II. The Refuge

INTRODUCTION AND HISTORY

Lake Ophelia National Wildlife Refuge is located in north Avoyelles Parish, Louisiana, about 15 miles northeast of the city of Marksville (population 6,087) and 30 miles southeast of Alexandria (population 46,000) (Figure 2-1). The Refuge covers a total of 17,525 acres within the 38,000-acre acquisition boundary and lies approximately eight miles northwest of where the Red River empties into the Atchafalaya River. This region is part of the Mississippi Alluvial Valley.

Lake Ophelia and the surrounding lands were once part of a vast bottomland hardwood forest that stretched along the Mississippi River. Much of this forested land, including large areas of what would later become the Lake Ophelia National Wildlife Refuge, was cleared for agriculture in the late 1970s. The Refuge was established in 1988 to provide wintering habitat for mallards, northern pintails, and wood ducks, as well as breeding and nesting habitat for wood ducks, and to assist in meeting the goals of the North American Waterfowl Management Plan. The Refuge is also being managed to provide habitat for a natural diversity of plants and animals, and to provide opportunities for compatible wildlife-dependent recreation, including hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

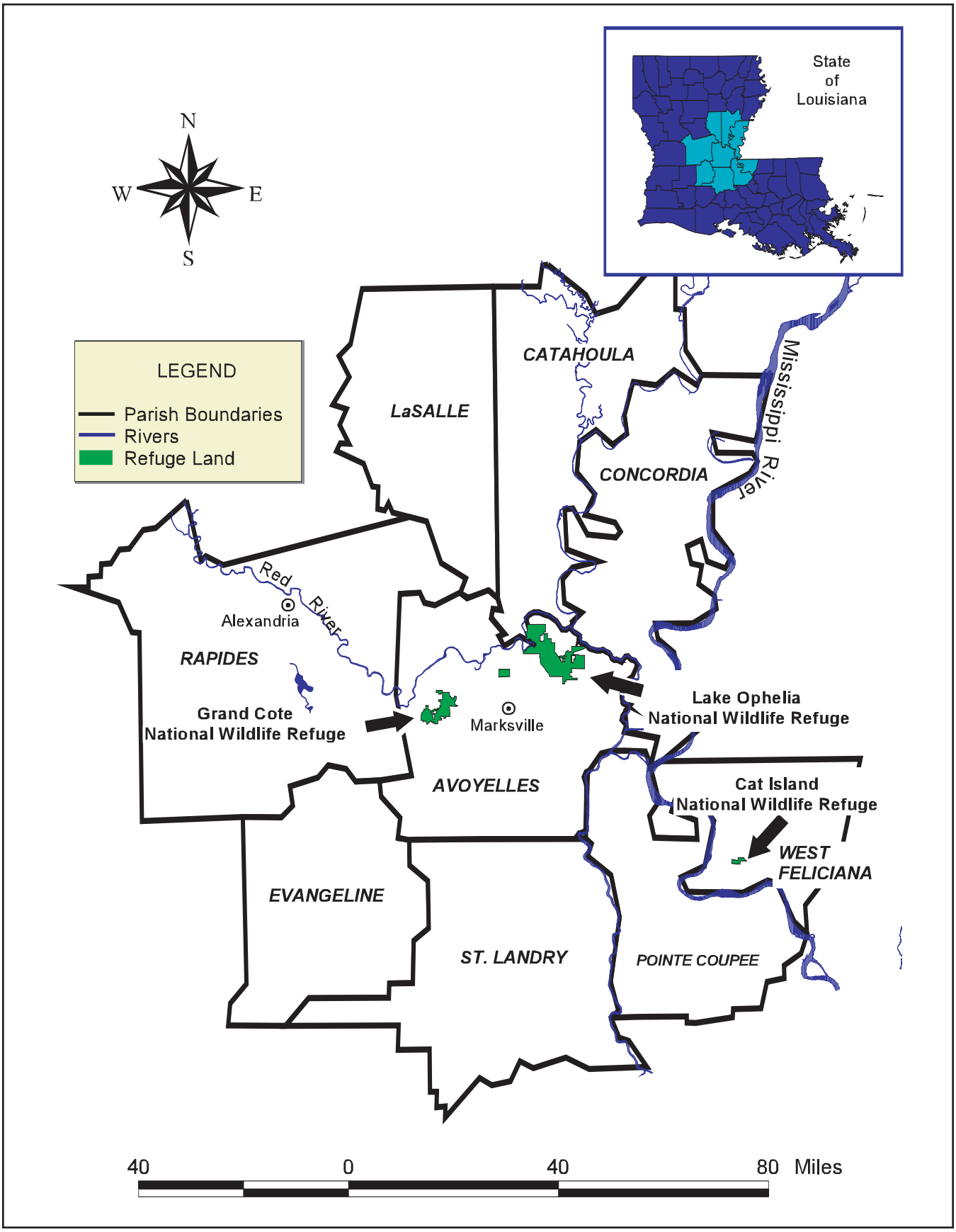
The Refuge is named for Lake Ophelia, a 350-acre, cypress-lined lake formed by a remnant channel of the Red River. The Service's interest in the Lake Ophelia area began in 1977. With support from the Louisiana congressional delegation, the State of Louisiana, and several conservation groups, the Service's Southeast Regional Director approved the first land acquisition for the Refuge in August 1978. At that time the property was rated by the Service as one of the five most important bottomland hardwood tracts for wintering waterfowl in Louisiana, and it was in imminent threat of being cleared for agriculture. Before the Service could begin acquisition, a core 20,000-acre tract was purchased by a private party and 13,000 acres were cleared for soybean production. Toward the end of the clearing operation, the Avoyelles Sportsman's League and Environmental Defense Fund filed suit to have the wetland clearing operation stopped. The lawsuit, which was successful, provided the precedent for the regulation of wetland clearing operations under Section 404 of the Clean Water Act.

The Service's interest in acquiring the property continued with the first land acquisition, which was scheduled for fiscal year 1982. However, the loss of the core tract, the unwillingness of some landowners to sell, and funding limitations, coupled with an emphasis on purchasing intact bottomland forest and other factors, relegated the project to a lower priority. In 1987, the cleared 13,000-acre tract was conveyed to the Federal

Land Bank for indebtedness. At that time, poor agricultural prices made selling farmland attractive, and the Service had refocused its attention on acquiring waterfowl habitat (particularly for northern pintails and mallards) in the MAV. In April 1988, the Service's Southeast Regional Director approved a Preliminary Project Proposal to acquire 38,000 acres for the establishment of Lake Ophelia National Wildlife Refuge. The first 1,536 acres were purchased in June 1988. With the aid of The Nature Conservancy, the Refuge grew to almost 15,000 acres within a few years. The last sizable addition (2,200 acres) was purchased in 1998.

Lake Ophelia National Wildlife Refuge is administered from an office located at Grand Cote National Wildlife Refuge (6,077 acres), about 20 miles southwest. This office, known as the Central Louisiana National Wildlife Refuge Complex, is responsible for managing the Lake Ophelia, Grand Cote, and Cat

Figure 2-1. The location of Central Louisiana National Wildlife Refuge Complex in Avoyelles Parish, Louisiana.



Island Refuges; three Farm Services Agency (FSA) fee title tracts covering a total of 1,990 acres (one each in Avoyelles, Rapides, and St. Landry Parishes); and 12 FSA conservation easements (190 and 74 total acres in Avoyelles and Rapides Parishes, respectively) (Figure 2-1). Although three staff members report for duty at Lake Ophelia Refuge, one at Cat Island and five at Grand Cote, the work responsibilities for each member include duties at all three complex refuges and FSA tracts. The Complex's current staff includes a Project Leader (GS-0485-13), Deputy Project Leader (GS-0485-11/12), Refuge Manager - Lake Ophelia (GS-0485-9/11), Refuge Manager - Cat Island (GS-0485-9/11), an Office Assistant (GS-0303-07), a Park Ranger (GS-0025-09), a Wildlife Biologist (GS-0486-11), a Natural Resource Planner (GS 0401-12), and two Engineering Equipment Operators (WG-5716-10).

PURPOSES AND ECOSYSTEM CONTEXT

The purpose of Lake Ophelia National Wildlife Refuge, as reflected in the Refuge's authorizing legislation, is to protect and conserve migratory birds and other wildlife resources through the protection of wetlands, in accordance with the following laws:

> *...the conservation of wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions...* 16 U.S.C., Sec. 3901(b), 100 Stat. 3583 (Emergency Wetlands Resources Act of 1986);
>
> *...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds...* 16 U.S.C. Sec. 664 (Migratory Bird Conservation Act of 1929);
>
> *...for the development, advancement, management, conservation, and protection of fish and wildlife resources...* 16 U.S.C. Sec 742f(a)4; and
>
> *...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services...* 16 U.S.C. Sec. 742f(b)1 (Fish and Wildlife Act of 1956).

The Refuge's purpose and importance to migratory birds, particularly waterfowl, were further described in the Service's Environmental Assessment for the proposed establishment of the Refuge (1989): *To preserve wintering habitat for mallards, pintails, and wood ducks and production habitat for wood ducks to meet the habitat goals presented in the Ten-Year Waterfowl Habitat Acquisition Plan and the North American Waterfowl Management Plan.*

The Refuge purpose was further described in the Approval Memorandum for the for the establishment of Lake Ophelia Refuge, where the primary reason for acquisition and inclusion of the area into the Refuge System was to preserve wintering habitat for mallards, pintails, and wood ducks, as well as production habitat for wood ducks (USFWS Southeast Region, Approval Memorandum 1989). Three objectives for which the area will be managed were identified in the Approval Memorandum: to preserve an area which has traditional high use for wintering waterfowl; to provide additional waterfowl habitat through refuge management; and to establish a waterfowl sanctuary.

The North American Waterfowl Management Plan's Lower Mississippi Valley Joint Venture office, working through a collaborative effort with private, State, and Federal agencies, has established certain habitat objectives for the MAV. These objectives have been stepped down for private and public lands throughout the MAV. The minimum step-down objectives for Lake Ophelia Refuge are to provide 1550 acres of managed water, including 350 acres of flooded moist soil plants; 500 acres of flooded timber; 200

acres of unharvested crops; and 500 acres of harvested crops. Managed water is defined as areas that can be flooded through management actions taken by Refuge staff, such as the pumping of water and the closing of gates on water control structures, etc. Lake Ophelia Refuge also has an objective to provide 50 acres of shorebird habitat during the annual fall migration period from July 15 through October 15.

The Three Rivers SPOA, which includes Lake Ophelia Refuge, is a 283,204-acre area with an objective of providing 100,000 acres of bottomland hardwood forest and a core area of 84,000 acres of forest land. A core area is a contiguous block of forest that is 1 kilometer (0.62 mile) from the forest edge. Waterways within forest blocks are included in that acreage. At the present time, the Three Rivers SPOA has a core area of 80,000, only 4,000 acres short of its objective. Reforestation of relatively small areas in appropriate locations could easily meet this objective.

One species of concern, the woodcock, is showing significant long-term declines in the eastern United States. Habitat loss, including the loss of preferred, safe, nocturnal wintering habitats, is likely a key factor. Lake Ophelia National Wildlife Refuge may be important in helping the Service to meet its objectives in the North American and Regional Woodcock Management Plans. The Refuge will maintain a minimum of 200+ acres of open areas or agriculturally manipulated fields that will be available in various stages of plant succession or crop removal to gauge the importance of such habitats for nocturnal wintering use by woodcock. Scrub-shrub and forested wetlands with overhead cover and open below are the woodcock's preferred daytime habitat. Blocks of 25 to 50 acres of scrub-shrub habitat support not only woodcock but several other species of birds, including the white-eyed vireo, painted bunting, and orchard oriole. This habitat is also important as dense cover used by Louisiana black bears and a host of other wildlife species. In addition, scrub-shrub habitat is generally considered to be unattractive to brown-headed cowbirds, which tend to favor more open or forest edge habitats.

The Three Rivers SPOA is considered a prime area for reestablishing populations of the threatened Louisiana black bear, and is an integral part of the effort to recover this high-visibility species. During the spring of 2003 and 2004 the Louisiana black bear repatriation project has successfully relocated 11 adult female bears (radio collared) with cubs on Lake Ophelia Refuge.

LEGAL POLICY

The administration of Lake Ophelia National Wildlife Refuge is guided by a variety of international treaties, Federal laws, and Presidential Executive Orders. Management options under the Refuge's establishing authority (Public Law 104, Stat. 2957, Section 108, H.R. 3338) and the National Wildlife Refuge System Improvement Act of 1997 (the legal and policy guidance for the operation of national wildlife Refuges) are contained in the documents and acts listed in Appendix III.

RESOURCE AND MANAGEMENT DESCRIPTIONS

PHYSICAL ENVIRONMENT

Climate

The climate at the Refuge is humid-subtropical and is primarily influenced by the Refuge's subtropical latitude and proximity to the Gulf of Mexico. The climate is controlled by two principal air masses. Warm, moist air from the Gulf of Mexico generally dominates in the spring and summer, and cooler, drier air from the Central Plains prevails during the winter months. Extended, hot, sultry summers and moderately cool winters are the norm.

The average annual air temperature is 65 degrees Fahrenheit. During winter, the average temperature is 50 degrees, with an average daily minimum of 39 degrees. Average seasonal snowfall is less than one inch. The average temperature is 81 degrees during the summer (Martin, 1986), but temperatures above 90 degrees occur almost daily.

The mean annual precipitation is 60 inches. Half of this rainfall (30 inches) usually falls during April through September. The growing season is about 235 days long and begins in mid-March and ends during early November. Thunderstorms occur on average about 70 days each year, with most occurring during the summer months. The average relative humidity in the mid-afternoon is about 60 percent. Humidities are higher at night, with the average at dawn being 90 percent (Martin, 1986).

The sun shines 60 percent of the time during the summer, and 50 percent during winter. Prevailing wind is from the south. Average wind speed is highest, 9 miles per hour, during the spring months. These climatic values play an important role in influencing the area's hydrologic regime, which subsequently shapes ecosystem process and functions.

Physiography and Geology

As the climate has changed on the Earth, marine and deltaic sediments have been deposited in alternating cycles in Louisiana. Geologists have determined from studying these deposits that a major river system, corresponding to the modern Mississippi River, has persisted here at least since the Gulf of Mexico began to form (Louisiana Geologic Survey, 1990).

The Tertiary period, which extended from 65 to 1.8 million years ago (mya), began with a warming trend in which the sea covered almost the entire Lower Red River Basin. In the early Eocene epoch, which began about 54 mya, the land began to build up again as the continental ice sheets advanced. However, this trend was reversed during the late Eocene, when a second advancement of the sea occurred. With the sea as far inland as Natchitoches Parish, the last cycle began in the early Oligocene Epoch (38 to 23 mya). In Miocene time (23 to 5 mya), the sea level dropped and sedimentation began to extend the land gulfward (U.S. Army Corps of Engineers, 1975).

The Refuge lies within the Mississippi Alluvial Plain section of the Coastal Plain Province (Beccasio et al., 1983), to the west of the confluence of the Mississippi and Red Rivers in Avoyelles Parish. The topography of the Refuge has been greatly influenced by the aggrading Mississippi and Red Rivers, and much of the geology is from Quaternary (1.8 mya to present) alluvial deposits. Although the continental ice sheets did not reach this far south, the lower Mississippi valley carried glacial meltwaters and outwash in a braided-stream pattern that concurrently widened and aggraded the valley during periods of waning glaciation. As each glacial cycle progressed and the sediment loads and stream discharges declined, the river abandoned its braided stream configuration in favor of a single-channel meandering pattern. This alluvium has been sorted, reworked, and deposited many times by riverine processes.

During flood periods prior to human influence, stream channels within the MAV, unable to hold the complete volume of water within their banks, overtopped and spilled onto adjacent floodplains. In this process, the velocity of these sediment-laden waters decreased dramatically. Unable to continue to carry their sediment load, these waters dropped the coarsest particles closest to the stream channel and the finer particles farther away. These deposits formed natural levees, which gained elevation closer to the river channel.

Another result of this localized deposition was the creation of lowlands at the base of these natural levees. These lowlands received only the clay particles held in suspension in flood waters (Fisk, 1940). These lowlands paralleled the meander belt of the stream for great distances and were utilized as seasonal backwater

flood storage areas. Water within the channel will continue to erode the banks, and often will cut through the natural levees. The stream will then change its course and occupy the lowland channel.

The formations of alluvium described above comprise the entire Lake Ophelia Refuge. Relict channels and natural levees, often referred to as ridge and swale topography, are easily seen by visitors to the Refuge. Human disturbances, including the construction of artificial levees and channelization projects, have drastically altered these natural alluvial processes within the Mississippi and Red River floodplains.

The elevation at the Refuge averages about 45 to 50 feet above mean sea level. The topography is complex, with numerous stream channels, small tributaries and depressions, old river meanders and oxbow lakes, multiple river terraces in various stages of erosion and deposition, and adjacent poorly drained lowlands. This subtle but complex topography has given rise to the flora and fauna found on the Refuge.

Soils

The soils at Lake Ophelia Refuge demonstrate the influence that the Mississippi and Red Rivers have had on the terrain. The Refuge contains mostly hydric soils that fall into two broad series of soil groups.

Most of the Refuge consists of Sharkey-Tensas soils, which are level to undulating and are either poorly drained or somewhat poorly drained. These soils have a clayey surface layer and a clayey or loamy subsoil. Many shallow lakes and bayous are found in most areas containing these soils, which are occasionally flooded during the winter months. Most of these soils are formed in Mississippi River alluvium.

Sharkey-Fausse-Moreland soils are found within the Sharkey-Tensas soils in a few areas on the Refuge. These clayey soils are level and either poorly drained or somewhat poorly drained, and are present in low positions on natural levees along the old channels of the Mississippi and Red Rivers.

Only one soil group containing nonhydric soils, the Roxana-Norwood group, is present (in minor amounts) on the Refuge. This series group is found on natural levees along the Lake Long drainage that flows through the center of the Refuge. These level to undulating, well drained, alkaline soils are loamy throughout (Martin, 1986).

Hydrology

In pre-modern times the Mississippi River was a dynamic and changing system. The many courses the river has taken in recent geologic history have been noted by geologists. Fisk (1940) wrote:

> *The youngest pre-modern course of the Mississippi River is the most easily interpreted; it can be traced along the Tensas River in northeastern Louisiana southward to Black River. Black River and Tensas River, which locally reverse the original drainage direction, unite and drain southeastward through a crevasse channel. Red River enters this meander belt in another crevasse channel opening. South of the Red River, the meander is occupied by Lake Long and Bayou des Glaises and continues to the Atchafalaya River, which follows an old meander from Lower Old River, a recent Mississippi cut-off meander, to Simmesport.*

The Refuge lies within the Bayou Natchitoches basin and the Red River alluvial cone, in an area commonly referred to as the Red River backwater area. During flood periods, the Mississippi and Atchafalaya Rivers reach levels that significantly slow and even back up the discharges from the Red River. This water enters the basin and occupies the lowland areas that dominate the Refuge. Statistical

analysis (based on river stage and precipitation data for the period from 1929 to 1975) indicates that somewhat more than half of the tract, at elevations up to 45.8 feet above mean sea level, is subject to the average annual flood, with an average duration of 13 percent of the year, with the entire tract flooding about once a decade (Combs, U.S. Army Corps of Engineers, in U.S. Court of Appeals Briefing, 1982).

The Red River borders the Refuge on the north. The main drainages within the Refuge include Lake Long, Possum Bayou, Palmetto Bayou, Bayou Jeansonne, and Bayou Sans Facon. Numerous lakes are present, including Nicholas, Duck, Long, Ophelia, and West Cut. Numerous unnamed sloughs and seasonal or ephemeral drainages are also found here. Flow into the Refuge enters from Little River to Bayou Jeansonne. Bayou Jeansonne flows south into Bayou Natchitoches. Flow also enters into Bayou Natchitoches from Lake Long, which meanders east and south through the Refuge.

Bayou Jeansonne has been leveed to prevent backwater flooding. A levee is also in place along the Red River east of the Refuge ; it ends a short distance below Lock and Dam Number One. Lake Long is not leveed, but is cut off from the Red River. The elevation of the 100-year flood event has been lowered four feet due to the diversion of Mississippi River flows down the Atchafalaya River through the U.S. Army Corps of Engineers' Old River control structure. The diverted flows have caused the Atchafalaya River bed to incise, thereby lowering the flood stage in the lower end of the Red River (Marcy, pers. comm.). Another contributing factor causing the Atchafalaya River bed to incise is the confinement of its floodplain for approximately 75 miles between levees.

In an effort to mimic the area's historical hydrology, the Service is manipulating the Refuge's hydrology in some areas through the use of levees, ditches, wells, and water control structures. These areas include approximately 850 acres of moist soil and cropland habitat; 340 acres of bottomland hardwoods; and 690 acres of permanent water.

Two distinct aquifer systems underlie Avoyelles Parish: the Quaternary and the upper Tertiary. The water levels in both of these aquifer systems are generally less than 50 feet below the surface. The Quaternary aquifer can supply very large quantities of fresh water to parish residents. The Quaternary aquifer is composed of poorly sorted sand and gravel. It ranges in thickness from 50 to 150 feet. This aquifer offers the greatest potential source of ground water. Water in this aquifer is generally suitable for irrigation, but its hardness and high iron content must be treated for most other uses (Martin, 1986).

Beneath this aquifer is the upper Tertiary system, which can yield moderate to large supplies of fresh water in the Bunkie-Hessmer and Simmesport-Odenburg areas (Marie, 1971). This aquifer system is recharged principally by rainfall. In areas where the aquifer system has been developed for public and industrial supplies, withdrawals from wells have lowered the water level as much as 20 feet (Marie, 1971). Aquifers in this system range from 20 to 80 feet in thickness and are composed principally of well-sorted, fine- to medium-grained sand (Martin, 1986).

Water Quality

Historically, the water quality of the Refuge has not been monitored. Water quality within the Red River north of Lake Ophelia Refuge has been affected by mercury contamination from an unknown source (Louisiana Department of Environmental Quality, 1998).

Recently, Lake Ophelia National Wildlife Refuge was one of 26 refuges in the MAV surveyed for chemical contamination. Samples of water, sediment, and fish were collected, and passive sampling devices deployed. Residues of current-use pesticides, organochlorine pesticides, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and mercury were measured and limited toxicity testing was done (Shea et

al, 2001). Lake Ophelia Refuge had one of the lowest levels of chemical contamination of all refuges surveyed. Although each of the chemical contaminants surveyed for was detected at Lake Ophelia Refuge, none were detected at levels of concern to human health or fish/wildlife.

The Environmental Protection Agency's *Index of Watershed Indicators* shows that 80 to 100 percent of the water bodies within this area of the lower Red River watershed are meeting designated uses, and characterizes the streams in this area as having good overall water quality and a low vulnerability to problems related to runoff. The EPA has identified a moderate loss of wetlands in this watershed. Wetlands perform many important functions, such as improving water quality, recharging groundwater, providing natural flood control, and supporting a wide variety of fish, wildlife, and plants. The economic importance of wetlands to commercial fisheries and recreational use is also known to be significant. Land clearing, man-made levees, navigation structures, stream channelization projects, and canal and ditch construction have impaired the historic functions of forested wetlands.

BIOLOGICAL ENVIRONMENT

Flora

The Refuge is a 17,525-acre complex of forested wetlands, shrub wetland habitats, recently reforested areas, agricultural lands, moist soil areas, open waters, and dirt access roads and trails (Figure 2-2; Table 2-1). The varied and diverse plant communities that remain on the Refuge reflect slight variations in topography, soils, and hydrologic regimes resulting from the influence of the Mississippi and Red Rivers, as well as the Service's management objectives (Figure 2-3).

Before human settlement, the area's alluvial soils and slight physiographic relief, combined with seasonal backwater inundation, created an extremely productive forested wetland ecosystem with several different habitat types. As the human populations increased in Louisiana, so did the demand for natural resources, and large expanses of bottomland hardwood forests were harvested for lumber and cleared for conversion to agricultural farmlands.

Prior to the establishment of the Refuge, the land was used for timber production and agriculture. During 1978, when worldwide demand for soybeans increased, the former landowners of this tract began clearing timber and draining the land to prepare the site for agricultural use. Much of the timber was pushed into huge windrows and burned. The remaining residue was then spread out, buried in pits, or pushed into cypress sloughs and Bayou Jeansonne.

The remaining natural forest on the Refuge totals 6,745 acres and is in small blocks of woods interspersed with lakes, sloughs, bayous, and fields. Of the remaining forests, most trees are from 20 to 60 years old. On these areas are a mix of even- and uneven-aged groups, likely as a result of previous timbering practices. The bottomland hardwoods occur at scattered locations, and depending upon the elevation and history of disturbance, their overstory vegetation consists of a variety of oaks (Nuttall, water, and willow). Other species include bitter pecan, water locust, green ash, sweetgum, black willow, red maple, box elder, American elm, sycamore, and hackberry. Persimmon, deciduous holly, dogwood, and hawthorn are common mid-story species.

To date, about 4,588 acres of the Refuge have been reforested. Species planted include Nuttall, overcup, water, and willow oaks; bald cypress; green ash; pecan; sweetgum; persimmon; and mayhaw. Natural regeneration of deciduous holly, persimmon, green ash, water hickory, and sweet gum has also occurred within the reforestation areas.

Figure 2-2. Vegetative habitat types of Lake Ophelia National Wildlife Refuge.

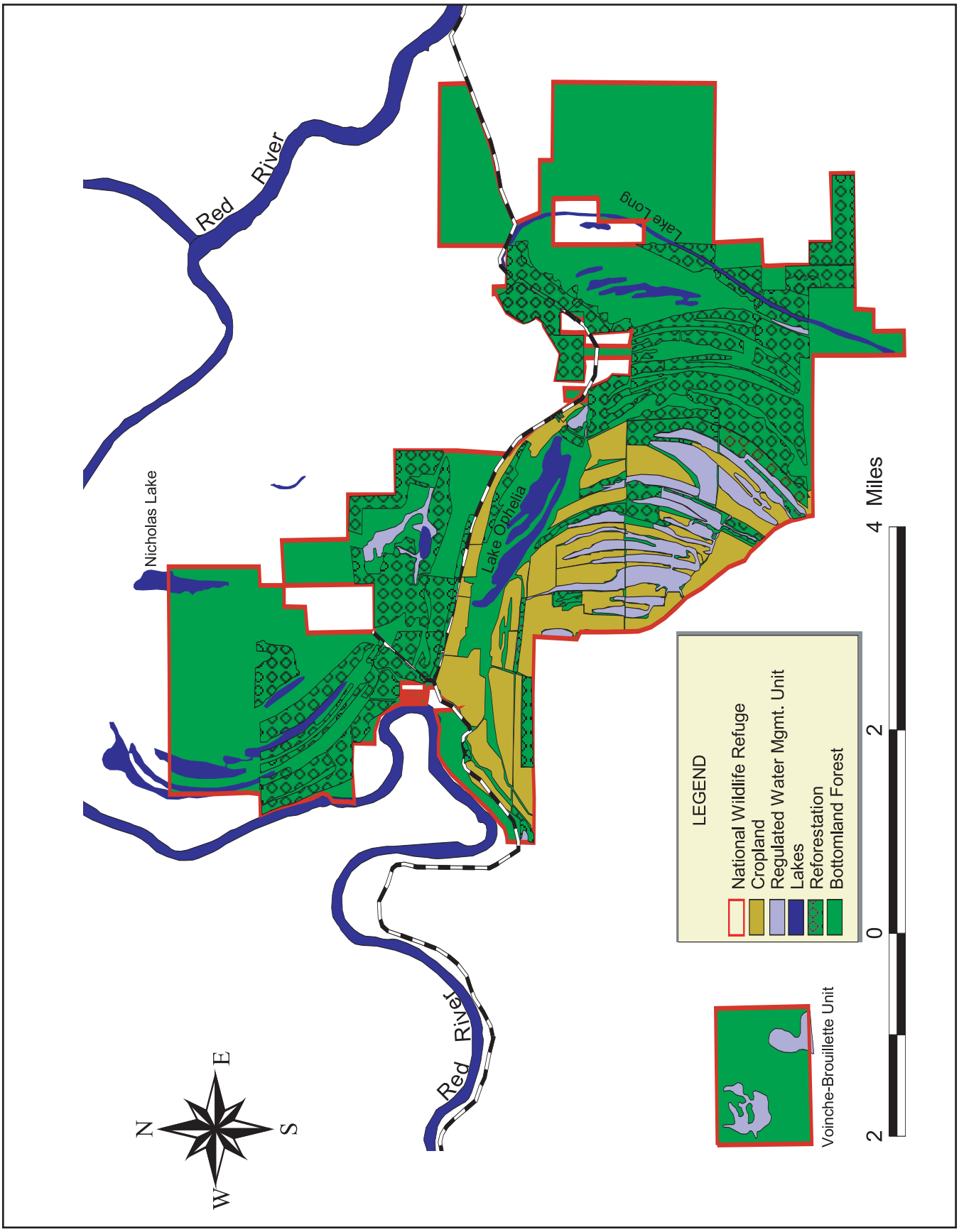
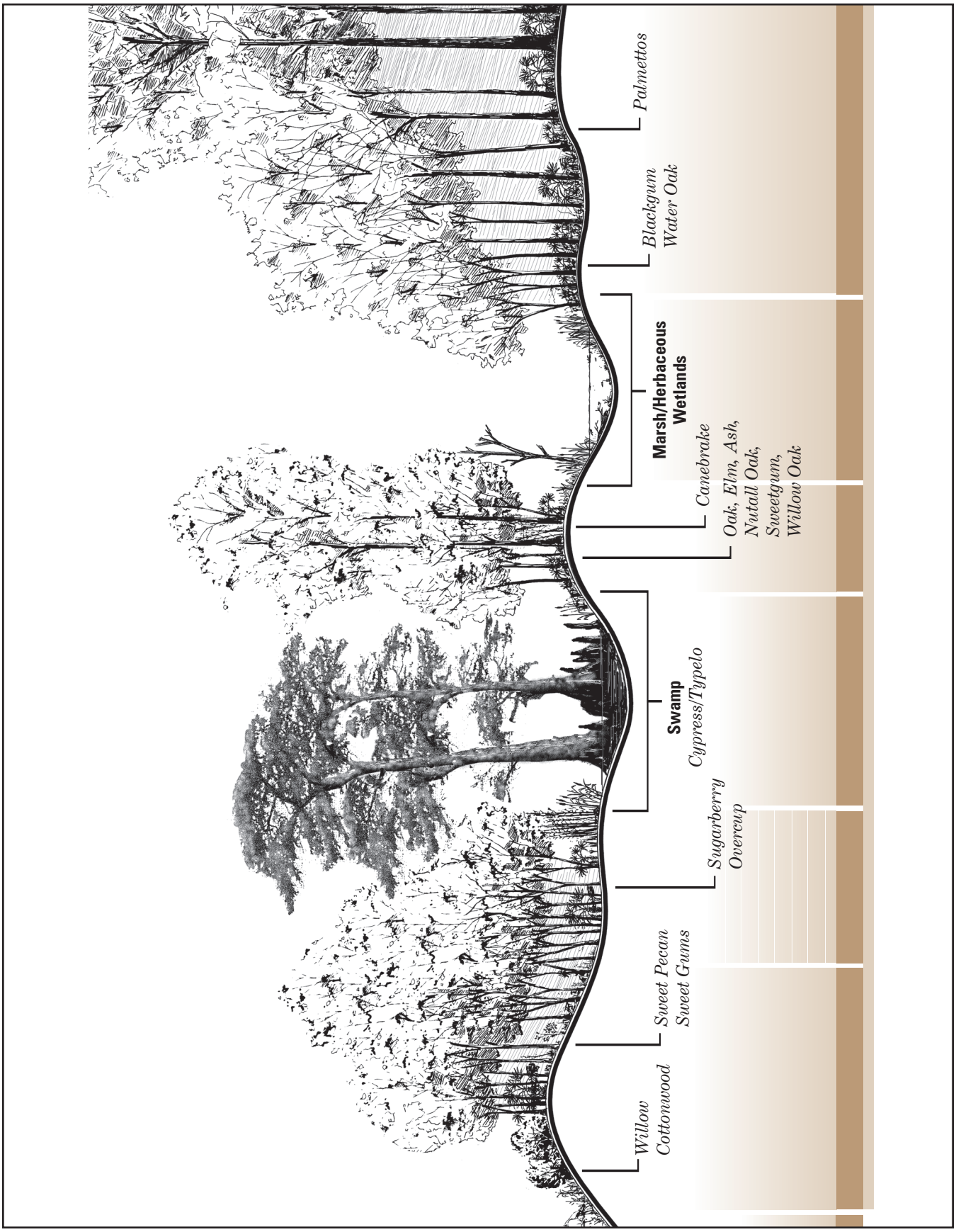


Figure 2-3. Habitat communities of ridge and swale topography.



These bottomland hardwoods may be transected by numerous permanently or semi-permanently wet areas, best described as inland open fresh water, shrub swamp, and wooded swamp. Shrub and wooded swamps are located in the fluvial scars or depressions within the bottomland hardwoods. Most of these depressions retain water throughout the year, and depending upon their depth, support a variety of vegetation, consisting of bald cypress, overcup oak, water tupelo, buttonbush, swamp privet, water elm, water locust, duckweed, American lotus, water hyacinth, smartweed, floating heart, pickerelweed, and several species of grasses and sedges. The open water areas are vegetated with water hyacinth, pennywort, duckweed, arrowhead, smartweed, water primrose, and other emergent aquatic vegetation.

The Refuge currently contains about 3,678 acres of non-forested lands that are managed to provide both natural moist soil plants and agricultural crops. The Refuge's water management capabilities allow seasonal flooding of approximately 1,155 acres of moist soil areas and agricultural fields on an annual basis. Common moist soil plants include smartweed, wild millet, various sedges, coffee bean, cocklebur, sprangletop, and trumpet creeper. Grain sorghum, soybeans, corn, and winter wheat are the agricultural crops.

Table 2-1. Summary of existing habitat types at Lake Ophelia National Wildlife Refuge.

Habitat Type	Existing Acreage
Bottomland Hardwood Forest	6,745
Reforestation	4,588
Non-flooded Cropland	2,523
Floodable Cropland	605-855
Floodable Moist Soil	300-550
Floodable Mud Flat	0
Floodable Bottomland Hardwoods Lakes, Bayous and Seasonally	345*
Flooded Forest Swales	1,879
Roads, Trails, Levees and Facilities	290
TOTAL	17,525

* Includes 68 acres of reforestation.

Fauna

Louisiana's mild climate, long growing season, abundant and varied plant species, rich soils, numerous streams, wet areas, and slight but varying elevations provide a wide variety of habitats and favorable conditions for terrestrial and semi-aquatic animals, including numerous game and nongame species. These animals may be residents, migrants, or transients at the Refuge.
The early explorers to this region sought fur, bear oil, and hides due to their commercial importance. They found an abundance of beaver, mink, otter, muskrat, deer, buffalo, bear, opossum, raccoon, bobcat, cougar, fox, wolf, and skunk (Lower Mississippi Region Comprehensive Study Coordinating Committee,

1974). As more and more settlers moved into the area, the demand for natural resources increased. Large expanses of bottomland hardwood forests were cleared for lumber and converted to agricultural operations. Along with this conversion came the extirpation of the wolf, bison, Florida panther, and several avian species. Game populations went from abundant prior to settlement to points of near or total elimination during the early 1900s (Lower Mississippi Region Comprehensive Study Coordinating Committee, 1974).

While some baseline wildlife surveys have been conducted (for waterfowl, wading birds, deer, furbearers, bear, woodcock, and shorebirds) on the Refuge, a thorough assessment of all wildlife occurrence is not available. Researchers from the U.S. Geological Survey's National Wetlands Research Center have recently begun to conduct baseline surveys of species groups about which little is known (e.g., reptiles, amphibians).

Mammals. The mammals that occur on the Refuge are those typical of bottomland hardwoods: white-tailed deer, fox and gray squirrels, swamp and cottontail rabbits, armadillos, beaver, bobcat, coyotes, opossum, Louisiana black bear, and raccoons. Nonnative feral hogs are abundant.

The Refuge's white-tailed deer population is thought to be near the desired level. While an internal parasite survey conducted by the Southeastern Wildlife Disease Study in fall 1999 suggested the population was near the upper limit of carrying capacity, browse surveys conducted by the Louisiana Department of Wildlife and Fisheries indicate the habitat is not being overbrowsed.

Gray and fox squirrel populations are abundant where mast-producing hardwoods occur. Fox squirrels are more abundant than gray. Due to their high reproductive and natural mortality rates, it is unlikely that any long-term changes in squirrel population densities have occurred.

Swamp rabbits, and to a somewhat lesser extent, cottontail rabbits, are common in this area. Again, their high reproductive and natural mortality rates would lead to the expectation that no long-term population changes have occurred and that rabbits should occupy all suitable habitat.

A number of furbearers, including nutria, raccoon, mink, opossum, coyote, bobcat, beaver, river otter, and striped skunk, are collectively abundant on the Refuge. Among this group, the beaver, muskrat, river otter, nutria, and mink are associated with the more permanently inundated wetlands and riverine systems. The raccoon is well adapted to all existing habitats; and the opossum, coyote, and bobcat are mostly associated with drier forested habitats. Most furbearers are found throughout the ecosystem.

Little or no formal data are available to provide population estimates for these species. However, informal surveys indicate that the population numbers of beaver and raccoon have increased in recent years, likely due to a decrease in the demand for fur. These two species are of concern because of their potential to significantly impact ecosystem functions. Beavers manipulate hydrology both on and off the Refuge by constructing dams that inundate bottomland forests for prolonged periods of time. Predation by raccoons may be adversely affecting populations of breeding Neotropical migratory birds (Cooper and Ford, 1993) and ground-nesting turkeys (Moore, 1993), as well as some bird rookeries in the forested wetlands on the Refuge.

Little is known about the species and populations of bats that may be found on the Refuge. The Rafinesque's big-eared bat, a species of management concern associated with bottomland hardwood forests, may be present on the Refuge.
Problem species include feral swine. Ample scientific evidence exists related to the adverse effects of feral swine on the habitat productivity and reproduction of most native wildlife (Lipscomb, 1989; Belden, 1972; Belden and Pelton, 1976; Scott, 1973; Yarrow, 1987; Jacobi, 1980; Baron, 1980; Lacki and Lancia

,1986; Willy, 1987). Because swine are omnivores, they utilize virtually every component of the habitat, resulting in direct competition with native wildlife, reductions in carrying capacity, and adverse impacts to reproduction/recruitment. In addition, existing documentation indicates feral swine serve as a source for many diseases that impact wildlife as well as domestic livestock and swine.

The Louisiana black bear is a threatened species protected under the Endangered Species Act. It is likely that male Louisiana black bears move through Refuge lands. As a part of the Recovery Plan for the bear, the Service and other partners have developed plans and have begun relocating females to protected lands within this area of Louisiana, in order to establish a new breeding population of bears in the State. The initial relocation effort took place in March 2001, when four female bears with cubs were relocated from existing breeding populations in north and south Louisiana to the Red River WMA, located directly across the Red River from Lake Ophelia National Wildlife Refuge. During the spring of 2003 and 2004, 11 adult female bears (radio-collared) with cubs were successfully relocated to Lake Ophelia National Wildlife Refuge.

Birds. The bottomland hardwood forests, moist-soil impoundments, open water, and early successional vegetation on Lake Ophelia Refuge provide outstanding habitat for a variety of bird life. The location of the Refuge within the Lower Mississippi River Valley migratory flyway adds to the value of the habitat for migratory birds. The Refuge's forested wetlands, moist soil units, flooded agricultural fields, and open water provide wintering and migrating waterfowl an area to rest, feed, and winter. Waterfowl found here include wood ducks, mallards, gadwall, hooded mergansers, blue- and green-winged teal, widgeon, northern pintail, and northern shoveler.

Some resident bird species also use the varying habitats at the Refuge year-round. The resident wood duck population derives essential life support elements from the bottomland hardwoods interspersed with other wetlands and interconnecting water bodies. Woodcock are a common winter resident in forested fields and scrub-shrub habitat. The northern bobwhite quail uses the Refuge's early successional habitats.

Forested wetlands offer a haven to many songbirds (Appendix IV). Recent bird surveys indicate that a minimum of 110 species inhabit or migrate through the Refuge (Lichtenberg, pers. comm.). Neotropical migratory birds use these habitats for breeding in the spring and summer and during their migrations in the spring and fall. Many species of songbirds are experiencing long-term declines as a result of widespread habitat loss. Bottomland hardwood forests and riparian woodlands have been identified as high priorities for restoration and management throughout the southeastern United States (Hunter et al., 1992). These critical areas on the Refuge will enhance the breeding, wintering, and transitional habitats for many species of migratory and resident songbirds.

Some of the more common year-round residents include the Carolina chickadee, tufted titmouse, northern cardinal, northern mockingbird, downy woodpecker, and red-winged blackbird. Several species of shorebirds, wading birds, and raptors are also common. Wading birds are often seen on the edges of open water in the Refuge. Common wading birds include the great blue heron, little blue heron, green heron, tricolored heron, white ibis, snowy egret, and great egret.

The bald eagle has been known to occur here, and the Refuge was once used as a hacking site. One unsuccessful starter nest was documented on the Refuge after the hacking project, and other nesting attempts are possible; however, none have been officially documented. Wintering eagles are occasionally observed on the Refuge and future nesting efforts are possible.

Amphibians and Reptiles. Amphibians and reptiles require quality wetland habitat for their survival, and they often serve as important indicators of environmental health. The Refuge's moist, forested bottomland hardwood habitat is conducive to an abundant and diverse reptile and amphibian community.

Amphibians present include salamanders, toads, and frogs, while reptiles include turtles, alligators, lizards, skinks, and snakes. As with other wildlife groups, detailed information is lacking. However, recent inventories have documented nine species of frogs and one species of toad (Appendix IV), although additional species are likely to exist (King, pers. comm.).

Fish. The topographical and inundation characteristics that create the Refuge's productive terrestrial habitat are also largely responsible for its excellent aquatic systems. The lakes, streams, and bayous of the Red River backwater area historically supported extensive populations of sport and commercial fish, such as crappie, largemouth bass, and bream.

The seasonal flooding that usually occurs in the late spring provides a timely increase in fish spawning areas that perpetuate a natural restocking of the fishery. Several species have adapted their spawning activities for this spring event, including black crappie, pickerel, carp, gar, and bigmouth buffalo. Zooplankton and phytoplankton counts are usually high during and following periods of flooding as compared with periods of normal water flow, supplying a critical food source for recently hatched fish.

During the summer 1999, a survey of Frazier/Whitehorse Lake (a Red River bend cut-off lake west of the Refuge), conducted by U.S. Army Corps of Engineers biologists, identified 39 species of fish. By number, the most abundant fishes included several species of sunfish; mosquito fish; and numerous species of shads, herrings, minnows, and shiners. Other less common species included paddlefish, spotted gar, channel catfish, and buffalo. While freshwater shrimp, crawfish, and shellfish are also known to occur, their specific occurrences and abundance are unknown.

Socioeconomic Environment

Lake Ophelia National Wildlife Refuge lies in the northern portion of Avoyelles Parish. Avoyelles Parish is located near the center of Louisiana and is bounded by Rapides Parish on the west; LaSalle and Catahoula Parishes on the north; Concordia Parish on the northwest; Pointe Coupee Parish to the southeast; St. Landry Parish to the south; and Evangeline Parish to the southwest. The Old River and Atchafalaya River form the southeastern boundary of Avoyelles Parish. The Red River flows through the northern portion of the parish and forms part of the Refuge's northeastern boundary.

Traditionally, Avoyelles Parish has not been in the forefront of economic growth or development in the State of Louisiana, and historically, unemployment figures in the double digits have been common. Instead, much of the economic and social life of the area centers on neighboring Rapides Parish and the City of Alexandria.

Avoyelles Parish is predominantly rural, with the largest town and parish seat being Marksville (1998 population: 6,087). As in other rural areas throughout the country, outdoor activities are both popular and necessary. Hunting and recreational fishing are popular pastimes, and farming, commercial fishing, and forestry are important elements of the economy.

Early Settlement of Avoyelles Parish

Avoyelles Parish received its name from the tribe of Avoyelles Indians that resided there when the first European settlers arrived. Native Americans play an important role in Avoyelles Parish, as the Tunica-Biloxi Indians are the largest employer, employing 1,100 employees out of an estimated labor force of 15,860 in 1997 (Louisiana Department of Economic Development, Avoyelles Parish Profile, 1998).
The first European settlers in Avoyelles Parish were the French. In Avoyelles Parish, the prairie land was settled first. The early settlers were primarily self-sufficient. Game and fish were plentiful. Cattle and pigs were allowed to roam the woods freely, and along with poultry, could be raised at little expense.

Corn, rice, and fruit were grown for personal consumption, while indigo was the primary cash crop, with some tobacco cultivation.

Around 1780, the area became known as Avoyelles Post. The post became an important center for trade, first between European settlers and Indians, then later as a merchandising center for the area (Avoyelles Parish Planning Board, 1947:11). Later settlers settled along the streams, where the land was very fertile and the streams could serve as sources of transportation. Canoes and flatboats were used to carry merchandise and were the primary methods of transportation.

In the early 1800s cotton began to replace indigo as the main money crop, and in 1804 a cotton gin was built in Avoyelles Parish (Saucier, 1943:23). The cotton farms were primarily small farms in the highlands. Although these higher lands were safe from floods, transporting the cotton to the river landings was sometimes a problem.

In 1815 the first steamboat went up the Red River, and by 1875, when navigation on the river began to decline, there were 52 boats traveling the Red River (Saucier, 1943:173). The Old River, the Bayou des Glaises, Lake Long, and Bayou Rouge were other navigable streams that were also used to transport cotton bales.

Land Use

Avoyelles Parish is predominantly rural. In 1990, 66.4 percent of the population lived in rural areas, with 6 percent of these living on farms (U.S. Department of Commerce, 1990). In 1992, 48 percent of the total land area was utilized by farms (U.S. Department of Commerce, U.S.A. Counties, 1996). There were 953 farms, with an average size of 269 acres. This is slightly smaller than the average size of a farm in Louisiana (306 acres; U.S. Department of Commerce, Census of Agriculture, 1992).

The number of farms, along with the total acreage in farmland, has declined over the past 10 years. At the same time, the average size of a farm has increased, mirroring a trend that is occurring across the nation.

As in much of the nation, agriculture has proved to be a volatile commodity in Avoyelles Parish. While cotton was king in the early days of the parish and enjoyed a resurgence in the early 1990s, its importance today has diminished considerably. With the decline of cotton, sugarcane has risen in importance to become the largest cash crop in 1998. Perhaps nothing has disrupted farming practices, and indeed land use in general, as much as the volatile nature of the soybean market. High soybean prices in the 1970s and 1980s led to the clearing of marginal lands, and the almost ruinous recent price decline has resulted in serious trouble for many farmers.

Demographics

Avoyelles Parish is primarily rural, with a total estimated population of 41,860 in 1998 (Louisiana Department of Economic Development, 1998). The parish actually lost population between 1980 and 1990. The 1980 population of Avoyelles Parish was 41,393, but by 1990 the population had declined to 38,159 (U.S. Department of Commerce, 1980, 1990). Marksville, the parish seat, is the largest town.

Most of the population is White, 27 percent is Black, 1.6 percent is Hispanic, and 0.3 percent is Native American (1990). In 1990, the median family income was $16,803, with 37.1 percent of the population falling below the poverty level. This compares unfavorably with the State of Louisiana's poverty rate of 23.6 percent (U.S. Department of Commerce, 1990). By 1996, the parish's median family income had risen to $20,252, and only 30.1 percent of the population was below the poverty level (U.S. Department of Commerce, 1999).

Employment

The service industry is the largest employer in Avoyelles Parish, employing 4,016 of 7,998 employees, with an annual payroll of $58.5 million in 1996 (U.S. Department of Commerce, County Business Patterns, 1996). This is due in large part to the Paragon Casino (the largest single employer) which employs over 1,000 employees (Louisiana Department of Economic Development, Avoyelles Parish Profile, 1998).

Employment in the parish in other economic sectors generally has been stable. In both 1993 and 1996, the sectors employing the largest numbers of persons were in decreasing order as follows: the service industry, retail trade, manufacturing, finance, construction, wholesale trade, and transportation (U.S. Department of Commerce, County Business Patterns, 1993, 1996).

Forestry

Timber has always been a source of wealth for Avoyelles Parish. In the years following the purchase of Louisiana from France (about 1815), cotton and lumber were the staples for Avoyelles Parish (Saucier, 1943:237). However, much of the timber was cleared in order to cultivate the land for cotton and other crops.

Today, Avoyelles Parish is approximately 27 percent forested, with 147,300 acres of timberland. In contrast, 52 percent of Louisiana is forested. Ninety percent of the parish's forest is in oak, gum, and cypress (USDA Forest Service, 1991).

In 1990, corporations were the largest forest landowner and owned 30 percent of the parish's forested land. The forest industry leased or owned 20 percent, and parish or municipal entities, private individuals, farmers, and miscellaneous Federal and State governments owned 17 percent, 13 percent, 10 percent, 3 percent, and 3 percent, respectively (USDA Forest Service, 1991).

Despite the diminished wooded acreage, timber is still a large source of income for Avoyelles Parish. In 1998, landowner income from the sale of timber was $3.3 million. In fact, income from the sale of timber increased 161 percent from 1988 to 1998 (Table 2-2). This is comparable with figures for the State of Louisiana, where landowner income from the sale of timber increased 162 percent during the same time period (Louisiana Department of Agriculture and Forestry, 1999).

Table 2-2: Summary of Avoyelles Parish, Louisiana, timber harvest and landowner income 1993 to 2003.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Saw Timber (million board feet)	10.6	8.5	6.9	13.4	8.9	9.4	3.9	2.4	7.6	7.7	10.0
Pine and Hardwood Pulpwood (thousand cords)	18.9	16.2	19.2	32.3	23.1	33.3	16.8	12.3	42.0	30.2	46.3
Landowner Income ($1,000,000)	1.73	2.26	2.24	4.14	2.32	3.33	1.39	0.95	2.52	3.01	4.05

Source: http://www.ldaf.state.la.us/divisions/forestry/reports/timberpulpwood/default.asp

Recreation

Avoyelles Parish has always had an abundance of fish and game, due to its diversity of lands and waters. As early as 1939 a sportsmen's club was created in Avoyelles Parish for the purpose of protecting game and wildlife (Saucier, 1943:303). Later, as part of a comprehensive wildlife management program, Lake Ophelia National Wildlife Refuge was created to preserve and restore habitat for native wildlife and migratory birds (U.S. Fish and Wildlife Service, n.d.). In addition to the Refuge, three State wildlife management areas are located within the parish: Grassy Lake (13,300 acres), Pomme de Terre (7,100 acres), and Spring Bayou (12,100 acres).

Refuge Recreational Use. Lake Ophelia Refuge contains large populations of fish and wildlife, including a number of game species. Indeed, these provide the primary recreational activities occurring on the Refuge, namely public hunting and fishing. Hunting and fishing on the Refuge are provided in accordance with Federal, State, and Refuge regulations.

Hunting is the most popular activity, with more than 1,500 hunters using the Refuge in 1998 (Lake Ophelia Refuge Management Information System, 2000). Deer, rabbits, squirrels, raccoons, waterfowl, woodcock, and snipe may be taken on the Refuge during the appropriate seasons. Feral swine may be taken during game seasons. Large portions of the Refuge are accessible for hunting only by all-terrain vehicle (ATV) trails, which are open only during the hunting season.

Fishing is the second most popular activity on the Refuge, with 1,000 participants in 1998 (Lake Ophelia Refuge Management Information System, 2000). There are three lakes suitable for fishing, with boat ramps on Duck Lake and Lake Ophelia.

Although Lake Ophelia Refuge is largely undeveloped (Figures 2-4 and 2-5), it received over 10,000 annual visits in both 2000 and 2001 (Lake Ophelia Refuge Management Information System, 2001). The Refuge has no camping facilities.

Outdoor Recreation Economics. In addition to those on the Refuge, the fish and game of Avoyelles Parish are economically important in two ways. First, a considerable commercial fishery is present in both the Red and Atchafalaya Rivers, along with local aquaculture operations. Crawfish and catfish are the major species harvested, and the buffalo fish is also important (Table 2-3). Secondly, hunting and fishing are economically important to local businesses, both directly as the local population spends money and indirectly as an attraction that draws sportsmen from outside the parish.

Unfortunately, a general lack of regard for the preservation of fish and wildlife resources, combined with wetland clearing and draining, has led to the loss of valuable fishery spawning grounds and to the loss of habitat for many wildlife species. In the attempt to restore and protect some of these resources, Lake Ophelia Refuge serves an important role, not only by providing habitat for a diversity of plant and wildlife species, but also as a place where people can go to enjoy these resources, either through observation or, more directly, through hunting or fishing.

When improved access, facilities, and staffing are added, Lake Ophelia Refuge can serve as an important commodity in the economic life of the community. Ecotourism, hunting, fishing, wildlife observation and photography, and environmental education and interpretation are increasingly being seen as a desirable industry. As the population increases and the number of places left to enjoy wildlife decreases, the Refuge may become even more important to the local community. It can benefit the community directly by providing recreational opportunities for the local population, and indirectly by attracting tourists from outside the parish to generate additional dollars to the local economy.

Tourism

With the opening of the Grand Casino Avoyelles (later renamed Paragon Casino) in May of 1994, tourism began to play a larger role in the local economy. Although tourism-related employment in Avoyelles Parish had been stagnant for a number of years, within two years after the opening of the Casino the parish's tourism employment increased 70 percent, along with a 53 percent increase in revenues and an 84 percent increase in payrolls. This compares with increases of 22 percent, 38 percent, and 37 percent, respectively, for the State (University of New Orleans, 1999; Table 2-4).

Because of its proximity to the Marksville community (and the casino), it is possible that Lake Ophelia Refuge could serve as an additional attraction to tourists visiting the area. If better roads and more facilities were provided within the Refuge, tourists might be enticed to stay longer in the area to enjoy the opportunities provided for wildlife-dependent recreation and environmental education. This could generate more income for the local economy.

Table 2-3. Major commercial fisheries harvest (pounds) in Avoyelles Parish, Louisiana, 1994-1998.

Fish	1994	1995	1996	1997	1998
Crawfish (Farm)	360,000	168,000	140,000	82,500	146,250
Catfish (Farm)	19,000	50,000	19,500	19,300	21,000
Crawfish (Wild)	295,000	297,000	287,000	306,000	311,000
Catfish (Wild)	64,000	65,000	63,000	147,000	150,200
Buffalo	86,000	89,000	87,000	105,000	105,200

Source: Louisiana Summary of Agriculture and Natural Resources

Table 2-4. Effects of tourism (revenue [$1000], payroll [$1000], and employment) on Avoyelles Parish, Louisiana, and the State of Louisiana 1992 to 1996.

		1992	1993	1994	1995	1996
Revenue	Louisiana	4,704,480	4,845,070	5,547,050	6,070,100	6,495,380
	Avoyelles	9,980	10,110	11,550	12,460	15,270
Payroll	Louisiana	977,110	999,120	1,162,960	1,270,970	1,337,530
	Avoyelles	1,150	1,180	1,430	1,590	2,120
Employment	Louisiana	77,480	77,310	85,230	91,120	94,190
	Avoyelles	100	100	100	120	170

Source: University of New Orleans, Division of Business Research

Transportation

In its early days, Avoyelles Parish relied on water transportation. The rivers and bayous which criss-cross the parish served as a means for transportation, trade, and communication for almost every community within the parish (Avoyelles Parish Planning Board, 1947:13). Some of the important waterways

Figure 2-4. Current visitor facilities at the northern end of Lake Ophelia National Wildlife Refuge.

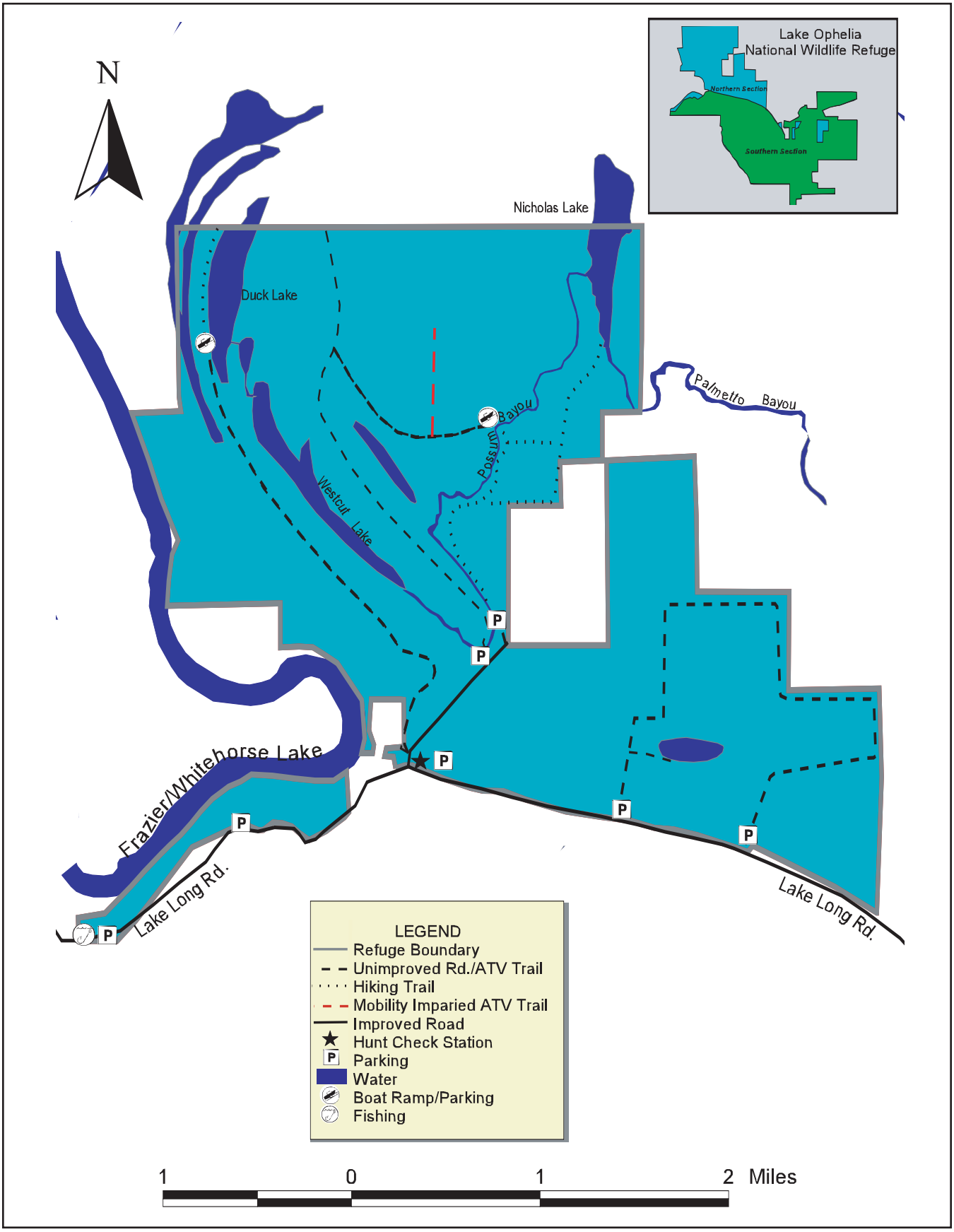
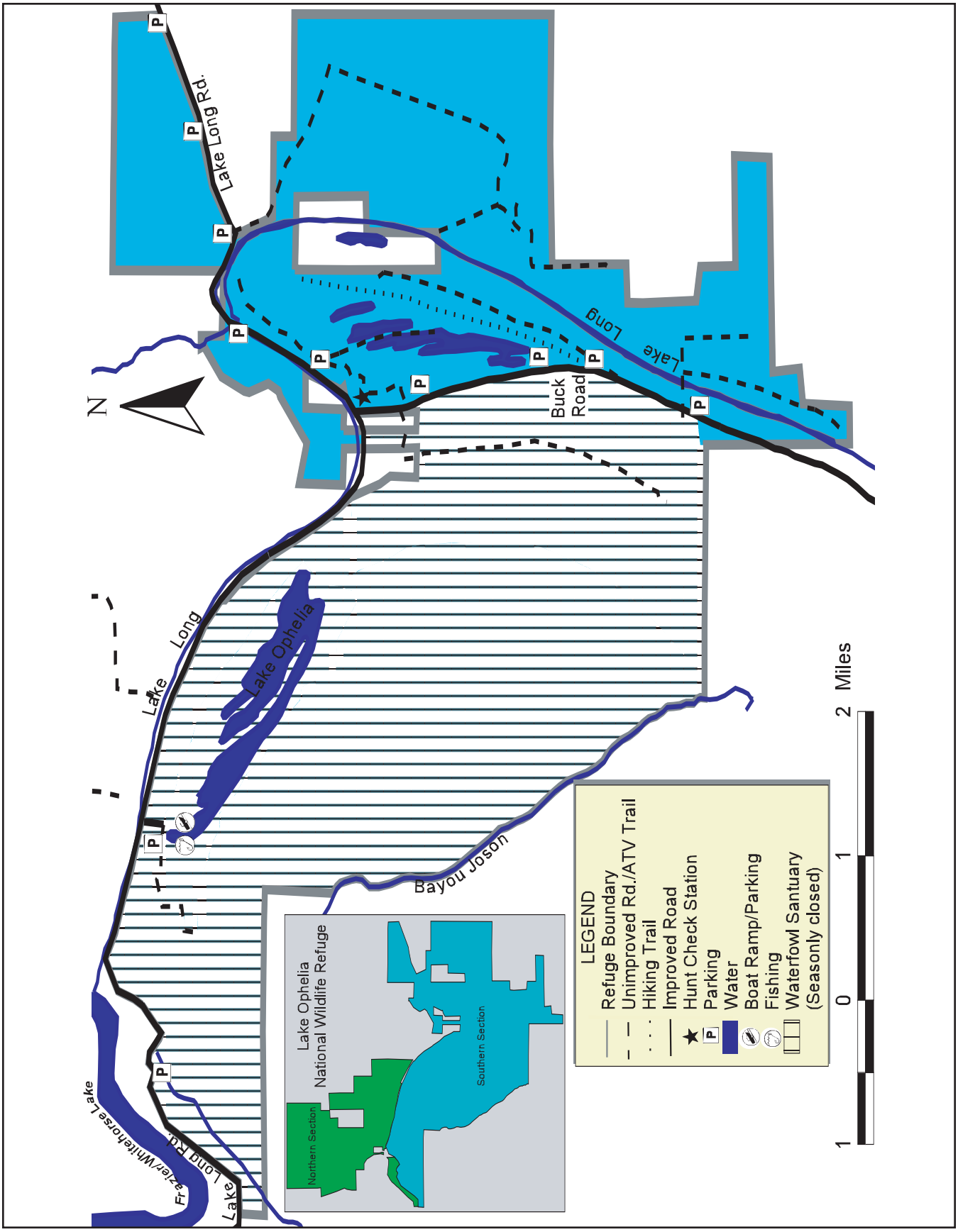


Figure 2-5. Current visitor facilities at the southern end of Lake Ophelia National Wildlife Refuge.



within the parish were the Red, Old, and Atchafalaya Rivers, and the Rouge, Des Glaises, Choctaw, and Boef Bayous. While today these waterways are no longer necessary for most of the transportation needs within the parish, they are still important as sources of income and for recreation.

Interstate Highway 49 and U.S. Highway 71 run through the southwestern portion of the parish, while Louisiana State Highway 1 runs through the center. A number of smaller roads connect the various communities within the parish.

Lake Ophelia National Wildlife Refuge, located in the northeastern part of Avoyelles Parish, can be reached via Louisiana Highway 452, a mostly paved road from Marksville. All roads within the Refuge are unpaved and are unsuitable for some vehicles. This is one of the primary factors limiting recreational use on the Refuge.

CULTURAL ENVIRONMENT

Archaeological investigations within the Refuge have been very limited and, with the exception of Gibson (1989), have occurred prior to the establishment of the Refuge. Eight archaeological sites have been recorded on the Refuge. The majority of the sites were occupied between 400 and1700 A.D. (Coles Creek and Plaquemine periods) and range from village sites to mound complexes. Two sites are 20th-century hunting and fishing camps. Sites from before 2000 B.C., if present on the Refuge, may be deeply buried or limited to the relict Pleistocene surfaces, such as the Avoyelles Terrace and Sicily Island. The meandering of the Red River's course over the last 12,000 years has essentially erased or buried earlier surfaces (Saucier, 1994).