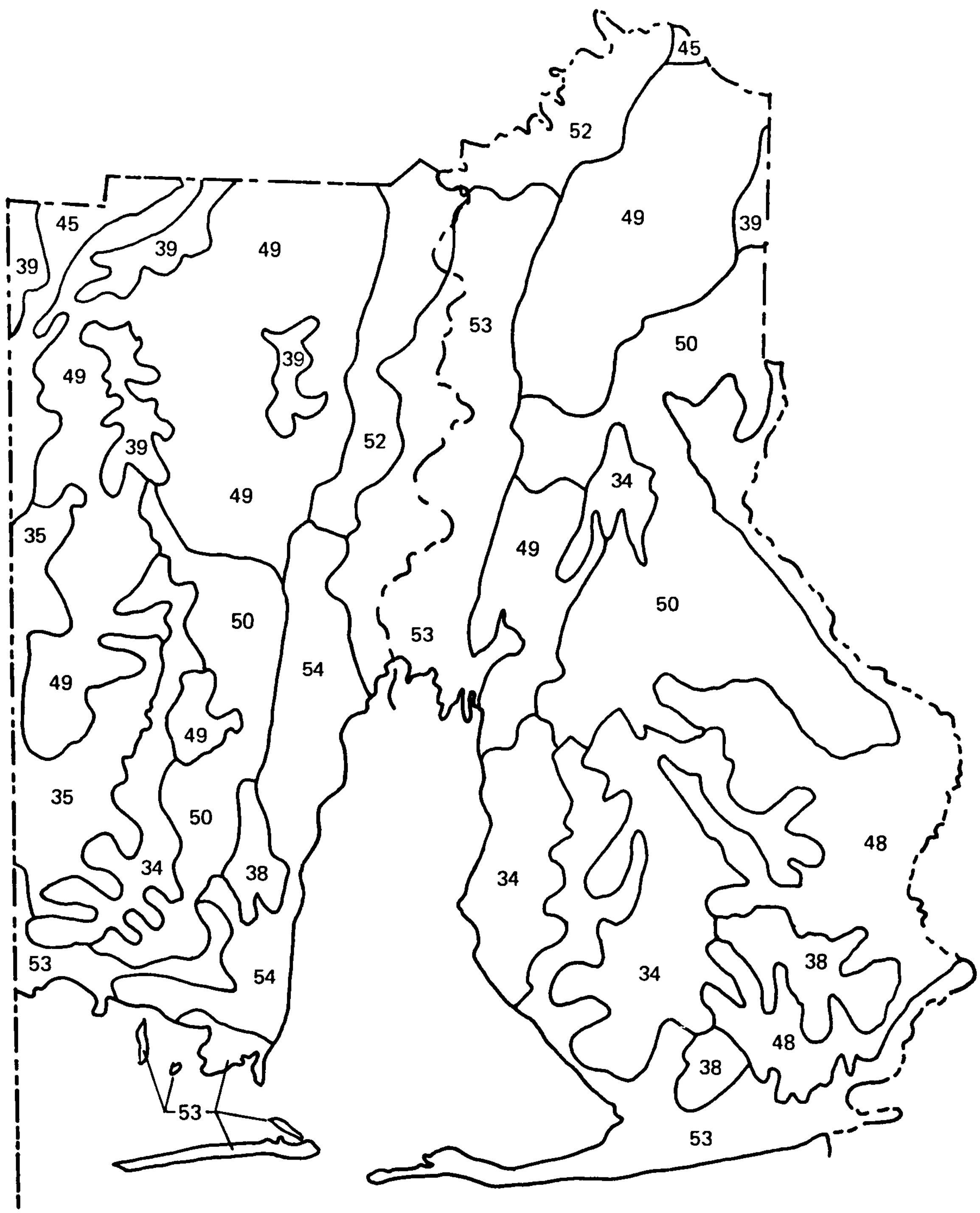


Figure 11. Major farm and forested areas in Mobile and Baldwin Counties, 1975 (South Alabama Regional Planning Commission 1981).

Table 48. Farms, land in farms, and land use in the Alabama Coastal Region 1959, 1969, 1978 (U.S. Department of Commerce, Bureau of the Census 1962, 1972, 1980a, 1980b).

Selected farm characteristics	Mobile County			Baldwin County			Coastal Region		
	1959	1969	1978	1959	1969	1978	1959	1969	1978
Number of farms	1,727	922	906[a]	1,830	1,432	1,215[a]	3,557	2,354	2,121[a]
Land in farms (acres)	186,699	169,444	132,674	320,966	308,933	256,998	507,665	478,377	389,672
Average size of farm (acres)	108	184	146	175	216	212	142	203	184
Value of land and buildings									
Average per farm (dollars)	23,094	58,086	184,785	28,335	66,180	252,448	25,790	63,101	223,545
Average per acre (dollars)	236	316	1,251	159	307	1,193	187	310	1,213
Land in farms according to use (acres)									
Cropland									
Harvested	47,217	50,511	56,877	119,037	156,807	156,362	166,254	207,318	213,239
Used only for pasture or grazing	17,336	25,246	17,954	22,332	24,452	20,758	39,668	49,698	38,712
Other	12,958	6,726	5,073	8,248	7,741	6,257	21,206	14,467	11,330
Subtotal	77,511	82,483	79,904	149,617	189,000	183,377	227,128	271,483	263,281
Woodland	88,381	64,213	33,014	134,942	96,275	54,258	223,323	160,488	87,272
Other	20,807	22,748	19,756	36,407	23,658	19,363	57,214	46,406	39,119
Total	186,699	169,444	132,674	320,966	308,933	256,998	507,665	478,377	389,672

[a] Effective August 1975, the Bureau of the Census changed the definition of a farm to any place from which $1,000 or more of agricultural products were sold or normally would have been sold during the year. The previous definition (used for the 1959, 1964, and 1969 censuses) counted as a farm any place with less than 10 acres from which $250 or more of agricultural products were sold or normally would have been sold during the census year, or any place of 10 acres or more from which $50 or more of agricultural products were sold or normally would have been sold during the census year. The effect of this change in definition on 1978 data is as follows: Mobile County - 906 farms (new definitions), 995 farms (old definition); Baldwin County - 1215 farms (new definition), 1304 farms (old definition).



34 Malbis-Orangeburg-Pansey
35 McLaurin-Troup-Ruston
38 Poarch-Benndale-Escambia
39 Lucedale-Ruston-Greenville
45 Smithton-Escambia-Troup
48 Troup-Plummer-Escambia
49 Troup-Smithdale-Esto
50 Troup-Smithdale-Escambia
52 Cahaba-Chewacla-Myatt
53 Dorovan-Plummer-Tidal marsh
54 Osier-Johnston

Figure 12. Soil associations (modified from Soil Conservation Service 1974).

Key to Soil Map (Figure 12)
Soil characteristics of Mobile and Baldwin Counties (Soil Conservation Service 1974).

Map symbol	Soil associations	Percent slope	Drainage	Dominant texture	Reaction	Erosion	Limitation for light construction	Desirable agricultural use
34	Malbis-Orangeburg Pansey	0-5	Moderate	Sandy clay loam	Strongly acid	Slight	Slight to severe	Cropland
35	McLaurin-Troup-Ruston	2-10	Good	Sand clay loam	Strongly acid	Slight	Slight	Cropland
38	Poarch-Benndale-Escambia	0-5	Good	Loam	Very acid	Slight	Moderate	Cropland
39	Lucedale-Ruston-Greenville	0-5	Good	Sandy clay loam	Strongly acid	Slight	Slight	Cropland
45	Smithton-Escambia-Troup	0-5	Moderate	Sandy loam	Very acid	Moderate	Slight to severe	Pasture
48	Troup-Plummer-Escambia	0-5	Moderate	Sandy loam	Very acid	Slight	Slight to severe	Forest
49	Troup-Smithdale-Esto	2-25	Good	Sandy clay loam	Strongly acid	Severe	Severe	Forest
50	Troup-Smithdale-Escambia	0-12	Good	Sandy clay loam	Strongly acid	Moderate	Moderate	Pasture
52	Cahaba-Chewacla-Myatt	0-5	Moderate	Loam	Strongly acid	Slight	Severe	Cropland
53	Dorovan-Plummer-Tidal marsh	0-1	Very poor	Organic	Extremely acid	Slight	Severe	Forest
54	Osier-Johnston	0-2	Very poor	Loamy sand	Very acid	Slight	Severe	Forest

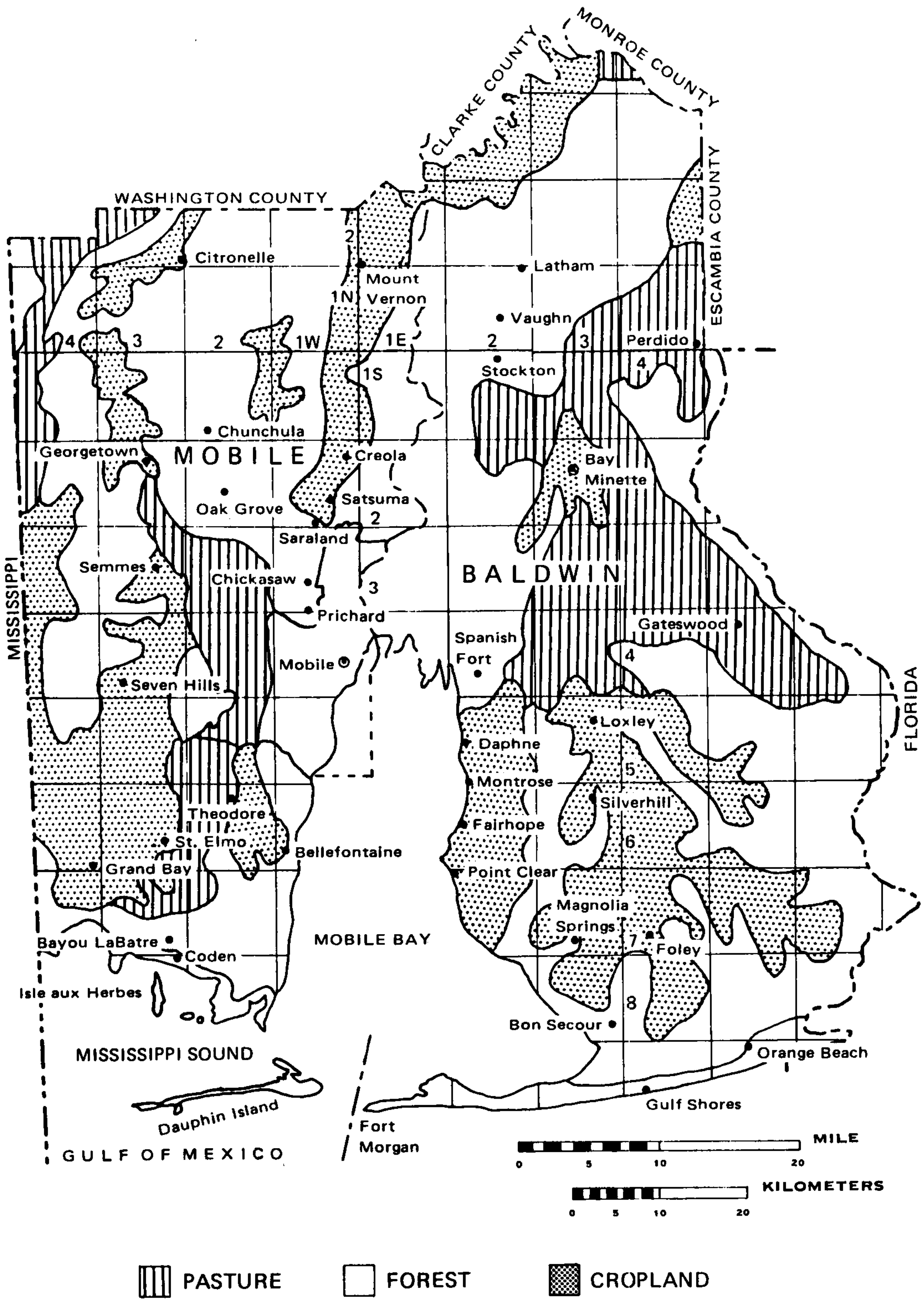


Figure 13. Preferred agricultural land use in Mobile and Baldwin Counties based on soil associations and financial return in 1977 (Moser and Chermock 1977).

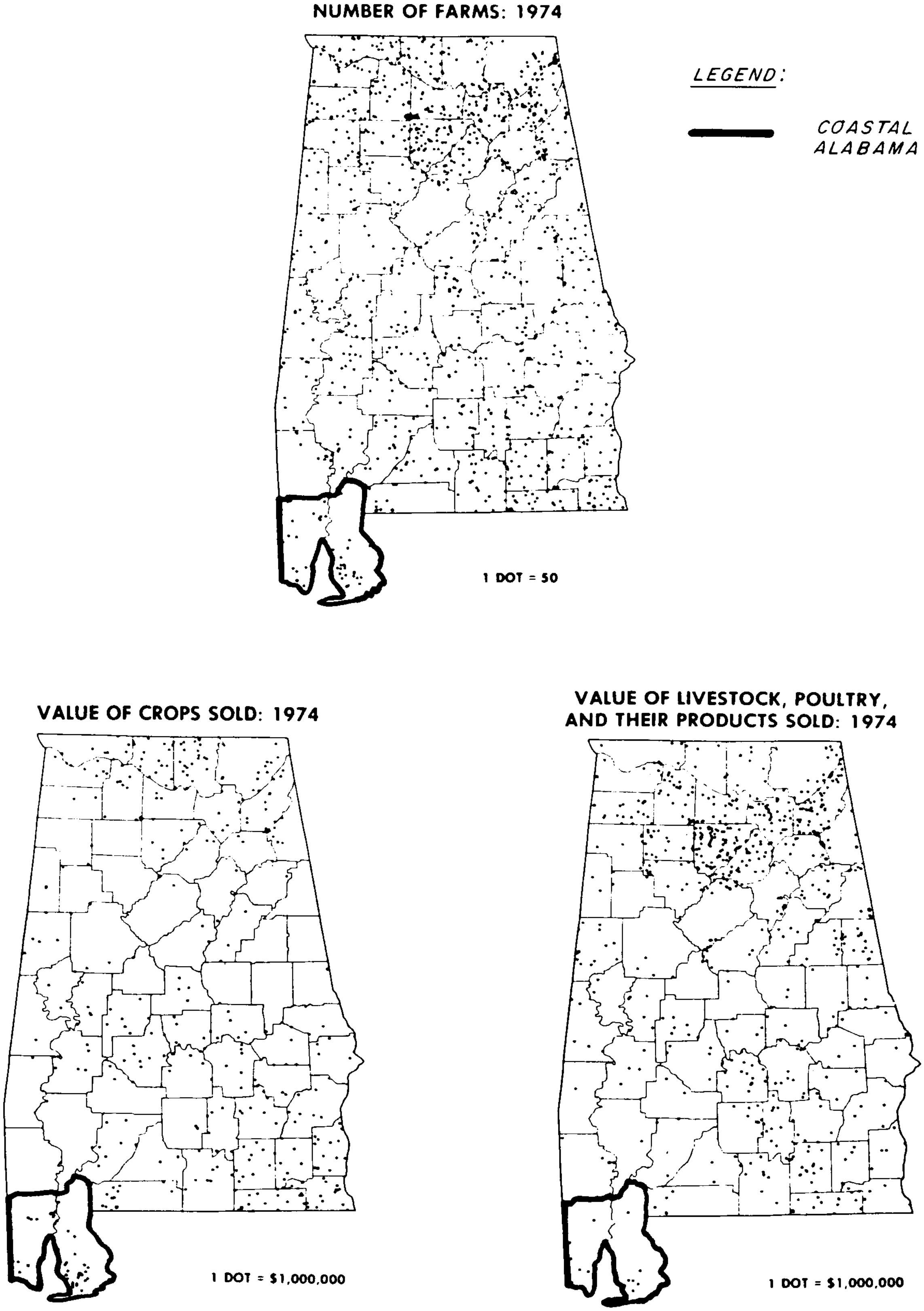


Figure 14. Number of farms, value of crops sold, and value of livestock, poultry, and their products sold in Alabama, 1974 (U.S. Department of Commerce, Bureau of the Census 1977).

Table 49. Value ($1,000's) and numbers of farm machinery and equipment on farms in the Alabama Coastal Region, 1959, 1969, 1978 (U.S. Department of Commerce, Bureau of the Census 1962, 1972, 1980a, 1980b).

Type machinery and equipment	Mobile County 1959	Mobile County 1969	Mobile County 1978	Baldwin County 1959	Baldwin County 1969	Baldwin County 1978	Coastal Region 1959	Coastal Region 1969	Coastal Region 1978
Estimated market value of all machinery and equipment	NA	6,647	19,493	NA	15,167	44,538	NA	21,814	64,031
Average per farm (dollars)	NA	7,630	21,659	NA	11,160	37,054	NA	9,777	30,478
Selected machinery and equipment (number)									
Motor trucks, including pickups	1,123	988	1,307	1,843	1,981	2,215	2,966	2,969	3,522
Wheel tractors	1,047	1,081[a]	1,162	2,067	2,240[a]	2,112	3,114	3,321[a]	3,274
Crawler tractors	NA		NA	NA		NA	NA		NA
Grain and bean combines, self-propelled	NA	77	NA	NA	406	NA	NA	483	NA
Corn heads for combines, other cornpickers and picker-shellers	NA	130	NA	NA	378	NA	NA	508	NA
Pickup balers	38	76	NA	74	113	NA	112	189	NA

[a] Combined totals for wheel tractors and crawler tractors.

Table 50. Selected farm production expenses ($1,000's) in the Alabama Coastal Region, 1959, 1969, 1978 (U.S. Department of Commerce, Bureau of the Census 1962, 1972, 1980a, 1980b).

Type expense	Mobile County 1959	Mobile County 1969	Mobile County 1978	Baldwin County 1959	Baldwin County 1969	Baldwin County 1978	Coastal Region 1959	Coastal Region 1969	Coastal Region 1978
Livestock and poultry purchased	NA	649	1,672	NA	1,581	3,735	NA	2,230	5,407
Feed purchased for livestock and poultry	1,111	1,568	2,813	1,515	1,350	3,692	2,626	2,918	6,505
Animal health costs	NA	NA	123	NA	NA	196	NA	NA	319
Seeds, bulbs, plants and trees	NA	431	1,278	NA	1,268	2,660	NA	1,699	3,938
Commercial fertilizer	NA	1,187	2,399	NA	3,352	6,873	NA	4,539	9,272
Other agricultural chemicals including lime	NA	269	1,108	NA	921	3,130	NA	1,190	4,238
Gasoline and other petroleum products	306	468	1,353	813	1,092	3,652	1,119	1,560	5,005
Hired farm labor	1,440	2,323	4,281	1,590	1,914	4,280	3,030	4,237	8,561
Contract labor	NA	317[a]	184	NA	1,199[a]	398	NA	1,516[a]	582
Machine hire and custom work	NA		385	NA		1,164	NA		1,549

[a] Combined totals for contract labor and machine hire and custom work.

Table 51. Cash receipts (x $1,000's) from farm[a] products in Mobile and Baldwin Counties, 1974, 1976, 1978, 1979 (Alabama Crop and Livestock Reporting Service 1977, 1979, 1980).

County and year	Cash receipts	Percentage of the two-county total
Mobile County		
1974	24,828	32.8
1976	32,502	31.9
1978	43,088	40.3
1979[b]	38,122	42.0
Baldwin County		
1974	50,770	67.2
1976	69,529	68.1
1978	63,782	59.7
1979[b]	52,750	58.0
Coastal Region		
1974	75,598	100.0
1976	102,031	100.0
1978	106,870	100.0
1979[b]	90,872	100.0

[a] A farm is defined as any place that has an annual agricultural production of $1,000 or more.

[b] Preliminary.

Table 52. Cash receipts ($1,000's) from farm[a] products sold in the Alabama Coastal Region, 1974, 1976, 1978, 1979 (Alabama Crop and Livestock Reporting Service 1977, 1979, 1980).

Product type	1974			1976			1978			1979[b]		
	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region
Crops												
Wheat	187	1,002	1,189	55	442	497	55	407	462	122	910	1,032
Corn	701	1,366	2,067	1,093	3,986	5,079	521	2,566	3,087	842	3,648	4,490
Hay	85	88	173	92	90	182	52	82	134	48	68	116
Cotton	2	336	368	--	289	289	--	--	--	--	---	--
Soybeans	5,523	22,582	28,105	6,562	31,670	38,232	10,932	23,243	34,175	7,197	18,143	25,340
Other crops	42	140	182	51	174	225	68	216	284	66	213	279
Fruits, vegetables, nuts, greenhouse and nursery	10,925	16,301	27,226	14,851	18,837	33,688	19,863	20,152	40,015	17,664	12,233	29,897
Farm forest products	483	1,051	1,534	475	706	1,181	572	2,045	2,617	603	1,918	2,521
Subtotal	17,948	42,896	60,844	23,179	56,194	79,373	32,063	48,711	80,774	26,542	37,133	63,675
Livestock and poultry												
Cattle and calves	1,292	2,180	3,472	4,536	7,185	11,721	5,908	9,328	15,236	6,096	9,998	16,094
Hogs	1,773	1,607	3,380	1,275	1,323	2,598	1,557	1,432	2,989	1,936	1,742	3,678
Milk	2,338	2,401	4,739	2,245	2,612	4,857	2,244	1,905	4,149	2,201	1,966	4,167
Broilers	--	--	--	150	86	236	192	99	291	217	111	328
Eggs	1,376	1,482	2,858	966	1,921	2,887	943	2,056	2,999	823	1,374	2,197
Other	101	204	305	151	208	359	181	251	432	307	426	733
Subtotal	6,880	7,874	14,754	9,323	13,335	22,658	11,025	15,071	26,096	11,580	15,617	27,197
Total	24,828	50,770	75,598	32,502	69,529	102,031	43,088	63,782	106,870	38,122	52,750	90,872

[a] A farm is defined as any place which has an annual agricultural production of $1,000 or more.

[b] Preliminary.

Table 53. Market value ($1,000's) of agricultural products sold in the Alabama Coastal Region, 1959, 1964, 1969, 1974, 1978 (U.S. Department of Commerce, Bureau of the Census 1962, 1967, 1972, 1977, 1980a, 1980b).

County, product type	1959	1964	1969	1974	1978
Mobile County					
Crops	1,025	1,761	6,480[a]	6,919	18,323[a]
Nursery and greenhouse	2,889[b]	3,385[b]		7,450	
Forest			164	196	(d)
Livestock and livestock products	1,224	1,291	5,068[c]	4,891	7,466
Poultry and poultry products	1,715	2,261		2,326	1,054
Total	6,854	8,698	11,712	21,783	26,843
Baldwin County					
Crops	7,400	13,775	13,246[a]	32,225	34,713[a]
Nursery and greenhouse	1,641[b]	1,208[b]		1,747	
Forest			346	702	(d)
Livestock and livestock products	2,546	2,084	6,919[c]	7,516	(D)
Poultry and poultry products	1,790	2,050		1,119	(D)
Subtotal	13,377	19,117	20,510	43,309	50,785
Coastal Region					
Crops	8,425	15,536	19,726[a]	39,144	53,047[a]
Nursery and greenhouse	4,530[b]	4,593[b]		9,197	
Forest			510	898	(d)
Livestock and livestock products	3,770	3,375	11,987[c]	12,407	(D)
Poultry and poultry products	3,505	4,311		3,445	(D)
Total	20,231	27,815	32,222	65,092	77,628[d]

[a] Combined totals for crops and nursery and greenhouse.

[b] Combined totals for nursery and greenhouse and forest.

[c] Combined totals for livestock and livestock products and poultry and poultry products.

[d] 1978 data excludes sales of forest products.

Table 54. Acres planted and quantity harvested for selected crops in the Alabama Coastal Region, 1969, 1974, 1978 (U.S. Department of Commerce, Bureau of the Census 1972, 1977, 1980a, 1980b).

Type crop	Mobile County			Baldwin County			Coastal Region		
	1969	1974	1978	1969	1974	1978	1969	1974	1978
Acres planted									
Corn for grain or seed	NA	8,145	10,874	NA	21,125	29,060	NA	29,270	39,934
Corn for silage or green chop (green)	NA	NA	1,418	NA	NA	2,232	NA	NA	3,650
Wheat for grain	1,610	1,331	991	25,643	10,889	7,132	27,253	12,220	8,132
Sorghums for grain or seed	NA	167	(D)	NA	901	587	NA	1,068	(D)
Soybeans for beans	28,784	27,723	32,895	98,953	103,477	108,687	121,737	131,200	141,582
Cotton	1,090	12	(D)	1,341	1,376	(D)	2,431	1,388	(D)
Irish potatoes	NA	1,808	1,961	NA	7,466	7,553	NA	9,274	9,514
Hay, all (dry)	3,497	4,954	5,829	5,019	5,871	8,347	8,516	10,825	14,176
Alfalfa hay (dry)	NA	NA	283	NA	NA	80	NA	NA	363
Pecans, improved	NA	NA	3,971	NA	NA	9,042	NA	NA	13,013
Vegetables, sweet corn or melons for sale	1,427	913	1,055	5,325	2,768	2,761	6,752	3,681	3,816
Peanuts for nuts	NA	45	(D)	6	8	-	NA	53	(D)
Quantity harvested									
Corn for grain or seed (bu)	NA	506,799	801,178	NA	1,676,470	2,697,681	NA	2,183,269	3,498,859
Corn for silage or green chop (green) (tons)	NA	NA	16,957	NA	NA	29,691	NA	NA	46,648
Wheat for grain (bu)	38,581	21,404	18,125	616,802	156,433	187,885	655,383	177,837	206,010
Sorghums for grain or seed (bu)	NA	2,283	(D)	NA	25,707	23,913	NA	27,990	(D)
Soybeans for beans (bu)	504,801	769,510	823,509	2,411,183	2,731,509	2,692,580	2,915,984	3,501,019	3,516,089
Cotton (bales)	648	9	(D)	1,683	1,737	(D)	2,331	1,746	(D)
Irish potatoes (cwt)	NA	168,430	104,818	NA	1,320,334	871,777	NA	1,488,764	976,595
Hay, all (dry) (tons)	6,276	9,707	11,209	9,684	10,149	13,634	15,960	19,856	24,843
Alfalfa hay (dry) (tons)	NA	NA	421	NA	NA	127	NA	NA	548
Pecans, improved (lbs)	NA	NA	151,987	NA	NA	1,052,841	NA	NA	1,204,828
Peanuts for nuts (lbs)	NA	19,560	(D)	1,400	2,760	-	NA	22,320	(D)

Table 55. Five-year average yields of selected crops and livestock production rates, Alabama and the United States, 1962-66 and 1972-76 (Alabama Development Office 1978).

Type crop	Alabama 1962-66	Alabama 1972-76	United States 1962-66	United States 1972-76
Cotton/acre (lb)	458	425	500	477
Corn/acre (bu)	35.1	50.0	68.3	86.9
Soybeans/acre (bu)	21.8	22.5	24.3	26.9
Peanuts/acre (lb)	1,191	2,246	1,496	2,409
Milk/cow (lb)	4,646	7,445	8,021	10,379
Eggs/hen per year (no)	214	231	216	230
Pigs/sow per litter (no)	7.2	7.5	6.9	7.2

Table 56. Growing stock and sawtimber volume, growth, and removals on commercial forest lands in Alabama and the Alabama Coastal Region 1963, 1972, 1975 (Hedlund and Earles 1972; Murphy 1973; Beltz 1975).

Volume, growth, removal	Growing stock[a] - million cubic feet				Sawtimber[b] - million board feet			
		Coastal Region				Coastal Region		
	Alabama	Mobile County	Baldwin County	Total	Alabama	Mobile County	Baldwin County	Total
Volume[c]								
1963	14,447.9	279.4	637.6	917.0	46,601.9	967.3	2,305.5	3,272.8
1972	20,211.7	371.3	744.6	1,115.9	63,517.1	1,192.5	2,911.1	4,103.6
1975	21,360.6	411.5	771.3	1,182.8	66,821.3	1,325.3	3,013.0	4,338.3
Net growth[d]								
1962	856.1	NA	NA	NA	NA	NA	NA	NA
1971	1,187.4	NA	NA	NA	4,201.7	NA	NA	NA
1974	1,270.5	25.0	33.5	58.5	4,069.8	85.9	135.9	221.8
Removals[e]								
1962	523.8	17.6	30.0	47.6	1,686.8	55.0	96.1	151.1
1971	739.6	NA	NA	NA	2,852.4	NA	NA	NA
1974	854.7	9.4	24.1	33.5	824.6	35.4	100.1	135.5

[a] Saw timber trees, pole timber trees, saplings, and seedlings; all live trees except rough and rotten trees.

[b] Live trees of commercial species, 9.0 inches and larger in diameter at breast height for softwoods and 11.0 inches and larger for hardwoods, and containing at least one 12-foot saw log.

[c] Volume of growing stock - the volume of sound wood in the bole of sawtimber and poletimber trees from stump to a minimum 4.0 inch top outside bark or to the point where the central stem breaks into limbs; volume of sawtimber - net volume of the saw log portion of live sawtimber trees in board feet of the International rule ¼-inch kerf.

[d] Net growth - increase in volume due to growth minus volume of trees that died or became rough or rotten during the year.

[e] Net volume of trees removed from the inventory by harvesting, cultural operations such as timber-stand improvement, land clearing, or changes in land use.

Table 57. Cash receipts ($1,000's) from sales of timber products[a], by forest landownership type in Alabama and the Alabama Coastal Region, 1976, 1978, 1979 (Alabama Crop and Livestock Reporting Service 1977, 1979, 1980).

Year, land ownership	Coastal Region: Mobile County	Coastal Region: Baldwin County	Coastal Region: Total	Alabama
1976				
Farmer	474.9	706.2	1,181.1	35,706.1
Other and misc. private	1,824.5	1,828.4	3,652.9	53,384.8
Forest industry	257.6	1,763.5	2,021.1	28,610.5
Government	126.1	34.7	160.8	4,098.1
Total	2,683.1	4,332.8	7,015.9	121,799.5
1978				
Farmer	571.5	2,045.0	2,616.5	64,357.4
Other and misc. private	2,195.5	5,294.4	7,489.9	92,890.4
Forest industry	309.9	5,106.2	5,416.1	51,439.1
Government	151.7	100.4	252.1	5,914.4
Total	3,228.6	12,546.0	15,774.6	214,601.3
1979				
Farmer	603.0	1,918.0	2,521.0	68,282.0
Other and misc. private	2,316.0	4,964.0	7,280.0	100,995.0
Forest industry	327.0	4,788.0	5,115.0	54,761.0
Government	160.0	94.0	254.0	8,118.0
Total	3,406.0	11,764.0	15,170.0	232,156.0

[a] Represents receipts to landowners from sales of raw stumpage products.

Table 58. Industrial roundwood production[a] by product type in the Alabama Coastal Region and Alabama, 1971 (Bertelson 1972).

	Roundwood volume in standard units					Roundwood volume[b] in million cubic feet			
			Coastal Region				Coastal Region		
Product	Unit	Alabama	Mobile County	Baldwin County	Total	Alabama	Mobile County	Baldwin County	Total
Saw logs	million board ft[c]	1,481,515	19,609	42,110	61,719	261,761	NA	NA	NA
Veneer logs	million board ft[c]	278,050	437	1,591	2,028	45,287	NA	NA	NA
Pulpwood	std. cords	4,858,671	NA[d]	NA[d]	NA[d]	392,126	NA	NA	NA
Piling	million linear ft	805	–	–	–	645	NA	NA	NA
Poles	million pieces	1,002	58	133	191	14,231	NA	NA	NA
Posts	million pieces	1,975	34	116	150	1,147	NA	NA	NA
Misc. products[e]	million ft^3	2,938	2	22	24	2,933	NA	NA	NA
Total		–	–	–	–	718,135	14,215	29,393	43,608

[a] Roundwood products cut from growing stock on commercial forest land.

[b] The volume of logs or other round products required to produce lumber, wood pulp, or other processed products.

[c] International ¼-inch rule.

[d] In 1978, round pulpwood production was 158,147 std. cords in Baldwin County and 48,823 std. cords in Mobile County (Bertelson 1979).

[e] Includes furniture stock, cooperage, miscellaneous dimensions, handlestock, excelsior, and shuttleblocks.

Table 59. Quantity of forest products in the Alabama Coastal Region, 1975 (Moser and Chermock 1977).

Product	Mobile County	Baldwin County	Coastal Region
Pine lumber (board feet)	5,950,767	21,196,867	27,147,634
Pine logs (board feet)	1,092,311	361,689	1,454,000
Hardwood lumber (board feet)	3,810,778	8,541,778	12,352,556
Hardwood logs (board feet)	123,933	16,300	140,233
Pulpwood (standard cords)	62,356	135,340	197,696
Pulpwood chips (cords)	65,678	10,046	75,724
Cross ties (pieces)	14,358	540	14,898
Poles (pieces)	141,837	199,029	340,866

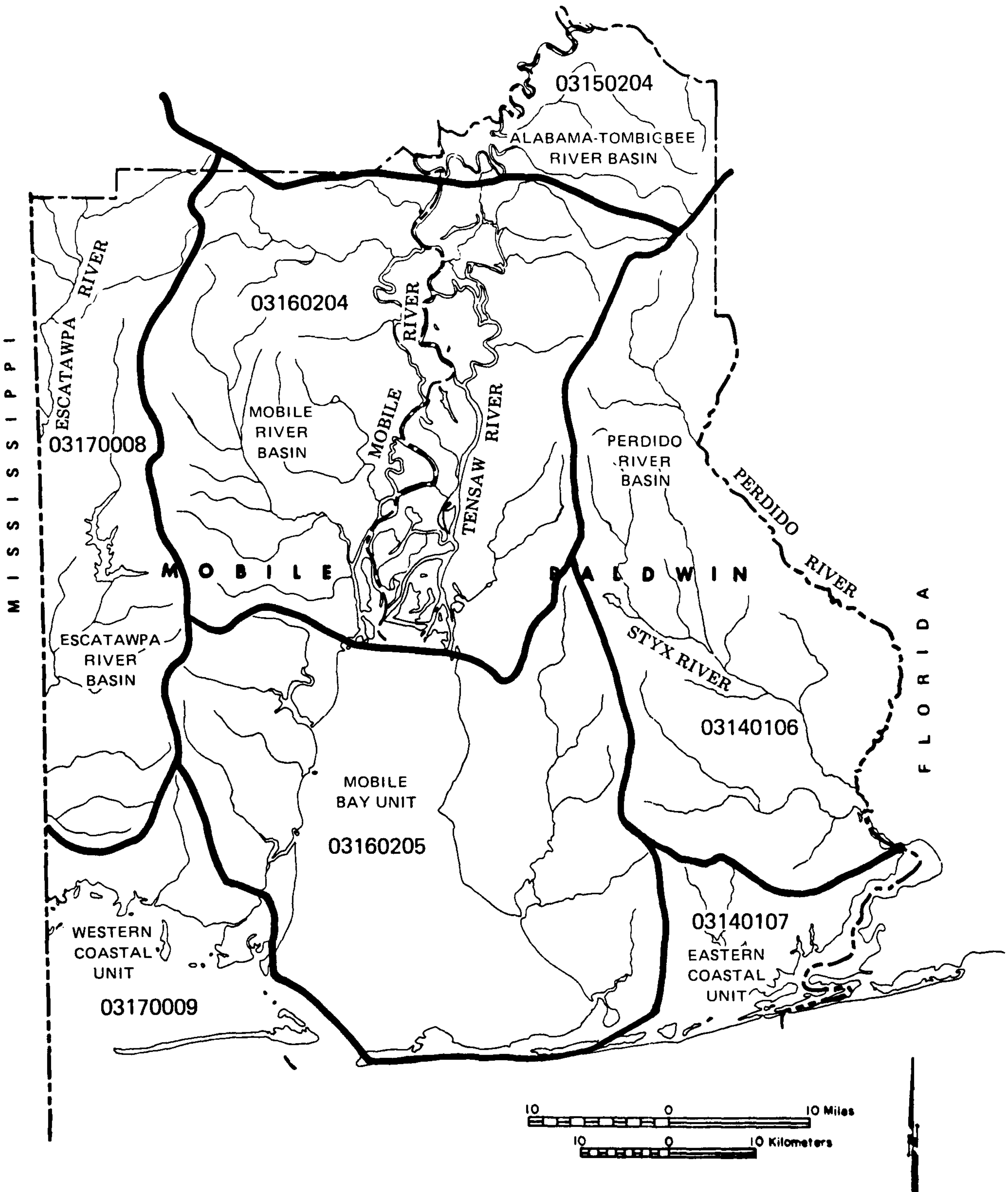


Figure 15. Drainage basins in coastal Alabama.

Table 60. Usage of agricultural chemicals on Alabama Coastal Region farms with sales of $2,500 and over: number of farms, acres treated, cost of materials, 1969, 1974 (U.S. Department of Commerce, Bureau of the Census 1977).

Agricultural chemicals	1969 Mobile County	1969 Baldwin County	1969 Coastal Region	1974 Mobile County	1974 Baldwin County	1974 Coastal Region
	Number of farms					
Commercial fertilizer	342	794	1,136	380	833	1,213
Lime	132	388	520	89	281	370
Sprays, dusts, granules, fumigants to control						
Insects on hay crops	3	28	31	4	13	17
Insects on other crops	118	489	607	116	373	489
Nematodes in crops	14	49	63	8	145	153
Diseases in crops and orchards	32	101	133	32	81	113
Weeds or grass in crops	34	182	216	59	226	285
Weeds or brush in pasture	5	19	24	7	31	38
Weeds on all other land	NA	NA	NA	11	27	38
Chemicals for defoliation or for growth control of crops or thinning of fruit	3	38	41	6	17	23
Insect control on livestock and poultry	56	167	223	19	60	79
Other chemicals	NA	NA	NA	51	133	184
Total	388	850	1,238	392	838	1,230
	Acres treated					
Commercial fertilizer	52,750	152,856	205,606	51,639	155,002	206,641
Lime	13,466	33,391	46,857	11,242	30,923	42,165
Sprays, dusts, granules, fumigants to control						
Insects on hay crops	72	523	595	59	187	246
Insects on other crops	21,387	81,020	102,407	23,676	80,521	104,197
Nematodes in crops	210	2,504	2,714	1,306	25,402	26,708
Diseases in crops and orchards	2,485	6,100	8,585	2,674	7,057	9,731
Weeds or grass in crops	34	22,657	22,691	59	45,242	45,301
Weeds or brush in pasture	167	745	912	797	1,809	2,606
Weeds in all other land	NA	NA	NA	74	650	724
Chemicals for defoliation or for growth control of crops or thinning of fruit	239	2,664	2,903	159	1,519	1,678
Insect control on livestock and poultry	-	-	-	-	-	-
Other chemicals	-	-	-	-	-	-

Table 60. Concluded

Agricultural chemicals	1969			1974		
	Mobile County	Baldwin County	Coastal Region	Mobile County	Baldwin County	Coastal Region
	Cost of materials ($1,000)					
Commerical fertilizer	1,067	3,223	4,290	2,061	6,383	8,444
Lime	99	253	352	103	359	462
Sprays, dusts, granules, fumigants to control						
Insects on hay crops	NA	3	NA	NA	1	NA
Insects on other crops	90	441	531	203	849	1,052
Nematodes in crops	3	49	52	17	228	245
Diseases in crops and orchards	25	56	81	59	145	204
Weeds or grass in crops	17	63	80	103	334	437
Weeds or brush in pasture	1	2	3	4	6	10
Weeds on all other land	NA	NA	NA	NA	4	NA
Chemicals for defoliation or for growth control of crops or thinning of fruit	1	9	10	1	13	14
Insect control on livestock and poultry	3	11	14	4	8	12
Other chemicals	NA	NA	NA	19	95	114
Total	1,313	4,113	5,426	2,574	8,424	10,998

Table 61. Acres of agricultural soils in the Alabama Coastal Region subject to erosion in 1978 (South Alabama Regional Planning Commission 1978).

Land use	Mobile County	Baldwin County	Coastal Region
Cropland and hayland	36,395	45,945	82,340
Pasture	17,986	19,290	37,276
Forest	311,036	361,737	672,773
Total	365,417	426,972	792,389

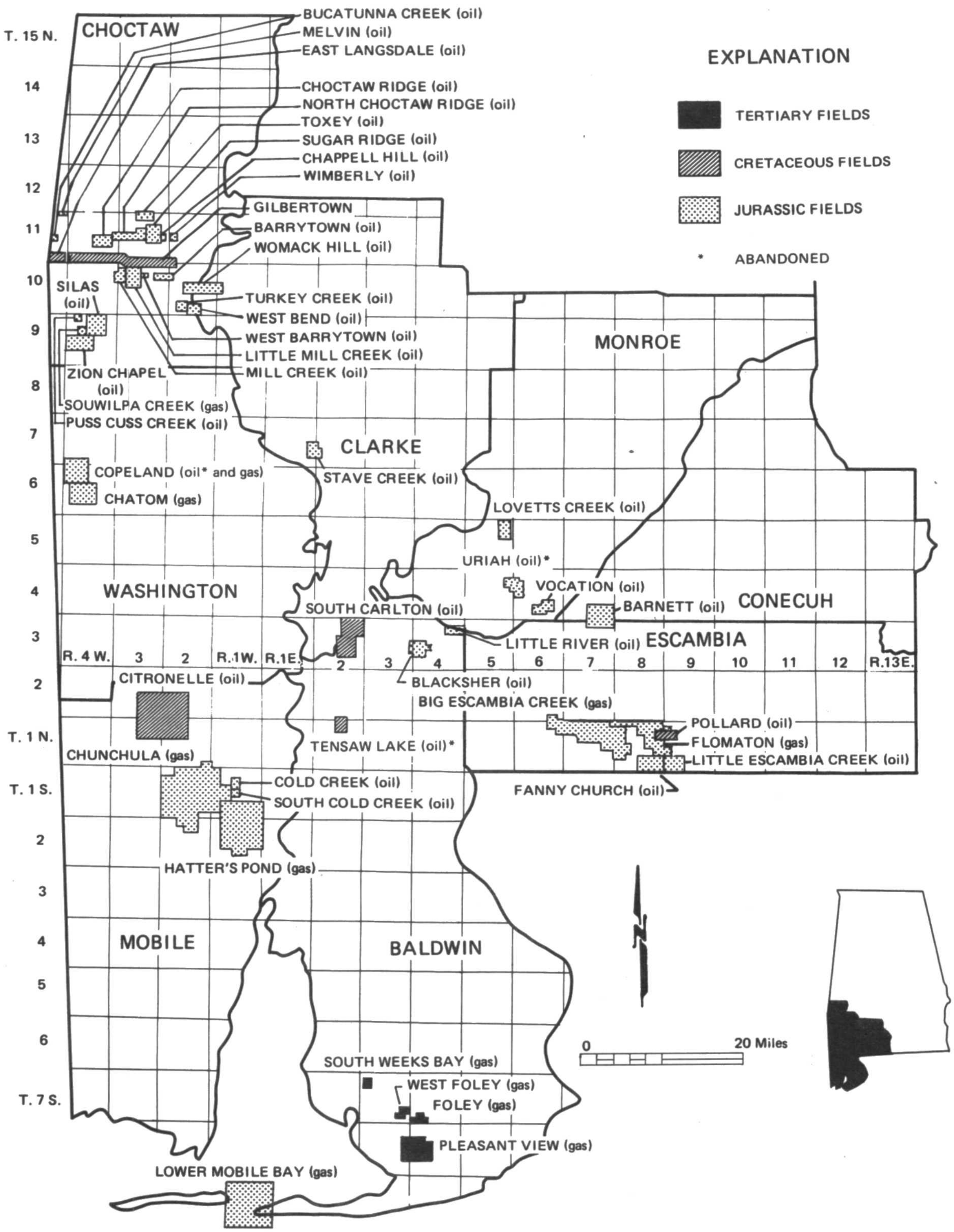


Figure 16. Oil and gas fields in Southwestern Alabama, 1979 (Masingill and McAnnally 1980).

Table 62. Selected data on oil and gas fields in the Alabama Coastal Region, 1979 (Masingill and McAnnally 1980).

County, field	Discovery date	Producing horizon(s)	Hydro-carbon type	Gravity °API	Number of producing wells	Total salt water produced 1979 (bbl)	Minimum surface-casing required from land-surface datum (ft)	Spacing (acres/well)	Allowables (per well or field where unitized)
Mobile County									
Citronelle	1955	Upper & Lower Devonian	Oil	40	447[b]	4,115,516	1,400	40 acres for Upper & Lower Donovan; zones below Lower Donovan 160 acre spacing; these exclude unitized field areas.	25,000 BOPD for Citronelle Unit; 7,600 BOPD for Southeast Citronelle Unit; 6,200 BOPD for East Citronelle Unit; no allowables for non-unitized areas.
Chunchula	1973	Smackover	Gas-condensate	60	34	186,769	1,800	640	Prorated share of gas processed through Chunchula Plant/month.
Hatter's Pond	1974	Smackover & Norphlet	Gas-condensate	61	11	49,431	1,800	640	Prorated share of gas processed through Hatter's Pond Plant/month.
Baldwin County									
South Carlton[a]	1950	Lower Tuscaloosa	Oil	15	47	2,831,416	600	40	100 BOPD/unit.
Tensaw Lake	1965	Lower Cretaceous	Oil	23	–	–	1,400	40	75 BOPD.

Note: BOPD - barrels of oil per day.

[a] Located in Clarke and Baldwin Counties.

[b] Enhanced recovery wells included as producers.

Table 63. Oil, condensate, and gas production by field in the Alabama Coastal Region, 1950, 1960, 1970, and 1979; cumulative production 1979 (Masingill, et al 1977; Masingill and Hall 1979; Masingill and McAnnally 1980).

County, product, field	Annual production 1950	1960	1970	1979	Cumulative production 1979
Mobile County					
Oil (bbl)					
Citronelle	--	6,226,197	6,040,003	2,806,919	129,447,754
Unnamed	--	--	--	--	30,643
Subtotal	--	6,226,197	6,040,003	2,806,919	129,478,397
Condensate (bbl)					
Chunchula	--	--	--	1,993,944	6,033,127
Hatter's Pond	--	--	--	1,850,370	5,246,695
Subtotal	--	--	--	3,844,214	11,459,822
Gas (mcf)					
Citronelle	--	563,040	541,722	233,032	11,714,626
Chunchula	--	--	--	4,015,697	12,637,018
Hatter's Pond	--	--	--	7,077,254	19,955,735
Unnamed	--	--	--	--	29,486
Subtotal	--	563,040	541,722	11,325,983	44,316,865
Baldwin County					
Oil (bbl)					
South Carlton[a]	12,093	172,509	149,785	241,273	4,430,642
Tensaw Lake	--	--	18,810	--	164,786
Subtotal	12,093	172,509	168,595	241,273	4,595,428
Coastal Region					
Oil (bbl)	12,093	6,398,706	6,208,598	3,048,192	134,073,825
Condensate (bbl)	--	--	--	3,844,314	11,459,822
Gas (mcf)	--	563,040	541,722	11,325,983	44,316,865
Alabama					
Oil (bbl)	699,988	7,328,813	7,291,098	10,556,301	209,686,012
Condensate (bbl)	--	--	18,898	8,585,224	35,019,814
Gas (mcf)	--	585,875	883,948	92,242,670	387,310,890

[a]Located in Clarke and Baldwin Counties.

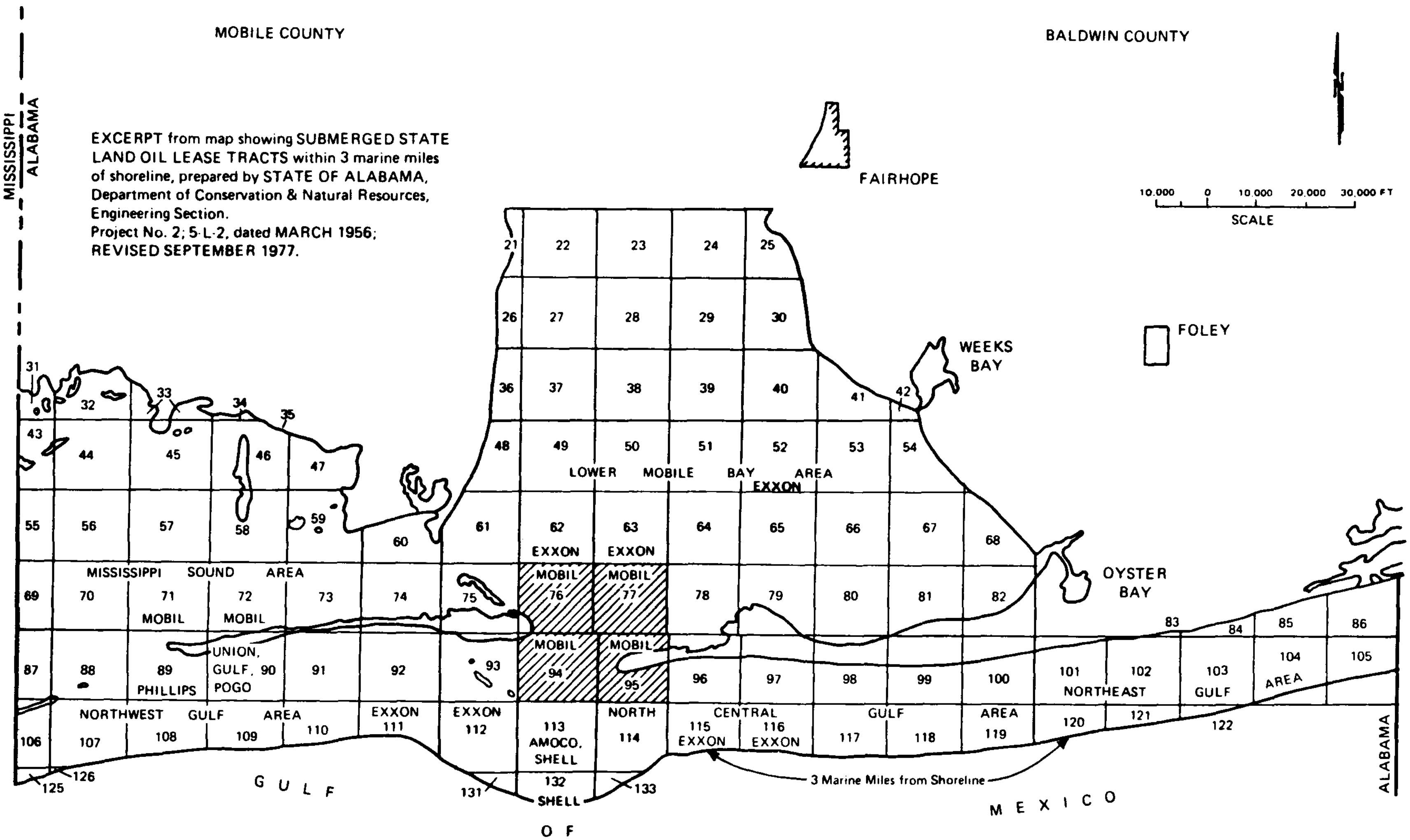


Figure 17. Offshore tracts within three marine miles of shoreline under active lease from the State of Alabama, 1981 (Alabama Department of Conservation and Natural Resources 1981a; Mobil Oil Corporation 1980b).

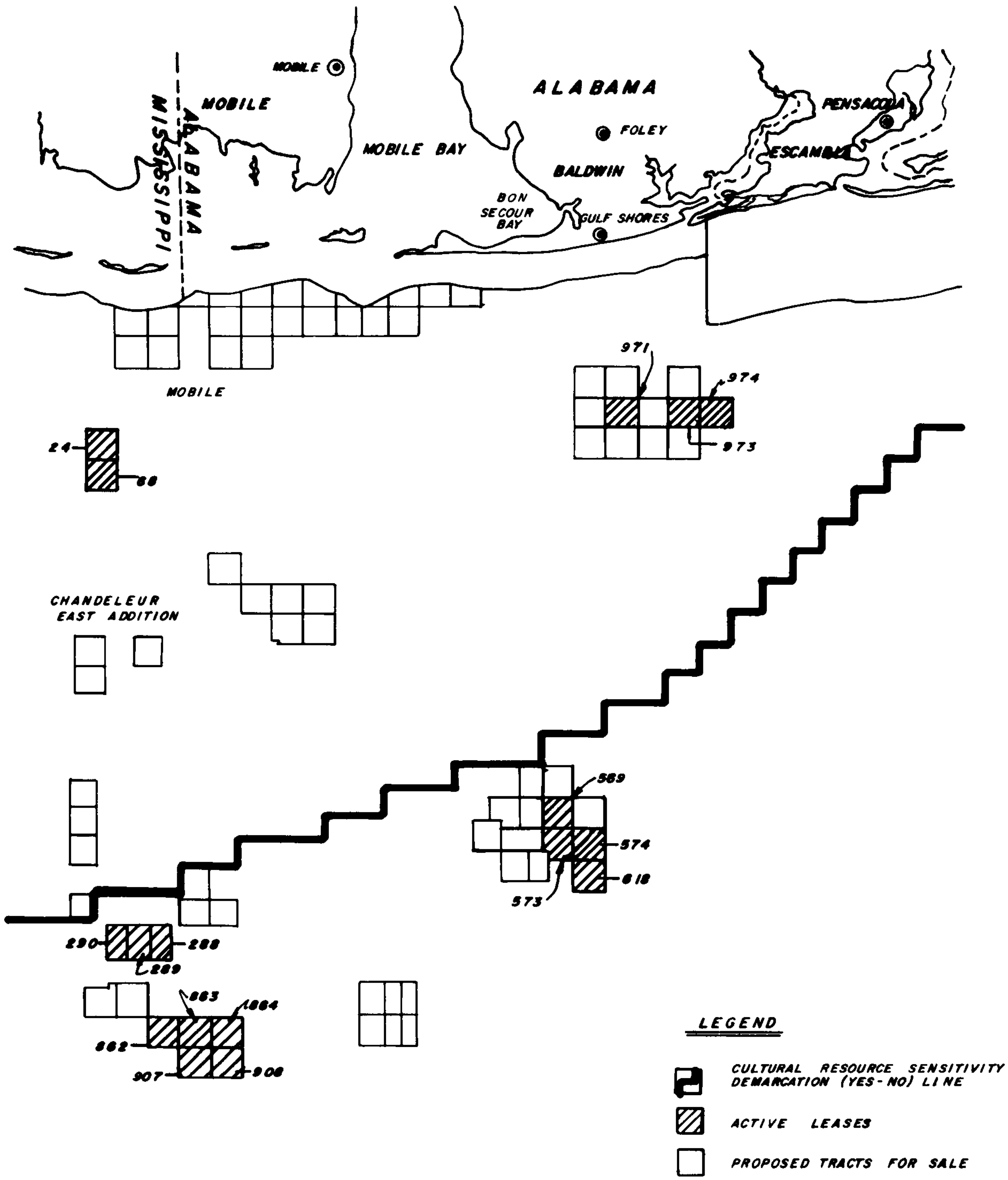


Figure 18. Outer continental shelf lease status for Alabama, 1981 (U.S. Department of Interior, Bureau of Land Management 1981).

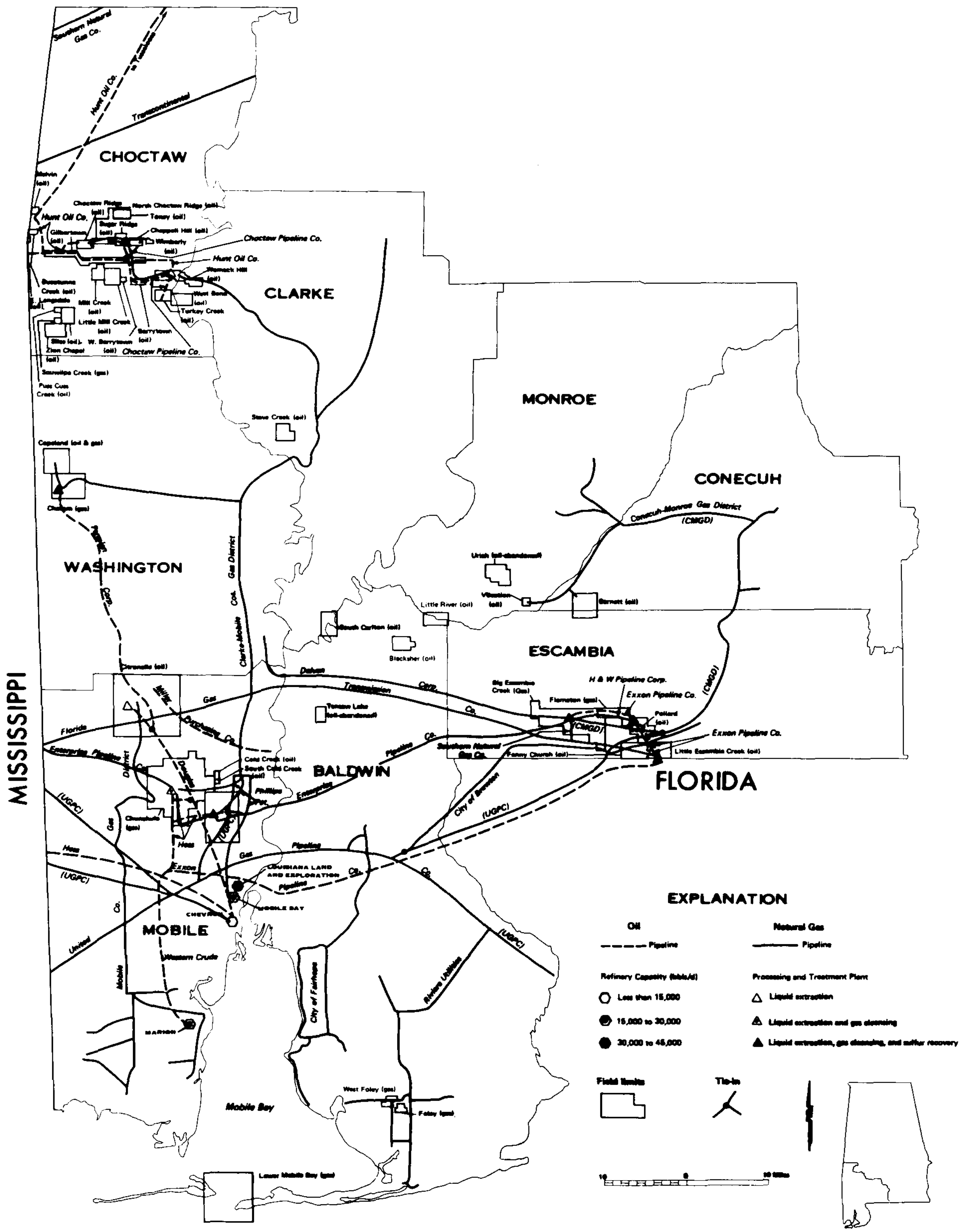


Figure 19. Major pipeline systems, gas processing plants, and oil refineries in Mobile and Baldwin Counties, 1979 (Masingill and McAnnally 1980).

Table 64. Design capacity and production (barrels per day) of petroleum refineries in the Alabama Coastal Region, 1977 (Alabama Coastal Area Board and U.S. Department of Commerce 1979).

Refinery	Location	Design capacity	Production
Louisiana Land and Exploration Co.	Saraland	40,000	34,200
Marion Corp.	Theodore	20,000	20,000
Mobile Bay	Chickasaw	20,000	10,000
Chevron	Mobile	<15,000	NA

Table 65. Primary capacity (barrels) of petroleum storage facilities in the Alabama Coastal Region, 1977 (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Company	Number of tanks	Primary capacity
Miller-Purchasing	2	135,000
Citronelle-Mobile Gathering System	4	525,000
Amerada Hess	16	1,500,000
Marion Oil	18	770,000
Louisiana Land and Exploration Co.	31	785,000
Mobile Bay	6	205,000
Gulf Oil	10	176,647
Radcliff-Mid Stream Fuel	2	8,000
Triangle Refinery	13	230,000
Murphy Oil	7	153,000
Shell Oil	4	102,000
Triangle Refinery of Choctaw	10	120,000
Texaco	21	414,000
Mobile Bulk Terminal	6	630,000
American Oil	6	135,000
Belcher of Alabama	7	227,500
Total	163	6,116,147

Table 66. Production of gasoline, butane, propane, condensate, and sulphur from natural gas processing and treatment plants in Alabama and the Alabama Coastal Region, 1970, 1975, 1979 (Masingill et al 1977; Masingill and McAnnally 1980).

			Plants in the Coastal Region[a]			
Year, product	Unit	Alabama	Chunchula	Citronelle	Hatter's Pond	Total
1970						
Gasoline	barrels	66,870	--	66,870	--	66,870
Butane	barrels	97,195[b]	--	97,195[b]	--	97,195[b]
Propane	barrels	--	--	--	--	--
Condensate	barrels	--	--	--	--	--
Sulphur	long tons	NA	--	--	--	--
1975						
Gasoline	barrels	223,385	--	39,901	--	39,901
Butane	barrels	444,934	--	79,770[b]	--	79,770[b]
Propane	barrels	478,909	--	--	--	--
Condensate	barrels	605	--	--	--	--
Sulphur	long tons	223,902	--	--	--	--
1979						
Gasoline	barrels	506,154	7,159	7,596	--	14,755
Butane	barrels	963,485	15,619	10,301[b]	133,106	159,026
Propane	barrels	1,275,663	29,241	--	163,773	193,014
Condensate	barrels	3,312	--	--	--	--
Sulphur	long tons	391,822	69	--	--	69

[a] All processing plants are located in Mobile County.

[b] Butane-propane mixture.

Table 67. Length (miles) and average daily throughput (barrels) of petroleum pipeline systems in the Alabama Coastal Region, 1977 (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Company	Length	Average daily throughput
Hess Pipeline	56	97,425
Exxon Pipeline	36	130,000
Western Crude	26	20,000
Citmoco	34	16,500
Miller Purchasing	20	2,500
Total	172	266,425

Table 68. Length (miles) and average daily distribution (million cubic feet per day) of gas pipelines in the Alabama Coastal Region, 1977 (Alabama Coastal Area Board and the U.S. Department of Commerce 1979).

Company	Length[a] (mi)	Average daily distributions (mmcf/d)
United Gas Pipeline	253	
Utility Sales		
Mobile Gas Service	1,390	36.6
Mobile County Gas District	315	3.2
City of Fairhope	75	0.8
Riviera Utilities	155	0.7
Clark-Mobile Cos. Gas District	18	6.0
City of Bay Minette	63	2.3
Industry Sales		28.7
Florida Gas Transmission	49	--[b]
Delvan	50	6.4
Phillips Petroleum	16	8.8
Total	2,384	93.5

[a] Equivalent of three-inch main.

[b] No sales outlets or pick-ups.

Table 69. State lease sale of offshore tracts within three marine miles of shoreline, March 1981; locations of tracts shown in Figure 17 (Alabama Department of Conservation and Natural Resources 1981b).

Tract number	Acreage	Company	Total bonus	Percentage
52	5,164	Exxon	$ 9,112,000	25
62	5,164	Exxon	10,522,000	27
63	5,164	Exxon	15,226,000	27
71	4,196	Mobil	40,425,000	25
72	5,164	Mobil	31,535,000	25
89	4,811	Phillips	42,712,000	25
90	4,612	Union, Gulf	21,879,000	25
111	1,687	Exxon	53,168,000	28
112	4,932	Exxon	137,254,000	28
113	5,123	Amoco, Shell	34,370,000	25
115	3,416	Exxon	12,308,000	27
116	3,254	Exxon	18,232,000	27
132	2,367	Shell	22,435,000	25
Total	55,054		$449,178,000	

Conditions of Sale

(1) Re: Tracts 72 and 89. No drilling permitted within one-half mile of shoreline of any land area regardless of location; may be directionally drilled from any approved location.
(2) Re: Tracts 90, 112, and 113. No drilling permitted within one mile of shoreline of any land area regardless of location; may be directionally drilled from any approved location.
(3) Re: Tracts 111, 112, 115, 116, and 132. Exact location of 3 marine mile line is subject to agreement with the United States. Amount of acreage and annual delay rental is subject to slight change. No pro rata refund of cash bonus will be made.
(4) Re: Tract 71. Only the S½, the S½ of the N½, and the NE¼ of the NE¼.

Table 70. Severance tax receipts[a] ($1,000's) attributable to oil and gas production in the Alabama Coastal Region, 1971-72, 1974-75, 1979-80 (Alabama Department of Revenue, Motor Fuels Division 1981).

Production area	Severance taxes		
	1971-72	1974-75	1979-80
Mobile County	1,084	950	8,122
Baldwin County	5	5	17
Coastal Region	1,089	955	8,139

[a] For fiscal year October 1 through September 30.

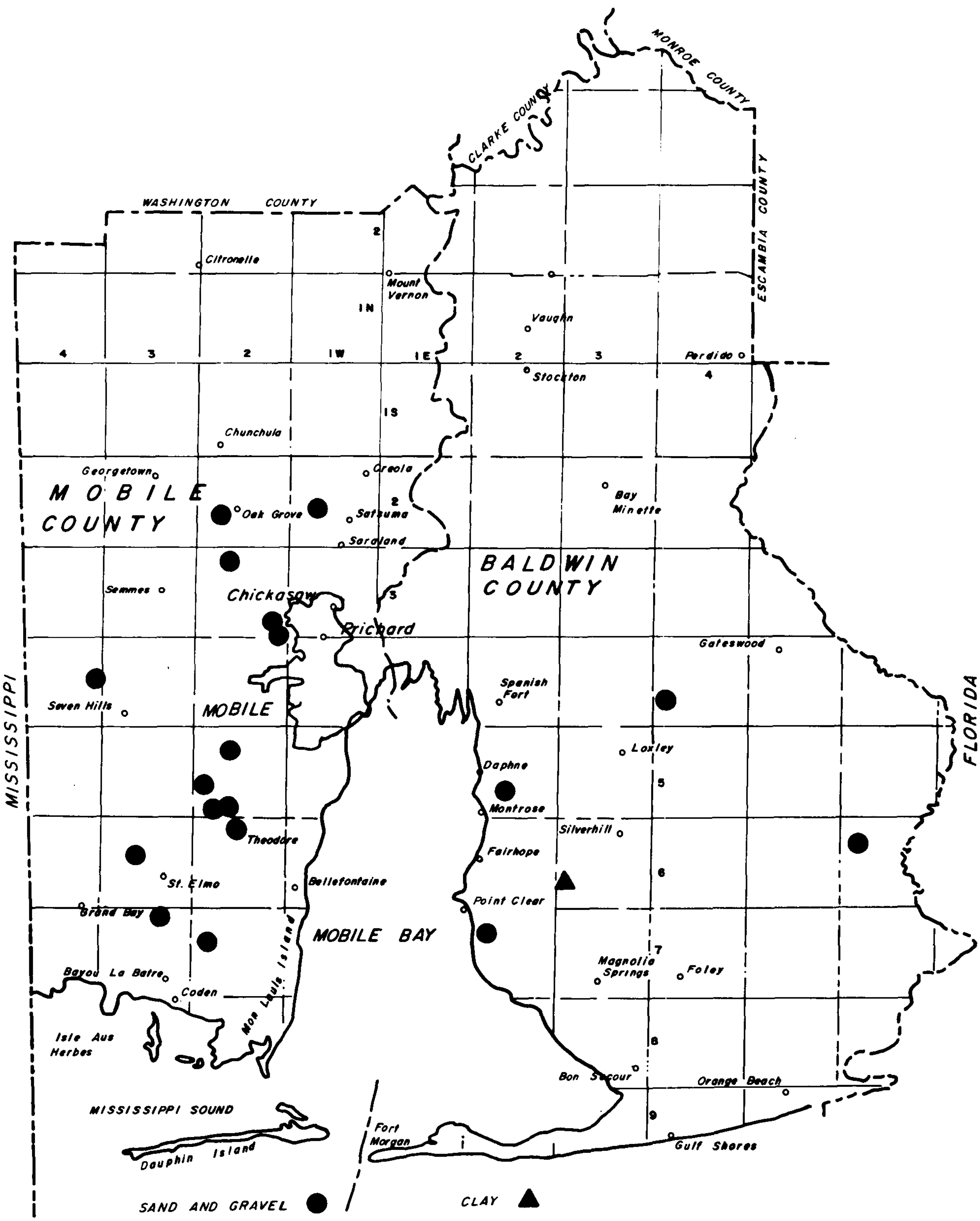


Figure 20. Active mines and quarries in Mobile and Baldwin Counties, 1975 (Moser and Chermock 1977).

Table 71. Production (net tons) of sand, gravel, and clay in the Alabama Coastal Region, 1971, 1973, 1975, 1977, 1979 (Moser and Chermock 1977; Alabama Department of Industrial Relations, Division of Safety and Inspection 1977, 1979).

	Fiscal year ending September 30				
Type mineral	1971	1973	1975	1977	1979
Mobile County					
Clay	NA	NA	NA	--	8,000
Sand	NA	NA	NA	70,400	59,085
Sand and clay	NA	NA	NA	380,598	1,488,758
Sand and gravel	NA	NA	NA	--	
Total	NA	NA	NA	450,998	1,555,843
Baldwin County					
Clay	NA	NA	NA	11,595	25,555
Sand	NA	NA	NA	391,288	--
Sand and clay	NA	NA	NA	92,926	84,400
Sand and gravel	NA	NA	NA	36,773	20,000
Total	NA	NA	NA	532,582	129,955
Coastal Region					
Clay	NA	NA	NA	11,595	33,555
Sand	NA	NA	NA	461,688	59,085
Sand and clay	NA	NA	NA	473,524	1,573,158
Sand and gravel	NA	NA	NA	36,773	20,000
Total	230,000	790,000	180,000	983,580	1,685,798

Table 72. Volume (million yd^3) of oyster shells dredged in Alabama Coastal Region waters, 1950, 1955, 1960, 1965 and 1978 (May 1971; Garrett 1981).

Year	Volume
1950	1.3
1955	2.1
1960	1.9
1965	2.0
1978	1.4

Table 73. Quantity and value of selected minerals production[a] in Alabama, 1975, 1977, 1979 (U.S. Department of the Interior, Bureau of Mines 1976, 1979).

	Crude petroleum (1,000 bbl)	Natural gas (mmcf)	Sand and gravel (1,000 short tons)	Clay[b] (1,000 short tons)
1975				
Quantity	13,477	37,814	9,232	2,231
Value ($1,000)	136,541	32,898	17,376	9,077
1977				
Quantity	18,252	57,227	14,372	2,677
Value ($1,000	176,540	84,124	35,204	21,984
1979				
Quantity	19,142[c]	92,243[c]	13,747[b]	2,571
Value ($1,000)	NA[d]	NA[d]	31,319	33,824

[a] Production is measured by mine shipments, sales, or marketable production (including consumption by producers).

[b] Excludes bentonite.

[c] (Masingill and Hall 1979).

[d] The economic value of oil and gas produced in Alabama in 1980 is estimated at $522.8 million (Hellmich, personal communication 1981).

Table 74. Number of employees in mining and related industries in the Alabama Coastal Region, 1970, 1975, 1978 (U.S. Department of Commerce, Bureau of the Census 1971, 1976, 1979).

SIC code		Area, industry	Year 1970	1975	1978
Mobile County					
10-14		Mining	162	305	277
	13	Oil and gas extraction	143	(a)	(b)
	138	Oil and gas field services	(D)	239	194
	14	Nonmetallic minerals, except fuel	--	--	(c)
291		Petroleum refineries	--	(b)	(b)
492		Gas production and distribution	(D)	(b)	(a)
517		Petroleum and petroleum products wholesale	303	651	434
		Total	(D)	(D)	(D)
Baldwin County					
10-14		Mining	--	--	(d)
	13	Oil and gas extraction	--	--	(D)
	138	Oil and gas field services	--	--	(D)
	14	Nonmetallic minerals, except fuel	--	--	(D)
291		Petroleum refineries	--	--	--
492		Gas production and distribution	--	--	--
517		Petroleum and petroleum products wholesale	--	--	73
		Total	--	--	(D)
Coastal Region					
10-14		Mining	162	305	(D)
	13	Oil and gas extraction	143	(a)	(D)
	138	Oil and gas field services	(D)	239	(D)
	14	Nonmetallic minerals, except fuel	--	(b)	(D)
291		Petroleum refineries	--	(b)	(D)
492		Gas production and distribution	(D)	(b)	(D)
517		Petroleum and petroleum products wholesale	303	651	507
		Total	(D)	(D)	(D)

(a) 250-499
(b) 100-249
(c) 20-99
(d) 0-19

Table 75. Commercial landings of finfish and shellfish by species at Alabama ports in 1955, 1960, 1965, 1970, 1975 and 1978 (U.S. Department of Commerce, National Marine Fisheries Service 1957, 1962, 1967, 1973, 1978a and 1980a).

Species	Mobile County		Baldwin County		Mobile and Baldwin Counties	
	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)
			1955			
Finfish						
Amberjack	--	--	0.5	40	0.5	40
Bluefish	12.9	903	2.5	175	15.4	1,078
Blue runner	--	--	0.9	63	0.9	63
Buffalofish	73.0	8,760	--	--	73.0	8,760
Cobia	--	--	17.8	1,246	17.8	1,246
Catfish and bullheads	70.2	19,656	--	--	70.2	19,656
Croaker	3.5	210	7.2	432	10.7	642
Drum, black	1.6	96	1.4	84	3.0	180
Drum, red	13.7	1,918	5.1	714	18.8	2,632
Flounders	38.6	5,186	66.0	8,580	104.6	13,766
Groupers	148.9	22,335	1.1	165	150.0	22,500
Jewfish	1.3	156	0.7	84	2.0	240
King whiting	18.6	1,302	17.9	1,253	36.5	2,555
Mullet	498.3	28,898	1,164.9	68,894	1,663.2	99,792
Paddlefish	0.7	98	--	--	0.7	98
Pompano	--	--	0.1	25	0.1	25
Sea catfish	0.3	21	6.5	455	6.8	476
Sea trout, spotted	44.4	11,100	36.8	9,200	81.2	20,300
Sea trout, white	69.9	4,893	5.5	385	75.4	5,278
Sheepshead, freshwater	0.1	12	--	--	0.1	12
Sheepshead, saltwater	10.0	800	2.5	200	12.5	1,000
Snapper, red	1,140.2	282,530	33.0	6,450	1,173.2	288,980
Spanish mackerel	12.9	1,935	37.5	5,625	50.4	7,560
Spot	--	--	3.0	240	3.0	240
Sturgeon	1.2	168	--	--	1.8	168
Subtotal	2,160.3	391,977	1,410.9	105,310	3,571.2	497,287
Shellfish						
Crab, blue	1,434.7	71,735	178.0	8,900	1,612.7	80,635
Oyster	1,447.4	303,658	133.2	34,643	1,580.6	338,301
Shrimp	4,890.1	996,717	1,786.2	352,308	6,676.3	1,349,025
Subtotal	7,772.2	1,372,110	2,097.4	395,851	9,869.6	1,767,961
Total	9,932.5	1,764,087	3,508.3	501,161	13,440.8	2,265,248
			1960			
Finfish						
Bluefish	--	--	1.1	77	1.1	77
Blue runner	--	--	0.1	7	0.1	7
Buffalo fish	35.6	4,634	--	--	35.6	4,634
Cobia	--	--	1.1	90	1.1	90
Catfish	33.3	8,319	--	--	33.3	8,319
Croaker	1.5	75	6.0	302	7.5	377
Drum, black	0.5	33	1.6	94	2.1	127
Drum, red	4.1	497	4.9	589	9.0	1,086
Flounders	43.2	6,732	60.4	9,549	103.6	16,281
Groupers	233.5	35,021	2.4	360	235.9	35,381
Jewfish	4.0	600	0.4	62	4.4	662

Table 75.--Continued.

Species	Mobile County Catch (1,000 lb)	Mobile County Value (dollars)	Baldwin County Catch (1,000 lb)	Baldwin County Value (dollars)	Mobile and Baldwin Counties Catch (1,000 lb)	Mobile and Baldwin Counties Value (dollars)
King whiting	64.8	3,242	23.0	1,149	87.8	4,391
Mullet	324.1	19,445	531.2	31,872	855.3	51,317
Paddlefish	1.9	222	--	--	1.9	222
Pampano	3.5	1,237	0.4	140	3.9	1,377
Sea catfish	32.7	1,635	4.7	236	37.4	1,871
Sea trout, spotted	11.5	2,879	25.5	6,372	37.0	9,251
Sea trout, white	22.1	1,160	2.5	123	24.6	1,229
Sheepshead, freshwater	17.1	1,878	--	--	17.1	1,878
Sheepshead, saltwater	4.7	282	11.8	708	16.5	990
Snapper, red	1,669.7	415,748	50.4	10,560	1,720.1	426,308
Spanish mackerel	8.1	1,052	14.0	1,825	22.1	2,877
Spot	0.1	6	10.8	650	10.9	656
Subtotal	2,516.0	503,743	752.3	64,765	3,268.3	569,408
Shellfish						
Crab, blue	457.3	23,946	41.5	2,076	498.8	26,022
Oyster	1,034.1	270,653	135.2	46,392	1,169.3	317,045
Shrimp	4,800.8	1,348,327	2,368.2	742,038	7,169.0	2,090,365
Squid	0.3	25	0.6	60	0.9	85
Subtotal	6,292.5	1,642,951	2,545.5	790,566	8,838.0	2,433,517
Total	8,808.5	2,146,694	3,297.8	855,331	12,106.3	3,002,925
1965						
Finfish						
Bluefish	1.8	164	3.6	344	5.4	508
Buffalofish	100.3	11,968	--	--	100.3	11,968
Cabio	--	--	0.3	19	0.3	19
Catfish	38.8	10,168	--	--	38.6	10,168
Croaker	3.5	248	11.7	1,010	15.2	1,258
Drum, black	1.0	71	2.1	141	3.1	212
Drum, red	0.7	109	3.0	444	3.7	553
Flounders	210.9	30,098	89.7	16,553	300.7	46,651
Groupers	364.8	40,046	23.8	2,618	388.6	42,664
Jewfish	125.4	12,541	8.7	858	134.0	13,399
King whiting	504.7	31,679	103.7	5,093	607.7	36,772
Mullet	330.7	16,660	1,177.8	52,528	1,508.5	69,188
Paddlefish	16.6	2,069	--	--	16.6	2,069
Pampano	0.3	139	1.4	795	1.7	934
Sea catfish	11.0	734	8.3	588	19.3	1,322
Seatrout, freshwater	18.6	4,757	35.1	9,109	53.8	13,866
Seatrout, saltwater	87.0	4,357	21.1	2,483	108.1	6,840
Sheepshead, freshwater	9.6	1,378	--	--	9.6	1,378
Sheepshead, saltwater	10.0	764	5.6	418	15.6	1,182
Snapper, red	2,251.0	633,813	243.9	73,489	2,494.9	707,302
Spanish mackerel	1.5	230	12.9	1,552	14.3	1,782
Spot	1.3	64	13.6	680	14.9	744
Subtotal	4,088.4	802,057	1,766.3	168,722	5,854.7	970,779

Table 75.--Continued.

Species	Mobile County		Baldwin County		Mobile and Baldwin Counties	
	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)
Shellfish						
Crabs	1,740.3	147,389	72.1	6,020	1,812.3	153,409
Oysters	303.8	128,535	188.7	78,150	492.5	206,685
Shrimp	6,893.2	2,632,630	2,726.3	1,021,543	9,619.5	3,654,173
Squid	2.0	157	4.1	359	6.0	516
Subtotal	8,939.3	2,908,711	2,911.1	1,106,072	11,930.4	4,014,783
Total	13,027.7	3,710,768	4,757.4	1,274,794	17,785.1	4,985,562
			1970			
Finfish						
Bluefish	11.1	826	10.8	862	21.8	1,688
Blue runner	--	--	0.1	5	0.1	5
Buffalofish	3.8	375	--	--	3.8	375
Cobia	8.3	507	4.9	240	13.1	747
Catfish	10.6	3,615	--	--	10.6	3,615
Croaker	5,063.6	645,417	627.1	93,646	5,690.7	739,063
Drum, black	17.4	910	6.7	406	24.0	1,316
Drum, red	26.6	2,685	8.6	917	35.2	3,602
Flounders	560.4	86,570	220.4	48,821	780.8	135,391
Groupers	248.3	30,719	17.1	2,189	265.5	32,908
Jewfish	60.0	6,244	13.5	1,402	73.5	7,646
King whiting	454.3	25,949	110.4	6,505	564.7	32,454
Mullet	388.3	24,646	2,723.2	167,160	3,111.5	191,806
Paddlefish	2.1	318	--	--	2.1	318
Pampano	1.1	406	0.9	426	2.0	832
Sea catfish	95.5	4,659	24.6	1,447	120.1	6,106
Sea trout, spotted	13.9	4,096	70.7	22,039	84.6	26,135
Sea trout, white	691.3	39,785	59.5	3,495	750.9	43,280
Sheepshead, freshwater	2.5	374	--	--	2.5	374
Sheepshead, saltwater	149.9	7,116	32.0	1,741	181.9	8,857
Snapper, red	836.4	262,935	146.9	63,334	983.3	326,269
Spanish mackerel	82.3	21,856	43.5	4,515	125.8	26,371
Spot	17.3	972	26.3	1,813	43.5	2,785
Swordfish	2.9	2,480	--	--	3.0	2,480
Subtotal	8,747.8	1,173,460	4,147.1	420,963	12,894.9	1,594,423
Finfish						
Crabs, blue	1,314.4	134,591	92.9	9,497	1,407.2	144,088
Oyster	223.3	126,440	56.2	31,060	279.4	157,500
Shrimp	11,640.1	6,186,152	3,391.0	1,853,885	15,031.1	8,040,037
Squid	2.4	207	5.4	410	7.9	617
Subtotal	13,180.2	6,447,390	3,545.5	1,894,852	16,725.6	8,342,242
Total	21,928.0	7,620,850	7,692.5	2,315,815	29,620.5	9,936,665

Table 75.--Continued.

Species	Mobile County Catch (1,000 lb)	Mobile County Value (dollars)	Baldwin County Catch (1,000 lb)	Baldwin County Value (dollars)	Mobile and Baldwin Counties Catch (1,000 lb)	Mobile and Baldwin Counties Value (dollars)
			1975			
Finfish						
Bluefish	2.2	167	5.3	455	7.6	622
Blue runner	--	--	--	1	--	1
Buffalofish	--	--	--	1	--	1
Cobia	2.0	131	4.8	295	6.8	426
Catfish	--	--	0.1	36	0.1	36
Croaker	8,616.3	1,110,358	448.6	75,999	9,065.0	1,186,357
Drum, black	17.2	979	2.3	135	19.5	1,114
Drum, red	57.9	8,065	15.8	1,815	73.7	9,880
Flounders	623.0	127,533	209.2	46,886	832.2	174,419
Groupers	96.5	24,740	17.5	5,630	114.1	30,370
Jewfish	19.0	3,578	3.9	632	22.9	4,210
King whiting	186.9	18,271	31.4	2,245	218.3	20,516
Mullet	514.5	44,229	1,103.2	104,355	1,617.7	148,584
Paddlefish	--	5	0.1	12	0.1	17
Pampano	7.3	4,238	2.2	963	9.5	5,201
Sea catfish	39.7	2,340	8.3	488	48.0	2,828
Sea trout, spotted	61.8	19,275	42.4	13,080	104.2	32,355
Sea trout, white	1,911.3	179,446	59.9	3,791	1,971.2	183,237
Sharks	8.6	1,211	--	--	8.6	1,211
Sheepshead, saltwater	90.8	5,687	20.1	1,252	110.9	6,939
Snapper, red	709.0	377,191	123.9	82,834	833.0	460,025
Spanish mackerel	33.7	2,397	58.3	8,968	91.9	11,365
Spot	46.0	2,896	9.2	665	55.2	3,561
Subtotal	13,043.8	1,932,737	2,166.8	350,538	15,210.6	2,283,275
Shellfish						
Crabs	1,574.3	272,865	65.2	10,286	1,639.5	283,151
Lobsters, spring	--	--	0.1	104	0.1	104
Oyster	637.0	575,173	1.1	976	638.1	576,149
Shrimp	10,311.6	12,914,628	3,744.7	4,928,507	14,056.3	17,843,135
Squid	0.8	154	1.5	262	2.3	416
Subtotal	12,523.7	13,762,820	3,812.6	4,940,135	16,336.3	18,702,955
Total	25,523.7	15,695,557	5,979.4	5,290,673	31,546.9	20,986,230

Table 75.--Concluded.

Species	Mobile County		Baldwin County		Mobile and Baldwin Counties	
	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)	Catch (1,000 lb)	Value (dollars)
			1978			
Finfish						
Bluefish	0.4	47	8.3	856	8.7	903
Blue runner	--	--	--	2	--	2
Buffalofish	--	--	--	1	--	1
Catfish	--	--	0.1	39	0.1	39
Cobia	0.5	48	2.8	189	3.3	237
Croaker	2,234.9	392,300	186.2	31,253	2,421.1	423,553
Drum, black	14.2	1,048	2.8	314	17.0	1,362
Drum, red	59.9	11,870	26.5	5,426	86.4	17,296
Flounders	398.2	124,295	240.3	85,352	638.6	209,647
Groupers	33.9	11,991	34.8	20,100	68.7	32,091
Jewfish	2.4	610	2.2	667	4.6	1,277
King whiting	162.9	26,108	35.8	4,575	198.6	30,683
Mullet	95.7	13,072	837.9	145,725	933.4	158,797
Pompano	4.7	1,839	5.0	3,225	9.7	5,064
Sea catfish	2.8	216	5.5	467	8.2	683
Sea trout, spotted	3.4	1,829	28.3	16,666	31.7	18,495
Sea trout, white	764.8	124,254	14.8	1,953	779.5	126,207
Sheepshead, saltwater	114.7	7,617	26.7	2,446	141.4	10,063
Snapper, red	299.8	197,354	126.5	117,181	426.3	314,535
Spanish mackerel	6.9	858	20.9	3,200	27.8	4,058
Spot	22.7	2,207	5.4	577	28.1	2,784
Tripletail	1.1	138	--	5	1.1	143
Subtotal	4,223.9	917,701	1,610.8	440,219	5,834.4	1,357,920
Shellfish						
Crabs, blue	1,931.0	441,576	77.9	16,572	2,008.9	438,148
Oysters (meat)	754.2	840,985	5.8	5,848	760.0	846,833
Shrimp (heads-on)	15,539.8	23,164,133	5,593.7	9,583,545	21,133.5	32,747,678
Squid	2.4	605	2.2	495	4.6	1,000
Subtotal	18,227.4	24,447,299	5,679.7	9,606,460	23,907.1	34,053,759
Total	22,451.3	25,365,000	7,290.5	10,046,679	29,741.5	35,411,679

Table 76. Weight (in thousands of pounds) and value (in thousands of dollars) of shellfish and finfish landed by commercial fishermen in coastal Alabama for selected years, 1955-78 (Swingle 1977 and U.S. Department of Commerce, National Marine Fisheries Service 1978a).

Year	Species								Total lbs	Index of change relative to 1955 weight	Value	Index of change relative to 1955 value
	Heads-on shrimp	Oysters	Crabs	Red snapper	Mullet	Flounder	Croaker	Others				
1955	6,671	1,581	1,613	1,173	1,663	104	11	619	13,441	1.00	$ 2,265	1.00
1957	6,029	1,291	1,462	932	1,436	100	21	577	11,882	0.88	2,649	1.17
1959	8,018	895	1,093	1,819	1,341	123	28	725	14,022	1.04	2,968	1.31
1961	3,525	509	838	1,784	897	98	15	792	8,458	0.63	1,991	0.88
1963	7,760	995	1,297	2,315	1,390	107	47	977	14,888	1.11	3,714	1.64
1965	9,624	492	1,812	2,495	1,508	301	15	1,542	17,789	1.32	4,986	2.20
1967	14,456	2,088	2,353	2,288	3,169	480	104	1,634	26,412	1.97	8,300	3.66
1969	14,977	481	1,920	1,246	3,193	540	3,687	1,866	28,517	2.12	10,548	4.66
1971	16,713	249	1,997	939	2,361	951	8,384	2,339	34,238	2.55	13,812	6.10
1973	12,019	590	2,098	960	2,786	709	13,299	2,647	36,744	2.73	17,667	7.80
1975	14,056	638	1,639	833	1,618	832	9,065	3,090	31,547	2.34	20,986	9.27
1977	25,020	1,549	2,174	520	877	599	2,766	1,084	34,589	2.57	36,787	16.24
1978	21,133	760	2,009	426	933	639	2,421	1,420	29,742	2.21	35,412	15.63

Table 77. Species of finfish and shellfish landed in coastal Alabama by commercial fishermen (adapted from Spencer et al. 1966; Swingle 1977; and U.S. Department of Commerce, National Marine Fisheries Service 1980a).

Type, common name	Scientific name
Shellfish	
Blue crab	*Callinectes sapidus*
Oyster	*Crassostrea virginica*
Seabob	*Xiphopeneus kroyeri*
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*P. duorarum*
White shrimp	*P. setiferus*
Royal red shrimp	*Hymenopenoeus robustus*
Squid	*Lolliguncula brevis*
Saltwater finfish	
Bluefish	*Pomatomus saltatrix*
Cobia	*Rachycentron canadum*
Catfish, gafftopsail	*Bagre marinus*
Croaker, Atlantic	*Micropogonias undulatus*
Drum, black	*Pogonias cromis*
Drum, red	*Sciaenops ocellata*
Flounder, Gulf	*Paralichythys albigutta*
Flounder, southern	*P. lethostigma*
Grouper	*Epinephelus* spp. *Mycteroperca* spp.
Jewfish	*Epinephelus itajara*
Kingfish, Gulf	*Menticirrhus littoralis*
Kingfish, southern	*M. americanus*
Mackerel, Spanish	*Scomberomorus maculatus*
Mullet, striped	*Mugil cephalus*
Pompano	*Trachinotus carolinus*
Seatrout, sand	*Cynoscion arenarius*
Seatrout, silver	*C. nothus*
Seatrout, spotted	*C. nebulosus*
Sheepshead	*Archosargus probatocephalus*
Snapper	*Lutjanus* spp.
Spot	*Leiostomus xanthurus*
Tripletail	*Lobotes surinamensis*
Freshwater finfish	
Bullhead, yellow	*Ictalurus natalis*
Buffalo, smallmouth	*Ictiobus bubalus*
Catfish, blue	*Ictalurus furcatus*
Catfish, channel	*I. punctatus*
Catfish, flathead	*Pylodictis olivaris*
Drum, freshwater	*Aplodinotus grunniens*
Paddlefish	*Polyodon spathula*

Table 78. Surface area (acres), water volume (acre feet), and shoreline distance (miles) of estuarine areas in coastal Alabama, 1971 (modified from Auburn University, Department of Agricultural Economics and Rural Sociology 1973).

Estuary	Surface area			Open water volume	Shoreline distance
	Open water	Marshland	Total		
Mobile Delta	20,323	15,257	35,580	166,368	55
Mobile Bay	264,470	6,224	270,694	2,585,446	142
Mississippi Sound	92,702	11,762	104,464	935,686	125
Little Lagoon	2,587	299	2,886	10,312	19
Perdido Bay	17,271	1,072	18,343	135,677	92
Total	397,353	34,614	431,967	3,833,489	433

Table 79. Number of commercial fishing boats, vessels, and fishermen in coastal Alabama, 1955, 1960, 1965, 1970 and 1976 (U.S. Department of Commerce, National Marine Fisheries Service 1957, 1962, 1967, 1973, 1980b).

Year	Boats (under 5 tons)	Vessels (over 5 tons)	Licensed fishermen
1955	660	139	1,297
1960	462	167	1,041
1965	659	316	1,854
1970	693	461	2,042
1976	510	521	1,923
Percent change 1955-76	-23	+275	+48

Table 80. Number of seafood processing and wholesale plants, number of employees, and value (thousands of dollars) of processed products in coastal Alabama in selected years, 1955-78 (Swingle 1976 and U.S. Department of Commerce, National Marine Fisheries Service 1957, 1962, 1973, 1978b, 1980b).

	Processing plants			Wholesale			Totals			Value
Year	Number of plants	Average number seasonal employees	Average number full-time employees	Number of plants	Average number seasonal employees	Average number full-time employees	Number of plants	Average number seasonal employees	Average number full-time employees	Processed products
1955	NA	NA	NA	NA	NA	NA	46	961	560	4,402
1960	NA	NA	NA	NA	NA	NA	61	814	564	5,971
1965	NA	NA	NA	NA	NA	NA	58	1,070	699	6,838
1970	43	1,383	875	13	423	186	56	1,806	1,061	20,575
1975	43	1,419	1,005	15	167	95	58	1,586	1,100	41,168
1979	50	1,869	1,284	18	181	101	68	2,050	1,385	NA
Percent change 1955-79	NA	NA	NA	NA	NA	NA	+48	+113	+147	NA

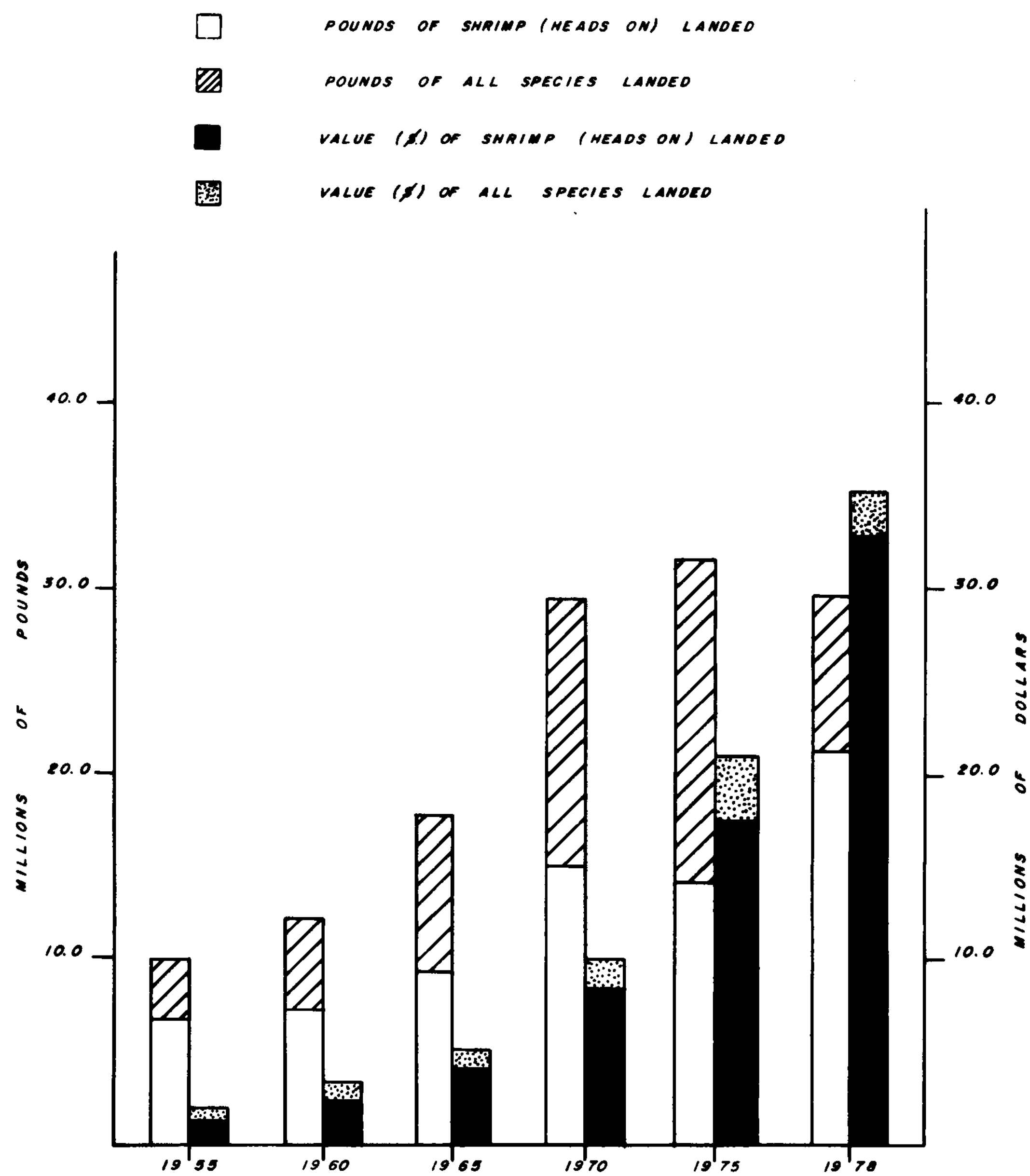


Figure 21. Landings (pounds) and value (dollars) of shrimp and all other shellfish and finfish combined in coastal Alabama in selected years 1955-78 (U.S. Department of Commerce, National Marine Fisheries Service 1957, 1962, 1967, 1973, 1978b, 1980a).

Table 81. Commercial landings (in thousands of pounds) of shrimp from Alabama coastal waters, 1964-72 (modified from Swingle 1976).

Year	Mobile and Bon Secour Bays	Perdido Bay	Mississippi Sound	Little Lagoon
1964	1,222.5	--	904.0	2.8
1965	1,085.6	--	955.5	23.5
1966	1,027.8	--	1,007.7	6.4
1967	1,726.3	8.8	1,419.4	--
1968	1,394.3	--	1,490.3	5.1
1969	954.3	--	930.8	--
1970	696.0	6.2	993.9	--
1971	543.2	5.1	914.9	--
1972	722.3	4.4	527.4	--
Percent change 1964-72	-41	NA	-42	NA

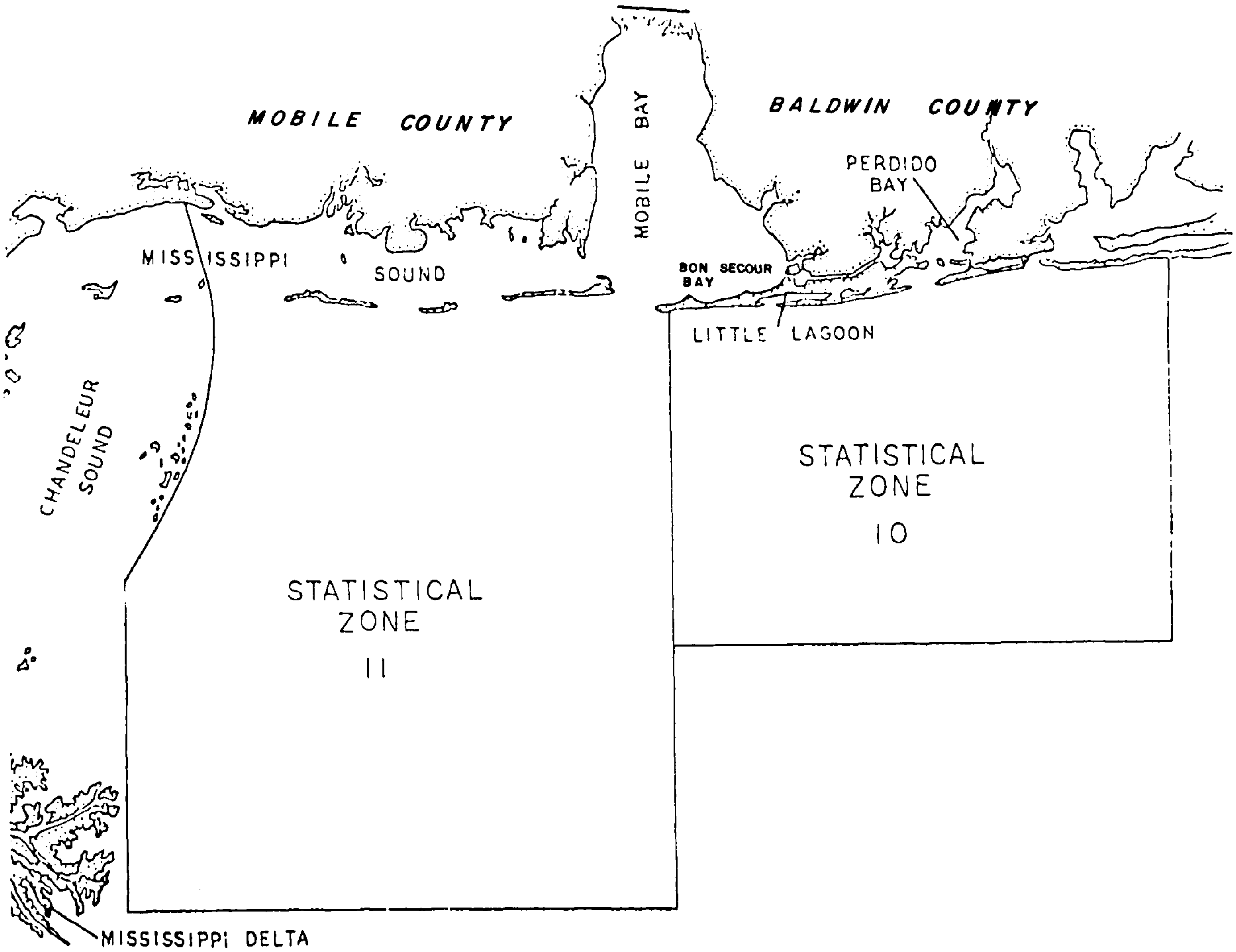


Figure 22. Location of National Marine Fisheries Service Statistical Zones 10 and 11 and coastal Alabama waters (Swingle 1976).

Table 82. Commercial landings (pounds, heads on) of shrimp reported by NMFS from Statistical Zone 11 (Figure 22) and the Alabama landings and percentage of total, 1964-72 (Swingle 1976).

	Species						Alabama	
Year	Brown shrimp	White shrimp	Pink shrimp	Royal red shrimp	Seabob	Total catch	Landings	Percent of total
1964	6,327,686	2,124,851	84,073	4,244	468	8,541,324	4,487,000	52.5
1965	11,685,180	1,931,099	52,452	15,075	500	13,684,306	6,825,900	49.8
1966	11,680,841	1,110,424	70,451	--	--	12,861,716	8,055,900	62.6
1967	12,717,338	1,308,742	238,350	9,068	--	14,273,498	9,566,800	67.0
1968	15,254,671	1,189,488	279,190	88,864	--	16,812,213	10,442,700	62.1
1969	13,322,054	3,788,367	595,416	58,642	--	17,764,479	11,281,900	63.5
1970	13,112,018	3,279,996	296,569	6,665	--	16,695,248	10,338,300	61.9
1971	15,706,878	2,852,970	283,556	7,380	--	18,849,784	12,938,900	68.6
1972	11,247,836	1,669,620	199,916	4,179	28,245	13,149,796	9,497,300	72.2
Percent change 1964-72	+78	-21	+138	-2	+5,035	+54	+112	+38

Table 83. Number of commercial shrimp boats, vessels, and fishermen in Alabama and number of resident shrimp vessels in the Gulf of Mexico, 1955, 1960, 1965, 1970, and 1976 (U.S. Department of Commerce, National Marine Fisheries Service 1957, 1962, 1967, 1973, 1980b).

	Alabama					Gulf of Mexico
Year	Boats (under 5 tons)	Fishermen on boats	Vessels (over 5 tons)	Fishermen on vessels	Average vessel gross tonnage	Vessels (over 5 tons)
1955	151	255	130	344	2,152	--
1960	206	346	222	564	6,737	2,941
1965	206	335	295	706	9,547	2,849
1970	149	174	448	1,143	24,904	3,579
1976	134	142	512	1,324	35,253	4,177
Percent change 1955-76	-11	-44	+294	+285	+1,538	NA

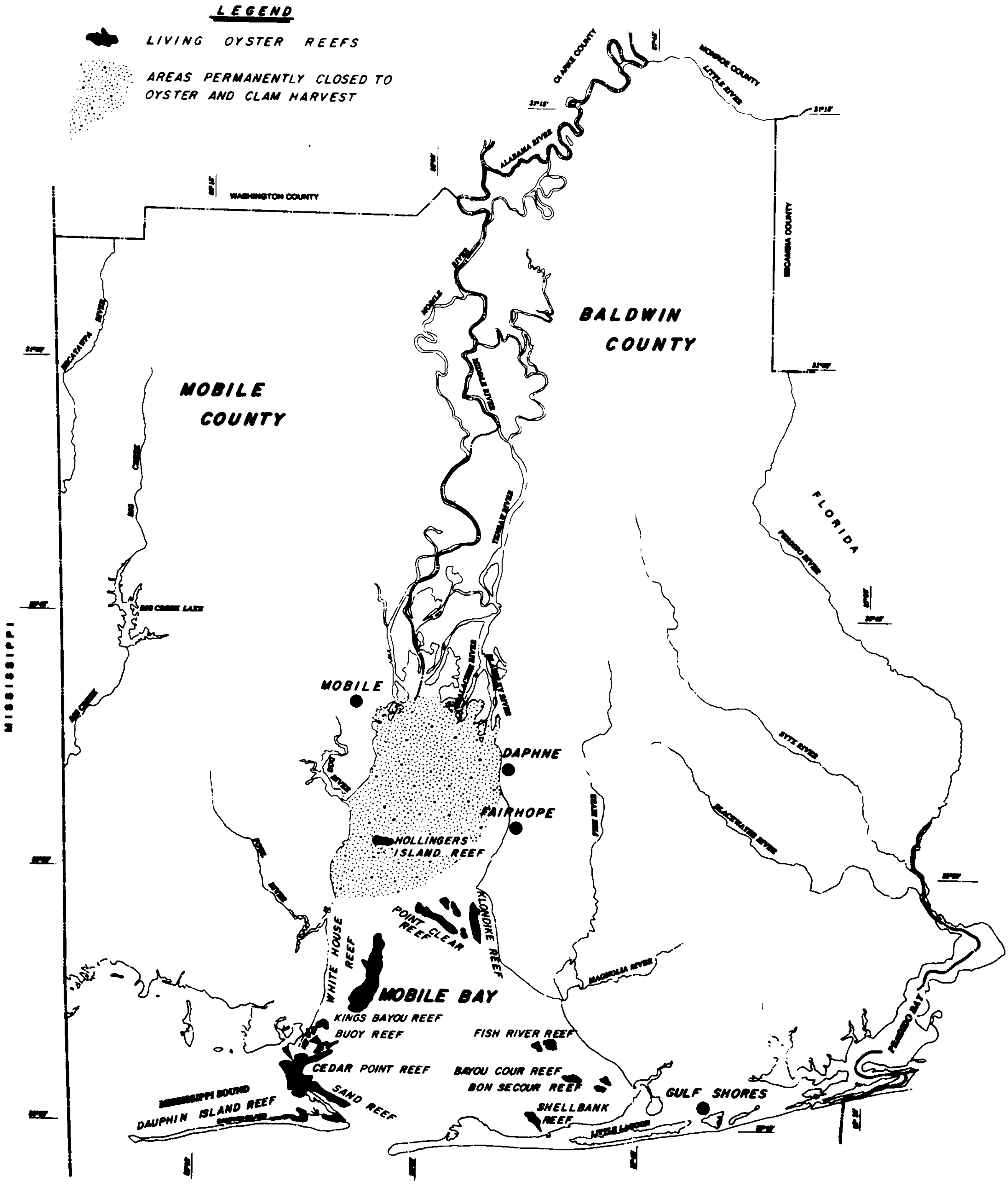


Figure 23. Location of oyster reefs in coastal Alabama and the area permanently closed to oyster and clam fishing in Mobile Bay (Crance 1971, May 1971).

Table 84. Commercial landings (in thousands of pounds) of finfish in Alabama from coastal Alabama waters and from other offshore Gulf waters as recorded by NMFS, 1964-72 (Swingle 1976).

Year	Mobile and Bon Secour Bays	Mobile Delta[a]	Little Lagoon	Mississippi Sound[b]	Offshore Alabama	Offshore Louisiana	Other gulf areas[c]	Total landings
1964	1,071.5	138.5	83.0	132.8	748.7	167.3	2,739.2	5,081.0
1965	1,436.6	165.0	69.7	248.8	967.0	51.2	2,916.8	5,855.1
1966	1,409.5	82.8	62.2	456.5	1,267.1	363.8	2,818.3	6,460.2
1967	2,965.2	81.4	47.3	368.7	1,314.9	377.0	2,356.8	7,511.3
1968	2,837.7	53.6	3.9	297.3	2,990.2	555.2	1,272.7	8,010.6
1969	2,984.2	48.8	2.5	432.7	5,483.7	790.0	1,300.9	11,043.1
1970	2,930.3	19.0	0.5	518.8	6,667.2	1,637.2	1,120.4	12,893.2
1971	2,178.3	--	0.1	534.7	8,592.3	1,110.7	730.1	15,146.2
1972	1,326.7	0.4	0.4	375.0	8,687.7	4,390.2	1,009.8	15,790.2
Percent change 1964-72	+24	-99.7	-99.5	+182	+1,060	+2,524	-63	+211

[a] Decline caused by mercury contamination of fish in this area.

[b] Includes NMFS statistical zones 10 and 11 (Figure 22).

[c] Primarily snapper and grouper caught in foreign and Texas waters.

Table 85. Finfish and shellfish species found in Alabama coastal waters, their yield potential, and their relative 1977 commercial and sport values (modified from Swingle 1977).

Yield potential by species	Current commercial value	Current sport value
High future yield potential		
Amberjack	none	moderate
Bonito	none	low
Buffalofish	low	none
Catfish, saltwater	low	low
Crevalle jack	none	moderate
Croaker	moderate	low
Cutlassfish	none	none
Drum, black	low	low
Gars	none	low
Ladyfish	none	low
Mackerel, Spanish	low	high
Menhaden	low	none
Rays	none	low
Redfish	low	high
Scaled sardine	none	none
Sharks	none	low
Sheepshead	low	moderate
Thread herring	none	low
Squid	low	low
Moderate future yield potential		
Anchovies	none	none
Blue runner	none	low
Cobia	low	high
Dolphin	none	low
Mackerel, king	none	high
Mullets	high	low
Seatrouts, white	high	moderate
Skates	none	none
Spadefish	none	low
Spot	low	low
Triggerfish	none	moderate
Oyster	moderate	low

Table 85. Concluded.

Yield potential by species	Current commercial value	Current sport value
Low future yield potential		
Bluefish	low	high
Butterfish	none	none
Carp	none	none
Catfish, freshwater	high	high
Drum, freshwater	low	low
Eel, freshwater	none	none
Eel, saltwater	none	none
Grouper	moderate	low
Jewfish	low	low
Kingfish	high	high
Paddlefish	low	none
Pigfish	none	low
Pinfish	none	low
Pompano	low	low
Seabass	none	low
Snappers	high	high
Suckers	none	none
Swordfish	low	low
Tuna	none	low
Clams	none	low
Crab, blue	high	low
Shrimp	high	high

Note: Stone crabs and lobsters were judged to have no future potential yield with low current sport fishing use of the former species and low current commercial use of the latter.

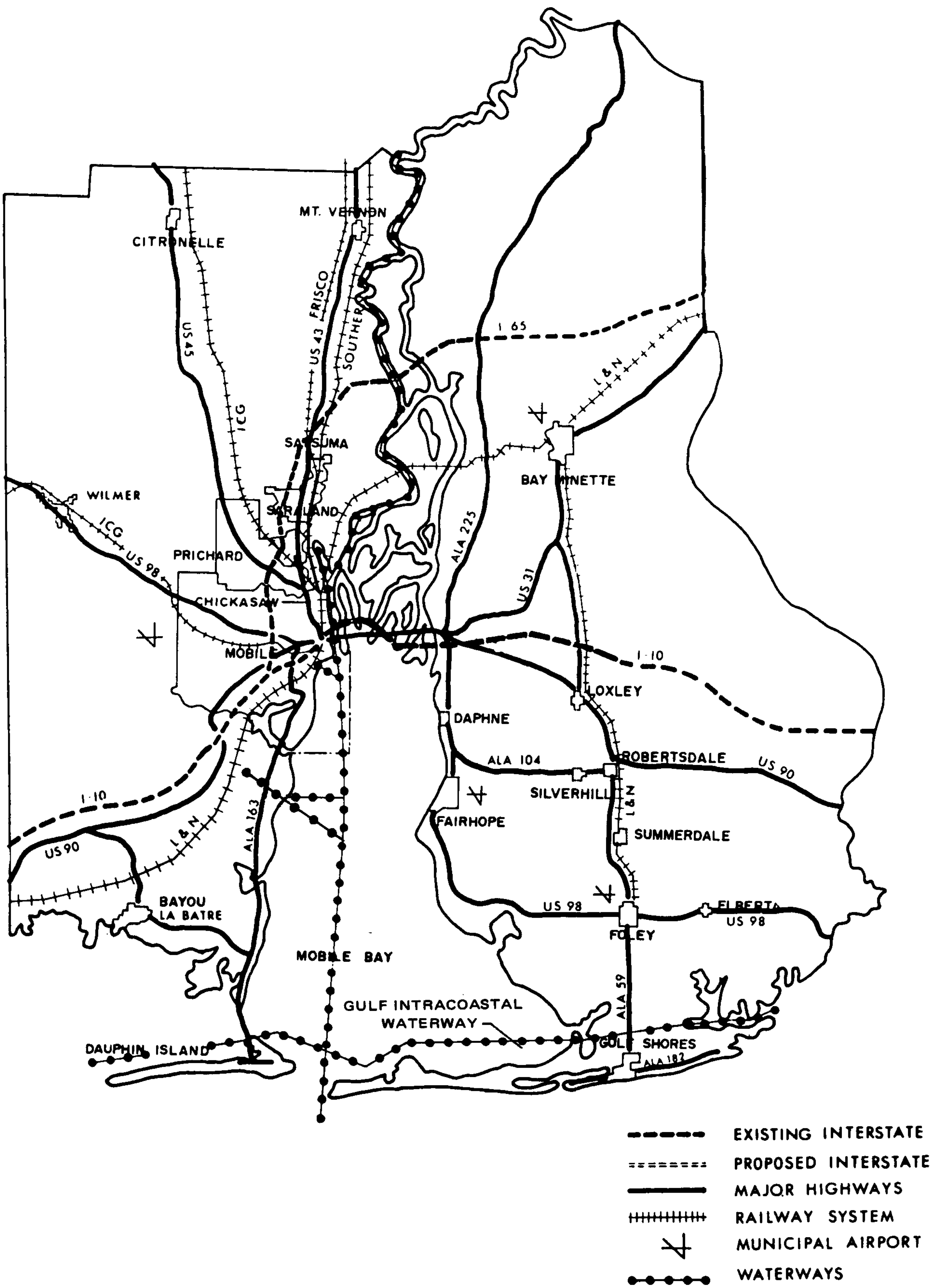


Figure 24. Transportation network in Mobile and Baldwin Counties, 1981 (South Alabama Regional Planning Commission 1981).

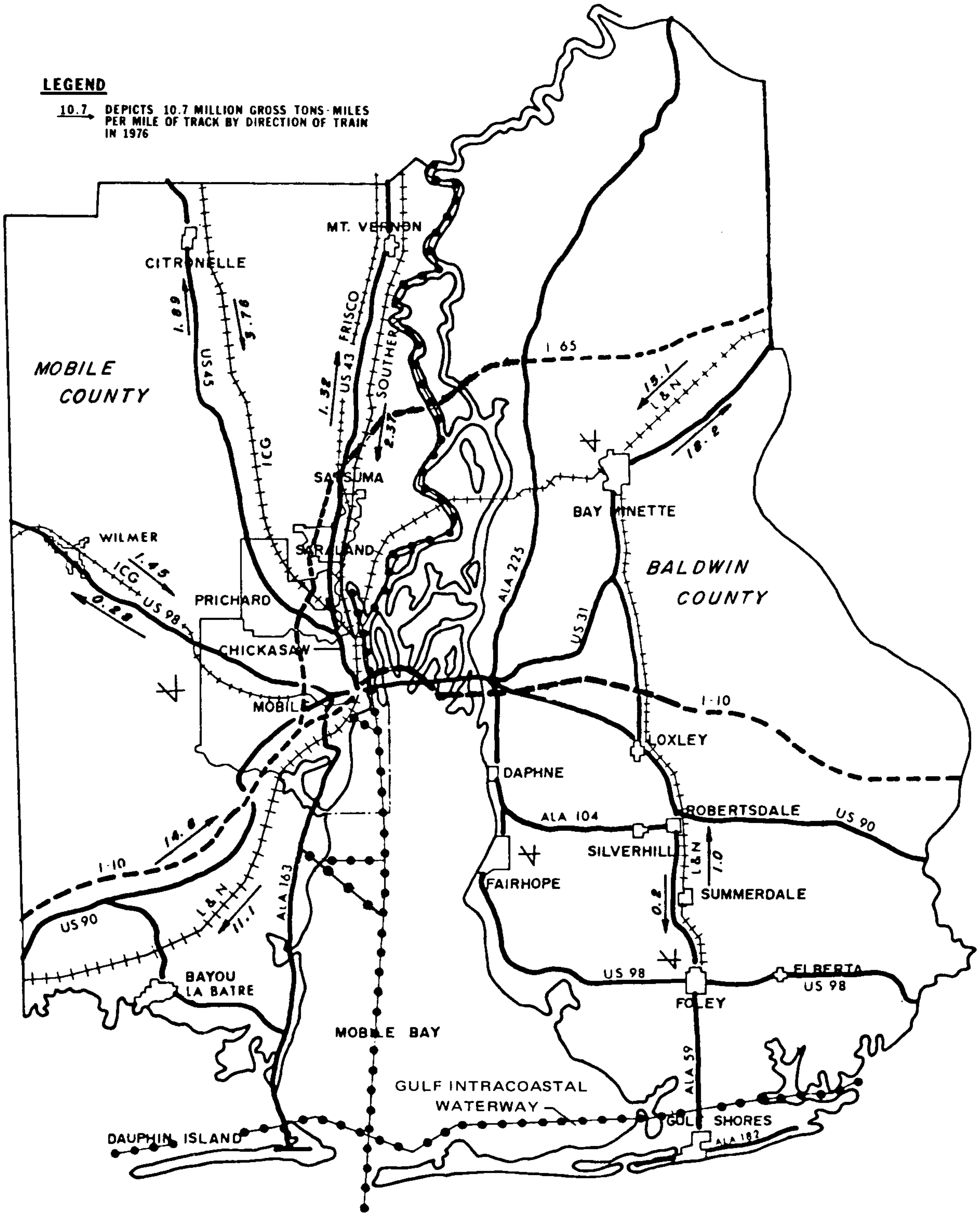


Figure 25. Railroad traffic densities in Alabama in 1979 (Alabama Highway Department, Bureau of State Planning 1980).

Table 86. Roadway mileage by type facility in the Alabama Coastal Region, 1978 (John H. Friend, Inc. 1978).

Type facility	Mobile County	Baldwin County	Coastal Region
Arterial			
Major			
Interstate	47	50	97
Other[a]	65	34	99
Subtotal	112	84	196
Minor[b]	192	80	272
Subtotal	304	164	468
Collector and local system[c]	2,517	1,802	4,319
Total	2,821	1,966	4,787

[a] Federal highways except interstate.

[b] State and county highways.

[c] Roads and streets providing access to adjacent land.

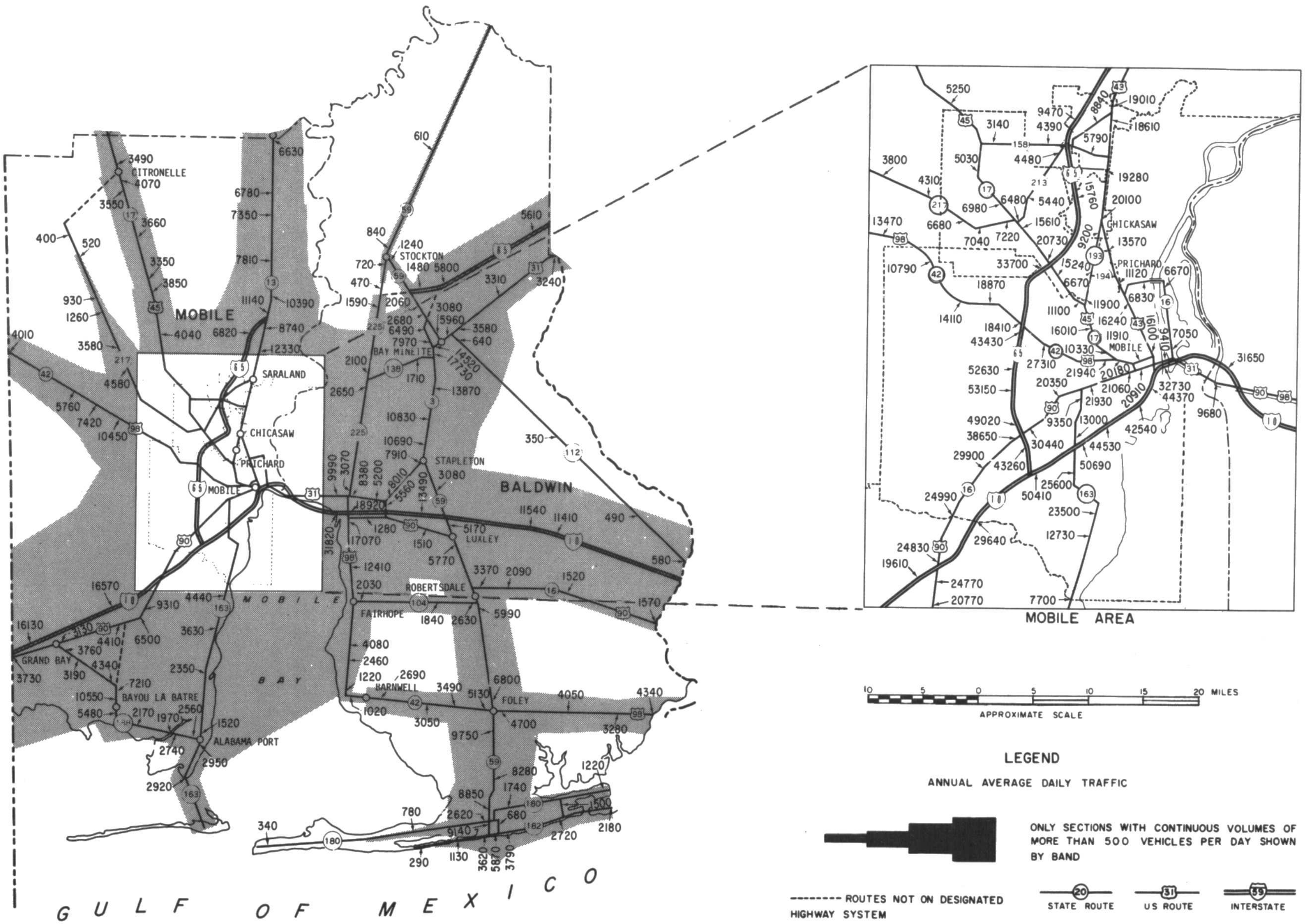


Figure 26. Coastal Alabama traffic flow, 1979 (Alabama Highway Department 1979).

Table 87. Annual average daily vehicular traffic at selected locations in the Alabama Coastal Region, 1965, 1970, and 1979 (Alabama Highway Department 1965, 1970, 1979).

Location	1965	1970	1979
At Alabama-Mississippi state line			
Interstate 10	4,890	8,400	16,130
U.S. 90	3,640	3,430	3,730
Total	8,530	11,830	19,860
At Alabama-Florida state line			
Interstate 10	Not open	5,650	11,410
U.S. 90	4,630	1,690	1,570
Total	4,630	7,340	12,980
At mouth of Mobile River			
Interstate 10	Not open	Not open	31,650
U.S. 31/90/98	21,450	23,580	9,680
Total	21,450	23,580	41,330
At Baldwin-Escambia county line			
Interstate 65	Not open	3,260	5,610
U.S. 31	4,370	2,500	3,240
Total	4,370	5,760	8,850

Table 88. Airport facilities in the Alabama Coastal Region by type, 1970 (John H. Friend, Inc. 1978).

Type airport	Mobile County	Baldwin County	Coastal Region
Air carrier	1	--	1
General aviation			
Public	6	6	12
Private	--	2	2
Military	--	7	7
Subtotal	6	15	21
Total	7	15	22

Table 89. Origin of passengers using the Mobile Municipal Airport, 1973 (Cunningham et al. 1979).

Passenger origin	Survey respondents Number	Percent
Alabama		
Mobile County		
City of Mobile	2,653	59.9
Other	465	10.5
Subtotal	3,118	70.4
Baldwin County	418	9.4
Other	146	3.3
Total	3,682	83.1
Mississippi		
Jackson County	481	10.8
Other	195	4.4
Total	676	15.2
Florida	74	1.7
Total	4,432	100.0

Table 90. Annual departures[a] and passenger enplanements[a], Mobile Municipal Airport (Bates Field), 1962, 1970, 1976, 1980, 1985, 1993, 2000 (Cunningham et al. 1979).

Year	Departures	Enplaned passengers
Actual		
1962	8,578	94,611
1970	8,342	202,939
1976	11,318	289,307
Projected		
1980	14,043	383,500
1985	17,091	490,300
1993	22,545	696,300
2000	28,812	920,400

[a] Includes major carriers and small commuter airlines.

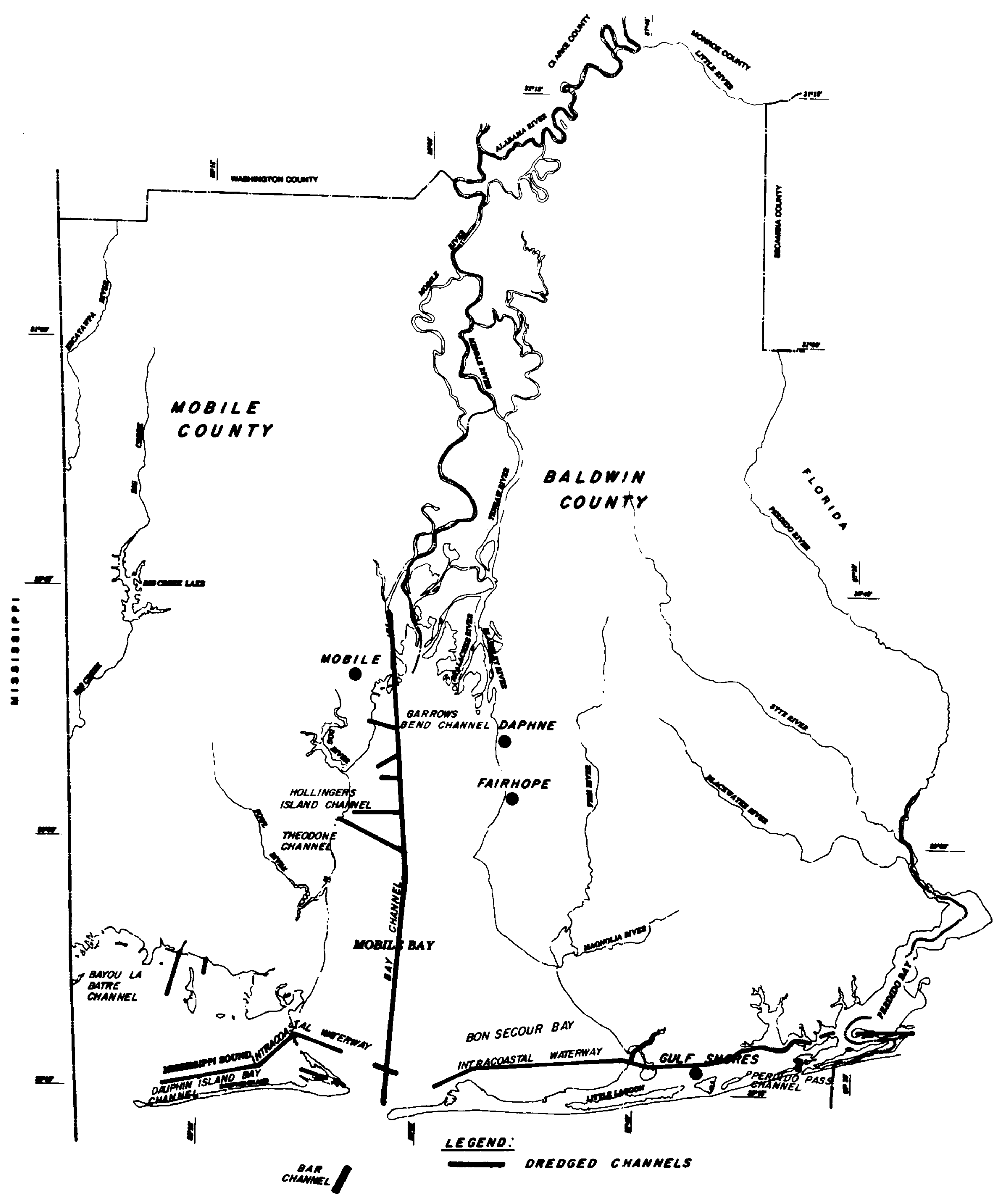


Figure 27. Major navigation channels in the Mobile Bay area, 1981 (Alabama Coastal Area Board, U.S. Department of Commerce 1979).

Table 91. Number of public and private port facilities, Port of Mobile, 1978 (U.S. Army Corps of Engineers 1978b).

Facility type	Number
Oil handling and oil bunkering (tanks)	266
Ore and other dry bulk handling (locations)	4
Cargo handling, mooring services (piers, wharves, docks)	125

Table 92. Proposed improvements to existing coal harbor channels, United States, 1980 (U.S. Department of Energy 1981).

Channel	Channel depth (ft)		Vessel size capacity (DWT[a])		Capital cost (10^6 $)	Annual operating and maintenance costs (10^6 $)		Amount of dredging required (10^6 yd^3)			Planning stage	Constraints
									Annual maintenance			
	Current	Proposed	Current	Proposed		Existing	Increased	Initial	Current	Increased		
Hampton Roads	45	55	80,000	100,000+	374 (April 1980)	6.2	2.5	100.1	4.9	1.2	Feasibility study[b]	Dredge material disposal; Chesapeak Tunnel
Baltimore	42	50	70,000	100,000+	278 (October 1980)	4.0	0.8	71.8	1.7	0.4	Project authorized but delayed	Dredge material disposal; little room for port expansion
Philadelphia	40	–	60,000	–	–	8.2	–	–	4.5	–	No actions	Dredge material disposal
Mobile	40	55	60,000	100,000+	392 (August 1980)	8.7	2.4	143.0	5.0	0.7	Feasibility study[b]	Dredge material disposal
New Orleans	40	55	60,000	100,000+	440 (May 1980)	19.5	75.0	133.0	21.0	57.0	Feasibility study[c]	Dredge material disposal; salt water intrusion

[a] Deadweight tonnage (DWT) is a measure of the total weight that a ship can carry, including cargo, crew, fuel stores, etc. DWT may be expressed in either long tons (2,240 lb) or metric tons (2,205 lb), but usually the latter.

[b] Feasibility studies completed and report now under review at levels of the Chief of Engineers and the Secretary of the Army.

[c] Feasibility study in final stages of completion by the District Engineer, New Orleans District, U.S. Army Corps of Engineers.

Table 93. Length, width, and depth of major channels in coastal Alabama (U.S. Army Corps of Engineers 1977b).

Location	Length/width/depth (metric)	Length/width/depth (English)
Mobile Harbor		
Mobile Bar	4.8 km x 183 m x 12.8 m	3.0 mi x 600 ft x 42 ft
Mobile Bay to mouth of Mobile River	47.0 km x 122 m x 12.2 m	29.2 mi x 400 ft x 40 ft
Mouth of Mobile River to Cochrane Bridge	7.4 km x 152 to 236.4 m x 12.2	4.6 mi x 500 to 775 ft x 40 ft
Gulf Intracoastal Waterway		
Mobile Bay to Florida line	59.6 km x 38 m x 3.7 m	37.0 mi x 125 ft x 12 ft
Mobile Bay to Mississippi line	35.4 km x 46 m x 3.7 m	22.0 mi x 150 ft x 12 ft

Table 94. Average annual volume (yd^3) of maintenance bottom materials dredged from the Mobile Harbor system, 1967-75 (U.S. Army Corps of Engineers 1980).

Channel	Volume
Mobile River (including Chickasaw Creek)	1,054,000
Mobile Bay	3,743,000
Mobile Bar Channel	264,000
Total	5,061,000

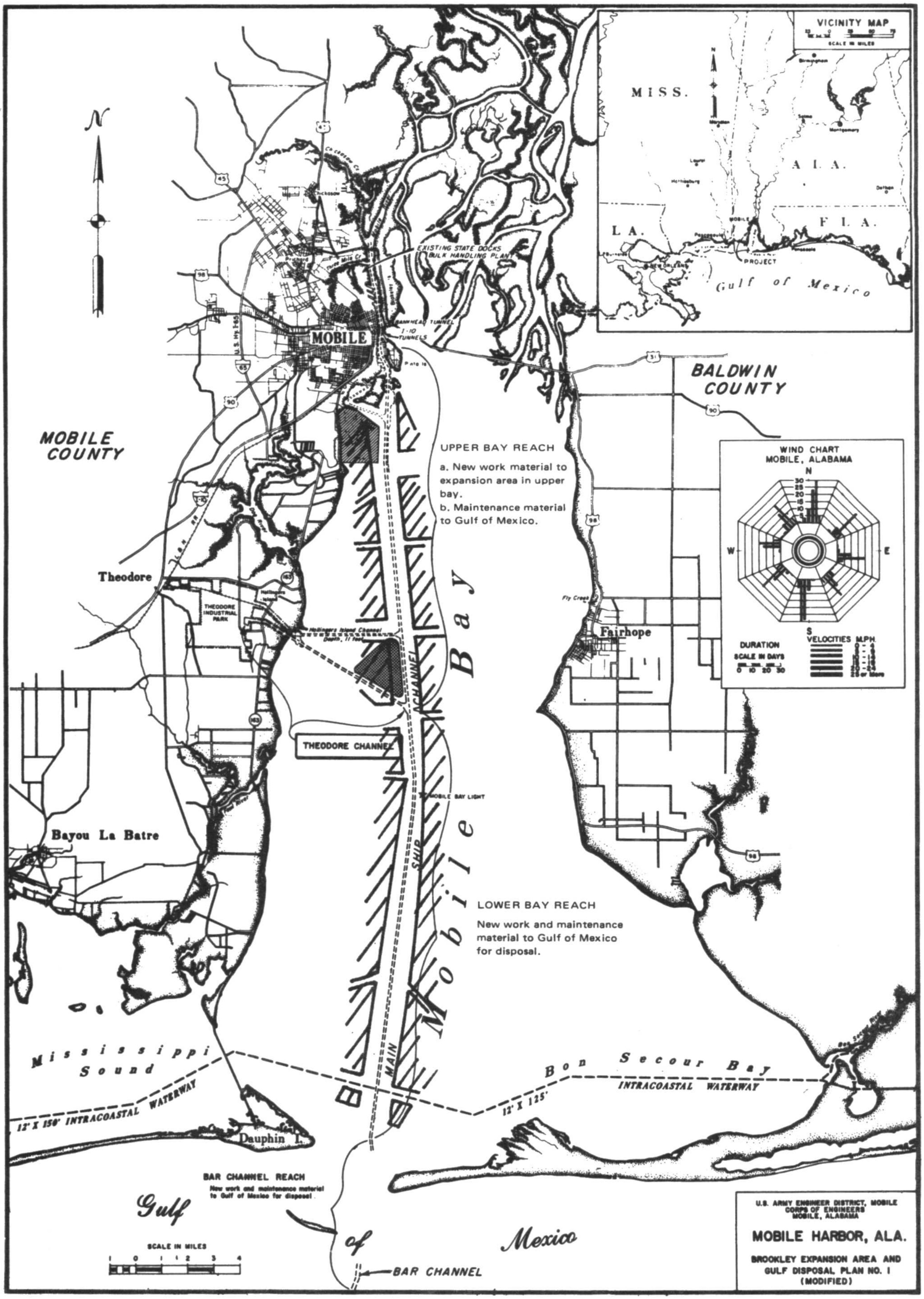


Figure 28. Proposed Mobile Bay ship channel improvements and spoil disposal areas (U.S. Army Corps of Engineers 1980).

Table 95. Loaded drafts (feet) of dry bulk vessels, by vessel class, 1977 (U.S. Department of Energy 1981).

Vessel class (DWT[a])	Loaded draft
15,000	29
25,000	33
35,000	36
50,000	40
60,000	42
80,000	46
100,000	49
120,000	52
150,000	57
175,000	61

[a] Deadweight tonnage (DWT) is a measure of the total weight that a ship can carry, including cargo, crew, fuel stores, etc. DWT may be expressed in either long tons (2,240 lbs) or metric tons (2,205 lbs), but usually the latter.

Table 96. Projected percent distribution of steam coal shipments, in ton-miles, by ship size, United States, 1980, 1985, 1990, 1995, 2000 (U.S. Department of Energy 1981).

Range of ship size (thousand DWT[a])	Year				
	1980	1985	1990	1995	2000
< 20	10	6	4	3	2
20-34	13	7	6	5	4
35-49	22	19	13	10	8
50-79	43	39	27	24	21
80-99	5	4	6	6	7
100-149	7	17	27	30	33
> 150	--	8	17	22	25
Total	100	100	100	100	100

[a] Deadweight tonnage (DWT) is a measure of the total weight that a ship can carry, including cargo, crew, fuel stores, etc. DWT may be expressed in either long tons (2,240 lb) or metric tons (2,205 lb), but usually the latter.

Table 97. Waterborne freight tonnage (short tons) through Mobile Harbor as reported by the U.S. Army Corps of Engineers and the Alabama State Docks, 1955, 1960, 1965, 1970, 1975, 1978, 1980 (Alabama State Docks Department 1956, 1961, 1966, 1971, 1976, 1979, 1981c; U.S. Corps of Engineers 1955, 1970, 1978b).

Year	Alabama State Docks	U.S. Army Corps of Engineers
1955	NA	15,083,028
1960	14,347,840	17,718,817
1965	18,701,072	21,836,686
1970	22,703,914	23,829,585
1975	34,637,924	32,452,912
1978	34,782,938	36,260,857
1980	40,836,122	NA

Table 98. Movement of foreign and domestic waterborne freight (short tons) in Mobile Harbor[a], 1955, 1970, 1978 (U.S. Army Corps of Engineers 1955, 1970, 1978b).

Type movement	1955	1970	1978
Foreign			
Imports	5,433,822	8,777,034	10,678,720
Exports	1,504,901	2,940,323	5,189,753
Subtotal	6,938,723	11,717,357	15,868,473
Domestic			
Coastwise			
Incoming shipments	625,466	33,236	445,680
Outgoing shipments	1,237,719	1,837,661	1,022,665
Internal			
Incoming shipments	1,758,944	5,009,713	7,327,341
Outgoing shipments	2,461,800	3,983,712	10,107,454
Local	2,060,376	1,247,906	1,489,244
Subtotal	8,144,305	12,122,228	20,392,384
Total shipments	15,083,028	23,829,585	36,260,857

[a] Includes Main Harbor, Three Mile Creek, and Chickasaw Creek.

Table 99. Major imported and exported commodities (short tons) in foreign waterborne freight in Mobile Harbor[a], 1978 (U.S. Army Corps of Engineers 1978b).

Commodity Classification Code[b]	Commodity	Imports		Exports		Total	
		Short tons	Percent	Short tons	Percent	Short tons	Percent
01	Farm products	61,026	0.6	2,110,220	40.7	2,171,246	13.7
	Soybeans	1	--	1,449,430	27.9	1,449,431	9.1
	Other	61,025	0.6	660,790	12.7	721,815	4.5
08	Forest products	7,678	0.1	156	--	7,834	--
09	Fresh fish and other marine products	3,746	--	50	--	3,796	--
10	Metallic ores	7,681,886	71.9	21,180	0.4	7,703,066	48.5
11	Coal	1,744,975	16.3	2,232,391	43.0	3,977,366	25.1
13	Crude petroleum	705,493	6.6	--	--	705,493	4.4
14	Non-metallic minerals except fuel	1,681	--	42,018	0.8	43,699	0.3
19	Ordnance and accessories	--	--	8	--	8	--
20	Food and kindred products	51,305	0.5	290,492	5.6	341,797	2.2
21	Tobacco products	--	--	31	--	31	--
22	Basic textiles	3,645	--	630	--	4,275	--
23	Apparel and other finished textile products	127	--	361	--	488	--
24	Lumber and wood products, except furniture	91,074	0.9	140,702	2.7	231,776	1.5
25	Furniture and fixtures	726	--	566	--	1,292	--
26	Pulp, paper and allied products	105,932	1.0	82,267	1.6	188,199	1.2
27	Printed matter	4	--	9	--	13	--
28	Chemicals and allied products	18,209	0.2	29,608	0.6	47,817	0.3
29	Petroleum and coal products	5,933	0.1	1,398	--	7,331	--
30	Rubber and miscellaneous plastic products	510	--	1,493	--	2,003	--
31	Leather and leather products	237	--	5	--	242	--
32	Stone, clay, glass and concrete products	1,761	--	31,184	0.6	32,945	0.2
33	Primary metals	177,126	1.7	69,172	1.3	246,298	1.6
34	Fabricated metal products	7,692	0.1	17,065	0.3	24,757	0.2
35	Machinery, except electrical	4,214	--	5,602	0.1	9,816	0.1
36	Electrical machinery and equipment	874	--	1,699	--	2,573	--
37	Transportation equipment	1,436	--	17,301	0.3	18,737	0.1

Table 99. Concluded.

Commodity Classification Code[b]	Commodity	Imports Short tons	Imports Percent	Exports Short tons	Exports Percent	Total Short tons	Total Percent
38	Instruments and related products	176	--	156	--	332	--
39	Miscellaneous manufactured products	693	--	266	--	959	--
40	Miscellaneous scrap products	236	--	90,467	1.7	90,703	0.6
41	Commodities not classified elsewhere	325	--	241	--	566	--
99	Department of Defense products	--	--	3,015	0.1	3,015	--
	Total	10,678,720	100.0	5,189,753	100.0	15,868,473	100.0

[a] Includes Main Harbor, Three Mile Creek, and Chickasaw Creek.

[b] U.S. Army Corps of Engineers code for domestic water-borne freight on first two digits of SIC broad categories.

Table 100. Inbound vessel trips by type vessel, Mobile Harbor[a], 1955, 1970, 1978 (U.S. Army Corps of Engineers 1955, 1970, 1978b).

Type vessel	1955	1970	1978
Self-propelled			
Passenger and dry cargo (deep-draft)	1,683	1,844	1,191
Tanker (deep-draft)	194	118	123
Towboat or tugboat	4,974	3,867	5,268
Subtotal	6,851	5,829	6,582
Non-self-propelled (barges)			
Dry cargo	6,096	7,476	8,419
Tanker	1,298	1,611	3,543
Subtotal	7,394	9,087	11,962
Total	14,245	14,916	18,544

[a] Includes Main Harbor, Three Mile Creek, and Chickasaw Creek.

Table 101. Waterborne freight (short tons) of major commodities in Mobile Harbor[a], 1955, 1978 (U.S. Army Corps of Engineers 1955, 1978b).

Commodity classification code[b]	Commodity	1955		1978	
		Short tons	Percent	Short tons	Percent
01	Farm products	533,275	3.5	2,940,374	8.1
08	Forest products	45,187	0.3	7,834	--
09	Fresh fish and other marine products	2,422,301	16.0	1,463,334	4.0
10	Metallic ores	2,720,129	18.0	10,575,217	29.2
11	Coal	722,123	4.8	7,994,229	22.0
13	Crude petroleum	2,051,540	13.6	3,804,711	10.5
14	Non-metallic minerals except fuel	503,090	3.3	1,291,690	3.6
19	Ordnance and accessories	--	--	8	--
20	Food and kindred products	132,083	0.9	458,857	1.3
21	Tobacco products	1,203	--	31	--
22	Basic textiles	6,266	--	4,363	--
23	Apparel and other finished textile products	--	--	488	--
24	Lumber and wood products, except furniture	185,619	1.2	491,465	1.4
25	Furniture and fixtures	--	--	1,448	--
26	Pulp, paper and allied products	235,151	1.6	211,255	0.6
27	Printed matter	--	--	13	--
28	Chemicals and allied products	165,129	1.1	354,215	1.0
29	Petroleum and coal products	1,595,053	10.6	5,669,650	15.6
30	Rubber and miscellaneous plastic products	340	--	2,497	--
31	Leather and leather products	762	--	242	--
32	Stone, clay, glass, and concrete products	426,840	2.8	368,654	1.0
33	Primary metals	3,048,141	20.2	431,803	1.2
34	Fabricated metal products	15,523	0.1	31,190	0.1
35	Machinery, except electrical	7,779	--	14,853	--
36	Electrical machinery and equipment	1,976	--	2,839	--
37	Transportation equipment	52,166	0.3	19,939	0.1
38	Instruments and related products	--	--	332	--
39	Miscellaneous manufactured products	755	--	959	--
40	Miscellaneous scrap products	56,386	0.4	111,750	0.3
41	Commodities not elsewhere classified	46,932	0.3	3,532	--
99	Department of Defense products	107,279	0.7	3,015	--
	Total	15,083,028	100.0	36,260,857	100.0

[a] Includes Main Harbor, Three Mile Creek, and Chickasaw Creek.

[b] U.S. Army Corps of Engineers code for domestic water-borne freight based on first two digits of SIC broad categories.

Table 102. Deep-draft vessel freight (short tons), Ports of Mobile and Theodore, selected years, 1975-2044 (U.S. Army Corps of Engineers 1980).

Port, commodity	1975	1986	1995	2000	2010	2020	2030	2035	2044
Port of Mobile									
Iron ore	4,781,000	5,291,000	5,856,000	6,264,000	7,292,000	8,400,000	9,595,000	10,475,000	10,475,000
Copper ore	–	13,000	15,000	16,000	20,000	24,000	28,000	31,000	31,000
Bauxite	1,872,000	2,671,000	2,781,000	2,840,000	2,984,000	3,172,000	3,507,000	3,550,000	3,550,000
Alumina	–	684,000	939,000	1,081,000	1,409,000	1,836,000	2,285,000	2,524,000	2,524,000
Manganese ore	45,000	188,000	223,000	243,000	286,000	337,000	392,000	423,000	423,000
Ferro-phosphorus	44,000	59,000	79,000	89,000	124,000	175,000	252,000	302,000	302,000
Ferro-silicon	–	22,000	26,000	28,000	32,000	38,000	45,000	48,000	48,000
Scrap iron	133,000	349,000	403,000	433,000	490,000	553,000	622,000	658,000	658,000
Coal	3,116,000	18,287,000	20,208,000	21,451,000	21,451,000	21,451,000	21,451,000	21,451,000	21,451,000
Coke	55,000	74,000	98,000	112,000	155,000	218,000	315,000	378,000	378,000
Grain	1,989,000	3,740,000	5,442,000	6,518,000	6,815,000	7,136,000	7,476,000	7,652,000	7,652,000
Petroleum (incl. crude oil)	2,701,000	3,605,000	4,544,000	5,067,000	6,261,000	7,739,000	9,574,000	10,770,000	10,770,000
Commerce through general general cargo terminals	1,407,000	1,870,000	2,314,000	2,577,000	3,174,000	3,916,000	4,805,000	5,250,000	5,250,000
Subtotal	16,143,000	36,853,000	42,928,000	46,719,000	50,493,000	54,995,000	60,347,000	63,512,000	63,512,000
Miscellaneous commerce (3%)	536,000	1,105,000	1,288,000	1,402,000	1,515,000	1,650,000	1,810,000	1,905,000	1,905,000
Total	16,679,000	37,958,000	44,216,000	48,121,000	52,008,000	56,645,000	62,157,000	65,417,000	65,417,000
Port of Theodore									
Manganese ore	–	548,000	726,000	825,000	1,011,000	1,200,000	1,389,000	1,483,000	1,483,000
Ferro alloys	–	54,000	71,000	81,000	99,000	116,000	133,000	142,000	142,000
Steel billets	–	111,000	160,000	187,000	251,000	312,000	373,000	404,000	404,000
Cement	–	958,000	1,350,000	1,568,000	2,147,000	2,725,000	3,303,000	3,592,000	3,592,000
Refined petroleum products	–	1,129,000	1,445,000	1,620,000	2,129,000	2,639,000	3,149,000	3,404,000	3,404,000
Crude oil	–	11,564,000	11,564,000	11,564,000	11,564,000	11,564,000	11,564,000	11,564,000	11,564,000
Total	–	14,364,000	15,316,000	15,845,000	17,201,000	18,556,000	19,911,000	20,589,000	20,589,000
Grand Total	16,679,000	52,322,000	59,532,000	63,966,000	69,209,000	75,201,000	82,068,000	86,006,000	86,006,000

Table 103. Waterborne freight (short tons) in the Gulf Intracoastal Waterway from Pensacola Bay, FL to Mobile Bay, AL and from Mobile Bay, AL to New Orleans, LA, 1955, 1970, 1978[a] (U.S. Army Corps of Engineers 1955, 1970, 1978b).

Section of the Gulf Intracoastal Waterway	1955	1970	1978
Pensacola Bay, FL to Mobile Bay, AL[b]	2,485,345	5,480,784	8,949,163
Mobile Bay, AL to New Orelans, LA[c]	7,228,874	16,075,626	22,610,406

[a] Freight on vessels traveling through both of these sections of the waterway is included in the tonnage for each section. Section tonnages thus include duplications and cannot be added.

[b] 46 miles, controlling depth 11.5 feet.

[c] Mobile Bay, AL via the Mississippi Sound and New Orleans-Rigolets cut to the innerharbor navigation canal at New Orleans, LA, 134 miles, controlling depth, 11 feet; alternate route, mouth of Rigolets through Lake Pontchartrain to near end of innerharbor navigation canal, controlling depth 7 feet.

Table 104. Waterborne freight (short tons) through harbors in the Alabama Coastal Region, 1955, 1970, 1978 (U.S. Army Corps of Engineers 1955, 1970, 1978b).

Harbor	1955	1970	1978
Mobile Harbor			
Main harbor	10,773,675	16,074,049	25,360,479
Three Mile Creek	4,128,369	7,030,682	8,673,825
Chickasaw Creek	180,984	724,854	2,226,553
Total	15,083,028	23,829,585	36,260,857
Bayou Coden	2,952	270	34
Bayou La Batre	19,600	24,556	12,302
Dauphin Island Bay	NA	329	13,042
Dog and Fowl Rivers	NA	NA	836
Bon Secour River	NA	5,283	9,943
Total	NA	NA	36,297,014

Table 105. Direct and indirect employment and income effects of the Port of Mobile, 1973 (John H. Friend, Inc. 1978).

Type employment	Number of employees	Wages ($1,000)
Direct		
Marine transportation	4,358	46,602.5
Auxiliary marine service	384	3,427.7
Inland transportation	1,364	13,039.2
Governmental and civic organizations	1,998	24,807.3
Tidewater industries	14,745	148,121.2
Manufacturing industries	16,003	153,192.6
Farm sector	3,142	51,909.9
Subtotal	41,994	441,100.4
Indirect [a]	83,988	882,200.9
Total	125,982	1,323,301.3

[a] Assumes a multiplier of 3.0; that is, for every worker employed directly, two are employed indirectly (Dunphy and Chang 1974).

Table 106. Revenue (dollars per ton) of major cargoes through the Port of Mobile, 1973 (Dunphy and Chang 1974).

Category	Revenue
General cargo	$32.23
Bulk handling	1.17
Grain elevator	1.63
Chickasaw and private piers	13.72

Table 107. Value ($1,000,000's) of grain shipped and indirect goods and number of jobs created by the Port of Mobile in Mobile and Baldwin Counties and Alabama, 1977 (Auburn University, Department of Agricultural Economics 1979).

Area	Value	Jobs
Baldwin County	63.8	1,931
Mobile County	17.2	520
Coastal Region	81.0	2,451
State of Alabama	282.7	8,562

Table 108. Payroll (dollars per ton) by type of cargo, Hampton Roads, 1980 (Silberman and Yochum 1980).

Type of cargo	Payroll (dollars/t)
Bulk cargo	2.91
General cargo	33.43
Container	30.57
Break-bulk	38.74

Table 109. Major recreational attractions of coastal Alabama, 1981; location of attractions shown in Figure 29 (Gulf Research Associates, Inc. 1981b).

<u>Historic Districts</u> ○
1. Oakleigh Garden District
2. Church Street East District
3. DeTonti Square District

<u>Federal and State Operated Recreational Sites</u> △
1. Gulf State Park
2. Meaher State Park
3. Bon Secour National Wildlife Refuge

<u>Special Tourist Attractions</u> □
1. Bellingrath Gardens
2. Battleship USS Alabama Memorial Park
3. Fort Conde Village
4. Fort Morgan
5. Fort Gaines
6. Mobile Greyhound Park
7. Grand Hotel

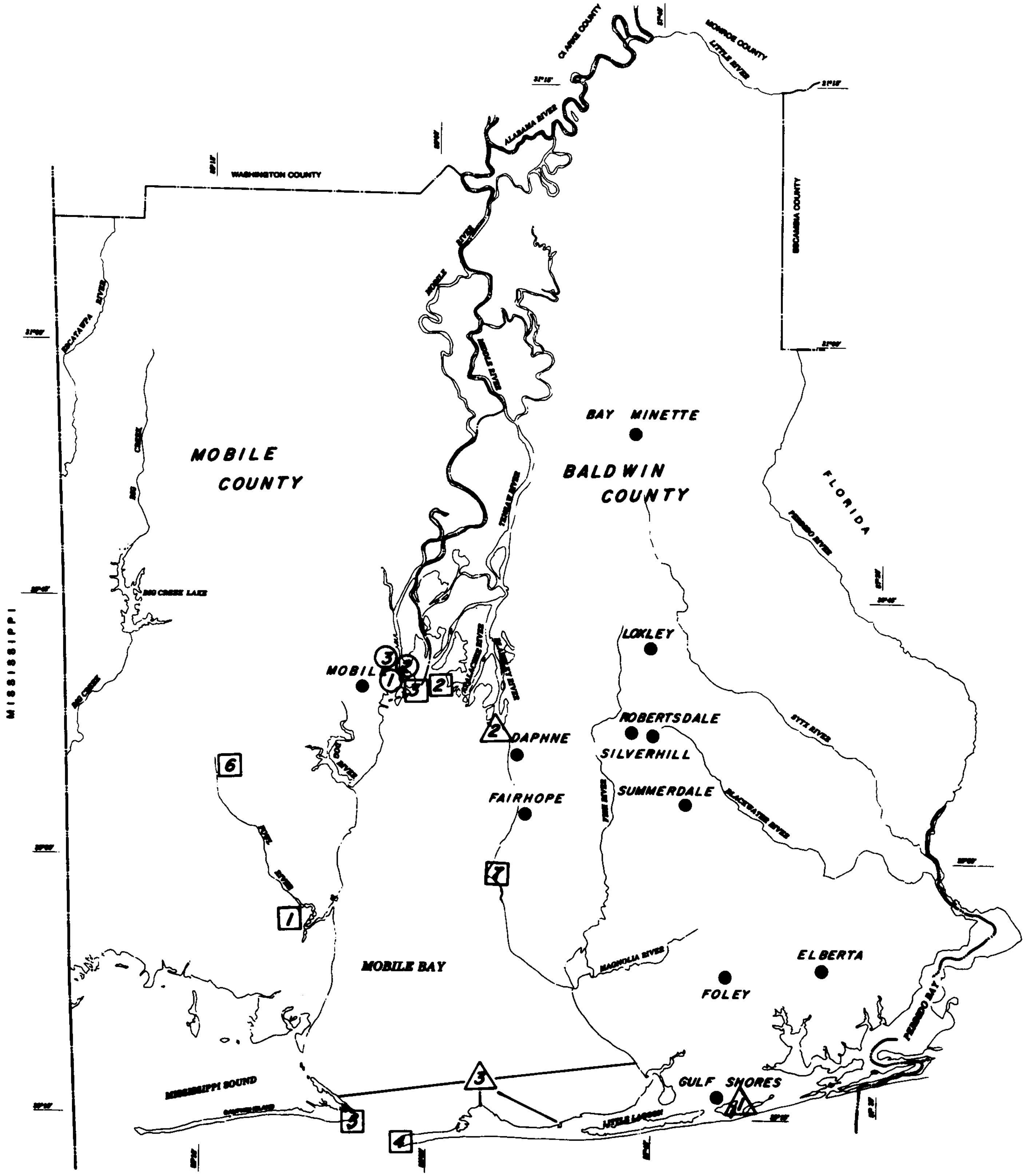


Figure 29. Major recreational attractions (numbered) of coastal Alabama in 1981; identification of attractions given in Table 109 (Gulf Research Associates, Inc. 1981b).

Table 110. Hurricane Frederic's effect on the operations of recreation-tourist facilities in the Gulf Shores area, as indicated by a February, 1980 survey (Blunt Associates, Inc. 1980).

Facility	Number in operation prior to 9/12/79 hurricane	Reopened by 2/11/80	Will reopen by 6/1/80	Will reopen after 6/1/80	Closed permanently
Campgrounds	6	4	--	2	--
Recreation facilities	10	1	7	2	--
Specialty shops	30	11	5	5	9
Restaurants, lounges	27	11	6	5	5
Hotels, motels	32	17	3	9	3
Total	105	44	21	23	17

Table 111. Number of charter boats in coastal Alabama, 1978 and 1981 (Garrett 1981).

Area	1978 "Pre-hurricane"		1981 "Post-hurricane"	
	Number	Percent	Number	Percent
Mobile County				
Dauphin Island	9	25	1	3
Bayou La Batre	2	6	1	3
Fowl River	--	--	2	5
Total	11	31	4	11
Baldwin County				
Orange Beach	25	69	33	89
Coastal Region	36	100	37	100

Table 112. National Wildlife Refuges, National Register Sites, Archaeological Sites and State Parks in coastal Alabama 1980 (Alabama Historical Commission 1981; Auburn University, Department of Agricultural Economics and Rural Sociology 1980).

Name	Location
MOBILE COUNTY	
National Wildlife Refuge	
Bon Secour National Wildlife Refuge	A newly created national wildlife refuge which will encompass up to 10,000 acres drawn from the following areas: Little Dauphin Island in Mobile County; and Little Point Clear, Skunk Bayou, and Perdue unit on Fort Morgan peninsula in Baldwin County (see "Environmental Issues" synthesis paper).
National Register Sites	
Barton Academy (1837)	504 Government Street
Battle House Royale (1906-08)	26 N. Royal Street
Bishop Portier House (1833)	307 Conti Street
City Hall-City Market (1856-57)	111 S. Royal Street
Carolina Hall (Yester House) (1846)	70 S. McGregor Ave.
City Hospital (1833-36)	850 St. Anthony Street
Church Street East Historic District (19th Century)	70 structures
De Tonti Square Historic District (19th Century)	53 structures
Ellicott Stone (1799)	one mile north of Bucks off US 43
Fort Conde (1822-24) - Charlotte House (1845-50)	104 Theatre Street
Fort Conde - Charlotte Site (1711)	104 Theatre Street
Fort Louis de la Louisiane Site (1702)	Twenty-seven Mile Bluff
Georgia Cottage (1845)	2564 Springhill Ave.
Horst House (Moongate) (1867)	407 Conti Street
Indian Mound Park (prehistoric)	Iberville Dr., Dauphin Island
Lafayette Street Cottages (19th century)	20, 22, and 23 S. Lafayette Street
Middle Bay Light (1905)	Mobile Bay
Nanna Hubba Bluff (Blue Ford Landing) (prehistoric)	West bank of Tombigbee River near Washington County line
Oakleigh (1833)	350 Oakleigh Place
Oakleigh Garden Historic District (19th century)	125 structures
Pincus Building (1891)	1 S. Royal Street
Protestant Children's Home (1845)	911 Dauphin Street

Table 112. Continued.

Name	Location
St. Louis Street Baptist Church (1872-1910)	114 N. Dearborn Street
(Admiral) Semmes House (1859)	804 Government Street
Staples-Pake Building (1850, 1904)	100 S. Royal Street
State Street AME Church (1854, 1890, 1920)	502 State Street
Bragg-Mitchell House (1847)	1906 Springhill Avenue
Brisk & Jacobson Store (1860)	51 S. Dauphin Street
First National Bank (1906)	68 St. Francis Street
Gates-Daves House (1842)	1570 Dauphin Street
Gulf, Mobile & Ohio Passenger Terminal (1907)	Beauregard and St. Joseph Street
Lower Dauphin Street Commercial District (19th and early 20th century)	Dauphin Street between Conception and Dearborn
Marine Hospital (1842)	800 St. Anthony Street
Springhill College Quadrangle (1866-1909)	4307 Old Shell Rd.
First Baptist Church (1908-09)	806 Government Street
Archaeological Sites	
Mound	2 mi S. Bayou La Batre
Shell mound	2 mi S. Heron Bay
Shell	4 mi W. Heron Bay
Small shell mounds (4 sites)	4 mi W. Heron Bay
Small shell mound	1 mi S. Bayou La Batre
Two mounds	1 mi SW. Bayou La Batre
Oyster shell mounds (5 sites)	Little Dauphin Island
Shell mounds (6 sites)	Little Dauphin Island
Shell mound	4 mi E. Little Rock Church
Village	24 Mile Bend
Shell mound	21 Mile Bluff
Shell midden	21 Mile Bluff
Shell midden	2 mi SW. Dead Lake Fishing Camp
Shell midden	6 mi E. Creola

Table 112. Continued.

Name	Location
Shell midden	2 mi SE. Courtauld's Chemical Plant
	21 Mile Bluff
Village	Beauford Landing (or Blue Ford Landing)
Campsites (3 sites)	Nanna Hubba Bluff
House	Nanna Hubba Bluff
Campsite	Nanna Hubba Bluff
Burial	Nanna Hubba Bluff
Firehearth	Nanna Hubba Bluff
Campsites (3 sites)	Nanna Hubba Bluff
House site	Nanna Hubba Bluff
House	Nanna Hubba Bluff
Fort	Fort Louis de la Mobile
Village	Dead Lake Fish Camp
Shell midden/sand mounds	Vicinity of N. Chickasaw
Shell mound	41 mi NE. Saraland
Campsite	½ mi N. Dead Lake
Campsite	Vicinity of Mt. Vernon
Fort	Fort Stoddert
Village	1.5 mi S. Mt. Vernon Landing
Shell midden	Whitehouse Bend
Earthen fortifications	Battery Huger
Earthen fortifications	Battery Tracy
Shell mound	Simpson Island Mound No. 1
Shell mound/burial	Simpson Island Mound No. 2
Shell mound	Simpson Island Mound No. 3
Shell mound	Big Chippewa Lake
Shell midden	Buzbee's Landing
Sand mounds	Byrnes Lake and Mounds

Table 112. Continued.

Name	Location
BALDWIN COUNTY	
National Wildlife Refuges	
Bon Secour National Wildlife Refuge	A newly created national wildlife refuge which will encompass up to 10,000 acres drawn from the following areas: Little Dauphin Island in Mobile County; and Little Point Clear, Skunk Bayou, and Perdue unit on Fort Morgan peninsula in Baldwin County (see "Environmental Issues" synthesis paper).
National Register Sites	
Blakeley Site	5 mi N. Spanish Fort off AL 225
Bottle Creek Indian Mounds	Near Stockton
Fort Mims Site	Between Tensaw and Alabama River
Fort Morgan	At entrance to Mobile Bay at Mobile Point
Montrose Historic District	Main & Second Street, Montrose
Sand Island Light	Mouth of Mobile Bay, 3 mi S. of Mobile Point
U.S.S. Tecumseh	Under 20 ft of water in Mobile Bay N. of Ft. Morgan
Old Daphne Methodist Church	1608 Old County Rd., Daphne
Archaeological Sites	
Village, ceremonial center	Vicinity of Stockton Battle Creek Indian Mounds
Mound	Vicinity of Bear Point
Village	Vicinity of Bear Point
Shell bank (2 sites)	Vicinity of Bear Point
Mound (2 sites)	Vicinity of Orange Beach
Village	Vicinity of Orange Beach
Mound (6 sites)	9 mi N. of Daphne
Mound	10 mi N. of Daphne
Village	2 mi N. of Daphne
Burials	1.5 mi N. of Daphne
Mound	1.5 mi N. of Daphne
Village	1.5 mi N. of Daphne
Mound	1.5 mi N. of Daphne
Shell bank	5 mi N. of Daphne

Table 112. Continued.

Name	Location
Burials, shell bank	5 mi N. of Daphne
Burials, mounds	5 mi N. of Daphne
Shell bank	5 mi N. of Daphne
(a)	Great Point Clear area
Shell banks	Vicinity of Point Clear
Burials, shell banks	Vicinity of Point Clear
Mound (2 sites)	Vicinity of Point Clear
Burials, shell banks	6 mi N. of Daphne
(a)	6 mi N. of Daphne
Shell banks	6 mi N. of Daphne
Village	6 mi N. of Daphne
Village	10 mi N. of Daphne
Fort, village	6 mi SW. of Foley
(a)	6 mi SW. of Foley
Village	6 mi SW. of Foley
Village	7 mi SW. of Foley
Mound, village	7 mi SW. of Foley
Mound, village	7 mi SW. of Foley
Village	5 mi SW. of Foley
Village	7 mi SW. of Foley
Mound	Vicinity of Gulf Shores
Mound	Vicinity of Gulf Shores
Village	Vicinity of Gulf Shores
Mound (2 sites)	Vicinity of Gulf Shores
Village	Vicinity of Gulf Shores
Village, mound	Vicinity of Gulf Shores
Mound (2 sites)	Vicinity of Gulf Shores
Village	Vicinity of Gulf Shores
Village, burials	3.5 mi W. of Gulf Shores
Village, burials	4.5 mi W. of Gulf Shores

Table 112. Continued.

Name	Location
Village, mound (9 sites)	5 mi W. of Gulf Shores
Village, mound	Vicinity of Gasque
Mound	2.5 mi NE. Faircloth Field (U.S. Navy)
Mound (4 sites)	Gulf State Park
Village	Gulf State Park
Village	Vicinity of Bon Secour
Mound (2 sites)	8 mi W. of Gulf Shores
Village, mounds (2 sites)	8 mi W. of Gulf Shores
Village	8 mi W. of Gulf Shores
Mound	8 mi W. of Gulf Shores
Shell mound	Bon Secour Bay area
Village	Collins Bayou
Shell mound	W. Shelby Lake
Shell bank	Shelby Lake
(a) (3 sites)	Shelby Lake
(a)	W. Shelby Lake
(a) (2 sites)	Alligator Island, Shelby Lake
(a)	South Island, Shelby Lake
(a) (2 sites)	Shelby Lake
Shell mound (3 sites)	W. Collins Bayou
Village	W. Collins Bayou
Shell mound	W. Collins Bayou
Village	N. of Dixie Graves Parkway
Village	S. Bon Secour Bay
Village	S. Andrews Bay
Village	W. Andrews Bay
Village	Andrews Bay
Village	3.5 mi E. of Ft. Morgan
Village	Vicinity of Palmetto Beach
Mound	1 mi W. of Gulf Shores
(a)	Vicinity of Gulf Shores

Table 112. Continued.

Name	Location
Mound	1 mi W. of Gulf Shores
(a) (3 sites)	Vicinity of Gulf Shores
Mound	2 mi W. of Gulf Shores
(a)	2 mi W. of Gulf Shores
Mound	Vicinity of Gulf Shores
Mound (2 sites)	2 mi NW. of Gulf Shores
Village	Vicinity of Bon Secour
Village, house site	Vicinity of Gulf Shores
Village (2 sites)	Vicinity of Gulf Shores
Village (9 sites)	4 mi SW. of Gulf Shores
(a)	4 mi SW. of Gulf Shores
Village (3 sites)	5.25 mi SW. of Gulf Shores
Village	6 mi SW. of Gulf Shores
Village	Gulf State Park
Mound	Gulf State Park
Village (2 sites)	Gulf State Park
Mound	Gulf State Park
Villages (11 sites)	Gulf State Park
Mound	Gulf State Park
House site	Grand Bay area
(a)	Grand Bay area
(a)	1 mi N. of McDonald's Fishing Camp
Shell midden	Junction of Lizard Creek and Mobile River
Shell midden	Larry Island
Shell midden	1.5 mi W. of Bryant's Landing
Shell bank	2 mi NW. of Vaughn
(a)	2 mi NW. of Vaughn
Shell bank (2 sites)	1 mi NW. of Vaughn
Shell bank	Vicinity of Vaughn
Shell bank	1 mi NW. of Vaughn
(a)	2 mi NW. of Vaughn

Table 112. Continued.

Name	Location
Shell bank (3 sites)	3 mi N. of Vaughn
Shell bank	5 mi NW. of Vaughn
Fort, village, cemetery	Fort Morgan
Village	Weeks Bay area
(a)	Weeks Bay area
Mound, village	Vicinity of Daphne
Settlement	Vicinity of Daphne
(a)	Grand Bay area
(a)	Chuckfee Bay area
(a)	Vicinity of Delvan Bay
Shell midden	Vicinity of Mobile Reserve Fleet
(a)	9 mi NW. of Bay Minette
(a)	Vicinity of Daphne
Shell midden (3 sites)	Grand Bay area
Shell midden	Chuckfee Bay area
Shell midden	5 mi N. of Daphne
Shell mound (3 sites)	5 mi N. of Daphne
Shell midden	5 mi N. of Daphne
Shell midden	3 mi N. of Daphne
Shell midden	5 mi N. of Daphne
Shell mound	3 mi N. of Daphne
Shell midden	Weeks Bay area
Shell midden	9 mi S. of Fairhope
(a)	Barlow Landing
Sand mound	Barlow Landing
Shell midden	N. Dennis Lake
(a)	SW. Chuckfee Bay
Town	5 mi W. of Spanish Fort
Earthworks (2 sites)	5 mi N. of Spanish Fort

Table 112. Concluded.

Name	Location
Shell bank	.5 mi N. of delta causeway at vessel point
Shell mound complex	SW. of Blakely Landing
Shell mounds (2 sites)	Bay Minette Basin
Village	Vicinity of Daphne
Shell midden, village	3 mi W. of Daphne
(a)	Vicinity of Barlow Landing
Plantation, Creek Indian War fort	1.5 mi ENE. of Blackshear
Creek Indian War fort	.5 mi W. of Hwy. 58 N near Tensaw
(a)	1 mi NW. of Bay Minette
State Parks	
Meaher Park (1,327 acres)	U.S. Hwy. 31 on Tensaw River and Mobile Bay
Gulf State Park (6,160 acres)	Hwy. 59

Table 113. Number of tourist trips, average length of stay, average party size, and number of tourists[a] visiting Mobile, Baldwin, and Escambia Counties by automobile, 1970, 1980 (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971; Gulf Research Associates, Inc. 1981a).

Tourist item	1970	1980
Number of tourist trips (1,000's)		
Terminal	218	328
Transient	942	1,422
Business	416	616
Total	1,576	2,366
Average length of stay in the area		
Terminal	2.1 days	2.1 days
Transient	½ hour	½ hour
Business	2.0 days	2.0 days
Average party size		
Terminal	3.0	3.3[b]
Transient	3.0	3.3[b]
Business	1.0	1.5[b]
Number of tourists (1,000's)		
Terminal	654	1,082
Transient[c]	1,413	2,347
Business	416	924
Total	2,483	4,353

[a] A tourist is defined as anyone traveling 100 miles or more from his county of residence to engage in pleasure-oriented activities. A terminal tourist is the tourist who has arrived at his primary destination; a transient tourist is the tourist who is traveling to or from his primary destination; and the business tourist is tourist traveling on business, but participating in pleasure-oriented activity not directly related to work.

[b] Estimate by Gulf Research Associates, Inc. based on data from Auburn University's Travel and Tourism in Alabama 1979 study.

[c] Assumes that 50% of transient tourists traveling through the area actually stop (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

Table 114. Number of tourists visiting major tourist attractions in the Alabama Coastal Region for selected years from 1960 to 1980 (Alabama Department of Conservation and Natural Resources, Parks Division 1981; Battleship USS Alabama 1981; Bellingrath Gardens 1981; Fort Conde 1981; Fort Morgan 1981; Fort Gaines 1981).

Tourist attraction	1960	1970	1977	1978	1979	1980
Gulf State Park[a]	NA	1,598,228	3,450,305	3,380,704	3,216,880	745,100
Battleship USS Alabama	--[b]	255,991	360,295	330,578	245,526	246,021
Bellingrath Gardens[a]	105,091	111,883	211,124	217,037	--[c]	85,716[c]
Fort Conde	--[b]	--[b]	61,623	48,357	NA	NA
Fort Morgan	NA	NA	165,988	147,624	131,252	84,342
Fort Gaines	NA	NA	29,150	25,872	24,350	125[d]

[a] For fiscal year ending September 31. Traffic volume data on Gulf Shores highways indicates that these estimates are probably high.

[b] Not in operation.

[c] Closed September 12, 1979, to March 1, 1980, due to hurricane damage.

[d] Fort Gaines pier, which accounted for the majority of the facility's visitors, was destroyed by Hurricane Frederic in 1979.

Table 115. Number of conventions and convention delegates in the Alabama Coastal Region[a], 1969-79 (Mobile Area Chamber of Commerce 1981).

Year	Conventions	Convention delegates
1969	106	31,162
1970	111	31,100
1971	262	52,054
1972	144	47,438
1973	149	56,416
1974	127	56,000
1975	225	60,185
1976	211	68,450
1977	158	51,673
1978	143	55,493
1979	114	52,145

[a] Excludes conventions at the Gulf State Park Convention Center in Baldwin County.

Table 116. Average daily two-way traffic volume (number of vehicles) on highways providing access to the Alabama Coastal Region's major recreational beach areas, 1965, 1970, 1977, 1978, 1979 (Alabama Highway Department 1965, 1970, 1977, 1978, 1979).

Year	Hwy. 163, immediately north of the Dauphin Island bridge	Hwy. 59, just north of the city of Gulf Shores	Gulf Shores Beach Hwy. 182, just west of the Florida State line
Annual average daily two-way volume			
1965	1,690	3,060	700
1970	2,440	4,720	850
1977	3,110	7,510	1,770
1978	3,220	8,430	2,290
1979[a]	2,920	8,850	2,180
Annual percent change			
1965-70	7.6	9.1	4.0
1970-79	2.0	7.2	11.0
1965-79	4.0	7.9	8.5

[a] Assuming "pre-hurricane" conditions.

Table 117. Number of recreational visitors to Dauphin Island, 1965, 1970, 1977, 1978, 1979 (Alabama Highway Department 1965, 1970, 1977, 1978, 1979; South Alabama Regional Planning Commission; John H. Friend, Inc. 1971; Gulf Research Associates 1981a).

Year	Annual average daily one-way traffic	Percent recreational	Annual recreational auto trips	Average persons per auto	Number of recreational visitors
1965	845	58	178,850	3	536,550
1970	1,220	58	258,420	3	775,260
1977	1,555	58	329,230	3	987,690
1978	1,610	58	340,910	3	1,022,730
1979[a]	1,460	58	309,155	3	927,465

[a] Assuming "pre-hurricane" conditions.

Table 118. Projected demand occasions for recreation activities and facilities in Mobile, Baldwin, and Escambia Counties, 1980, 1990, 2000 (Auburn University, Department of Agricultural Economics and Rural Sociology 1980).

Recreation activity, facility	1980		1990		2000	
	Number	Percent of total	Number	Percent of total	Number	Percent of total
Camping	1,102,485	2.1	1,320,915	2.2	1,422,840	2.2
Pedestrian trails	595,980	1.2	712,080	1.2	766,260	1.2
Golf	553,410	1.1	642,510	1.0	695,970	1.1
Fishing	6,392,135	12.4	7,698,950	12.5	8,385,945	12.7
Water-skiing	299,700	0.6	361,935	0.6	390,510	0.6
Boating	1,067,154	2.1	1,274,166	2.1	1,366,746	2.1
Picnicking	3,938,760	7.7	4,702,320	7.7	5,042,520	7.6
Swimming	9,665,059	18.8	11,522,283	18.8	12,399,197	18.7
Bicycling on trails	366,080	0.7	436,480	0.7	464,640	0.7
Horseback riding on trails	210,000	0.4	252,000	0.4	273,000	0.4
Off-road vehicles on roads or trails	48,600	0.1	64,260	0.1	65,340	0.1
Sightseeing by motor vehicle	18,585,000	36.2	22,050,000	35.9	23,782,500	35.9
Games and sports	6,699,630	13.0	8,106,150	13.2	8,707,500	13.2
Hunting	1,844,866	3.6	2,260,847	3.7	2,393,790	3.6
Total	51,368,859	100.0	61,404,896	100.1	66,156,758	100.1

Table 119. Demand[a] and supply[a] for outdoor recreational activities and facilities in Mobile, Baldwin, and Escambia Counties[b], 1980, 1990, 2000 (Auburn University, Department of Agricultural Economics and Rural Sociology 1980).

Activity	Unit	1980 supply	Demand[a] 1980	Demand[a] 1990	Demand[a] 2000	Requirements[a] - surplus (deficit) 1980	Requirements[a] - surplus (deficit) 1990	Requirements[a] - surplus (deficit) 2000
Camping								
Developed	acres	817	251	300	322	566	517	495
Primitive	acres	27	2,513	3,041	3,254	(2,486)	(3,014)	(3,227)
Semi-primitive	acres	24	49	59	65	(25)	(35)	(41)
Day and group	acres	265	53	64	69	212	201	196
Pedestrian trails	miles	37	77	92	99	(40)	(55)	(62)
Golf								
18 hole	courses	11	--	--	--	--	--	--
9 hole	courses	33	31	36	39	2	(3)	(6)
Driving range	tees	190	1	1	1	189	189	189
Fishing								
Freshwater	acres	5,362	58,276	69,495	74,587	(52,914)	(64,133)	(69,225)
Saltwater	acres	107,520	70,697	83,717	92,826	36,823	23,803	14,694
Brackish water	acres	397,353	75,210	95,755	106,005	322,143	301,598	291,348
Water-skiing	acres	800	6,660	8,043	8,678	(5,860)	(7,243)	(78,778)
Boating								
Sail	acres	4,446	91	99	103	4,355	4,347	4,343
Power	acres	4,543	29,264	34,981	37,536	(24,721)	(30,438)	(32,993)
Picnicking	acres	335	521	622	667	(186)	(287)	(332)
Swimming								
Saltwater beach	acres	1,134	63	75	82	1,071	1,059	1,052
Pool	sq. ft.	131,848	219,658	262,312	281,395	(87,810)	(130,464)	(149,547)
River or lake	acres	175	57	68	72	118	107	103

Bicycling on trails	miles	--	26	31	33	(26)	(31)	(33)
Horseback riding on trails	miles	81	50	60	65	31	21	16
Off-road vehicles on roads or trails								
4-wheel	miles	33	25	32	33	8	1	--
2-wheel	miles	33	8	11	11	25	22	22
Sightseeing by motor vehicle	miles	55	118	140	151	(63)	(85)	(96)
Games and sports								
Baseball	fields	147	203	242	259	(56)	(95)	(112)
Softball	fields	298	171	204	219	127	95	80
Football	fields	87	103	123	132	(16)	(36)	(45)
Track and field	fields	10	24	29	32	(14)	19	(22)
Basketball	goals	442	339	404	435	103	38	7
Tennis	courts	261	283	338	364	(22)	(77)	(103)
Volleyball	courts	181	66	80	85	115	101	96
Archery	targets	19	76	91	98	(57)	(72)	(79)
Miniature golf	holes	207	53	66	70	154	141	137
Playgrounds	acres	301	85	108	116	216	193	185
Hunting								
Big game	acres	421,137	519,692	662,504	662,231	(98,555)	(201,367)	(241,094)
Small game	acres	401,696	319,762	382,179	411,040	81,934	19,517	(9,344)
Waterfowl	acres	4,330	52,978	66,107	72,788	(48,648)	(61,777)	(68,458)
Target shooting	acres	11	75	90	96	(64)	(79)	(85)

[a] Based on base, or average, usage levels.

[b] Data only available for Alabama Planning District 8 which includes Mobile, Baldwin and Escambia Counties.

Table 120. Percent distribution by quarter of selected indicators of tourist activity in the United States in 1977 and in the Alabama Coastal Region in selected years from 1966 through 1978 (U.S. Department of Commerce, Bureau of the Census 1979; South Alabama Regional Planning Commission; John H. Friend, Inc. 1971; Mobile Area Chamber of Commerce 1981; Fort Conde 1981).

	Quarter				
	January-March	April-June	July-September	October-December	Total
United States					
Vacation trips (person trips), 1977	18.0	23.9	40.7	17.4	100.0
Alabama Coastal Region					
Tourist traffic, major highways, 1966	22.1	26.5	27.2	24.2	100.0
Tax lodging receipts, City of Mobile, 1978	21.0	30.3	27.0	21.8	100.1
Conventions					
Number of convention delegates					
1975	13.7	46.2	22.1	18.0	100.0
1978	17.7	38.0	21.9	22.4	100.0
Attendance at special tourist attractions					
USS Battleship Alabama, 1978	18.8	28.9	39.6	12.7	100.0
Fort Conde, 1978	22.9	31.5	31.9	13.7	100.0

Table 121. Percent distribution of destinations and origins of tourist auto trips[a] through the Mobile urban area, 1966 (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

Area	Destinations	Origins: Total	Origins: Destinations out of Coastal Region[b]	Origins: Destinations in Coastal Region[b]
Florida				
Escambia, Santa Rosa, Okaloosa Counties	17.7	--	--	--
Remainder	23.7	13.5	18.8	7.5
Total	41.4	13.4	18.8	7.5
Louisiana	12.1	19.9	20.0	19.4
Alabama				
Coastal Region				
Mobile County	16.5	--	--	--
Baldwin County	5.1	--	--	--
Subtotal	21.6	--	--	--
Other counties within 100 miles of Mobile urban area	0.7	--	--	--
Remainder	2.1	10.5	5.0	16.7
Total	24.4	10.5	5.0	16.7
Mississippi				
Coastal counties	7.5	--	--	--
Remainder	1.3	5.9	3.4	8.8
Total	8.8	5.9	3.4	8.8
Western States	7.5	26.5	29.7	22.9
Georgia	2.3	5.2	6.1	4.3
Other Southeastern States	2.0	4.0	3.5	4.5
Tennessee	0.6	1.7	1.7	1.6
Northeastern States	0.5	2.9	3.3	2.5
North Central States	0.4	10.0	8.5	11.8
Total	100.0	100.0	100.0	100.0

[a] Data based on survey of vehicles garaged 100 miles or more from the Mobile urban area.

[b] Includes Escambia County.

Table 122. Expenditures (dollars) by tourists[a] (based on tourist data in table 113) traveling by automobile in Mobile, Baldwin, and Escambia Counties, 1970, 1980 (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971, Gulf Research Associates 1981a).

Type Tourist	1970	1980
Average expenditure in the area		
Terminal (per day, per person)	$19.00	$40.30
Transient (per stop, per party)[b]	5.00	10.60
Business (pleasure-oriented expenditures, per day, per person)[c]	4.75	10.10
Total tourist expenditures in the area (1,000's)		
Terminal	25,700	91,600
Transient	2,400	7,500
Business	4,000	18,700
Total	$32,100	$117,800

[a] A tourist is defined as anyone traveling 100 miles or more from his county of residence to engage in pleasure-oriented activities. A terminal tourist is the tourist who has arrived at his primary destination; a transient tourist is the tourist who is traveling to or from his primary destination; and the business tourist is the tourist traveling on business, but participating in pleasure-oriented activity not directly related to work.

[b] 50% of transient tourists traveling through the area actually stop (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

[c] 25% of the businessman's 12-hour day is devoted to pleasure-oriented activities (South Alabama Regional Planning Commission; John H. Friend, Inc. 1971).

Table 123. Number of establishments and annual receipts and payroll ($1,000's) and number of employees working in hotels, motels, trailer parks, and camps in the Alabama Coastal Region, 1958, 1963, 1967, 1972, 1977 (U.S. Department of Commerce, Bureau of the Census 1961, 1966, 1970, 1975b, 1980b).

	All establishments		Establishments with payroll			
Area, year	Number	Receipts	Number	Receipts	Payroll	Number of employees for week including March 12
Mobile County						
1958	74	3,387	42	3,209	1,080	734[a]
1963	71	5,248	39	5,084	1,525	710[a]
1967	72	7,408	42	7,208	2,125	810
1972	94	9,530	40	8,821	2,722	826
1977	96	20,391	40	19,418	5,420	1,122
Baldwin County						
1958	NA	NA	NA	NA	NA	NA
1963	58	3,067	30	2,981	891	384[a]
1967	64	3,840	31	3,563	1,277	457
1972	70	7,973	32	7,541	2,498	564
1977	57	11,010	27	10,568	3,364	477
Coastal Region						
1958	NA	NA	NA	NA	NA	NA
1963	129	8,315	69	8,065	2,416	1,094[a]
1967	136	11,248	73	10,771	3,402	1,267
1972	164	17,503	72	16,362	5,220	1,390
1977	153	31,401	67	29,986	8,784	1,599

[a] For full workweek ended nearest November 15.

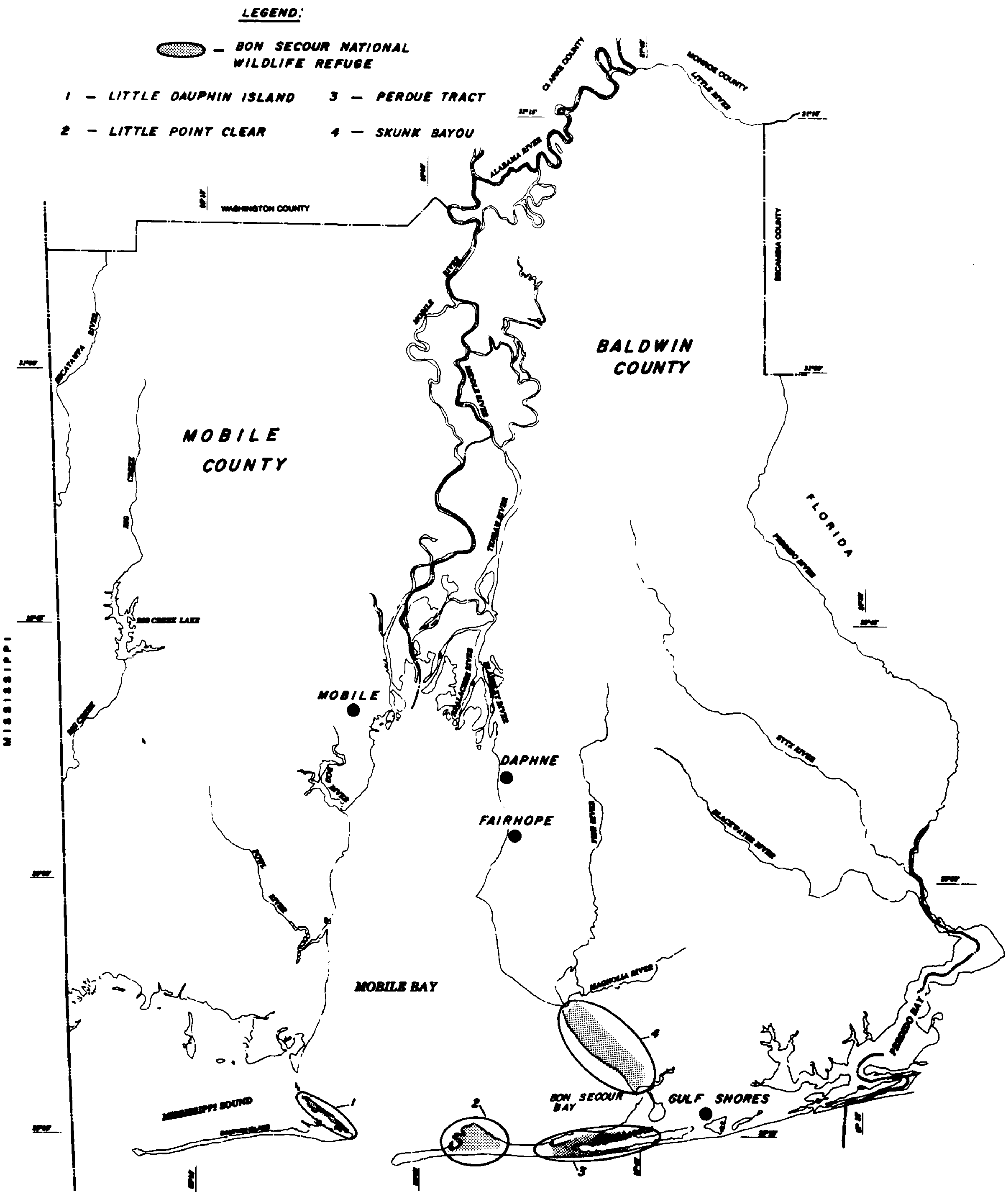


Figure 30. Proposed Bon Secour National Wildlife Refuge (U.S. Department of the Interior, Fish and Wildlife Service 1980).

Table 124. Sport and commercial landings (in pounds) in coastal Alabama by species of marine finfish harvested from National Marine Fisheries Service Statistical Zones 10 and 11, 1975 (Figure 22) (Wade 1977).

Species	Sport	Commercial
Amberjack	143,450	--
Bluefish	908,260	5,500
Bluerunner	65,063	--
Catfish	140,968	42,200
Cobia	138,782	6,500
Croaker	526,149	6,582,100
Dolphin	57,717	--
Drum, black	10,432	14,100
Drum, red	387,132	45,200
Flounders	126,229	650,600
Groupers	3,850	18,600
Jack crevalle	216,292	--
Jewfish	--	6,200
Kingfish	140,762	187,800
Ladyfish	169,624	--
Little tunny	388,444	--
King mackerel	1,053,936	--
Spanish mackerel	961,709	85,000
Mullet	80,500	1,593,000
Pompano	1,331	7,500
Sand seatrout	520,301	1,493,200
Sharks	596,690	6,700
Sheepshead	204,936	94,600
Snappers	139,042	308,500
Spot	--	45,900
Spotted seatrout	798,637	28,200
Miscellaneous	247,493	--
Total	8,027,779	11,221,400

Table 125. Number of fishing licenses sold by type in Mobile and Baldwin Counties in selected years, 1955-79 (Alabama Department of Conservation and Natural Resources, Game and Fish Division, License Section 1981).

County, license type	Year 1955-56	1960-61	1965-66	1970-71	1975-76	1978-79
Mobile County						
Resident, rod and reel	19,377	22,091	21,499	20,858	24,041	23,812
Resident, hook and line	4,428	4,864	2,964	1,231	821	599
Resident, over 65 for life	1,085	473	651	695	929	949
Resident, disabled	NA	NA	NA	7	63	90
Non-resident, annual	92	114	154	94	394	281
Non-resident, 7-day trip	307	391	432	463	694	647
Total	25,289	27,933	25,700	23,348	26,942	26,378
Baldwin County						
Resident, rod and reel	12,178	9,493	10,353	11,130	13,407	15,018
Resident, hook and line	3,030	2,304	1,893	1,035	1,135	908
Resident, over 65 for life	598	164	118	287	343	438
Resident, disabled	NA	NA	NA	4	74	140
Non-resident, annual	1,919	2,581	3,446	4,215	7,081	5,716
Non-resident, 7-day trip	2,402	1,936	1,954	1,786	3,041	4,345
Total	20,127	16,478	17,764	18,457	25,081	26,565
Coastal Region						
Resident, rod and reel	31,555	31,584	31,852	31,988	37,448	38,830
Resident, hook and line	7,458	7,168	4,857	2,266	1,956	1,507
Resident, over 65 for life	1,683	637	769	982	1,272	1,387
Resident, disabled	NA	NA	NA	11	137	230
Non-resident, annual	2,011	2,695	3,600	4,309	7,475	5,997
Non-resident, 7-day trip	2,709	2,327	2,386	2,249	3,735	4,992
Total	45,416	44,411	43,464	41,805	52,023	52,943
State						
Resident	NA	NA	NA	NA	NA	545,002
Non-resident	NA	NA	NA	NA	NA	76,859
Total	NA	NA	NA	NA	NA	621,861

Table 126. Number of boat licenses sold by boat classes[a], Mobile and Baldwin Counties, 1959-60, 1964-65, 1969-70, 1974-75, and 1979-80 (Alabama Department of Conservation and Natural Resources, Division of Marine Police, License Section 1981).

County, license type	1959-60	1964-65	1969 - 70	1974-75	1979-80
Mobile County					
Class I	7,703	8,534	10,557	11,962	11,886
Class II	1,869	2,457	3,607	4,632	5,775
Class III	362	393	NA	361	429
Class IV	29	19	NA	23	34
Subtotal	9,963	11,403	NA	16,978	18,124
Baldwin County					
Class I	2,774	2,199	2,704	4,701	4,686
Class II	425	377	686	1,757	2,036
Class III	125	53	NA	170	175
Class IV	11	5	NA	14	18
Subtotal	3,335	2,634	NA	6,642	6,915
Coastal Region					
Class I	10,477	10,733	13,261	16,663	16,572
Class II	2,294	2,834	4,293	6,389	7,811
Class III	487	446	NA	531	604
Class IV	40	24	NA	37	52
Total	13,298	14,037	NA	23,620	25,039

[a] Class I - boats less than 16 ft in length; Class II - boats at least 16 ft but less than 26 ft; Class III - boats at least 26 ft long but less than 40 ft; Class IV - boats 40 ft or more in length.

Table 127. Estimated number of sport fishing trips, estimated catch by month, and average catch per trip, Mobile Delta, July 1, 1963 through June 30, 1964 (modified from Swingle et al. 1966).

Month	Estimated number of trips	Estimated catch		Average catch per fisherman	
		Number of fish	Pounds of fish	Number of fish	Pounds of fish
July	3,800	32,300	12,654	8.5	3.3
August	5,347	35,935	11,765	6.7	2.2
September	3,465	16,597	6,895	4.8	2.0
October	4,123	17,688	8,576	4.3	2.1
November	1,940	9,545	3,434	4.9	1.8
December	651	5,436	1,269	8.4	2.0
January	300	354	327	1.2	1.1
February	1,247	4,801	2,619	3.9	2.1
March	1,488	2,961	1,295	2.0	0.9
April	3,390	24,035	7,695	7.1	2.3
May	8,579	59,060	24,879	8.1	2.9
June	9,740	69,445	28,732	7.1	3.0

Table 128. Summary of sport saltwater fishing data in coastal Alabama for 1975 from a four-part creel survey (modified from Wade 1977).

Activity and catch	Private boat fishery	Pier fishery	Shoreline fishery	Charter boat fishery	Totals
Number of trips	247,858	32,219	23,942	4,026	308,045
Fisherman occasions	621,680	79,774	43,560	20,130	765,117
Expenses[a]	$3,365,301	$763,623	$230,668	$593,835	$4,953,427
Hours fished	1,141,444	197,195	129,283	32,208	1,500,130
Man-hours fished	2,884,722	499,712	231,452	161,040	3,776,926
Pounds catch by species					
Amberjack	10,306	--	--	133,144	143,450
Black drum	--	5,285	5,147	--	10,432
Bluefish	885,182	17,155	5,923	--	908,260
Blue runner	63,560	1,503	--	--	65,063
Catfish	80,699	51,360	8,909	--	140,968
Cobia	100,565	32,673	--	5,544	138,782
Croaker	441,477	40,715	43,957	--	526,149
Dolphin	51,689	--	--	6,028	57,717
Flounder	76,884	44,869	4,476	--	126,229
Grouper	--	--	--	3,850	3,850
Jack crevalle	156,051	39,283	15,989	4,969	216,292
Kingfish	70,092	53,029	17,641	--	140,762
King mackerel	939,054	38,438	--	76,494	1,053,986
Ladyfish	163,972	5,652	--	--	169.624
Little tunny	333,506	7,396	--	47,542	388,444
Mullet	42,583	2,855	35,062	--	80,500
Pompano	--	1,267	64	--	1,331
Red drum	306,719	35,723	44,690	--	387,132
Sand seatrout	483,822	17,586	18,893	--	520,301
Shark	563,028	33,662	--	--	596,690
Sheepshead	145,030	49,208	10,698	--	204,936
Snapper	79,410	1,750	--	57,882	139,042
Spanish mackerel	920,622	26,589	--	14,498	961,709
Spotted seatrout	774,740	14,679	9,218	--	798,637
Miscellaneous	195,568	34,413	17,512	--	247,493
Total in pounds	6,884,559	555,090	238,179	349,951	8,027,779
Pounds per man-hour	2.39	1.11	1.03	2.17	1.68

[a] Estimated expenditures for expendable items (e.g., ice, bait) for fishing trips.

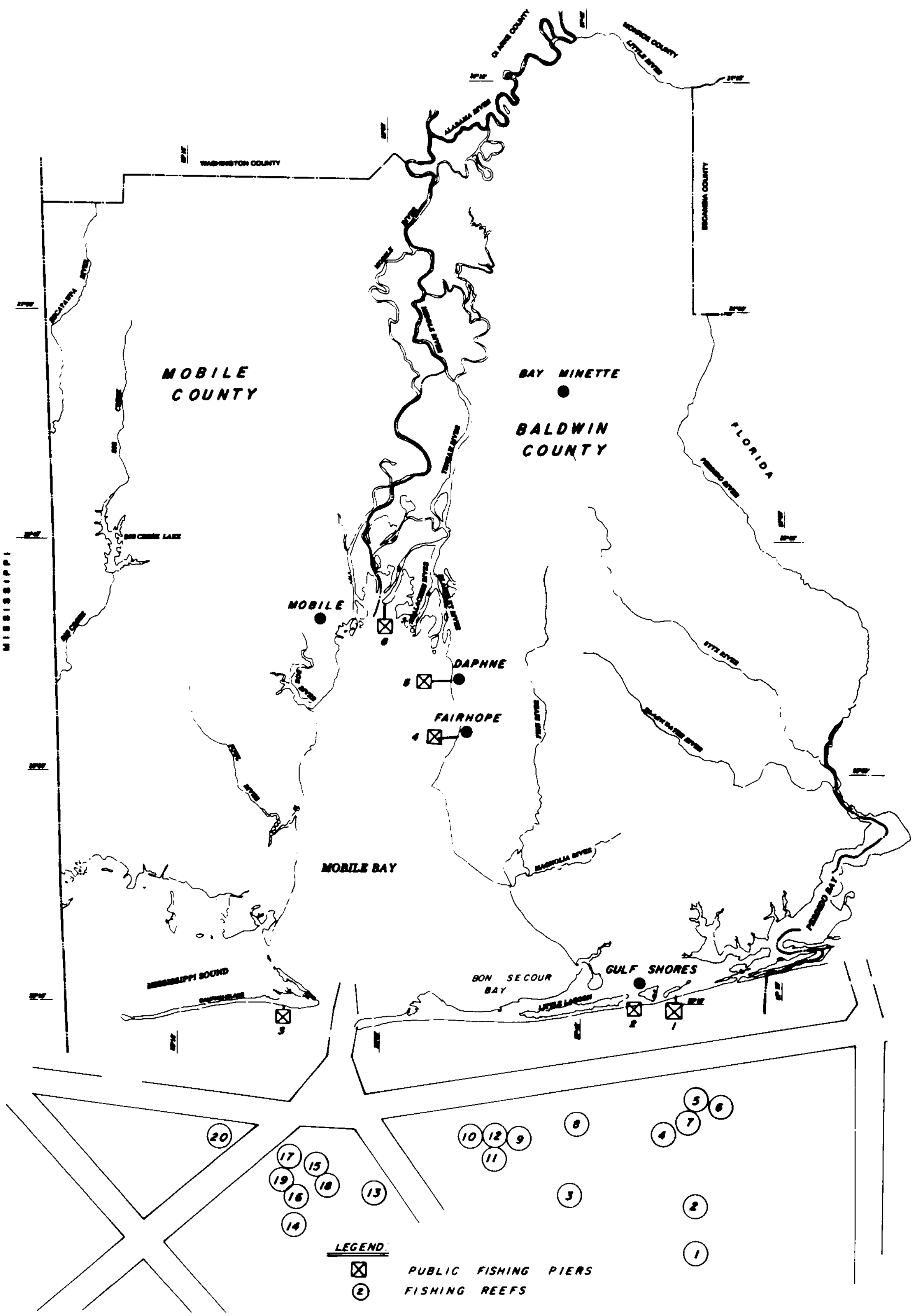


Figure 31. Public fishing piers and artificial fishing reefs (identified in Table 130) in coastal Alabama, 1981 (Alabama Department of Conservation and Natural Resources, Marine Resources Division 1981).

Table 129. Number of boat-owner sport fishing trips by boat class[a], Mobile and Baldwin Counties, 1974, 1975 (modified from Wade 1977).

		Mobile County		Baldwin County		Coastal Region	
Boat type	Type of trip	1974	1975	1974	1975	1974	1975
Class I	Offshore	16,681	7,988	7,954	4,729	24,635	12,717
	Inshore	57,028	42,934	46,134	50,163	103,162	93,097
	Out-of-state	9,084	8,736	1,184	1,686	10,268	10,422
	Total	82,793	59,658	55,272	56,578	138,065	116,236
Class II	Offshore	45,401	40,885	6,638	7,166	52,039	48,051
	Inshore	22,703	30,837	10,933	12,448	33,636	43,280
	Out-of-state	3,833	4,201	1,049	585	4,882	4,786
	Total	71,937	75,923	18,620	20,194	90,557	96,117
Class III	Offshore	3,378	3,813	2,404	3,471	5,782	7,284
	Inshore	383	913	284	167	667	1,080
	Out-of-state	267	385	532	137	799	522
	Total	4,028	5,111	3,220	3,775	7,248	8,886
All boats	Offshore	65,460	52,686	16,996	15,366	82,456	68,052
	Inshore	80,114	74,684	57,351	62,778	137,465	137,462
	Out-of-state	13,184	13,322	2,765	2,408	15,949	15,730
	Total	158,758	140,692	77,112	80,552	235,870	221,244

[a] Class I - boats less than 16 ft in length; Class II - boats at least 16 ft but less than 26 ft; Class III - boats 26 ft but less than 40 ft. Trips are by owners of boats registered in Mobile and Baldwin Counties.

Table 130. Approximate locations of Alabama's artificial fishing reefs (Alabama Department of Conservation and Natural Resources, Marine Resources Division 1981).

Number	Reef Name	Loran C Coordinates Gulf Chain	Compass Readings: Sand Island Light	Compass Readings: Perdido Pass Sea Buoy	Approximate Water Depth ft.
1	Trysler Grounds	13060.0 47000.0	119° (31.0)	174° (22.0)	102
2	Mobil Oil Platform	13070.0 47020.0	113° (29.0)	184° (17.0)	96
3	Sparkman (Liberty Ship)	12948.1 47020.2	120° (20.3)	206° (17.7)	93
4	Wallace (Liberty Ship)	13038.0 47046.0	101° (25.3)	182° (10.5)	90
5	Kelley Pipes and Lillian Bridge No. 1	13046.7 47062.8	100° (25.5)	181° (9.7)	60
6	Allen (Liberty Ship)	13069.2 47059.0	94° (26.3)	172° (8.0)	88
7	Lillian Bridge No. 2	13059.2 47054.9	92° (27.5)	177° (9.0)	92
8	105' Tug	12957.8 47039.9	102° (19.0)	212° (19.5)	64
9	Lipscomb Tug	12900.9 47045.0	114° (13.9)	229° (16.5)	65
10	Buffalo Barge No. 1	12883.1 47045.8	115° (13.0)	231° (17.2)	54
11	Fort Morgan Pipes	12883.1 47040.0	117° (13.2)	230° (18.0)	66
12	Buffalo Barge No. 2	12883.1 47045.8	116° (12.3)	223° (17.7)	66
13	Southeast Banks	12808.3 47027.0	160° (11.6)	233° (27.8)	75
14	Edwards (Liberty Ship)	12709.4 47013.6	190° (13.8)	236° (34.4)	84
15	Anderson (Liberty Ship)	12733.4 47018.6	187° (10.3)	240° (30.9)	82
16	Tulsa Wreck	12711.9 47027.4	190° (11.0)	240° (32.5)	84
17	Drydock	12704.6 47028.7	194° (10.6)	241° (32.1)	72
18	East Marker Dauphin Island Bridge Spans	12735.0 47035.0	190° (11.0)	240° (30.0)	65
19	West Marker Dauphin Island Bridge Spans	12706.0 47035.0	204° (12.0)	244° (34.0)	65
20	Southwest Banks	12650.0 47045.0	269° (11.0)	239° (37.0)	66

Table 131. Selected characteristics of catch by species for charter boat operators, Orange Beach, Alabama, 1975 (modified from Wade 1977).

Species	Average catch per boat (lb)	Distribution of catch (percent)	Average catch by man-hours (lb)
Amberjack	6,052	38.0	0.83
Cobia	252	1.6	0.03
Dolphin	274	1.7	0.04
Groupers	175	0.1	0.02
Jack crevalle	226	1.4	0.03
King mackerel	3,477	21.9	0.48
Little tunny	2,161	13.6	0.30
Snapper	2,631	16.5	0.36
Spanish mackerel	659	4.1	0.09
Total		98.9	

Table 132. Principal marine fish caught by sport fishermen in Mobile Bay (Wade 1979).

Common name	Scientific name
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Bluefish	*Pomatomus saltatrix*
Crevalle jack	*Cranax hippos*
Gulf flounder	*Paralichtys albigutta*
Kingfishes	*Menticirrhus* spp.
Red drum	*Sciaenops ocellata*
Sheepshead	*Archosargus probatocephalus*
Sand seatrout	*Cynoscion arenarius*
Spotted seatrout	*Cynoscion nebulosus*
Striped mullet	*Mugil cephalus*
Tarpon	*Megalops atlantica*
Tripletail	*Lobotes surinamensis*

Table 133. Intensity (number of trawls and trips), catch (lbs heads on), and trip expenditures of the 16-foot trawl sport shrimp fishery in Mobile and Baldwin Counties, 1972-74[a] (modified from Swingle et al. 1976).

Item, area	Year 1972	1973	1974
Estimated trawls used			
Mobile County	3,083	2,983	3,049
Baldwin County	1,878	1,801	1,702
Total	4,961	4,784	4,751
Trips per year			
Mobile County	29,520	27,145	30,185
Baldwin County	16,410	17,110	14,987
Total	45,930	44,255	45,163
Catch per trip			
Mobile County	5.8	3.9	6.8
Baldwin County	6.5	4.7	6.3
Average	6.2	4.3	6.4
Catch per year			
Mobile County	171,160	127,582	193,184
Baldwin County	105,891	79,995	97,357
Total	277,051	204,577	290,541
Expenditures per trip			
Mobile County	NA	$11.72	$12.50
Baldwin County	NA	7.72	9.67
Average	NA	9.72	11.08
Expenditures per year			
Mobile County	NA	$318,139	$377,312
Baldwin County	NA	132,089	144,837
Total	NA	450,228	522,149

[a] Card survey data for 1972, 1973 and 1974; intercept data for 1973 and 1974.

Table 134. Estimated catch (lbs heads on) of shrimp in Alabama waters, 1972-74 (Swingle et al. 1976).

Type of catch	Year 1972	1973[a]	1974
Commercial	1,621,073	855,012	1,009,300
16-foot trawl	277,051	204,577	209,541

[a] Commercial harvest was lowest in several years because of flooding in the river systems of the northern Gulf of Mexico.

Table 135. Hunting intensity and bag reports for Alabama, 1964-65 and 1979-80 (Kelly 1965, 1980).

Year and species	Total hunters	Percentage of total licensees who hunted	Total days afield	Total bag	Average daily bag	Average season bag	Average days afield
1964-65							
Squirrel	168,792	57.9	1,321,849	2,341,374	1.8	13.9	7.8
Rabbit	106,084	36.4	705,361	988,592	1.4	9.3	6.6
Dove	101,975	35.0	489,185	2,068,696	4.2	20.3	4.8
Deer	96,764	33.2	682,580	59,230	0.1	0.6	7.1
Quail	85,279	29.3	677,547	2,909,480	3.1	24.5	7.9
Turkey	36,358	12.5	171,534	22,556	0.1	0.6	4.7
Raccoon	26,743	9.2	315,487	211,017	0.7	7.9	11.8
Duck	21,491	7.3	83,226	65,823	0.8	3.1	3.9
Opossum	16,116	5.5	137,741	101,284	0.7	6.3	8.5
Woodcock	4,087	1.4	17,918	11,103	0.6	2.7	4.4
1979-80							
Deer	211,309	77.9	2,439,100	140,685	0.1	0.6	11.5
Squirrel	143,020	52.7	957,852	1,665,540	1.7	11.6	6.7
Dove	102,041	37.6	591,462	3,160,950	5.3	30.9	5.8
Rabbit	74,861	27.6	478,074	595,547	1.2	7.9	6.4
Quail	64,964	23.9	529,162	1,593,310	3.0	24.5	8.1
Turkey	46,889	17.3	328,198	30,341	0.1	0.6	7.0
Raccoon	24,846	9.1	294,722	234,099	0.8	9.4	11.9
Duck	22,677	8.4	107,456	126,160	1.2	5.6	4.7
Opossum	10,172	3.7	76,978	98,494	1.3	9.7	7.6
Woodcock	6,035	2.2	18,351	25,355	1.4	4.2	3.0

Table 136. Number of hunting licenses sold by type, Mobile and Baldwin Counties, selected years, 1955-79 (Alabama Department of Conservation and Natural Resources, Game and Fish Division, License Section 1981).

Area, license type	Year 1955-56	1960-61	1965-66	1970-71	1975-76	1978-79
Mobile County						
Resident, state	12,093	15,167	17,676	18,951	20,414	21,998
Resident, county	5,322	5,191	4,477	3,270	1,630	1,183
Resident, over 65, state	NA	NA	904	1,413	1,925	609
Non-resident, annual all game	9	26	38	107	192	127
Non-resident, annual small game	NA	NA	76	87	55	66
Non-resident, 5-day trip all game	116	106	41	90	151	123
Non-resident, 5-day small game	NA	NA	23	17	17	25
Management area	NA	NA	162	914	1,299	1,397
Total	17,540	20,490	23,397	24,849	25,683	25,528
Baldwin County						
Resident, state	2,328	2,856	3,873	4,625	5,781	7,035
Resident, county	5,313	5,042	5,496	4,479	3,453	3,213
Resident, over 65, state	NA	NA	291	579	825	244
Non-resident, annual all game	77	218	240	301	866	752
Non-resident, annual small game	NA	NA	233	367	296	239
Non-resident, 5-day trip all game	257	397	126	103	462	311
Non-resident, 5-day small game	NA	NA	17	72	55	50
Management area	NA	NA	--	17	93	259
Total	7,975	8,513	10,276	10,543	11,831	12,103
Coastal Region						
Resident, state	14,421	18,023	21,549	23,576	26,195	29,033
Resident, county	10,635	10,233	9,973	7,749	5,083	4,396
Resident, over 65, state	NA	NA	1,195	1,992	2,750	853
Non-resident, annual all game	86	244	278	408	1,058	879
Non-resident, annual small game	NA	NA	309	454	351	305
Non-resident, 5-day trip all game	373	503	167	193	617	434
Non-resident, 5-day small game	NA	NA	40	89	72	75
Management area	NA	NA	162	931	1,391	1,656
Total	25,515	29,003	33,673	35,392	37,514	37,631

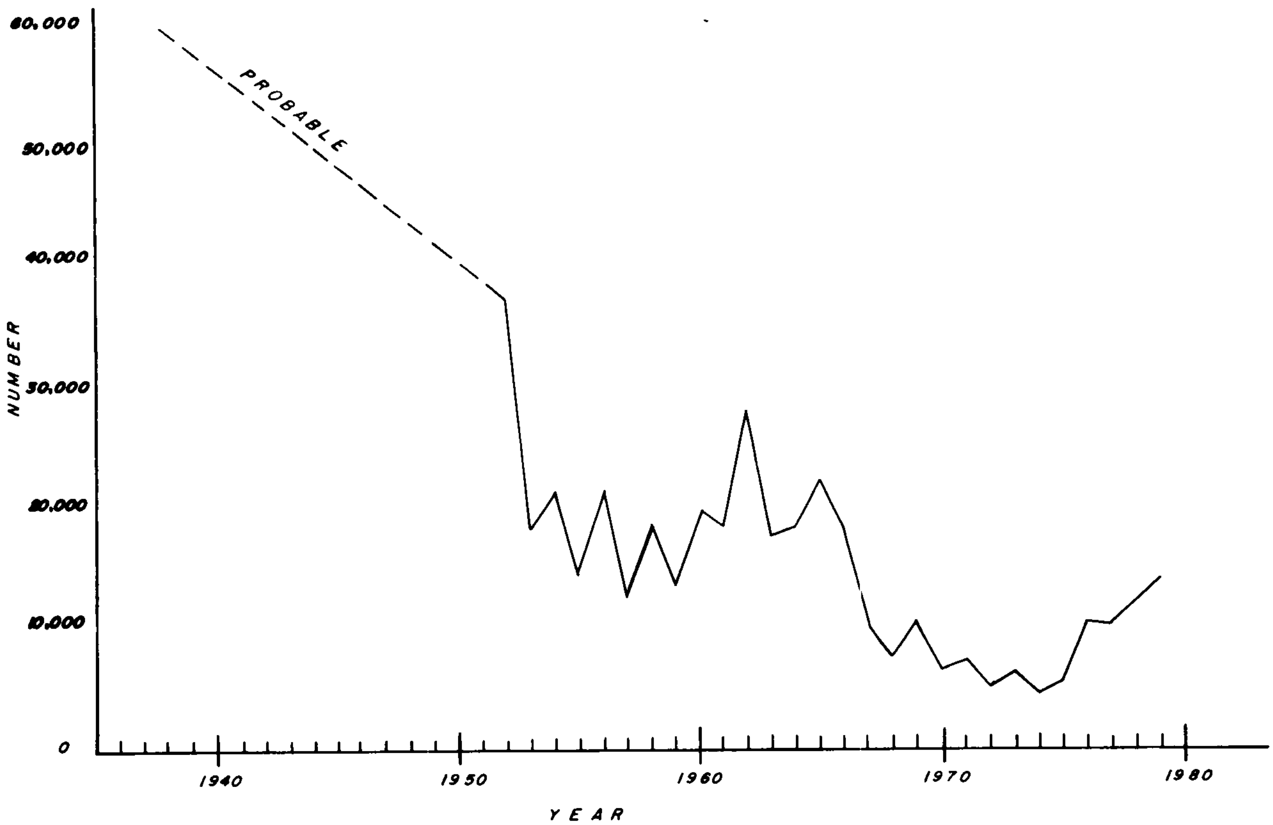


Figure 32. Estimated numbers of wintering ducks in the lower Mobile Delta, 1952-79 (Besheears 1979, 1980).

Table 137. Wintering populations of ducks and coots in the lower Mobile Delta 1955-79 (Beshears 1979, 1980).

Year	November		December		January	
	Ducks	Coots	Ducks	Coots	Ducks	Coots
1955	12,750	10,000	17,045	11,800	14,930	8,600
1956	19,200	15,000	27,150	18,000	21,310	17,005
1957	11,870	6,300	9,715	11,800	12,627	12,000
1958	25,000	25,000	18,800	16,000	18,625	16,275
1959	14,060	13,050	16,000	15,000	13,165	19,450
1960	23,146	21,440	18,250	25,000	19,759	29,500
1961	11,770	13,925	17,151	18,760	18,800	18,300
1962	22,000	17,975	29,935	36,265	28,599	28,825
1963	28,050	27,175	24,170	23,225	17,850	19,950
1964	17,842	24,700	17,200	15,000	18,922	17,600
1965	36,805	35,550	20,000	12,000	22,500	16,225
1966	25,000	25,000	18,450	27,200	18,475	20,600
1967	5,560	8,200	11,743	14,644	10,000	10,000
1968	17,500	7,250	19,175	22,580	7,575	7,625
1969	12,303	20,825	14,778	12,115	10,600	10,000
1970	15,126	31,240	7,116	20,095	6,765	14,035
1971	13,387	35,225	8,365	17,760	7,198	12,725
1972	8,559	16,745	5,160	11,550	5,043	11,595
1973	NA	NA	12,108	35,100	6,300	21,800
1974	NA	NA	22,948	28,150	4,918	15,595
1975	NA	NA	13,476	36,360	5,610	27,570
1976	NA	NA	13,931	37,942	10,895	28,722
1977	NA	NA	11,990	19,050	10,680	22,900
1978	12,300	16,600	NA	NA	12,000	14,000
1979	5,850	7,400	NA	NA	14,000	12,000

NA - Only two counts have been made per year since 1973.

Table 138. Results of hunter and waterfowl bag-check surveys in the lower Mobile Delta, 1955-79 (Beshears 1979, 1980).

Year	Hunters checked	Hours hunted	Hours/ hunter	Ducks checked	Ducks/ hunter	Coots checked	Coots/ hunter
1955	577	2,715	4.7	986	1.7	1,278	2.2
1956	497	2,050	4.1	654	1.3	1,201	2.4
1957	323	1,365	4.2	297	0.9	943	2.9
1958	387	1,477	3.8	530	1.4	1,137	2.9
1959	111	329	3.0	204	1.8	112	1.0
1960	NA	NA	NA	NA	NA	NA	NA
1961	153	490	3.2	274	1.8	158	1.0
1962	79	225	2.8	63	0.8	143	1.8
1963	116	364	3.1	203	1.8	186	1.6
1964	57	228	4.0	121	2.1	220	3.9
1965	106	415	3.9	204	1.9	85	0.8
1966	87	284	3.3	68	0.8	169	1.9
1967	97	392	4.0	199	2.1	130	1.3
1968	163	570	3.5	221	1.4	147	0.9
1969	84	410	4.5	214	2.5	77	0.9
1970	147	523	3.6	246	1.7	306	2.1
1971	50	124	2.5	48	1.0	73	1.5
1972	220	592	2.7	186	0.9	674	3.1
1973	270	720	3.5	665	2.5	865	3.2
1974	85	280	3.3	126	1.5	101	1.2
1975	279	1,001	3.6	492	1.8	1,419	5.1
1976	217	732	3.4	354	1.6	644	2.9
1977	281	664	2.4	568	2.0	593	2.1
1978	336	1,361	4.1	872	2.6	899	2.6
1979	297	1,015	3.4	389	1.3	517	1.7

NA - No bag checks were made in 1960.

Table 139. Number of fur trapper licenses sold, Mobile and Baldwin Counties, selected years, 1955-79 (Alabama Department of Conservation and Natural Resources, Game and Fish Division, License Section 1981).

County	1955-56	1960-61	1965-66	1970-71	1975-76	1978-79
Baldwin	38	17	8	9	19	64
Mobile	44	35	10	10	17	45
Total	82	52	18	19	36	109

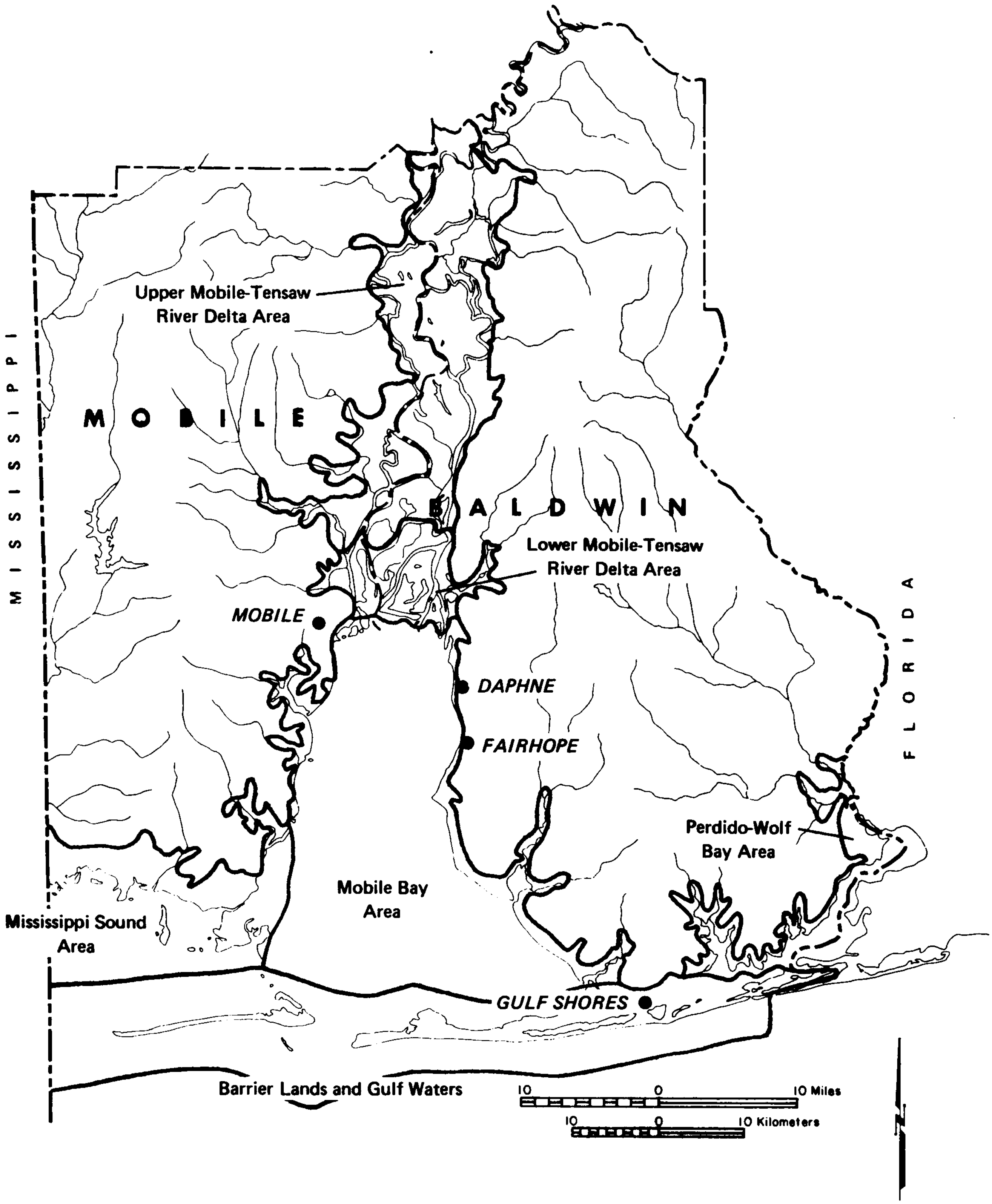


Figure 33. Major geographic areas of the Alabama Coastal Region, 1981 (South Alabama Regional Planning Commission 1981).

Table 140. Locations and number of acres of marsh destroyed by dredging and number of acres of marsh created by spoil deposition, Mobile Bay delta (modified from Stout 1979).

Location	Hectares	Acres
Loss to spoil disposal		
Bon Secour River	38	95
Blakeley Island	1,215	3,000
East Fowl River	70	172
Little Dauphin Island	4	10
Dog River	33	81
Interstate 10 highway	73	180
Interstate 10 tunnels	5	13
Alcoa-Blakeley Island	122	300
Scott Paper Company--		
Three Mile Creek	61	150
Private projects	405	1,000
Total	2,026	5,001
Loss to canal dredging		
Interstate 10	14	34
Interstate 65	3	8
Theodore Industrial Canal	20	50
Private projects	19	46
Total	56	138
Creation by spoil deposition		
Blakeley Island	365	900
Polecat Bay	365	900
Pinto Island	157	387
Theodore Spoil Island	3	7
Total	890	2,194
Net loss	1,192	2,945

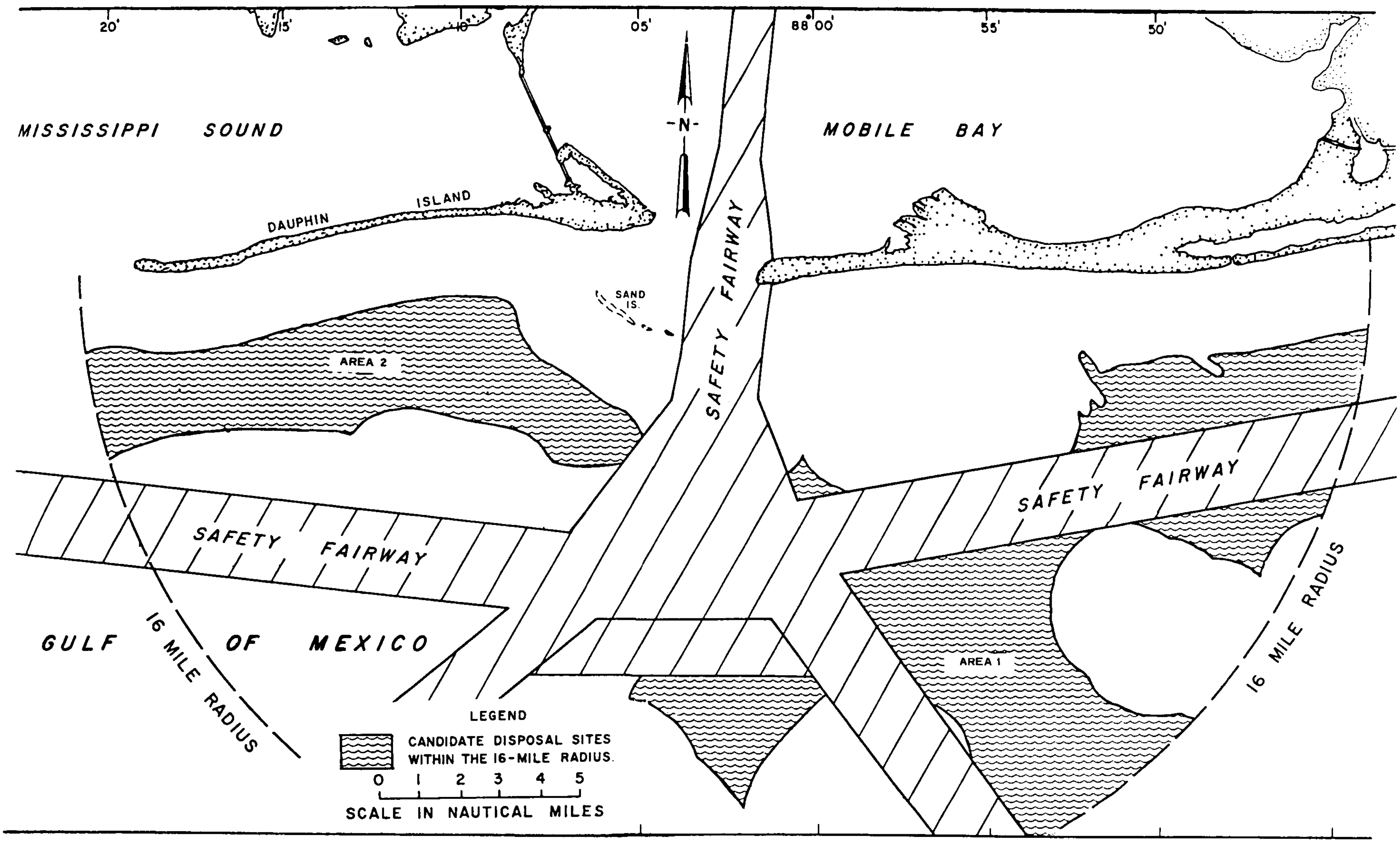


Figure 34. Proposed gulf disposal sites for dredged material from proposed Mobile ship channel and harbor improvements (U.S. Army Corps of Engineers 1979b).

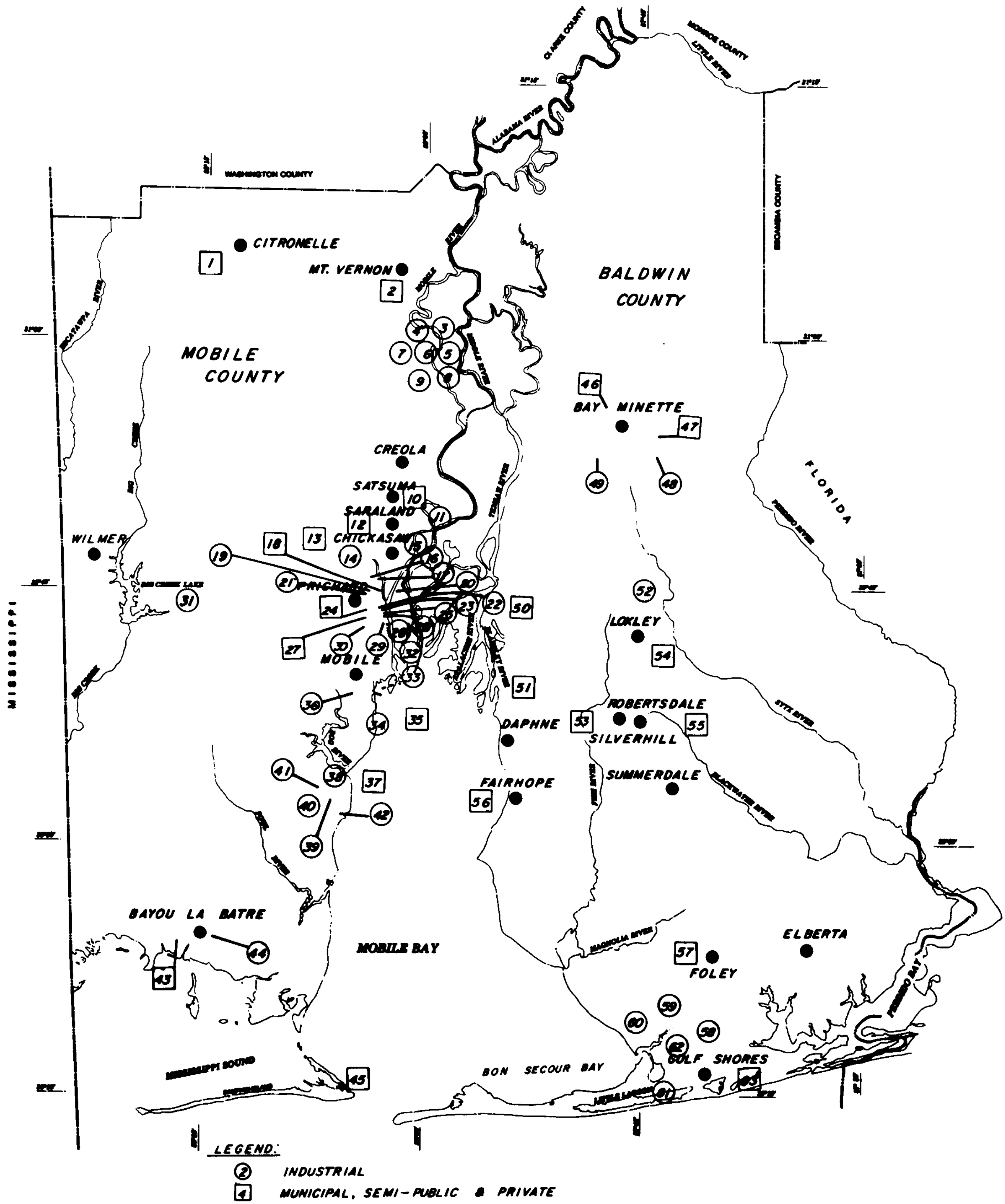


Figure 35. Industrial and municipal wastewater point sources in Mobile and Baldwin Counties, 1981; identification of sources given in Table 141 (Alabama Coastal Area Board and U.S. Department of Commerce 1979, South Alabama Regional Planning Commission 1979, Alabama Water Improvement Commission 1981).

Table 141. Identification of municipal, semi-public, private, and industrial point source discharges in Mobile and Baldwin Counties in 1981; locations shown in Figure 35 (Alabama Coastal Area Board and U.S. Department of Commerce 1979; South Alabama Regional Planning Commission 1979; Alabama Water Improvement Commission 1981).

MUNICIPAL, SEMI-PUBLIC, AND PRIVATE

Mobile County

1. Citronelle Lagoon
2. Searcy Hospital
10. Saraland Wastewater Treatment Plant
12. Chickasaw Lagoon (M)
13. Eight-Mile Wastewater Treatment Plant (M)
18. Hog Bayou Wastewater Treatment Plant
24. Grover Street Wastewater Treatment Plant (M)
27. Three Mile Creek Wastewater Treatment Plant (M)
35. McDuffie Island Wastewater Treatment Plant (M)
37. Bill Zieback Wastewater Treatment Plant (M)
43. Bayou La Batre Wastewater Treatment Plant (M)
45. Dauphin Island Wastewater Treatment Plant

Baldwin County

46. Westside Lagoon
47. Bay Minette Wastewater Treatment Plant (M)
50. Spanish Fort Estates Lagoon
51. Lake Forest Subdivision Wastewater Treatment Plant
53. Plantation Estates Wastewater Treatment Plant[b]
54. Loxley Wastewater Treatment Plant
55. Robertsdale Wastewater Treatment Plant
56. Fairhope Wastewater Treatment Plant (M)
57. Foley Wastewater Treatment Plant
63. Gulf Shores Lagoon

INDUSTRIAL

Mobile County

3. Barry Steam Plant, Alabama Power Co. (M)[a]
4. Virginia Chemicals, Inc. (M)
5. Stauffer Chemical Co., Lemoyne Plant (M)
6. Stauffer Chemical Co., Cold Creek Plant (M)
7. M & T Chemicals (M)[b]
8. Courtaulds North America (M)
9. Shell Chemical Co. (M)
11. Jacintoport Lagoon
14. Diamond Shamrock Corp. (M)
15. Chickasaw Steam Plant, Alabama Power Co. (M)
16. Eagle Chemical Co.
17. North Mobile Industrial Treatment Plant (M)
19. Union Carbide Corp., Linde Division (M)
20. Scott Paper Co. (M)
21. Thompson-Hayward Chemical Co.
22. Crown Zellerbach Corp. (M)
23. Alabama State Docks
25. Aluminum Company of America (M)
26. Star Fish and Oyster Co.
28. St. Louis-San Francisco Railroad Co.
29. Illinois Central-Gulf Railroad Co.
30. Gulf Lumber Co.
31. Stone Container Co. (M)
32. Chevron Asphalt Co.
33. Kaiser Aluminum and Chemical
34. Alabama Wood Treating Co.
36. Teledyne Continental Motors
38. Marion Corp. (M)
39. Kerr-McGee Chemical Corp. (M)
40. Autlan Manganese Corp. (M)
41. Ideal Basic Industries (M)[b]
42. Degussa Alabama, Inc. (M)
44. Blue Gulf Seafood, Inc.

Baldwin County

48. Reichhold Chemicals, Inc. (M)
49. Alpine Laboratories
52. SARS, Inc.
58. Bon Secour Fisheries
59. Wallace Seafood
60. Aquilla Seafood
61. Plash's Crabmeat
62. Gulf Coast White Knight Seafood

[a] (M) indicates major dischargers. Major municipal dischargers are those which have a design capacity equal to or greater than 3.8 million liters (1 million gal) per day. Major industrial dischargers are determined by EPA based on a matrix concept. Factors considered in rating a discharger are BOD, COD, TSS, and ammonia concentrations; expected toxicity of the industry class (SIC); discharge volume; distance upstream from a drinking water intake; temperature of discharge; and present water quality of the receiving stream.

[b] Plantation Estates Wastewater Treatment Plant, M & T Chemicals, and Ideal Basic Industries have received NPDES permits but are not yet operational.

Table 142. Total EPA estimated emissions (tons per year) of five major air pollutants in Mobile, Baldwin, and Escambia Counties, Alabama, 1976 (U.S. Army Corps of Engineers 1979a).

Source	Particulates	Sulfur oxides	Nitrogen oxides	Hydrocarbons	Carbon monoxide
Point source emissions	40,076	220,651	55,991	20,074	17,429
Non-point source emissions	8,403	3,707	22,161	36,029	179,140
Total	48,479	224,358	78,152	56,103	196,569

Table 143. Percent contribution of major pollutants from different sources in Mobile, Baldwin, and Escambia Counties, Alabama, 1976 compiled by EPA (U.S. Army Corps of Engineers 1979a).

Source	Particulates	Sulfur oxides	Nitrogen oxides	Hydrocarbons	Carbon monoxide
Electric power generation	47.0	73.0	62.0	1.0	2.0
Mineral production industries	24.0	11.5	6.5	--	--
Chemical manufacturing	< 0.1	8.0	< 0.1	2.0	< 0.1
Highway vehicle transportation	4.5	0.5	24.0	43.0	73.0
Waste disposal (open burning)	4.0	< 0.1	< 0.1	< 0.5	< 0.2
Evaporation from industrial processes	--	--	--	32.0	--
Others	20.5	7.0	7.5	22.0	25.0
Total	100.0	100.0	100.0	100.0	100.0

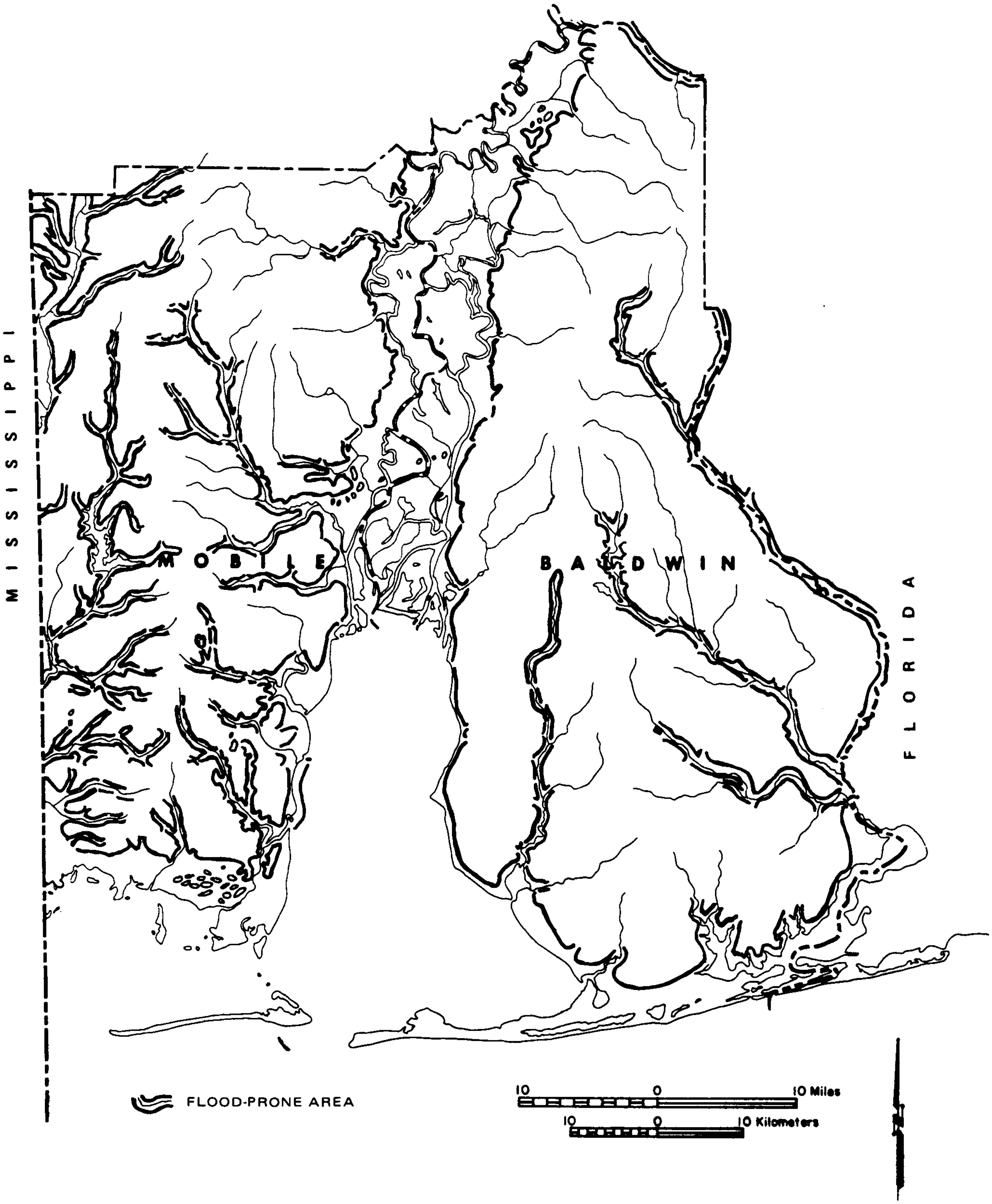


Figure 36. Flood-prone areas in Mobile and Baldwin Counties, 1979 (Alabama Coastal Area Board 1979).

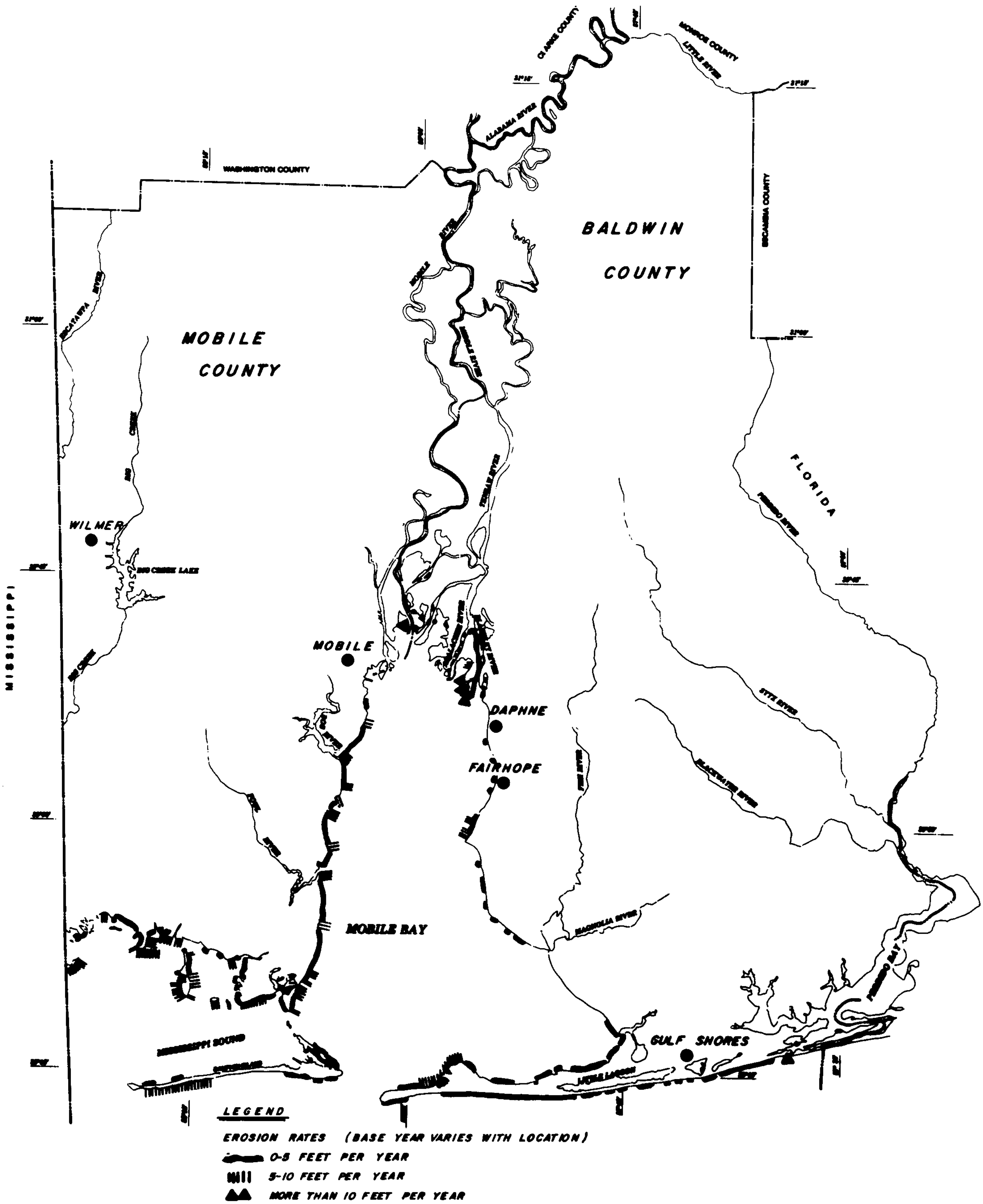


Figure 37. Shoreline erosion rates in coastal Alabama, 1917-74 (Hardin et al. 1976).

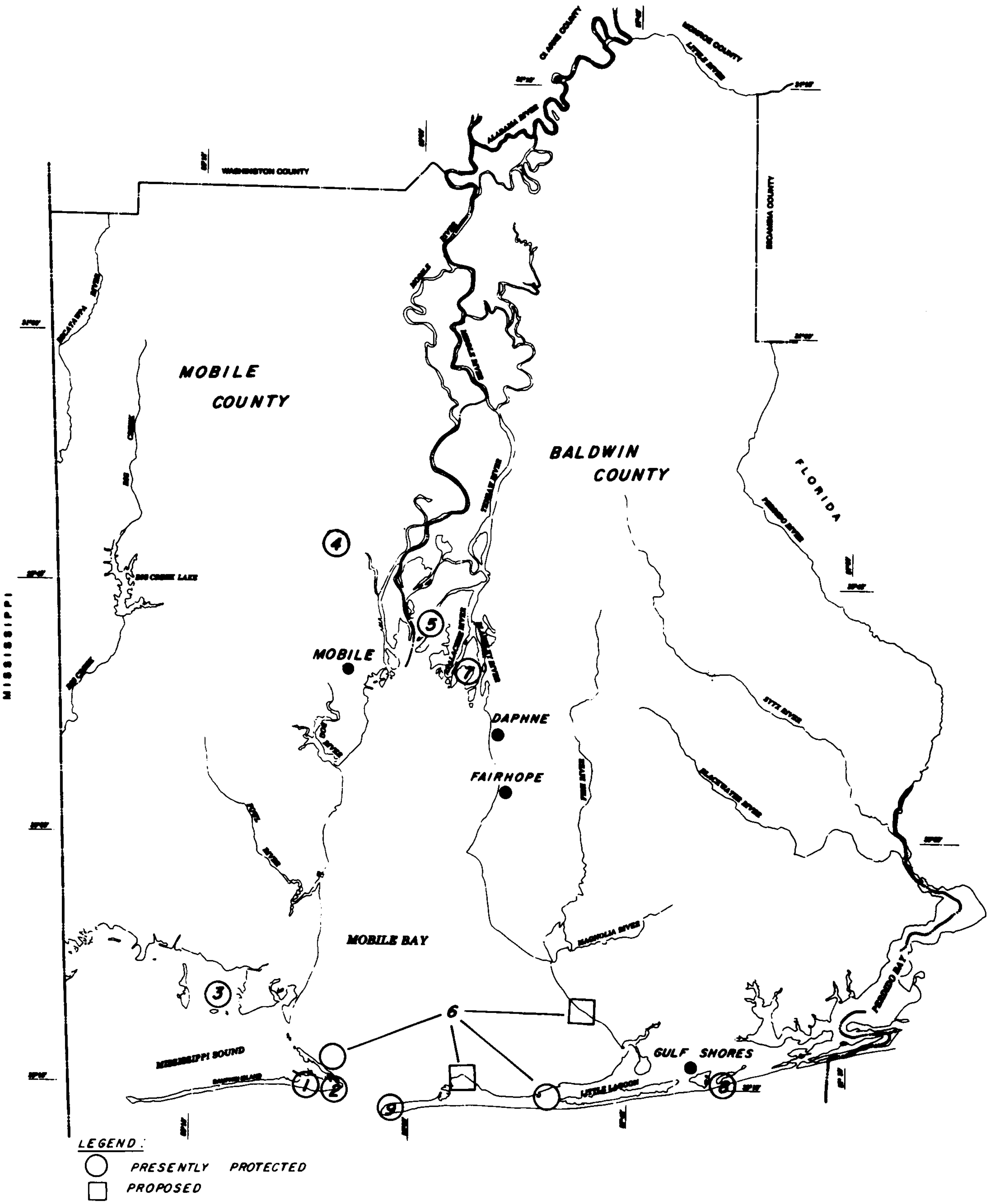


Figure 38. Areas with high natural values in Mobile and Baldwin Counties that are presently protected or proposed for protection; identification of areas given in Table 144 (Garrett 1981).

Table 144. Areas with significant natural values which are protected[a] or proposed for protection in Baldwin(B) and Mobile (M) Counties; locations of areas shown in Figure 38 (Garrett 1981).

No.	Site	Location	Size	Status and description	Natural values
1	Shell Mound Park	Dauphin Island (M)	3 acres (1.2 ha)	State park. Large oyster shell midden, bordered by live oaks. Many herbaceous plants.	Excellent feeding and resting location for many migratory song bird (passerine) species.
2	National Audubon Sanctuary	Dauphin Island (M)	159 acres (63.6 ha)	Owned by Mobile County, leased by National Audubon Sanctuary. Includes beach-dune complex with high dunes, gum swamp, a large freshwater lake and sandy pine woods.	Vital to large numbers of migratory song birds for feeding, resting and freshwater supply prior to and upon arrival from trans-Gulf flights. Habitat for amphibians, reptiles and small mammals which is being lost with island development. Only large area other than western end of island not slated for development.
3	Cat Island	North of Dauphin Island; 0.6 miles (11 km) south of mainland (M)	13 acres (5.2 ha)	Leased for lifetime by Dr. W. W. Gaillard from Henderson estate as sanctuary. Fifty percent is tidally inundated salt marsh; 20% dense stands of marsh elder and saltbush.	Shrubby portions support largest heron-egret colony in coastal Alabama. Salt marsh portions are ideal feeding habitat for wading birds. Nesting species are little blue, Louisiana and green herons, cattle and snowy egrets, glossy and white-faced ibis. Major active site for Louisiana heron in coastal Alabama. One of three sites in world where the two ibis nest together.
4	Chickasabogue Creek Park	Near town of Chickasaw (M)	1,050 acres (420 ha)	Mobile County park. Includes relatively pristine example of coastal, acidic stream with associated bay forest.	Creek banks support large stands of mountain laurel and Atlantic white cedar, a species of special concern on Alabama's list of special status[b] plants. Abundant wildlife, including alligator; bears have been sighted.
5	Mobile Delta (State acreage)	Mobile Delta (B, M)	3,000+ acres (1,200 ha)	State-owned. Habitats are fresh-mixed marsh, submerged grassbeds, and mixed bottom-land forest.	Wading bird, rail, waterfowl, small mammal and fishery species habitats. Supports endemic red-bellied turtle, alligator and swallow-tailed kite, species on the State list of special status[b] animals. Only large acreage in State ownership within the Mobile-Tensaw River Bottomlands Natural Landmark.

Table 144. Concluded.

No.	Site	Location	Size	Status and description	Natural values
6	Bon Secour National Wildlife Refuge	Little Dauphin Island (M); Perdue tract, Fort Morgan peninsula (B)	up to 10,000 acres (4,000 ha)	New refuge authorized by Congress, 1980, which will consist of lands totalling a maximum of 10,000 acres from four units. Little Dauphin Island and a major portion of the Perdue Unit have been acquired. Skunk Bayou unit is primarily a young cypress-gum swamp. Other units consist of beach-dune complex, interior lowlands and freshwater sloughs, sandy pine woods, oak hammocks, and bayside saltmarshes.	Includes best remaining examples of barrier island vegetation in coastal Alabama. Barrier island-peninsular areas are vital to large numbers of migratory birds. Little Point Clear is staging area for many hawk species in fall prior to their trans-Gulf flights, including peregrine falcons and merlins. Bobcat, fox, armadillo, raccoon, fox squirrel and alligator occur. Vital habitat for endemic Alabama Gulf beach mouse and marsh rabbit. Osprey, a State endangered species, nests on the Perdue tract.
7	Meaher State Park	Mobile Delta (B)	1,327 acres (530.8 ha)	State park. Lower Delta with portions south and north of Battleship Parkway. Principally fresh-mixed marsh. Significant submerged grassbeds.	Wading bird, rail, waterfowl, small mammal and fishery species habitats. Endemic red-bellied turtle and alligator occur.
8	Gulf State Park	Major park section east of Gulf Shores (B)	5,687 acres (2,274.8 ha) + two non-adjacent sections of 443 acres (177.2 ha)	State park. Undeveloped sections include representations of many coastal habitats, including freshwater marsh, beach-dune complex, swamp, bay forest and pine woods.	Excellent representations of coastal vegetation. Variety of habitats support wading birds, rails, shorebirds, and migratory song birds. The threatened marsh rabbit is common, and there is habitat for the endangered Alabama Gulf beach mouse. Such rare plants as wild canna occur.
9	Fort Morgan State Park	Eastern end, Fort Morgan peninsula	410 acres (164 ha)	State park. Extensively modified but with some sizeable areas of low dunes and Bay shoreline.	Departure point for numerous migratory hawks in fall for trans-Gulf flights. Used by migratory song and shorebirds. Dunes are habitat for beach mice, fox, and other species. One of two nesting sites in State for gray kingbirds.

[a] These are areas that by virtue of ownership are not available for private development. However, some of them, particularly in State parks, are subject to conversion to non-natural recreation usages. The Bon Secour National Wildlife Refuge is the only area listed which exists to protect natural values in perpetuity, and only one unit and a portion of a second have been purchased. Cat Island and the National Audubon Sanctuary on Dauphin Island are leased, and therefore their continued preservation is not assured. A 75-mile stretch of the Escatawpa River in Mobile and Washington Counties in Alabama and Jackson County in Mississippi and 12 miles of its tributary, Brushy Creek, were designated by Congress in 1978 for study to determine their suitability for inclusion in the National Wild and Scenic River system. The river corridor may eventually be protected if there is a favorable recommendation at the conclusion of the study.

[b] Special status species are those included in the Alabama list of endangered, threatened, and special concern species (Boschung 1976).

Table 145. Major habitat types of coastal Alabama, their degree of sensitivity to alteration, and activities that most threaten them (modified from Vittor and Stout 1975).

Habitat	Degree of sensitivity[a]	Adverse activities
Beach	A	Vegetation destruction for construction and vehicular traffic
Sand dune	A	Vegetation destruction for construction and vehicular traffic
Saltmarsh	A	Sedimentation; dredge-fill
Brackish-mixed marsh	A	Sedimentation; dredge-fill
Saltbush	B	Diking; dredge-fill
Saltflat	B	Ditching; pollution
Savannah	B	Ditching; diking
Fresh-mixed marsh	A	Diking; dredge-fill; pollution
Swamp	A	Ditching; dredge-fill
Mixed bottomland forest	B	Vegetation destruction by agriculture and forestry; filling
Mixed upland forest	B	Vegetation destruction for pine monoculture and agriculture
Pine	B	Clear-cutting; logging
Submerged grassbeds	A	Siltation; salinity changes
Black needlerush	A	Sedimentation; dredge-fill
Saltmeadow cordgrass	B	Diking; dredge-fill
Reeds	B	Vegetation destruction
Sawgrass	A	Diking; dredge-fill
Bog	A	Ditching; pollution

[a] Class A sensitivity reflects intolerance to alteration by man; class B sensitivity indicates some tolerance to alteration by man.

Table 146. Critical and ecologically valuable habitats[a] of coastal Alabama and their most valuable attributes (modified from Vittor and Stout 1975).

Type	Major attributes
Critical habitats	
Beach	Shore erosion control; storm protection
Sand dune	Shore erosion control; storm protection
Saltmarsh	High biological productivity; erosion and storm protection
Brackish-mixed marsh	High biological productivity; waste assimilation
Fresh-mixed marsh	High biological productivity; waste assimilation
Swamp	Water storage; endangered species habitat
Submerged grassbeds	High biological productivity; erosion protection
Black needlerush	High biological productivity; erosion protection
Saltmeadow cordgrass	High biological productivity
Sawgrass	High biological productivity; waste assimilation
Bog	Endangered species habitat
Ecologically valuable habitats	
Saltbush	Rookeries for several wading bird species[b]
Saltflat	High biological productivity
Savannah	High biological productivity; water storage
Mixed bottomland forest	High biological productivity; endangered species habitat
Mixed upland forest	Erosion protection
Pine	High biological productivity; erosion protection
Reeds	High biological productivity

[a] A critical habitat possesses one or more of the following: is highly productive and supportive of the energetics of other coastal habitats, including estuarine and near-shore environments; is particularly intolerant to alteration by man (see Table 145); and sustains rare and endangered species of plants and animals.

[b] Only some saltbush areas serve as rookeries.

Table 147. Endangered and threatened animals of Mobile and Baldwin Counties.

Scientific name	Common name	Boschung (1976)	U.S. Dept. of Interior (1980)
Crayfishes			
Cambarellus diminutus		SC[a]	
Cambarellus shufeldtii		SC	
Procambarus bivittatus		SC	
Procambarus evermanni		SC	
Procambarus lecontei		SC	
Fishes			
Acipenser oxyrhynchus	Atlantic sturgeon	T	
Ammocrypta asprella	Crystal darter	T	
Cycleptus elongatus	Blue sucker	T	
Leptolucania ommata	Pygmy killifish	SC	
Percina lenticula	Freckled darter	T	
Scaphirhynchus sp.	Alabama shovelnose sturgeon	E	
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	E	
Rana heckscheri	River frog	SC	
Rana areolata sevosa	Dusky gopher frog	T	
Siren lacertina	Greater siren	SC	
Reptiles			
Alligator mississippiensis	American alligator	T	E
Caretta caretta caretta	Atlantic loggerhead turtle	E	T
Chelonia mydas	Green sea turtle	E	T
Crotalus adamanteus	Eastern diamondback rattlesnake	SC	
Dermochelys coriacea	Leatherback sea turtle	T	E
Drymarchon corais couperi	Eastern indigo snake	E	T
Eretmochelys imbricata imbricata	Atlantic hawksbill turtle	E	E
Gopherus polyphemus	Gopher tortoise	T	
Lepidochelys kempi	Atlantic ridley turtle	E	E
Nerodia cyclopion floridana	Florida green water snake	SC	
Pitophis melanoleucas lodingi	Black pine snake	E	
Pseudemys alabamensis	Alabama red-bellied turtle	T	
Rhadinaea flavilata	Pine woods snake	SC	
Trionyx ferox	Florida softshell turtle	SC	

Table 147. Concluded.

Scientific name	Common name	Boschung (1976)	U.S. Dept. of Interior (1980)
Birds			
Accipiter cooperii	Cooper's hawk	SC	
Accipiter striatus	Sharp-shinned hawk	SC	
Aimophila aestivalis	Bachman's sparrow	SC	
Anas fulvigula	Mottled duck	T	
Buteo lineatus	Red-shouldered hawk	SC	
Charadrius alexandrinus	Snowy plover	E	
Dichromanassa rufescens	Reddish egret	T	
Elanoides forficatus	Swallow-tailed kite	SC	
Falco columbarius	Merlin	SC	
Falco peregrinus	Peregrine falcon	E	E
Florida caerulea	Little blue heron	SC	
Grus canadensis	Sandhill crane	SC	
Haematopus palliatus	American oyster-catcher	SC	
Haliaeetus leucocephalus	Bald eagle	E	E
Laterallus jamaicensis	Black rail	SC	
Limnothlypis swainsonii	Swainson's warbler	SC	
Mycteria americana	Wood stork	SC	
Nycticorax nycticorax	Black-crowned night heron	SC	
Pandion haliaetus	Osprey	E	
Pelecanus occidentalis	Brown pelican	E	E
Picoides borealis	Red-cockaded wood-pecker	E	E
Thryomanes bewickii	Bewick's wren	SC	
Mammals			
Balaenoptera physalus	Finback whale		E
Felis concolor coryi	Florida panther	E	E
Lasiurus floridanus	Florida yellow bat	SC	
Myotis austroriparius austroriparius	Southeastern myotis	SC	
Peromyscus polionotus ammomates	Alabama gulf beach mouse	E	
Peromyscus polionotus trissyllepsis	Perdido Bay beach mouse	E	
Sciurus carolinensis fuliginosus	Bayou gray squirrel	SC	
Ursus americanus floridanus	Florida black bear	E	

[a]E–Endangered, T–Threatened, SC–Special concern.

Table 148. Endangered and threatened plants of Mobile and Baldwin Counties.

Scientific name	Common name	Freeman et al. (1979)	U.S. Dept. of Interior (1975)
Aquifoliaceae			
Ilex amelanchier		E[a]	E
Araceae			
Acorus calamus	Sweet flag	T	
Peltandra sagittaefolia	Spoon flower	T	
Aspidiaceae			
Thelypteris dentata	Fern	SC	
Thelypteris ovata	Fern	SC	
Thelypteris quadrangularis	Fern	SC	
Asteraceae			
Liatris chapmanii	Blazing star	SC	
Cannaceae			
Canna flaccida	Golden canna	T	
Capparidaceae			
Cleome tenuifolia	Spider flower	SC	
Caryophyllaceae			
Pieris phillyreifolia		T	T
Clethraceae			
Clethra alnifolia	White alder	SC	
Cupressaceae			
Chamaecyparis thyoides	Juniper	SC	
Cyperaceae			
Rhynchospora crinipes	Horned rush	E	E
Ericaceae			
Kalmia hirsuta		SC	
Rhododendron austrinum		SC	T
Eriocaulaceae			
Eriocaulon lineare	Pipewort	SC	
Eriocaulon texenes	Pipewort	SC	
Fabaceae			
Psoralea simplex		E	
Fagaceae			
Quercus minima	Dwarf live oak	SC	
Quercus pumila	Running oak	SC	
Gentianaceae			
Eustoma exaltatum		SC	
Sabatia brevifolia		T	
Sabatia foliosa		SC	
Hamamelidaceae			
Fothergilla gardenii	Witch-alder	SC	
Hypericaceae			
Hypericum nitidum	St. Johns wort	T	
Hypericum reductum	St. Johns wort	SC	

Table 148. Continued.

Scientific name	Common name	Freeman et al. (1979)	U.S. Dept. of Interior (1975)
Lamiaceae			
Utricularia floridana	Bladderwort	T	
Utricularia inflata	Bladderwort	T	
Utricularia puppurea	Bladderwort	T	
Lentibulariaceae			
Pinguicula planifolia	Butterwort	SC	
Pinguicula primuliflora	Butterwort	SC	
Liliaceae			
Lilium iridollae	Lily	E	E
Pleea tenuifolia	Rush featherline	SC	
Lycopodiaceae			
Lycopodium cernuum	Clubmoss	SC	
Onagraceae			
Ludwigia arcuata		T	
Oneothera grandiflora	Evening primrose	E	
Ophioglossaceae			
Botrychium alabamense	Alabama grapefern	SC	
Botrychium lunarioides	Winter grapefern	SC	
Ophioglossum crotalophoroides	Bulbous adder's-tongue	SC	
Ophioglossum nudicaule	Least adder's-tongue	SC	
Orchidaceae			
Cleistes divaricata	Spreading pogonia	T	
Epidendrum conopseum	Green-fly orchid	E	
Platanthera integra	Yellow fringeless orchid	SC	
Poaceae			
Manisuris tuberculosa	Jointgrass	SC	T
Panicum nudicaule		T	T
Potamogetonaceae			
Potomogeton robbinsii	Pondweed	E	
Rhamnaceae			
Segeretia minutiflora		T	
Sarraceniaceae			
Sarracenia psittacina	Pitcher-plant	T	T
Sarracenia rupra	Sweet pitcher-plant	T	T
Scrophulariaceae			
Agalinis pseudophylla		SC	
Penstemon multiflorus		SC	
Selaginellaceae			
Selaginella ludoviciana	Spikemoss	SC	

ERRATA

p. 361 - delete *Rhododendron austrinum* from Federal list

p. 362 - delete *Sarracenia psittacina* from Federal list

NOTE: All plant species listed in table 148 under Federal list are only candidate species and are not on the official Federal list of endangered and threatened species.

Table 148. Concluded.

Scientific name	Common name	Freeman et al. (1979)	U.S. Dept. of Interior (1975)
Theaceae			
Gordonia lasianthus	Loblolly bay	T	
Stewartia malacodendron	Silky camellia	SC	
Ulmaceae			
Mornisia iguanea		T	
Vitaceae			
Vitis munsoniana	Grape	SC	
Xridaceae			
Xyris drummondii	Yellow-eyed grass	T	T
Xyris scabrifolia	Yellow-eyed grass	T	T

[a] E--Endangered, T--Threatened, SC--Special concern.

Table 149. Highly valued or unique habitats in Baldwin (B) and Mobile (M) Counties (Vittor and Stout 1975).

Area	Habitat	Value
Point aux Pins (M)	Brackish-mixed marsh	Most pristine remaining marsh-estuary in coastal Alabama.
Isle aux Herbes (M)	Saltmarsh	Accounts for over 30% of saltmarsh in coastal Alabama; protects grassbeds, particularly on island's western shore.
Cat Island (M)	Saltbush, saltmarsh	Major rookery for several species of wading birds.
Dauphin Island Airport marsh (M)	Saltmarsh	Highly productive area for shellfish and fish.
Dauphin Island sand dunes (M)	Sand dune	Provides protection from severe storms for forested eastern section of island.
Alabama Port bogs (M)	Bog	Extensive savannahs support unique assemblage of bog-dwelling plants.
Mobile Delta (M, B)	Fresh-mixed marsh Submerged grassbeds Mixed bottomland forest	Encompasses 44% of total emergent palustrine plant acreage in coastal Alabama. Functions include flood water storage, habitat for wintering waterfowl and many fishery species.
Oyster Bay (B)	Saltmarsh	Contains major stand of smooth cordgrass; nearly 40% of this habitat in coastal Alabama is at this site.
Baldwin County sand dunes (B)	Sand dune	Essential protection from storms.

Table 150. Major federal environmental acts and executive orders affecting environmental decisions in coastal Alabama (Bureau of National Affairs 1980).

Acts and orders	Purpose, provisions
National Environmental Policy Act of 1969, as amended	Required statements of environmental impacts of major activities which would have significant adverse results if permitted. Establishes Council on Environmental Quality. EPA carries out provisions of air and water quality laws.
Clean Water Act of 1977	Sets national water quality goals of wherever possible to achieve fishable and swimmable waters by 1983, eliminate discharge of pollutants into navigable waters by 1985. Establishes NPDES and provides for water quality management (Sections 201, 208, and 303e) and construction grants for publicly owned waste treatment plants (Sections 201, 202, and 204). Required any non-federal applicant for a federal license or permit for an activity which may discharge a pollutant into waters to obtain State certification that such discharge will comply with the acceptable effluent limitations and water quality standards (Section 404). Requires EPA to focus control efforts away from conventional to toxic pollutants and develop effluent limits based on best available technology for control of 65 classes of toxic priority pollutants.
Clean Air Act, as amended	Requires National Ambient Air Quality Standards. 1977 amendments mandate control of hazardous air pollutants (Section 112).
Rivers and Harbors Act of 1899	Prohibits unauthorized obstruction or alteration of any navigable water (Section 10). Construction of any structure over or under water, excavation or deposition of any material, or modification of stream course requires approval from the U.S. Army Corps of Engineers.
Coastal Zone Management Act, as amended	Provides financial assistance to coastal states for development of management plans for their coastal zones. Requires that federal activities requiring federal permits must be determined to be consistent with state CZM plans.
Marine Protection, Research and Sanctuaries Act of 1972	Prevents or strictly limits ocean dumping of any material which would adversely affect human health, welfare, or amenities, the marine environment, or economic potential. Disposal of dredged material in marine waters requires permits from the U.S. Army Corps of Engineers.
Toxic Substances Control Act	Gives EPA responsibility for regulating the manufacture, use, and disposal of toxic substances.
Marine Mammal Protection Act	Regulates the taking and transporting of marine mammals and marine mammal products.
Endangered Species Act of 1973, as amended	Requires Secretary of Commerce to be responsibile for recovery of some marine mammals and the Secretary of the Interior to identify endangered and threatened species, designate critical habitats, and conduct recovery programs.

Table 150. Concluded.

Acts and orders	Purpose, provisions
Oil, Hazardous Substances and Hazardous Waste Response, Liability and Compensation Act	Establishes a $1.6 billion fund for cleanup of oil spills of hazardous substances and for cleanup of inactive hazardous waste disposal sites.
Resource Conservation and Recovery Act of 1978	Replaces Solid Waste Disposal Act. Provides technical and financial assistance for development and management plans for recovery of energy and other resources from discarded materials and to regulate management of hazardous wastes.
Fish and Wildlife Coordination Act of 1958, as amended	Requires consultation by any federal agency and public and private under federal license with U.S. Fish and Wildlife Service concerning any activity which may impact wildlife. Requires equal consideration of effects on wildlife with other aspects of project.
Wild and Scenic Rivers Act, as amended	Establishes a national system of wild and scenic rivers.
Watershed Protection and Flood Prevention Act	Provides for surveys and investigation of river basins and establishment of local agencies for watershed development planning.
Executive Order 11990	Federal agencies will take actions to minimize destruction or degradation of the nation's wetlands.
Executive Order 11988	Federal agencies will consider alternatives to major federal actions in floodplains and avoid adverse effects and incompatible development in these areas.

Table 151. Environmental acts of Alabama (Alabama Coastal Area Board and U.S. Department of Commerce 1979).

Alabama Coastal Area Act of 1976 (Act 534)
Alabama Air Pollution Control Act of 1971 (Act 769)
Alabama Water Pollution Control Act of 1971 (Act 1260)
Wild Sea Oats Act of 1973 (Act 971)
Sand Dune Protection Act of 1973 (Act 775)
Island Beaches & Dune Preservation Act of 1973 (Act 1096)
Land Management & Use Program in Floodprone Areas of Alabama Act of 1971 (Act 119)

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.