CHAPTER 6

CONSEQUENCES OF LANDSCAPE DETERIORATION

Economic Setting

The economic well-being of Louisiana's coastal communities and the competitiveness of the coastal industries are important not only to the State but also to national growth and prosperity. To be competitive in the 21st century, the United States will continue to depend on Louisiana's rich coastal resources, and the nation will be called on to make substantial investments to insure that these resources are protected and remain productive over the long term.

Overview

Offshore oil and natural gas production, along with all its related service industries, continues to command the State's coastal economy. The fisheries industry, particularly shrimp, oysters, and menhaden, remains very important. Petrochemical processing and manufacturing, which dominate the industrial corridors on either side of the Mississippi River from below New Orleans to Baton Rouge, and the Calcasieu River in the vicinity of Lake Charles, are also of great importance. Industries related to navigation, such as ship- and boat-building and repair, are major activities along the principal navigable waterways, and millions of tons of cargo are shipped annually to and from foreign or inland U.S. locations. Rice, sugar cane, soybeans, and cattle are the most important agricultural commodities produced in the region. In fact, until the oil boom changed the region and State's economy, this area was largely an agrarian society where residents farmed, fished, and trapped extensively. Aquaculture, especially the pond aquaculture of crawfish, has become a significant regional economic activity since the 1970's. Extensive tourism and recreational activities revolve around the area's wildlife, fisheries, and wetland-based culture.

Most recently, the region's economy has rebounded from a 1980's downturn in the oil and gas industry that had resulted in a reduced population, as thousands of people migrated elsewhere to seek work. The main impetus for this recent resurgence has been the discovery of oil and gas in the deepwater fields of the central Gulf of Mexico. This discovery, along with deepwater royalty tax relief and new and improved technology, has brought about an increase in offshore and shore-based activities. The sheer volume of activity that has taken place in the last three or four years—and the forecast is for this situation to continue—has raised serious concerns about the coastal infrastructure's ability to handle current and additional growth.

The infrastructure needs, along with fisheries issues and coastal restoration, are the topics of greatest concern to coastal leaders, according to a 1998 study by the Economic Development Administration. These leaders have pointed out that recent economic growth has added pressure to a deteriorating infrastructure network. Coastal parishes and cities are having to rapidly respond to many deferred maintenance problems, while at the same time having to find the means for undertaking the additional public works projects urgently needed to cope with new developments.

Coastal leaders also contend that due to the many challenges facing commercial fisheries and the associated seafood production sector, there is a need to insure the industry's sustainability. Traditionally, thousands of Louisianians have depended on shrimp, menhaden, oysters, crabs, and commercial finfish harvesting and processing. But many challenges confront this industry and all the interests involved from Federal and State governments to harvesters, wholesalers, and even consumers will have to become proactive to insure the sector's continued importance in the coastal economy.

Coastal leaders have expressed great concern about the continued deterioration of coastal wetlands. Their consensus is that the problem has not only significant ecological implications, but also major economic ones. Many coastal communities and economic sectors are at risk, and undue delays in responding to the problem could result in grave economic and social consequences. For example, habitat loss and major changes in the balance of freshwater and saltwater in these ecosystems can lead to the loss of fisheries sensitive to this balance, significantly disrupting Louisiana's vitally important seafood production sector. Another example is agriculture. Citrus growers in Plaquemines Parish are experiencing crop losses caused by saltwater intrusion, and rice growers in central Acadiana are concerned about the continued supply of fresh water for their crops.

Coastal Communities and Demographics

Coastal Louisiana's residents represent a diversity of nationalities and cultures, including French, Spanish, Portuguese, German, Italian, English, Caribbean, Croatian, African, and American Indian. The largest and oldest immigrant group to colonize the wetlands is of French descent. New Orleans was founded by Bienville in 1718. Exiled Acadians from what is now Nova Scotia, Canada, began moving into the region beginning in the 1750's. According to Donald W. Davis (1994), all immigrants to Louisiana's wetland landscapes developed cultural practices tied to the annual-use cycle that is still linked to the region's natural resource base. Traditionally, thousands of coastal residents have been engaged in farming, hunting, trapping, shrimping, crabbing, oystering, and fishing.

Louisiana's coast is a flat coastal lowland characterized mainly by marshes, swamps, lakes, levees, cheniers, bays and bayous. The area also includes several metropolitan and mid-sized communities that serve as population, trade, and service centers. The 1997 population in the 20 coastal parishes was approximately 2 million residents, according to U.S. Census estimates, an increase of 84,000 persons since 1990. Louisiana had over 4.2 million residents in 1990 and gained about 131,600 persons between those same years. In other words, 64% of the State's population gain during the 7-year period took place within these parishes. In 1997, about 60% of this population resided in the four most populated parishes: Orleans, Jefferson, and St. Tammany in the eastern most part of the study area, and Calcasieu in the far western portion.

Physical Infrastructure

Description of Infrastructure

Physical infrastructure refers to capital facilities and land assets—private, State, Federal, parish or municipal—that are necessary to (1) support development and (2) protect public health, safety, and well-being. It includes, but is not limited to, water supply and wastewater disposal, transportation (ports, roads, bridges, airports, rail, navigation, highways), solid waste disposal, drainage, flood protection, industrial parks, electricity, oil and gas structures, and educational facilities and parks.

Louisiana ranks first in the nation in total shipping tonnage, handling over 450 million tons of cargo each year through the public and private installations located within the State's jurisdiction of six deep-draft ports: New Orleans, Greater Baton Rouge, Lake Charles, South Louisiana, Plaquemines Parish, and St. Bernard. These ports are the mainstays of Louisiana's maritime shipping industry, and have given the region both national and international prominence. In addition, the privately-owned Louisiana Offshore Oil Port offloads approximately 10-13% of the country's imported crude petroleum that eventually is moved via pipelines to refineries and consumers throughout the nation. Significant contributions to the State's economy are also made by the fifteen smaller ports that are situated within the coastal zone, primarily serving the oil and gas and fishing industries. The Gulf Intracoastal Waterway is a critical shallow-draft transportation link that carries an annual average of 70 million tons of freight (primarily liquid bulk items such as petroleum and petroleum products) between the Mississippi and Texas state lines. An alternate Gulf Intracoastal Waterway route, linking Morgan City and Port Allen, averages 25 million tons of cargo shipped per year.

In addition to the 3,000 miles of commercially navigable waterways, coastal Louisiana has railroad transportation, Interstate, U.S. and state highways, commercial and general aviation airports, and an extensive network of oil and gas pipelines. Southern Pacific, Kansas City Southern, Amtrak, Illinois Central, and Union Pacific are the main railroads serving the area, although several other smaller railway companies have emerged in recent years and serve some of the more remote parts of the region. Interstate

Highways 10 and 12, U.S. Highways 90 and 190, and La. Highway 82 are the main east-west routes. North-south service consists of Interstates 49, 55, and 59 along with U.S. Highways 51, 61, and 165, and La. Highway 1. Several state highways such as Highways 1, 23, 27, 39, and 82 serve as evacuation routes from the coastal zone. Some 14,000 miles of onshore and 2,000 miles of offshore pipelines are located in the region.

Concerns About Infrastructure

The most frequently identified public infrastructure concerns of coastal Louisiana involve roadways, navigation and ports, sanitation and water supplies, drainage and flood control, and coastal erosion prevention structures.

Roads, highways, and bridges, many of which are vital evacuation routes, are deteriorating and becoming more congested. Many coastal highways and roads are in poor or mediocre condition. Highway 82, for example, in Cameron Parish is being eroded by gulf waves. Between $20 million and $80 million are needed to prevent its structural failure in the next 5 years. Many bridges, particularly those referred to as off-system, are structurally deficient or functionally obsolete. In addition, state-run ferries that have served many communities in lieu of bridges are being turned over to local governments, who lack the resources to properly operate and maintain the systems.

Navigation and port interests are concerned about the continued development of port facilities and the replacement of several strategic navigation structures which have become obsolete. The navigation locks in the Gulf Intracoastal Waterway system, including the Inner Harbor Navigation Canal in the New Orleans area, are outdated and need to be replaced. Ports face severe access problems on both the water and land sides, and facilities are inadequate to meet the growing demands of international commerce and offshore services. Additional coastal deterioration will only exacerbate the problem.

The environmental infrastructure is also facing severe deterioration because of substantial under-funding, particularly for solid waste management, water supplies, and wastewater systems. Not only is compliance with State and Federal mandates a concern, but if water quality is not maintained, and in some localized instances restored, this situation will result in negative effects on certain sectors of the economy. Oyster production and harvesting, tourism, and outdoor recreation are only a few of the sectors that rely on the availability of clean, safe water supplies.

Local drainage and flood control infrastructure are a growing concern for local and parish governments. As protective marshes continue to disappear, long term maintenance costs will be prohibitive.

In an earlier study for La. Department of Natural Resources' Coastal Restoration Division, the Louisiana Sea Grant College Program at Louisiana State

University inventoried the major components of the State’s coastal infrastructure and estimated its value to exceed $48 billion (Louisiana Sea Grant College Program 1998). This figure is considered conservative because (1) all public infrastructure components were not included in the inventory—for example, levees, public utilities, etc. were excluded, and (2) the per unit cost estimates that were used to arrive at the total amount were primarily “rules-of thumb” figures obtained from experts in the field, and extrapolated to apply throughout the Coast 2050 study region.

Storm Surge Protection

When a hurricane makes landfall in Louisiana, a large percentage of the infrastructure damage is caused by flooding associated with the storm surge and heavy rains. Wind related damage is also significant, and depending on the strength of the storm and the location of landfall, wind damage costs may be greater than the cost of flood damage. Hurricane damages to coastal communities can result in increased costs of living and doing business in flood prone areas with a concomitant regional economic decline. Historically, this has been followed by gradual emigration from coastal communities (Smith et al. 1998).

It is commonly acknowledged that barrier islands and coastal wetlands reduce the magnitude of hurricane storm surges and related flooding; however, there are scant data as to the degree of reduction. The best data available relating to this issue come from continuous water level recorders that were in place prior to Hurricane Andrew making landfall in St. Mary Parish at Point Chevreuil on August 26, 1992. Hurricane Andrew was a Category 3 storm on the Saffir-Simpson scale. Andrew’s winds produced a positive storm tide in areas east of landfall and a negative storm tide west of landfall. The highest recorded water elevation during Andrew was 9.3 ft at Cocodrie (Lovelace 1994).

Hurricane Andrew gave direct evidence that the physiography of marshes where a storm makes landfall affects the degree to which the storm surge is dampened. The surge amplitude in the Terrebonne marsh system decreased from 9.3 ft above sea level in Cocodrie to 3.3 ft (Swenson 1994) in the Houma Navigation Canal approximately 23 miles due north. This equates to a reduction in surge amplitude of approximately 3.1 inches per linear mile of marsh and open water between Houma and Cocodrie. Similarly, the magnitude of the storm’s surge was reduced from 4.9 ft at Oyster Bayou to 0.5 ft at Kent Bayou located 19 miles due north. This equates to a reduction in surge amplitude of approximately 2.8 inches per linear mile of fairly solid marsh between these sites.

It is important to bear in mind that these are data points from only one storm. The role of coastal marshes in ameliorating hurricane storm surges depends on a variety of factors including the physical characteristics of the storm, coastal geomorphic setting and the track of a storm when it makes landfall.

Quantitative computer simulation modeling of the effect of various barrier island configurations on hurricane storm surges (Suhayda 1997) has shown that changing coastal inlet geometry at the barrier shoreline can reduce storm surges in inland locations such as Cocodrie by over 3 ft. Clearly, the effect of storms on the human population and infrastructure in the coastal zone can be ameliorated by the maintenance of extensive coastal marshes and barrier islands.

Consumptive Uses of Wetlands

Louisiana's coastal wetlands are essential for numerous species of fish and wildlife, food production, habitat for fish and wildlife reproduction and nursery activities, and overall support of the food chain. National Marine Fisheries Service statistics for the last 20 years indicate that coastal Louisiana contributes about 20% of the nation's total commercial fisheries harvest. According to the Louisiana Cooperative Extension Service, in 1995 alone the gross commercial value of coastal fisheries and wildlife production exceeded $300 million. Value-added activities meant another $900 million to the State's economy. In 1996, the total economic effect of marine commercial fisheries was $2.2 billion, and $944 million for marine recreational fisheries (Southwick Associates 1997). Commercial fisheries resources also support a wide range of related seafood processors and similar operations, and help maintain between 50,000 and 70,000 jobs statewide in the processing, wholesaling, transporting, retailing, and services sectors.

Wild fur pelts continue to be harvested, and trappers annually receive approximately $1.3 million for the product, according to a report to the Fur and Alligator Advisory Council (Louisiana Department of Wildlife and Fisheries 1997). The same source reports that annually the harvest of wild alligators results in skins and meat worth over $9.3 million, and alligator farming yields approximately $11.5 million per year.

Coastal Louisiana also provides an excellent setting for outdoor activity. Use of outdoor recreation resources has grown considerably in recent years, and there are several major initiatives to attract more visitors to the region. The preliminary "1996 National Survey of Fishing, Hunting and Wildlife Associated Recreation" (U.S. Department of the Interior, Fish and Wildlife Service 1997) estimated that 1.2 million Louisianians enjoy the outdoors, and that between 1989 and 1995, the annualized growth rate in saltwater recreational fishing licenses was 6% (Louisiana Department of Wildlife and Fisheries 1996). Combination freshwater and saltwater recreational fishing licenses for residents and nonresidents for fiscal year 1997 totaled about 540,000. Charter fishing trips have also been increasing and the latest figures indicate that approximately 60,000 nearshore and inland saltwater charter fishing trips were taken in 1995.

The latest available figures from the Louisiana Department of Wildlife and Fisheries indicate that Louisiana had 275,000 registered boats in 1994. Over

49,000 (18%) were registered in the six Coast 2050 parishes that are contiguous to Lake Pontchartrain: Orleans, Jefferson, St. Tammany, St. John the Baptist, St. Charles, and Tangipahoa.

Louisiana's coast is at the end of the Mississippi and Central flyways, and nearly 70% of the waterfowl migrating along these routes overwinter at sites in coastal Louisiana. If extensive healthy marsh habitats are not available, waterfowl would return to their nesting areas in a weakened condition, resulting in lower nesting success and decreased fall flights. Over 90,000 Louisiana residents and 14,000 non-residents purchased migratory bird hunting licenses in 1996. The U.S. Fish and Wildlife Service estimates over 860,000 migratory bird hunting days for 1996.

Nonconsumptive Uses of Wetlands

The coastal parishes, more than ever before, are deriving greater economic benefits from tourism development. Attractions, employment and income attributed to this sector have grown, tax revenues have increased, and virtually every coastal parish is fully organized for and has embarked on this type of development. Increased tourism is apparent from the U.S. Travel Data Center statistics that are compiled annually, by parish, for travel and tourism-related employment, expenditures, and payroll. Between 1990 and 1995, the number of persons employed by this industry grew by over 8%; expenditures, when adjusted for inflation, climbed by over 21%; and the adjusted payroll figures increased by 26%. This included over 800,000 visitors that engaged in "wildlife watching" or other nonconsumptive uses such as observing, photographing, and visiting public parks and other natural areas.

According to the 1993-98 Statewide Comprehensive Outdoor Recreation Plan (Louisiana Department of Culture, Recreation and Tourism 1993), 7 of the State's 28 state parks and 2 of 12 commemorative areas are located in the region. Some 800,000 visitors made use of these facilities in 1994. Also, the Department of Wildlife and Fisheries and the U.S. Fish and Wildlife Service provide for recreational uses at wildlife management areas and refuges.

Major Case Studies and Smaller Vignettes

Louisiana contains numerous coastal communities at the end of natural levee ridges which are surrounded by marshes and estuaries. Examples include: Yscloskey, Venice, Port Fourchon, Isle de St. John Charles, Cocodrie, Theriot, and Intracoastal City. People have lived in these small communities for a number of generations and have traditionally relied on the region's plentiful natural resource base. Five communities (Fig. 6-1) were chosen to illustrate how future marsh loss is expected to affect some of the communities, particularly the public infrastructure. The discussion of the South Lafourche Corridor is detailed because Port Fourchon is Louisiana's

Figure 6-1. Communities discussed in case studies and vignettes (Larger stars indicate communities highlighted in case studies and vignettes, smaller stars are other communities mentioned).

primary port directly located on the Gulf of Mexico. New Orleans is discussed because it represents an area with high population levels. Three other communities (Yscloskey, Cocodrie, and Holly Beach/Constance Beach) are discussed as smaller case studies or vignettes. They were chosen because they typify the problems facing many of Louisiana's smaller coastal communities. More details on the public infrastructure values for each of these communities can be found in Appendices C-F. Coastal Louisiana communities share a basic connection to their surrounding environments—their cultures and economies are part land based and part water based, and most have become similarly threatened by the conversion of land to water. The human settlement of the region is a history of opportunities and constraints. It is very likely that the future loss of marsh will tip the balance toward the constraints in all of these communities.

Community at risk: South Lafourche Corridor

The South Lafourche development corridor is located in the central Louisiana coast region, in Lafourche and Jefferson Parishes (Fig. 6-1). It provides access through the coastal lowlands to the productive estuarine zones and the Gulf of Mexico. The corridor is in a strategic position, running along the Bayou Lafourche natural levee ridge through the Barataria and Terrebonne estuaries. Over the years, it has been one of the country's most productive oil and gas regions. The corridor's strategic position is enhanced by its role as a staging area for offshore services, waterborne commerce activities, and as a center for sport and commercial fishing.

Population

The population of Lafourche Parish, as estimated in 1995, was 87,625 persons. This translates to a parish-wide population density of approximately 81 persons per square mile. There are higher population concentrations in the Lafourche corridor, where there are approximately 364 residents per square mile (U.S. Census 1990, 1998). In effect, 85% of the parish's population lives on 18% of the land, an indication of the clustered linear settlement pattern of natural levee ridges.

Economy

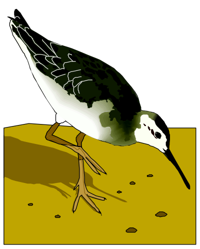
Renewable and nonrenewable resource extraction and use characterize the regional economy. The renewable resources are largely the products of the surrounding estuaries and wetlands: commercial fishing, hunting and trapping. Most nonrenewable extraction (oil and gas) takes place offshore and in the estuaries and is highly dependent on the area's infrastructure.

The total value of the Lafourche estuarine dependent industries in 1994 was almost half a billion dollars. The 1994 value of the renewable resources produced in Lafourche Parish was $70 million. Oil and gas extraction had a value of $388 million. This represents 81% of the parish's resource use economy (McKenzie et al. 1995; Industrial Economics 1996).

Population Settlement Balance

The opportunity/constraint balance in South Lafourche has fluctuated throughout its settlement history. In the 19th century, the opportunities were primarily fishing and agriculture. The main constraint was the proximity to the dangerous forces of the gulf. In the late 1800's, a significant south Lafourche fishing community called Caminadaville existed near the gulf on Cheniere Caminada, west of Grand Isle. The chenier had 1,470 inhabitants in 1893 when a hurricane destroyed the community. The settlement was abandoned and most of the surviving inhabitants moved farther inland to the area that would eventually become the towns of Leeville and Missville (Rogers 1985; McKenzie et al. 1995).

Facing another hurricane in 1909, Leeville and Missville residents took to their oyster luggers and sought more protected land. Though the towns were destroyed, the majority of residents rebuilt. Unfortunately, a stronger storm hit the region in 1915, inundating Leeville and Missville with 20 feet of water. Faced again with the destruction of the communities and substantial loss of life, the communities were abandoned and many of the survivors relocated still farther north along the bayou to the relative protection of Golden Meadow. The Golden Meadow ridge was the final stop on their retreat from the gulf (Rogers 1985).



New Opportunities

In the 1930's, oil was discovered along the Lafourche corridor. The once-abandoned Leeville community was resettled in 1931 and had 98 producing wells by 1937 (Woolfolk 1980). The economic opportunities of oil drew people back down the corridor to the places from where fisherfolk had only recently retreated. The tremendous economic opportunity of oil extraction made addressing the environmental constraints of the South Lafourche corridor feasible.

Changing Opportunities

Oil and gas activity within the corridor, the surrounding estuaries, and the State's offshore waters has been in a period of substantial decline. Meanwhile, the Federal offshore industry is presently projecting a 40-year production cycle, with 50% to 100% growth by the year 2000 (Cranswick and Regg 1997; Guo et al. 1998). With the industry moving offshore, the locations of service and support industries in Louisiana are becoming increasingly important. The land and the gulf are linked by two important complexes in the corridor—Port Fourchon and the Louisiana Offshore Oil Port.

Port Fourchon is one of Louisiana's port complexes closest to the Gulf of Mexico. Over $750 million of public and private investments have been made in this complex that primarily supports offshore oil and gas activities in the Gulf of Mexico. Over 100 businesses provide support for such services. Port development has barely kept up with the demand for waterfront property. There is a waiting list of tenants, and the third and final phase of the "E-slip" development that has served as the centerpiece for the port's growth is being fast-tracked and is scheduled to be completed in the next couple of years.

Louisiana Highway 1 is Port Fourchon's only land-based access. It is estimated that on a monthly basis, 30,000 trucks and over 200,000 passenger vehicles travel on this highway below Galliano. Traffic flow figures are predicted to continue to increase at a rate of somewhere between 3% and 6% annually in the next decade with the expansion of deepwater oil and gas activities. A major impediment, however, is the Leeville Bridge, which already is in a deteriorated condition. In fact, a recent report concludes that 21% of Highway 1 is in poor condition, and 98% is in need of some kind of improvement (Guo et al. 1998).

Located 21 miles south of Port Fourchon, the Louisiana Offshore Oil Port is the nation's only deepwater port, handling between 10% and 13% of the nation's imported oil supply. The offshore facility is connected by a 42-inch pipeline to the Clovelly Dome Storage Terminal, an underground salt cavern in the south Lafourche corridor. The storage terminal is connected by five pipelines to 30% of the national refining capacity. Recently connected to the Shell MARS production platform, the Louisiana Offshore Oil Port will handle domestic production as well as foreign imports.

According to preliminary findings of an Outer Continental Shelf (OCS) impacts study (Hughes 1998), OCS development may cause substantial growth in the south Lafourche corridor. Nearly 60% of the gulf's future offshore drilling in the next 30 years can be served from Port Fourchon. An 8-year conservative growth projection of almost 5,000 new jobs, with over $500 million in wages, is expected as a result of OCS expansion. While the recent growth of the industry has absorbed the existing regional labor pool, future growth may be hampered because the presently taxed infrastructure may limit growth (Hughes 1998). OCS operations use Port Fourchon mainly because it is the closest port to their activities (Falgout 1998). As OCS extraction pushes farther into the gulf, even Louisiana's central location becomes less strategic.

If the South Lafourche corridor continues to deteriorate, business investments will also deteriorate (White 1998). It has been estimated that if the deepwater oil support industry is not fully established at Port Fourchon by 2000, then oil companies will expand elsewhere, (Galveston or Mobile) and by 2004 will steadily pull out of the port altogether (White 1998). The economic losses to the region would be high, potentially worse than the oil downturn of the 1980's. Louisiana's network of 3,819 vendors that receive

$2.4 billion worth of annual business could lose their link to OCS activities with an accompanying devastating effect on their businesses. Undoubtably, some portion of the $3 billion annual revenue that Gulf of Mexico offshore oil and gas operations generate in Louisiana (Applied Technology Research Corp. 1998) would be lost.

Land Loss—The New Constraint

The threat of coastal land loss may impede the continued growth and/or sustainability of the south Lafourche corridor. The social and economic threats to the Lafourche corridor by 2050 from unabated land loss can be evaluated from two distinct perspectives.

1. Theoretical Approach—Impact of Land Loss on Infrastructure. Without positive human intervention, land loss caused by erosion, subsidence, and other factors will continue for the next 50 years, much as it has for the last century. It is projected that by 2050, more than 49 square miles of marsh will be lost just to the east of the corridor; over 50% of the adjacent marsh will be open water. Another 33 square miles of marsh just to the west will disappear, and nearly 70% of these existing marshes will be gone. Highway 1 will be breached in numerous places, rendering it impassable. The theoretical replacement cost, if the same type of road could be laid in the same place, would be approximately $20 million. Approximately 8.5 miles of secondary roads would be impacted as well, at a loss of over $24 million. The 119 currently active oil and gas wells, now surrounded by land, could find themselves in the water, a possible loss of $12.3 million of infrastructure. Approximately 8.3 miles of the ring levee in the vicinity of Golden Meadow would be sporadically exposed to open water and possibly breached, at a replacement cost of $4.2 million. The value of the lost wetlands, based on an estimated use value of $5,000 per acre (Industrial Economics 1996), would amount to $260 million in losses to recreation and ecosystem services to the region.

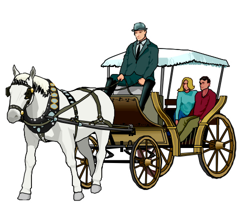
*2. Catastrophic Event Approach—Impact of Storms on People and Infrastructure***.** It is highly likely that a storm will strike the region and cause extensive damage to the weakened system. This could happen in the very near term, though each year that land loss continues unabated and infrastructure remains unprotected, the potential for storm damage increases. The Louisiana Department of Public Safety Services (1985) identified 12 comprehensive storm scenarios and mapped 62 distinct storm surge patterns. The region is exceptionally vulnerable to storm surge impacts. In the event of a category 3, 4, or 5 storm, approximately 35,000 people will need to evacuate from the area south of the Leeville bridge on the only evacuation route, Louisiana Highway 1 (Curole 1998). In addition to the possible loss of life and property, accelerated erosion, and cleanup costs typical of hurricane force storms, a breach in the highway or damage to the Leeville bridge would paralyze the largest portion of the corridor's economy until repairs could be made.

South Lafourche Corridor Conclusion

Human settlement has been drawn to the South Lafourche corridor for the past 1,000 to 2,000 years because of the estuary, the marshes, the Gulf of Mexico and the natural levee ridges. Land loss is not just a constraint to realizing the region's resource opportunities; it threatens the very existence of the opportunities. The marshes and transportation access to the gulf are threatened, and the dangers of the gulf have only become more dangerous to the corridor. The potential impact of land loss in the corridor is the eventual abandonment of the corridor as a viable community. Like Caminadaville in 1893, Leeville (and Missville) in 1909 and 1915, and other similar settlements along the gulf that have faced overbearing constraints, the choice is either to abandon the corridor or recognize the dangers and defend against them. Reversing the land loss is the first step in that defense.

Community at risk: New Orleans

All communities in Louisiana south of I-10 are threatened by coastal erosion, but New Orleans' potential losses are especially high. New Orleans lies at the center of a nearly 2,600 square mile metropolitan area containing 1.2 million people and five parishes (Fig. 6-1). Taxable real estate and property in the region are assessed at more than $5 billion, and fair market value of these assets exceeds $40 billion.



The Threat

The Mississippi River flows through the center of the metropolitan area. The northern boundary is Lake Pontchartrain and coastal wetlands surround the other margins. No other major city in the country is surrounded by so many flood-prone habitats. New Orleans is virtually an island already; as wetland loss continues, the amount of water around the city will increase. In addition, at least 45% of the metropolitan core is at or below sea level. In New Orleans, elevations vary from 10 feet below sea level in developed areas to 15 feet above sea level along the natural ridges of the Mississippi.

Today, New Orleans is protected from flooding rainwater, river water and seawater by 520 miles of levees and floodwalls, 270 floodgates, and 92 pumping stations connecting thousands of miles of drainage canals and pipes. The wetland buffer that now partially protects New Orleans from storm surges is disappearing. By 2050, the city will be closer to and more exposed to the Gulf of Mexico.

Hurricanes pose the worst threats.

- In 1965 the eye of Hurricane Betsy (a Category 3 storm) passed about 50 miles west of New Orleans and the tidal surge into St. Bernard and Orleans Parishes caused $2 billion in damages and 81 deaths.

- In 1985 Hurricane Juan (a Category 1 storm) caused higher tides than Betsy in some areas because of its slow movement. The West Bank of Jefferson Parish sustained $52 million in damage.

The current hurricane protection system, to be completed in 2002, protects the city from a storm surge associated with a fast moving Category 3 hurricane. But what if the storm is more intense (Hurricane Camille in 1969 was a Category 5) or the storm moves slowly, allowing more time for the storm surge to build? Storm surge models show that a hurricane could produce an 18-foot storm surge in Lake Pontchartrain, which could be topped with 10 foot waves. None of the current or planned protection measures would be effective under those circumstances.

The Possible Consequences

Unfortunately, storm surge heights will only increase as subsidence and sea-level rise continue and more wetlands are lost. A portion of the West Bank of Orleans and Jefferson Parishes, bounded by the Mississippi River and Harvey Canal, is a 22,500 acre urban area with substandard hurricane protection and 34,362 structures valued at more than $3 billion. The projected future for this area combines the effect of a 100-year return period hurricane on a landscape experiencing continued wetland loss. Some structures in this area, which in 1991 would flood with a 100-year event, by 2050 would flood with only a 50-year event. The cost of a 100-year hurricane for these structures, their contents, and vehicles in the area could increase by 280% in this area of the West Bank by 2050. The cost of flood damage from such a storm in 1991 would theoretically have been $629 million, by 2050 this could increase to $1.8 billion.

Community at risk: Yscloskey (St. Bernard Parish)

The small fishing village of Yscloskey lies in St. Bernard Parish about 25 miles east of New Orleans (Fig. 6-1). The village is at the intersection of Bayous La Loutre and Yscloskey and is entirely surrounded by marshes and estuaries. The area analyzed for this vignette includes all structures along Louisiana Highway 46 from its junction with Louisiana Highway 300 to the end of Highway 46 at the Mississippi River Gulf Outlet. These highways link the fishing communities of St. Bernard Parish with the New Orleans Metropolitan Area.

Approximately 325 permanent residents live in Yscloskey (Metrovision 1998). In addition, there are approximately 50 commercial establishments in the general vicinity. Fishing is the most important aspect of the local economy. A trip to the area reveals oyster luggers offloading sacks of oysters at the wholesale houses, and shrimp boats docked beneath moss covered oaks along the scenic bayous. Recreational fishing is also important, and several marinas cater to anglers. When the Mississippi River Gulf Outlet was built, the residents of Old Shell Beach had to be relocated and many moved west to Yscloskey.

The entire length of Highway 46 from Verret east lies outside the hurricane protection levees. Hurricane Betsy heavily damaged the corridor in 1965, and in 1969 Hurricane Camille destroyed many homes and boats.

The community's public infrastructure includes a fire station and a community hall. The transportation infrastructure includes 1.75 miles of paved road on Highways 46 and 624, one mile of asphalt road, and a lift bridge across Bayou La Loutre, built in 1957. A power substation, transmission lines, distribution lines, and transformers supply electricity. The water supply system consists of a water tower with corresponding supply lines.

Land loss in the vicinity of Yscloskey is moderate. The marshes to the south are benefitting from the Caernarvon Freshwater Diversion Project, but will still lose nearly 10 square miles by 2050. Thirteen percent of the existing marshes will be open water. To the east and north more than 34 square miles of marsh will be lost by 2050, causing nearly 16% of today's marshes to be converted to open water. This loss of land will mean that the infrastructure at Yscloskey is at even greater risk from storms and high waters.

The replacement cost of the bridge over Bayou La Loutre is estimated at between $4 million and $5 million, the paved highway at $5.25 million, and the asphalt road at $1 million. The total replacement cost of roads, highways, and bridges in the Yscloskey area is $10.75 million. Electric lines and transformers would cost approximately $98,000 to replace. The power substation has a replacement cost of $1.3 million. The replacement of natural gas lines in Yscloskey would cost between $116,000 and $174,000. The water tower is valued at $261,000, and its supply lines have a replacement cost of $80,000. If the entire community infrastructure had to be replaced because of a combination of marsh loss and storm damage, it could cost as much as $13 million. Marsh loss will also affect people's livelihoods. As significant areas of marsh are lost, there will be fewer oysters, shrimp, spotted seatrout, and red drum.

Community at risk: Cocodrie (Terrebonne Parish)

Cocodrie is a village located in the southern marshes of Terrebonne Parish between the Houma Navigation Canal and Bayou Petit Caillou (Fig. 6-1). The study area includes the lower 8.7 miles of Highway 56 ending at Point Cocodrie. Approximately 600 people live in the area (Metrovision 1998). There are 200 residential structures and approximately 20 commercial buildings located in the area. Cocodrie is entirely surrounded by marsh, and there is no hurricane protection for the area.

Cocodrie is an ideal location for recreational fishing. Recreational anglers, along with commercial fishing guides, operate out of local marinas. Several commercial fishing operations are also present. Cocodrie is the home of Louisiana Universities Marine Consortium (LUMCON), home of the W.J. DeFelice Marine Center. The marine center is a 75,000 square foot complex of research, instructional, housing and support facilities. It includes 26,000 square feet of laboratory, classroom, office, and library space. Dormitory rooms and apartments provide housing for up to 80 people. The only other public building in Cocodrie is a fire station at the northern extreme of the study area. There are 8.7 miles of pavement on Highway 56, five miles of gravel road, and a bridge just south of the fire station. The water supply system includes a water tower, a metering station, and supply lines. There are also natural gas lines serving the area. Cocodrie's public infrastructure is estimated to be worth over $53 million.

Land loss in the vicinity of Cocodrie is projected to be very severe. By 2050 over 55% of the marsh north of Cocodrie will be gone. Even more seriously, over 65% of the marsh to the east and 35% of the marsh to the west and south will have turned to open water. The barrier islands to the south will be tiny remnants of what they are today. Even if Cocodrie were to still exist by 2050, it would be an island community surrounded by water. The sport and commercial fisheries will be seriously reduced.

Loss of marsh will significantly impact the public infrastructure. Roads, highways, and bridges will have to be replaced and raised at an approximate cost of $27 million. The public utilities will be at much greater risk than they are today from hurricanes or even winter storms. The replacement cost of electrical utility infrastructure is estimated at almost $800,000. The cost estimate for replacing the water supply system is approximately $1 million. Natural gas lines would have to be replaced at a cost of nearly $580,000.

The replacement cost of LUMCON would be approximately $24 million. The fire station is valued at $150,000. If the entire infrastructure had to be replaced due to a combination of marsh loss and storm damage, it could cost up to $53 million.

Community at risk: Holly Beach/Constance Beach (Cameron Parish)

The Holly Beach/Constance Beach corridor is located in Cameron Parish (Fig. 6-1). It includes the area from the intersection of Louisiana Highways 27 and 82 westward for 10 miles along Highway 82 toward the town of Johnson's Bayou. The area contains some of the few sand beaches along Louisiana's Gulf of Mexico Coast. The small communities of Holly Beach, Constance Beach, Martin Beach, Peveto Beach, and Little Florida are clustered along the highway. Approximately 800 permanent residents live in the area. Proximity to Lake Charles and other communities in southwest Louisiana make this an ideal spot for a weekend vacation. There are approximately 400 residential structures in the area and nearly 100 commercial establishments. Many of the structures are small camps and motels that serve the area's recreational and tourism interests. Hunting, fishing, birding, and beach recreational activities are the major tourist attractions.

The community infrastructure includes a fire station and an ambulance building on Highway 27. There are approximately 10 miles of highway and seven miles of bituminous road in the area. Highway 82 is part of the Creole Nature Trail. Another highway of importance to the beaches lies outside the study area. Louisiana Highway 27 runs north from the gulf through the Sabine National Wildlife Refuge to high ground near Lake Charles. Highways 27 and 82 are the only hurricane evacuation routes from the beaches and the communities along the coast. There are no hurricane protection levees in the area. There is a power substation on Highway 82 and a transmission line runs the length of the highway. A water tower and 17 miles of supply lines bring water to the area.

In this area, coastal erosion has led to shoreline retreat such that La. Highway 82 is now at the Gulf of Mexico shoreline. The highway has been severely damaged during several winter and tropical storms and has been moved landward several times. It is now built on the last natural ridge, or chenier, before the marsh. Between 1991 and 1994 the Louisiana Department of Natural Resources constructed a series of 85 breakwaters along 8 miles of the coastline. The combined cost of these breakwaters and other road-protection measures has been over $12 million in the last 10 years. The breakwaters provide some protection to the highway, but more work is needed to prevent loss of the highway. It cannot be relocated farther inland because of the lack of suitable substrate in the marsh plain. If the highway can no longer be maintained and the chenier is breached, there will be interior marsh loss.

La. Highway 82 is one of the two roads out of this area. By 2050, approximately 20% of the marshes north of this highway will become open water. If these marshes are not protected, the evacuation route will be more at risk. Shoreline erosion on the gulf side is already a problem, but as the interior marshes are lost, the ridge on which the road is built may be exposed to attack from the northern side as well (albeit of a lesser magnitude). If measures are not taken to protect the shoreline and to maintain the interior marshes, community infrastructure worth $300,000 will be at risk. More importantly, communities will need to relocate because their hurricane evacuation route, as well as their means of conducting everyday business, will be lost. The replacement cost of the roads would be $37 million. The utility infrastructure replacement cost would be $2.1 million.

Summary of Coastal Communities at Risk

The Fourchon corridor and the three isolated communities discussed in the vignettes all share a reliance on the wetlands surrounding them. They depend heavily on the fish and wildlife that, in turn, are dependent on the vanishing marshes. They rely on ecotourism that is based on the natural resources of the coast. Their livelihood depends on the oil and gas resources in the wetlands or offshore. People live in these communities to be near the bountiful resources of the coast. New Orleans sits astride the Mississippi River, surrounded by lakes and wetlands, and depends on shipping, tourism, and manufacturing. Its inhabitants recreate in the wetlands. The severe loss of the wetlands that is projected to occur in the future puts all these communities at risk.

In the past, people made decisions that are destroying the coastal resources: the wetlands, the fisheries and the wildlife. The opportunity now exists to slow the loss of wetlands, which will preserve the natural system while at the same time help these communities to continue to exist. It is a wiser decision to save the wetlands than to move communities or replace the infrastructure. By preserving the wetlands, we would help preserve a way of life and retain the economic viability of these coastal communities.

Fisheries

Loss of coastal wetlands in Louisiana has severe implications for the long-term sustainability of fisheries resources. The remarkable level of productivity of the State's marine systems is tied to both the quantity and quality of estuarine fisheries habitat. Recent high production has been linked to the amount of land-water interface, which is highest in marshes undergoing the early stages of subsidence and disintegration. A drastic downturn in the harvest of the majority of the most valued species of fish and shellfish is expected as open water replaces marsh in most areas. Coastal fisheries resource managers are looking toward coastal restoration for protection of existing wetlands and the creation of new marshes to replace some portion of those which have been lost.

Historic Trends in Fisheries Production

Methodology

To assess the recent trends and future projections of fishery populations within the Coast 2050 study area, four broad species assemblages were established based on salinity preferences. These assemblages were marine, estuarine dependent, estuarine resident, and freshwater. Within each of the four assemblages, "guilds" of fishery organisms were established. As used in this document, "guilds" are groupings of ecologically similar species identified by a single, representative species and, hereafter, the terms "guild" and "species" are used interchangeably. Fishery guilds common to coastal Louisiana, within each salinity-preference assemblage are:

- Spanish mackerel guild—marine,
- Red drum, black drum, spotted seatrout, gulf menhaden, southern flounder, white shrimp, brown shrimp, and blue crab guilds—estuarine dependent,
- American oyster guild—estuarine resident, and
- Largemouth bass and channel catfish guilds—freshwater.

In a broad sense, each of the 12 guilds is uniquely identified by the combination of the representative species' habitat preference, salinity preference, primary habitat function, seasonal occurrence in the estuary, and spawning or migratory seasons (Table 6-1). Habitat and life history information is based on available scientific literature specific to the northwestern Gulf of Mexico, but it is somewhat generalized to accommodate the establishment of guilds.

Once the species representing each fishery guild was identified, population changes of each species were assessed and displayed by using a matrix for each of the four coastal regions (*see* Appendix B for methodology, Appendices C-F for Regions 1-4, respectively). The matrices display mapping units and guilds and, within the mapping units, provide information on the population stability (recent change trends) and population projections for each species group. The discussion of fishery population projections follows this section. Most of the recent trend information was provided by biologists of the Louisiana Department of Wildlife and Fisheries (LDWF). The assessments were based on LDWF fishery-independent sampling data and personal observation of area fishery biologists, and generally span a period of 10 to 20 years. Staff members of LDWF believe that, because of selectivity of sample gear, the trend information is most reflective of recent changes in the subadult portion of each guild. Historic trend information represented in each coastal region matrix is summarized below.

Region 1 Trends

Within Region 1 (Appendix C), the freshwater assemblage, represented by largemouth bass and channel catfish guilds, occurs in the low salinity (generally less than 2 parts per thousand) to freshwater areas of the basin. In general, freshwater fishery populations have been steady over the past 10-20 years. Similarly, the Spanish mackerel guild, representing the marine fishery assemblage and found only in higher salinity waters on the perimeter of the basin, has exhibited stable population numbers.

The estuarine dependent species assemblage is found throughout Lake Pontchartrain and in the brackish to saline zones of the Lake Borgne and Chandeleur Sound areas. With the exception of the red drum guild, whose populations have increased in the eastern units of the region, recent population levels have been relatively steady for all guilds throughout the units in which they occur. The resident species assemblage, represented by the American oyster, has exhibited steady to declining populations.

Not included within the matrix is the gulf sturgeon, which is federally listed as a threatened or endangered species. Population levels in coastal Louisiana are unknown; however, recent records indicate that this anadromous species occurs in this region.

Region 2 Trends

Region 2 (Appendix D) exhibits mixed population trends among mapping units and species guilds. The freshwater assemblage occurs in the upper and mid-basin zones, the Mississippi River delta and in the vicinity of freshwater diversions. Largemouth bass exhibited generally steady population levels, as did channel catfish, except in several of the mid-basin mapping units where populations increased in response to freshwater input.

The marine assemblage guild (Spanish mackerel) showed steady population trends in the Mississippi River delta units. Within the lower estuary and barrier island units, populations showed patterns of increase.

Estuarine resident and dependent species do not occur in the uppermost units of Region 2. No guild showed a consistent pattern throughout all mapping units. In general, species within these guilds have shown decreasing numbers in units nearest the Gulf of Mexico, increasing levels in the vicinity of freshwater diversions, and steady populations in other mid-basin and Mississippi River delta mapping units.

Region 3 Trends

Region 3 (Appendix E) includes multiple estuarine basins, extending from the Terrebonne/Timbalier Bay complex to the Vermilion Bay estuary. Similar to Region 2, fish and shellfish within these basins exhibit mixed historic trends among mapping units and species guilds. The two guilds within the freshwater assemblage show stable population trends, except in the central basin area where populations have generally decreased.

Where the marine guild representative occurs, in the gulf fringe of the basin, populations have tended to increase in Region 3.

The estuarine resident, American oyster, shows both increasing and decreasing trends except in the western units where populations are reported to be stable. Upward and downward trends of the oyster appear to be related to recent habitat and salinity shifts, occurring between the barrier islands and the intermediate/brackish marsh zones of the Terrebonne estuary.

Estuarine dependent species also have an erratic pattern of change from steady population levels. An overall pattern of population decreases is noted for the barrier islands, Marsh Island, and the Terrebonne, Penchant, and Pelto marshes, while generalized increases are reported in the area of the Houma Navigation Channel and for the guild represented by red and black drum and blue crab. From the Atchafalaya subdelta west, generally steady population trends were noted.

Region 4 Trends

Region 4 (Appendix F) contains two estuarine basins: Mermentau and Calcasieu-Sabine. The two guilds representing the freshwater assemblage exhibit steady population levels in nearly all units providing suitable fresh to low salinity habitat in the basins. Exceptions occur in several units in the vicinity of

Black Lake and Sabine Pool, where population increases have occurred.

Spanish mackerel from the marine assemblage had limited occurrence within these basins. Present in the lower portions of Calcasieu Lake and near the gulf shoreline of the Rockefeller Refuge area, populations have been steady. Among the species representing the estuarine dependent assemblage, blue crab populations have been steady. White and brown shrimp have shown steady to declining patterns, with a greater number of units showing declines, especially in the Calcasieu-Sabine basin. Geographically, estuarine dependent species have tended to decline in the Grand Lake, Mud Lake, Southeast Sabine, Brown's Lake, West Black Lake, and Cameron-Creole mapping units, which are areas influenced by weirs and other types of water control structures. Other units, some of which are also subject to water level control, often reflected steady to increasing population patterns.

Projected Trends in Fisheries Production

The projection of possible future changes in fishery production for coastal Louisiana is based solely on landscape change model predictions previously discussed in Chapter 5. The key parameters in making those projections were percent and pattern of wetland loss in each mapping unit. It should be recognized that numerous other factors which could not be forecast, such as changes in water quality, fishery harvest levels, wetland development activities (e.g., dredging and filling), and blockages of migratory pathways also could negatively impact fishery production. Because of the potential for great inaccuracy in predicting land loss and fishery population changes 50 years into the future, especially when considered at a mapping unit scale, discussion of future changes is presented as a coastwide assessment with reference to specific units to exemplify those changes. Projected trends in production are presented for each guild and for each mapping unit in the Appendices C-F.

Marine Assemblage

Within the marine assemblage and dependent on individual species habitat requirements, habitats utilized by species of this assemblage are expected to expand as barrier islands submerge, land and land platforms subside, saline marsh deteriorates and retreats, tidal prisms increase, and higher salinity waters intrude farther inland. This habitat shift would increase the area of near shore habitat available for the marine assemblage. Accordingly, the future projections do not reflect adverse production impacts typically associated with land loss, and in a number of cases increases are forecast. As shallow marine habitat expands, however, it is likely that the forage base, composed partly of estuarine-dependent species, would diminish. It is possible that, even though habitat conditions would remain suitable, a reduction in populations of estuarine-dependent forage species would cause decreased production of the marine assemblage.

Estuarine Resident Assemblage

As barrier islands erode and wetland erosion and submergence continue over the next 50 years, it is likely that higher salinity levels will occur at more inland locations. To remain in preferred salinity zones, the estuarine resident assemblage will continue to be displaced northward as salinity shifts occur. The magnitude of population relocations will be related to the salinity tolerance and habitat preferences of individual species within the assemblage. The American oyster is especially sensitive to salinity changes because of its susceptibility to attack by predators and parasites as average salinities increase above 15 parts per thousand. Overall, as preferred wetland habitats deteriorate, detrital based food sources diminish, and zones of optimal salinity are reduced or shift to areas having otherwise unsuitable habitats, populations of species within the American oyster guild will decline.

Estuarine Dependent Assemblage

Guilds within the estuarine-dependent assemblage can tolerate a variety of salinity conditions, so salinity change alone should not significantly affect populations. Production of many of the guilds, however, is closely associated with the areal extent and interspersion of vegetated, intertidal wetlands. In areas such as the Terrebonne Wetlands mapping unit of Region 3, estuarine wetlands are already highly fragmented (high water-marsh interspersion). The predicted continued marsh loss within such mapping units would result in reduced wetland habitat availability and a decline in production. In areas where extensive marshes exist, the pattern of future marsh loss would influence how that loss impacts productivity. A gradual loss of marsh edge (enlargement of water bodies) should not have a major short-term effect.

Where land loss occurs in the form of internal marsh break-up (formation of numerous small water bodies in an otherwise continuous marsh), production could be enhanced by increased habitat accessibility and the export of nutrients and plant detritus. The Johnson’s Bayou mapping units in Region 4 provide an example of such a loss pattern and associated fishery production increases. Even in these areas, however, as deterioration continues beyond the year 2050, production would decline. Overall, the matrices (Appendices C-F) indicate that wetland erosion and fragmentation will cause a reduction in the productivity of guilds within the estuarine-dependent assemblage.

Freshwater Assemblage

Freshwater assemblages have a low tolerance for salinity. They generally are found in coastal areas having salinities of 2 parts per thousand or less. As higher salinity water encroaches into previously fresh wetlands, species within the freshwater guilds would be displaced. The ability of these guilds to relocate to suitable habitat is restricted by land elevation. That is, at some point the freshwater aquatic habitats of the coastal area grade into nonaquatic habitat. Populations within the largemouth bass and channel catfish guilds may not be greatly affected in areas having a relatively low predicted rate of wetland loss. The total area of suitable, freshwater habitat, however, will diminish as marsh and barrier island buffers between the Gulf of Mexico and fresh to low salinity zones deteriorate. Reduction of the area available for use by the freshwater assemblage guilds would result in an overall reduction of those populations. Only in the area of Atchafalaya and East Cote Blanche Bays and in the vicinity of river diversion outfall sites is there an expected expansion of freshwater fishery habitat by 2050.

Summary

In general, populations within the marine assemblage should remain relatively steady unless there is a decline in food availability related to the loss of wetland habitat. Species within the estuarine resident and estuarine dependent assemblages will decline based on habitat loss predictions for the year 2050. The two guilds representing the freshwater assemblage are predicted to have steady to decreasing population levels except in those mapping units with significant freshwater inflows.

Wildlife

Louisiana's coastal wetlands, extending from the forested wetlands at the upper end to the barrier shorelines bordering the gulf, provide a diverse array of habitats for numerous wildlife communities. In addition to fulfilling all life cycle needs for many resident species, coastal wetlands provide wintering or stopover habitat for migratory waterfowl and many other birds. The bald eagle and brown pelican, protected by the Endangered Species Act, are recovering from very low populations experienced over the last three decades. Increasing populations for those two species are projected to continue in the future, independent of near-term wetland changes. The fate of other species groups in coastal Louisiana will be influenced by habitat conditions there. These groups include migratory birds, such as wintering waterfowl, which rely on the abundant food supply in coastal wetlands to store sufficient energy reserves for migration and nesting. The prediction of extensive land loss and habitat change by the year 2050 prompted an examination of the effect of such losses and changes in the abundance of wildlife.

Methodology

To assess the recent trends and future projections of wildlife abundance within the Coast 2050 study area (Appendices B-F), 21 prominent wildlife species and/or species groups were identified:
(1) brown pelican, (2) bald eagle,
(3) seabirds, (4) wading birds,
(5) shorebirds, (6) dabbling ducks,
(7) diving ducks, (8) geese, (9) raptors,
(10) rails, gallinules, and coots,
(11) other marsh and open water residents, (12) other woodland residents,
(13) other marsh and open water migrants, (14) other woodland migrants,
(15) nutria, (16) muskrat, (17) mink, otter, and raccoon, (18) rabbit,
(19) squirrel, (20) white-tailed deer, and
(21) American alligator. A matrix was developed for each region to present the function, status, trend (over last 10 to 20 years), and projection (through the year 2050) for the above listed species and/or species groups for each habitat type

within each mapping unit. Habitat types which occupied less than 5% of a given mapping unit were excluded unless that habitat type was viewed to be unique or unless it performed a critical function.

Information displayed in the matrices (*see* Appendices C-F for Regions 1-4, respectively) represents common understandings of the selected species and/or species groups, field observations, some data, and recent and projected habitat changes, all synthesized by wildlife biologists from the Louisiana Department of Wildlife and Fisheries, U.S. Fish and Wildlife Service, and the Natural Resources Conservation Service.

Because the amount of information contained in the matrices is quite extensive (21 species or species groups, 140 mapping units, and up to seven habitat types per mapping unit), a general discussion is presented, by region, of only those instances where species or species groups have been decreasing or increasing in abundance over the last 10 to 20 years, or are projected to decrease or increase in abundance through the year 2050. If a species or species group is not discussed within a region, the abundance of that species or species group has been generally steady over the last 10 to 20 years and is expected to remain generally steady through the year 2050.

The projection of wildlife abundance through the year 2050 is based almost exclusively on the predicted conversion of marsh to open water and the gradual relative sinking and resultant deterioration of forested habitat throughout the study area. Such predictions may or may not prove to be accurate. Additionally, numerous other factors including water quality, harvesting level, and habitat changes elsewhere in the species' range cannot be predicted and were not considered in these projections. Therefore, the projections presented below and in the Appendices are to be viewed and used with caution.

Region 1 Wildlife Trends and Projections

Trends

Brown pelican and bald eagle abundances are increasing. Wading bird abundance has increased in all but four mapping units which surround Lake Borgne. Dabbling duck, diving duck, rail, gallinule, and coot numbers are declining in Central Wetlands and South Lake Borgne. The abundance of raptors and other woodland species are increasing in forested wetlands. Alligator abundance has been increasing in the upper basin and decreasing in the lower basin.

Projections

Brown pelican and bald eagle numbers are projected to increase in areas presently occupied. Seabird abundance is expected to decrease in the lower basin and in the Bonnet Carré and LaBranche Wetland mapping units. Wading bird numbers are expected to decrease in the four mapping units which surround Lake Borgne. The numbers of dabbling ducks, diving ducks, geese, rails, gallinules, and coots are expected to decline in the Manchac and East Orleans Land Bridge areas, Central Wetlands, and South Lake

Borgne. The abundance of other birds utilizing marsh and open water habitats is expected to decrease in three units on the periphery of Lake Borgne and in the LaBranche Wetlands.

The abundance of raptors and other woodland species is expected to decrease in forested habitats. Raptor abundance is expected to decrease for five marsh-dominated units around Lake Pontchartrain and Lake Borgne. Furbearer and alligator numbers are expected to decrease in the lower basin. Alligator abundance in the upper basin is expected to increase. In mapping units surrounding Lake Maurepas, in Central Wetlands, and in South Lake Borgne, squirrel, rabbit, and white-tailed deer abundance are expected to decrease.

Region 2 Wildlife Trends and Projections

Trends

Brown pelican and bald eagle abundance are increasing. Seabird abundance is decreasing in areas of high land loss. Dabbling duck and diving duck numbers are declining in the brackish and saline marshes of the central and lower portions of Region 2, declining in the less active parts of the Mississippi River delta, and increasing in the vicinity of freshwater diversions. Goose numbers are declining in less active parts of the delta. Rail, gallinule, and coot trends are similar to that of dabbling ducks, except that Cataouatche/Salvador and Gheens have increasing numbers. The abundance of other birds using marsh and open water habitats is declining in areas of high land loss. Raptor abundance has increased in forested habitats and decreased in deteriorating marshes. Furbearer and alligator numbers are decreasing in areas experiencing high land loss.

Projections

Brown pelican and bald eagle numbers are projected to increase in areas presently occupied. Seabird abundance is expected to decrease in areas of high land loss. Wading bird and shorebird abundance are expected to decrease in the region except in areas influenced by river diversions. The numbers of dabbling ducks, diving ducks, rails, gallinules, and coots are expected to increase in the vicinity of freshwater diversions and decline in the other central and lower region marshes. Goose abundance is expected to decrease in the less active delta areas.

The abundance of other birds using marsh and open water habitats is projected to decrease in deteriorating wetlands and increase in projected land-building areas such as West Bay. Decreased numbers of raptors and other woodland birds are expected across the region except in areas influenced by river diversions. Furbearer and alligator numbers are projected to decrease in areas expected to experience high land loss. Squirrel abundance is expected to decline throughout Region 2. Rabbit and white-tailed deer numbers are expected to decline in much of the fresh swamp, hardwood forest, and central and lower marshes.

Region 3 Wildlife Trends and Projections

Trends

Brown pelican and bald eagle numbers are increasing. Seabird abundance has declined in the Terrebonne-Timbalier Bay area. Wading bird abundance has increased in stable wetlands and has decreased in deteriorated habitats. Shorebird abundance is decreasing in the Terrebonne-Timbalier mainland marshes. Goose numbers are increasing in the Penchant mapping unit and in the marshes near the Atchafalaya River. Rail, gallinule, and coot numbers are decreasing in areas where marshes are deteriorating. The abundance of raptors has increased in forested wetlands.

Furbearer numbers have decreased in the deteriorated wetlands of the Terrebonne-Timbalier Bay area and in the Mechant-de Cade mapping unit. Alligator abundance is increasing in marsh-dominated mapping units which are strongly influenced by the Atchafalaya River and is decreasing in units that have experienced high land loss.

Projections

Brown pelican and bald eagle numbers are projected to increase in areas presently occupied. The abundances of seabirds, wading birds, shorebirds, raptors, and other birds utilizing marsh and open water habitats are expected to decrease in deteriorating wetland areas. Dabbling duck, diving duck, goose, rail, gallinule, and coot numbers are expected to decline in the lower central Terrebonne, lower eastern Terrebonne, and Penchant marshes. The abundances of raptors and other birds utilizing hardwood forests are expected to decrease.

Furbearer and alligator populations are expected to decrease in deteriorating wetlands of the Terrebonne-Timbalier Bay area and in Mechant-de Cade. Squirrel abundance is expected to decline throughout Region 3, except in the Avoca mapping unit. Rabbit and white-tailed deer numbers are expected to decline in much of the fresh swamp and hardwood forest habitats and in the lower central Terrebonne, lower eastern Terrebonne, and Penchant marshes.

Region 4 Wildlife Trends and Projections

Trends

In the vicinity of the gulf, Calcasieu Lake, and Sabine Lake, brown pelican numbers are increasing. Bald eagles have shown a small but increased presence in the South White Lake unit. Wading bird abundance is increasing in marsh habitats. In the Mermentau Basin, dabbling duck and diving duck abundances have declined in mapping units surrounding Grand Lake and White Lake. In the Calcasieu-Sabine basin, duck abundance has been generally increasing. Goose abundance is increasing throughout much of Region 4. Alligator abundance is generally increasing in mapping units with low to moderate salinity regimes and low to moderate tidal energy.

Projections

Brown pelican and bald eagle numbers are projected to increase in areas presently occupied. Seabird abundance is projected to decrease in marsh habitats of the Calcasieu-Sabine Basin. Decreases in wading bird abundance are expected in marsh habitats of eight Calcasieu-Sabine Basin mapping units and six Mermentau Basin units. Decreased shorebird abundance is expected in marsh habitats in 11 Calcasieu-Sabine Basin mapping units and 11 Mermentau Basin mapping units. The abundances of dabbling ducks, diving ducks, geese, rails, gallinules, and coots are expected to decline in mapping units surrounding Grand Lake and White Lake, and in other mapping units throughout Region 4 where conversion of marsh to open water is expected. Decreased abundance of other birds utilizing marsh and open water habitats is expected in marsh habitats in 17 Calcasieu-Sabine basin mapping units and 12 Mermentau Basin mapping units. The abundances of raptors and other birds utilizing forested habitats are expected to decrease. The abundance of furbearers is expected to increase in the Cameron-Creole Watershed mapping unit. Alligator numbers are expected to increase in six low salinity mapping units and two mapping units where salinity and water level regimes are now manipulated (Cameron-Creole Watershed and West Black Lake). In mapping units with high land loss projections, rabbit and white-tailed deer numbers are expected to decline.

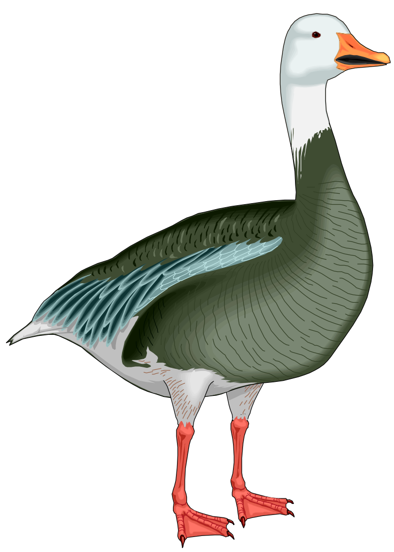


Table 6-1. Representative fish and invertebrate guilds of coastal Louisiana.

Species (guild)	Life stage	Habitat preference				Salinity preference				Primary habitat function			Seasonal preference				
		EM	SH	DW	FS	F	I	B	SA	S	NU	FO	SP	SU	FA	WI	YR
Marine assemblage																	
Spanish mackerel	Adult			■				■	■	■		■	■	■			
	Juvenile			■				■	■		■	■	■	■			
Estuarine dependent assemblage																	
Red drum	Adult		■	■				■	■			■					■
	Juvenile	■	■				■	■	■		■	■			*		■
Black drum	Adult		■	■				■	■			■					■
	Juvenile		■				■	■	■		■	■	■ *				■
Spotted seatrout	Adult		■	■				■	■			■					■
	Juvenile	■	■				■	■	■		■	■		■ *	■		
Gulf menhaden	Adult			■					■	■		■					■
	Juvenile		■	■		■	■	■	■		■	■				■ *	■
Southern flounder	Adult		■	■				■	■			■		■	■		
	Juvenile		■				■	■	■		■	■	■	■		■ *	
White shrimp	Subadult	■	■	■				■	■			■		■	■	■	
	Juvenile	■	■			■	■	■	■		■	■		■ *	■		
Brown shrimp	Subadult	■	■	■				■	■			■		■	■		
	Juvenile	■	■				■	■	■		■	■	■ *	■	■		
Blue crab	Adult	■	■	■		■	■	■	■	■		■					■
	Juvenile	■	■	■		■	■	■	■		■	■	■ *	■ *			■
Estuarine resident assemblage																	
American oyster			■					■		■		■	■ *	■ *			■
Freshwater assemblage																	
Large mouth bass	Adult		■	■	■	■	■			■		■	■ *				■
	Juvenile		■	■	■	■	■				■	■					■
Channel catfish	Adult		■	■		■	■			■		■	■ *				■
	Juvenile		■	■		■	■				■	■					■

Habitat preference—EM=emergent marsh; SH=shallow water; DW=channel, open water > 6 ft; FS=fresh swamp
Salinity preference—F=fresh; I=intermediate; B=brackish; SA=saline
Primary habitat function—S=spawning; NU=nursery; FO=foraging
Seasonal preference—SP=spring; SU=summer; FA=fall; WI=winter; YR=year round
<All preferences denoted by block shading>
* Indicates immigration period for marine transient species and spawning season for resident species.