

HABITAT MANAGEMENT PLAN

BLACK BAYOU LAKE NATIONAL WILDLIFE REFUGE

Ouachita Parish, Louisiana



Southeast Region





Black Bayou Lake National Wildlife Refuge

Habitat Management Plan



U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region

September 2013

Submitted by:

Brett Hortman

Date:

4-2-13

Brett Hortman, Refuge Manager,
Black Bayou Lake NWR

Submitted by:

Joe Saenz

Date:

4/2/13

Joe Saenz, Project Leader, North LA Refuges

Concur:

for Chuck Hunter

Date:

11/13/2013

Chuck Hunter,
Division Chief of Strategic Resource Management,
Southeast Region

Concur:

Richard P. Ingram

Date:

11/14/13

Ricky Ingram, Area Supervisor, Southeast Region

Approved by:

David Viker

Date:

12/4/13

David Viker, Regional Chief, Southeast Region



Table Of Contents

HABITAT MANAGEMENT PLAN

Chapter I. Introduction.....	1
Scope and Rationale	1
Legal Mandates.....	2
Relationship to Other Plans.....	3
Bird Conservation Plan for the Mississippi Alluvial Valley.....	4
Bird Conservation Plan for the West Gulf Coastal Plain	4
Southeast United States Regional Waterbird Conservation Plan.	4
Louisiana Comprehensive Wildlife Conservation Strategy	5
Chapter II. Background, Inventory and Description of Habitat.....	1
Location.....	1
Management Unit Descriptions.....	1
Physical or Geographic Setting.....	1
Climate	1
Topography and Hydrology.....	1
Soils.....	5
Historic Habitat Conditions.....	7
Current Habitat Conditions.....	11
Habitat Changes from Historic to Current Condition.....	17
Changes Associated with Global Climate Change	19
Chapter III. Resources of Concern.....	22
Breeding Wood Ducks.....	22
Significance	22
Identification of Habitat Requirements.....	23
Forest Interior Songbirds	24
Significance	24
Identification of Habitat Requirements.....	24
Rafinesque's Big-eared Bat and Southeastern Bat.....	25
Significance	25
Identification of Habitat Requirements.....	25
Upland Hardwood Forest.....	27
Significance	27

Identification of Habitat Requirements.....	27
Alligator Snapping Turtle	28
Significance	28
Identification of Habitat Requirements.....	28
Wading Birds.....	28
Identification of Habitat Requirements.....	29
Chapter IV. Habitat Goals and Objectives	30
Goal	30
Objective 1.1. Bottomland Hardwood Habitat.....	30
Objective 1.2. Bottomland Hardwood Habitat.....	31
Objective 1.3. Bottomland Hardwood Habitat.....	31
Objective 1.4. Bottomland Hardwood Habitat.....	32
Objective 1.5. Bottomland Hardwood Habitat.....	33
Objective 2.1. Upland Pine-Hardwood Habitat	33
Objective 3.1. Demonstration Prairie.....	34
Objective 3.2. Demonstration Moist Soil Units.....	34
Chapter V. Habitat Management Strategies	35
Potential Management Strategies.....	35
Strategy A. Potential Moist Soil Management Strategies.....	35
Strategy B. Potential Chemical Management Strategies	35
Strategy C. Potential Prescribed Fire Management Strategies.....	36
Strategy D. Potential Beaver and Feral hog Management Strategies.....	37
Strategy E. Potential Forest Management Strategies.....	37
Management Strategy Prescriptions.....	39
Strategy A. Moist Soil Management Strategy Prescription	39
Strategy B. Chemical Management Strategy Prescription	39
Strategy C. Prescribed Fire Management Strategy Prescription.....	40
Strategy D. Beaver and Feral Hog Management Strategy Prescription	40
Strategy E. Forest Management Strategy Prescription.....	41
Chapter VI. Literature Citations.....	43

APPENDICES

Appendix A. The Commercial Sale of Timber	49
Execution of Timber Harvest	49
Cruising and Marking Timber	49
Logging Operations.....	52
Monitoring	53
Archeological and Cultural Resources	54
Aesthetics	55
Forest Openings	55
Insects and Disease.....	55
Timber Salvage and Unscheduled Harvesting	56
Administration of Sales.....	56
Conditions Applicable to Timber Harvesting Permits.....	56
Control Records.....	58
Sale Folders.....	58
Bid Invitations	58
Bids and Performance Deposits.....	59
Special Use Permit	59
Payment for Forest Products and Administration of Receipts.....	59
Appendix B. Environmental Action Statement	71
Preferred Alternative.....	71
Categorical Exclusion(s).....	71
Permits/Approvals	72
Public Involvement/Interagency Coordination	72
Supporting Documents	73

LIST OF FIGURES

Figure 1. North Louisiana Refuges Complex.	2
Figure 2. Six management units of Black Bayou Lake NWR.	3
Figure 3. Elevation levels at Black Bayou Lake NWR.....	4
Figure 4. Water levels for Black Bayou Lake, 2010-2012.	5
Figure 5. Soil types on Black Bayou Lake NWR.....	8
Figure 6. Historical aerial photo from 1950s of Black Bayou Lake NWR.....	10
Figure 7. Vegetation types present on Black Bayou Lake NWR.	13
Figure 8. Baldcypress trees showing signs of stress due to constant inundation.....	14

LIST OF TABLES

Table 1. Description of six management units on Black Bayou Lake NWR.	6
Table 2. Historical timeline of the area before Black Bayou Lake National Wildlife Refuge was established.....	20
Table 3. Baldcypress and tupelo old-growth attributes (modified from Devall 1998).	26
Table 4. Order of Entry 2013-2025.....	49

I. INTRODUCTION

Throughout the century of its existence, the National Wildlife Refuge System has established a reputation as a premier ground for the refinement of wildlife habitat management techniques. Since the establishment of Pelican Island National Wildlife Refuge in 1903, refuge employees have taken pride in developing the latest tools for wildlife conservation with limited resources. Some of the first examples of rocket nets and airboats—equipment now considered essential for wildlife management—were developed by refuge employees. The first prescribed fire on refuge lands was conducted in 1927 at a time when the benefits of this natural process were not well recognized, and when most federal agencies still considered fire to have “no place in any forest” (USFS 2004).

As the discipline of wildlife management evolved, largely through the efforts of Aldo Leopold with his publication of *Game Management* in 1933, it was recognized that a greater emphasis needed to be placed on making decisions that are based on the best science of the day, while retaining some of the artful intuition that comes from years of field experience. Sound wildlife and habitat management will always involve the skillful integration of science and art in disciplines as diverse as biology and sociology.

Habitat is defined as simply “the physical and biological surroundings of an organism” (Bolen and Robinson 1995). It includes all of the natural components of an ecosystem that are essential for survival, including food, cover, and water. The processes that shaped the natural resources of northern Louisiana, including Black Bayou Lake National Wildlife Refuge, are complex and dynamic. This Habitat Management Plan was developed to provide a clear, science-based outline for managing Black Bayou Lake National Wildlife Refuge in today’s challenging environment. To this end, this plan was developed as a first step in closing the gap between the needs of the refuge’s wildlife and the knowledge of its stewards.

SCOPE AND RATIONALE

Habitat management plans (HMPs) are dynamic working documents that provide refuge managers with a decision-making process; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the role of refuge habitat in international, national, regional, tribal, state, ecosystem, and refuge goals and objectives; guides the analysis and selection of specific habitat management strategies to achieve those habitat goals and objectives; and utilizes key data, scientific literature, expert opinion, and staff expertise.

An HMP is a step-down management plan of the refuge’s Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a refuge or planning unit. It provides long-range guidance and management direction to achieve the purpose(s) of the refuge; helps fulfill the mission of the System; maintains and, where appropriate, restores the biological integrity, diversity, and environmental health of each refuge and the System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates. The CCP for Black Bayou Lake National Wildlife Refuge (NWR) was completed in 2010 (USFWS 2010).

HMPs comply with all applicable laws, regulations, and policies governing the management of the National Wildlife Refuge System. The lifespan of an HMP is 15 years and parallels that of the refuge's CCP. HMPs are reviewed every 5 years through peer review recommendations, as appropriate, in the HMP revision process or when initiating refuge CCPs. Annual Habitat Work Plans (AHWPs) are prepared to guide the implementation and assessment of specific management prescriptions to meet the habitat objectives established in the HMP.

LEGAL MANDATES

The statutory authority for conducting habitat management planning on national wildlife refuges is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (Refuge Improvement Act), 16 U.S.C. 668dd - 668ee. Section 4(a)(3) of the Refuge Improvement Act states, "With respect to the System, it is the policy of the United States that each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established ..." Section 4(a)(4) states, "In administering the System, the Secretary shall monitor the status and trends of fish, wildlife, and plants in each refuge." The Refuge Improvement Act provides the U.S. Fish and Wildlife Service (Service) with the authority to establish policies, regulations, and guidelines governing habitat management planning within the System (Service Manual 620 FW 1).

The purposes of a national wildlife refuge, as established by Congress or the Executive Branch, are the barometer by which all actions on that designated public land are measured. Habitat management, public use, and all other programs are conducted as required to fulfill the established purposes of the refuge.

Black Bayou Lake NWR was established in 1997 for "... the conservation of the 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. 3901 (b) (Wetlands Extension Act) when approximately 1,700 acres of the lake proper were leased (free) from the City of Monroe, Louisiana, for 99 years. Additional acreage has been acquired since its establishment.

In addition to the specific purposes that were established for each refuge, Congress passed the National Wildlife Refuge System Improvement Act in 1997. This legislation provides clear guidance for the mission of the Refuge System and prioritizes wildlife-dependent public uses. The Act states that each refuge will:

- Fulfill the mission of the National Wildlife Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Fulfill the requirement of preparing a comprehensive conservation plan for each unit of the Refuge System;
- Maintain the biological integrity, diversity, and environmental health of the Refuge System;
- Recognize that wildlife-dependent recreation activities, including hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation are legitimate and priority public uses; and
- Retain the authority of refuge managers to determine compatible public uses.

The vision for Black Bayou Lake NWR was developed during the planning for the refuge's Comprehensive Conservation Plan (USFWS 2010). It states:

The Black Bayou Lake National Wildlife Refuge will be managed to provide for the restoration, enhancement, and conservation of bottomland hardwood forests, wetlands, and mixed pine/hardwood uplands, as an integral component of the Black Bayou Lake ecosystem. These habitats will support a variety of migratory birds, species of special concern, and other associated wildlife and plants. This effort will be enhanced and encouraged through both strong partnerships and public support by providing opportunities for environmental education and interpretation, hunting, fishing, and wildlife observation and photography. Black Bayou Lake NWR will be the focal point for environmental education and interpretation for the entire North Louisiana National Wildlife Refuge Complex.

It is important to note that because Black Bayou Lake NWR is situated partially within the city limits of Monroe, it serves primarily as an environmental education center. The refuge's facilities include an observation tower, a wildlife pier and boardwalk, an amphitheater, a photo blind, a birdwatching blind, hiking trails, visitor center, the Conservation Learning Center, and a boat ramp. The refuge also has a demonstration prairie and demonstration moist soil units for educational purposes.

RELATIONSHIP TO OTHER PLANS

The CCP for Black Bayou Lake NWR was completed in 2010. It includes the goals and objectives for refuge management over a 15-year period (USFWS 2010). The Biological Review Report was instrumental in the development of the CCP (USFWS 2008). The purpose of this Habitat Management Plan is to provide more specific guidance that will facilitate the selection of prescriptions for implementing the goals and objectives of the CCP. In order to maintain consistent strategies for managing the refuge's wildlife and habitats, several other planning documents were also used in the development of this HMP.

Currently, no threatened or endangered species are known to inhabit the refuge. There is always the possibility that a Louisiana black bear could traverse the refuge; however, the refuge is not officially considered critical habitat for bears, nor does the refuge have sufficient habitat to support a population of Louisiana black bear. When the Service first acquired lands to the east of the lake, one endangered red-cockaded woodpecker was found; however, it has not been present for over eleven years.

Black Bayou Lake NWR is located on the western edge of the Mississippi Alluvial Valley (MAV) and within the Gulf Coastal Plain Ozarks Landscape Conservation Cooperative (GCPOLCC). Because the refuge is situated so close to the West Gulf Coastal Plain, it does contain the upland pine forest associated with this ecoregion, unlike most areas in the MAV that are floodplain forests. Although the refuge is technically within the MAV, plans for the West Gulf Coastal Plain are included in this planning effort to direct management of the pine forest on the refuge. Other plans incorporated into the HMP include the Bird Conservation Plans for the Mississippi Alluvial Valley (Twedt et al. 1999) and West Gulf Coastal Plain (Taulman et al. 1999); the Southeast United States Waterbird Conservation Plan (Hunter et al. 2006); and the Louisiana Comprehensive Wildlife Conservation Strategy (Lester et al. 2005). These plans are summarized in the following sections.

BIRD CONSERVATION PLAN FOR THE MISSISSIPPI ALLUVIAL VALLEY

The Mississippi Alluvial Valley mostly contains bottomland hardwood forest comprised of oak-hickory or oak-gum-cypress vegetation types. These forests are of high conservation priority for conserving the natural communities and the bird populations within these habitats. The primary threats to these forests include hydrological alteration and habitat conversion, often to agriculture. This HMP will define conservation strategies to foster support for the priorities of the Mississippi Alluvial Valley. The habitats found on Black Bayou Lake NWR and the associated species of birds that are considered a priority in the MAV include:

Bottomland Hardwood Forest: Swainson's warbler, swallow-tailed kite, cerulean warbler, prothonotary warbler, painted bunting, red-headed woodpecker, northern parula, worm-eating warbler, Kentucky warbler, orchard oriole, yellow-billed cuckoo, wood thrush, and white-eyed vireo.

BIRD CONSERVATION PLAN FOR THE WEST GULF COASTAL PLAIN

This section of the region is primarily mixed pine/hardwood types with bottomland hardwood forest species in the more mesic areas and on slopes. These forests are of high conservation priority for conserving the natural communities and the bird populations within these habitats. The primary threats to these forests include reservoir construction; stream modifications; destructive timber harvesting practices; and conversion to pine plantations, pastures, and other land uses (Taulman et al. 1999). This HMP will define conservation strategies to foster support for the priorities of the West Gulf Coastal Plain. The habitats found on Black Bayou Lake NWR and the associated species of birds that are considered a priority in the West Gulf Coastal Plain include:

Upland Mixed Hardwood/Pine Forest: American woodcock, chuck-will's-widow, red-headed woodpecker, eastern wood-pewee, yellow-throated vireo, brown-headed nuthatch, worm-eating warbler, Kentucky warbler, and hooded warbler.

Bottomland Hardwood Forest: Swainson's warbler, American woodcock, red-headed woodpecker, eastern wood-pewee, Acadian flycatcher, white-eyed vireo, wood thrush, yellow-throated warbler, cerulean warbler, prothonotary warbler, Kentucky warbler, hooded warbler, and orchard oriole.

SOUTHEAST UNITED STATES REGIONAL WATERBIRD CONSERVATION PLAN.

This plan provides a framework for the conservation and management of waterbirds in the Southeast that are not covered by either the North American Waterfowl Management Plan or the U.S. Shorebird Conservation Plan. Threats to waterbird populations include destruction of inland and coastal wetlands; introduced predators and invasive species; pollutants; mortality from fisheries and industries; disturbance; and conflicts arising from abundant species. Particularly important habitats include pelagic areas, marshes, forested wetlands, and barrier and sea island complexes. The Mississippi Alluvial Valley is considered to have "high responsibility and interest" for these species of concern needing management attention: little blue herons, white ibis, and yellow-crowned night-herons.

All three species can be found on the refuge. A rookery existed on the lake in 2000 that had nests of all three species; however, it was short-lived.

LOUISIANA COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

The Louisiana Department of Wildlife and Fisheries (LDWF) is a critical partner in the effort to implement conservation strategies. In 2005, the LDWF published the Louisiana Comprehensive Wildlife Conservation Strategy as required by Congress in association with federal funding. This state plan is a “blueprint for guiding LDWF in the development of management actions for Louisiana’s fish and wildlife species with emphasis on species of conservation concern and associated habitat they depend upon” (Lester et al. 2005). The state plan identifies all vegetation communities in the state, along with the species of concern and threats that are associated with each community. Black Bayou Lake NWR has habitats described as Mixed Hardwood-Loblolly Forest, Bottomland Hardwood Forest, and Cypress Swamp communities listed in the state plan.

This Habitat Management Plan also incorporates the recommendations of other approved station plans, including the Fire Management Plan (USFWS 2011) and the Wildlife and Habitat Biological Review Report (USFWS 2008). The prescribed fire strategies detailed in this HMP will be incorporated into the next revision of the Fire Management Plan.

II. BACKGROUND, INVENTORY AND DESCRIPTION OF HABITAT

LOCATION

Black Bayou Lake NWR is located in northeastern Louisiana, seven miles north of Interstate Highway 20 in Monroe, Louisiana, in Ouachita Parish. The northwestern portion of the refuge borders Bayou Desiard and overlays most of Black Bayou Lake. The refuge's current acquisition area encompasses 6,200 acres, of which 4,522 acres have been purchased. Black Bayou Lake NWR is administered by the North Louisiana Refuges Complex (Figure 1).

MANAGEMENT UNIT DESCRIPTIONS

The refuge is delineated into six management units (Figure 2) that represent manageable blocks of habitat. The habitat type, size, soil type, current condition, and past management history for each unit is described in Table 1. It is important to note that the Service does not own the lake itself. It leased from the City of Monroe for free. The city uses the lake as its secondary water supply and manages the lake levels accordingly. The Service cannot manage the lake's water levels.

PHYSICAL OR GEOGRAPHIC SETTING

CLIMATE

Temperatures normally range between 20°F (Fahrenheit) to 70°F during the winter, and 70°F to 95°F during the summer. The average annual growing season is 237 days. Mean annual precipitation is 49.6 inches. Thirty percent of the total occurs in the wettest months of February through April, and 15.7 percent in the driest months of August through October. Snowfall and ice storms are uncommon occurrences.

TOPOGRAPHY AND HYDROLOGY

The western portion of the refuge along Bayou Desiard is relatively flat with elevations averaging 82 feet above mean sea level (MSL). The lake shoreline averages 70-72 feet. The eastern portion of the refuge is a flat terrace at 94-97 feet, with fingers of the lake entwined throughout the uplands causing 20 feet of elevation change (Figure 3).

Black Bayou Lake NWR is in the northern portion of the Lower Ouachita Watershed. The water levels at Black Bayou Lake are managed by the City of Monroe according to a water management plan to ensure a readily available drinking water source. A water control structure located near Hannah's Run on the western edge of the lake is used by the city to manage water levels by regulating the flow of water from the adjacent Bayou Desiard. Because the city is interested in ensuring an available water supply during the drought of summer, the lake has been kept high at 72 feet (Figure 4). During the winter and spring when flooding is possible in Monroe, the city lowered the level of the lake for flood protection to 70.5 feet. This hydrological regime is opposite of what would naturally occur, with water levels lower during the hot months of summer and higher during the winter and spring when most rainfall occurs. In 2010, the U.S.

Figure 1. North Louisiana Refuges Complex.

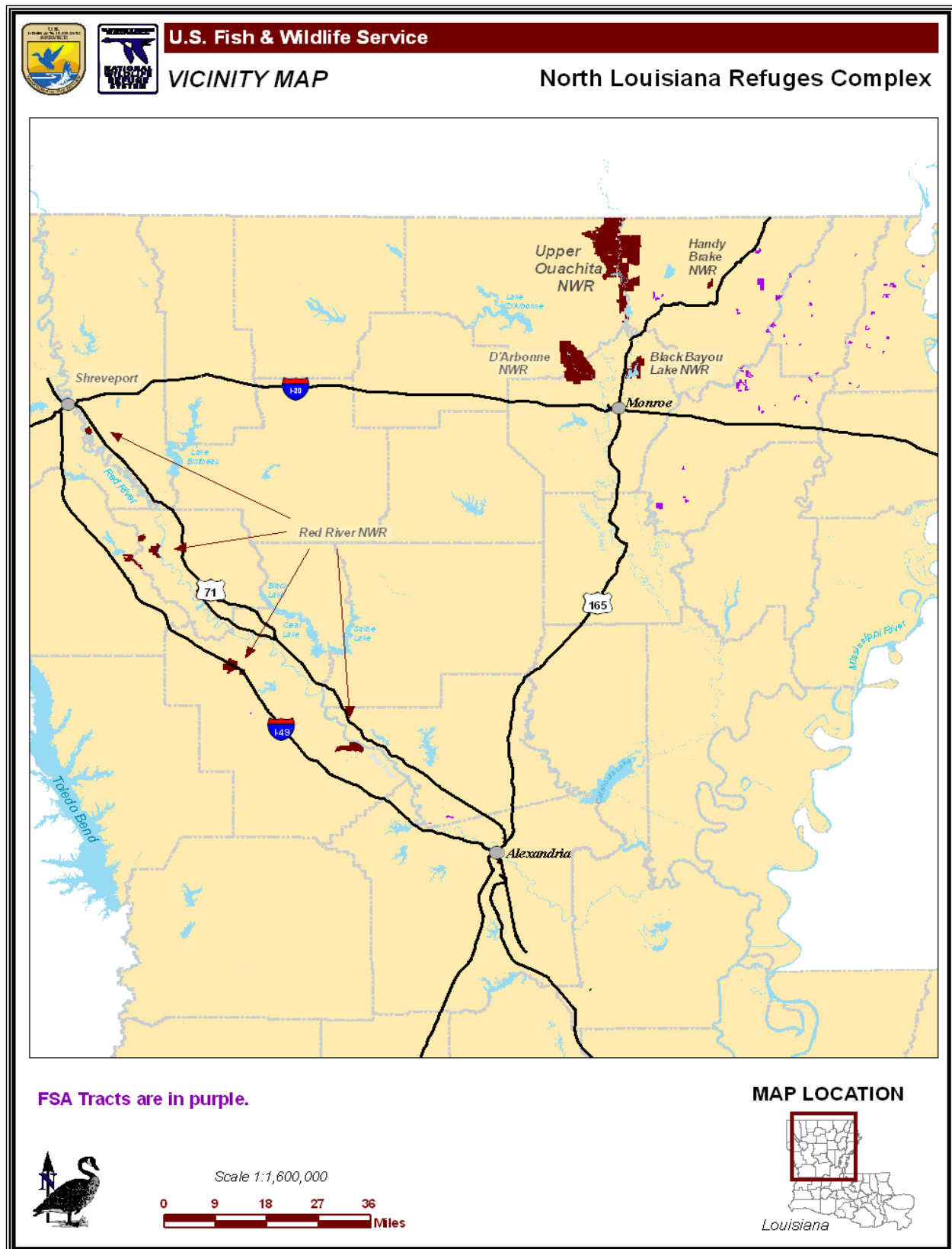


Figure 2. Six management units of Black Bayou Lake NWR.

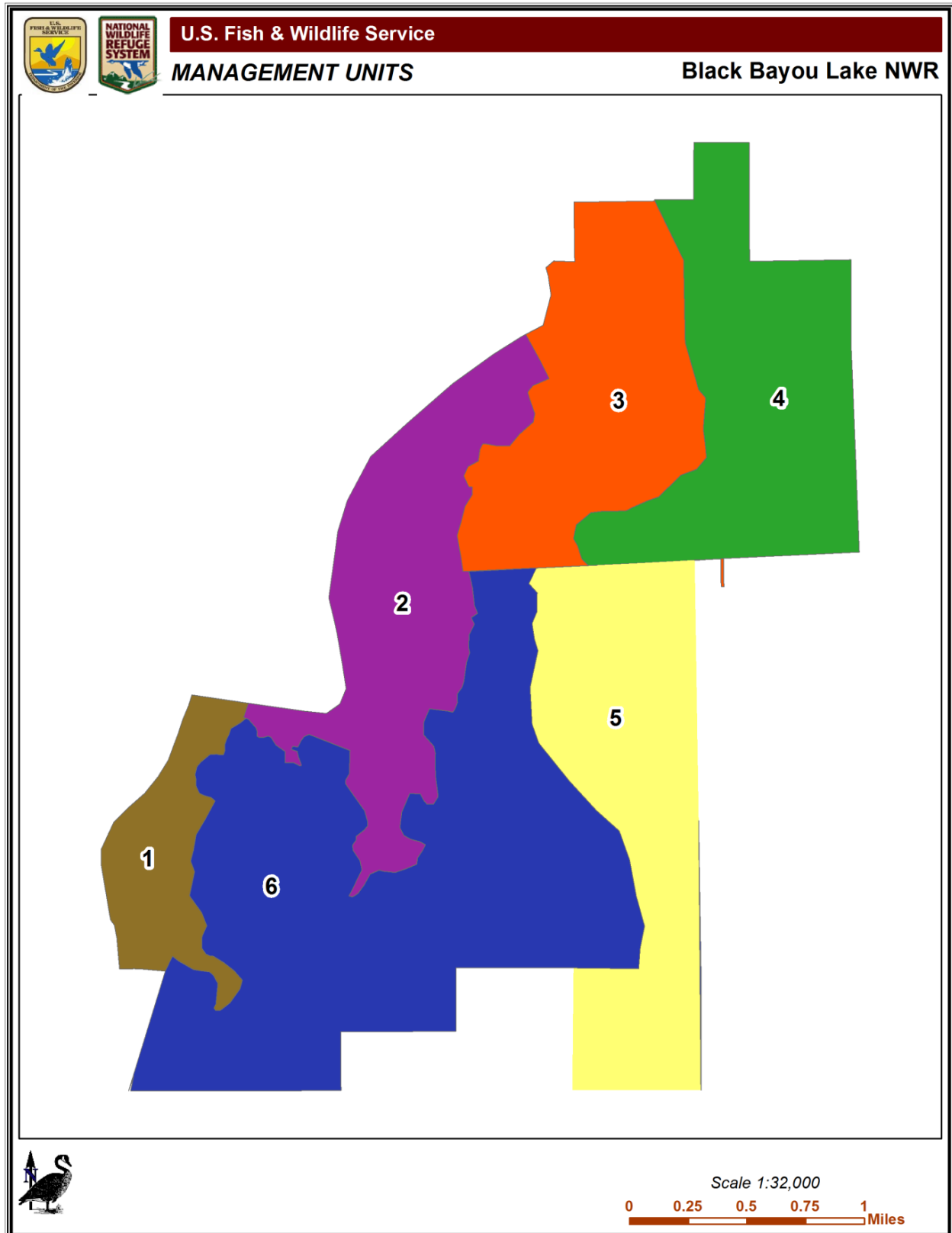


Figure 3. Elevation levels at Black Bayou Lake NWR.

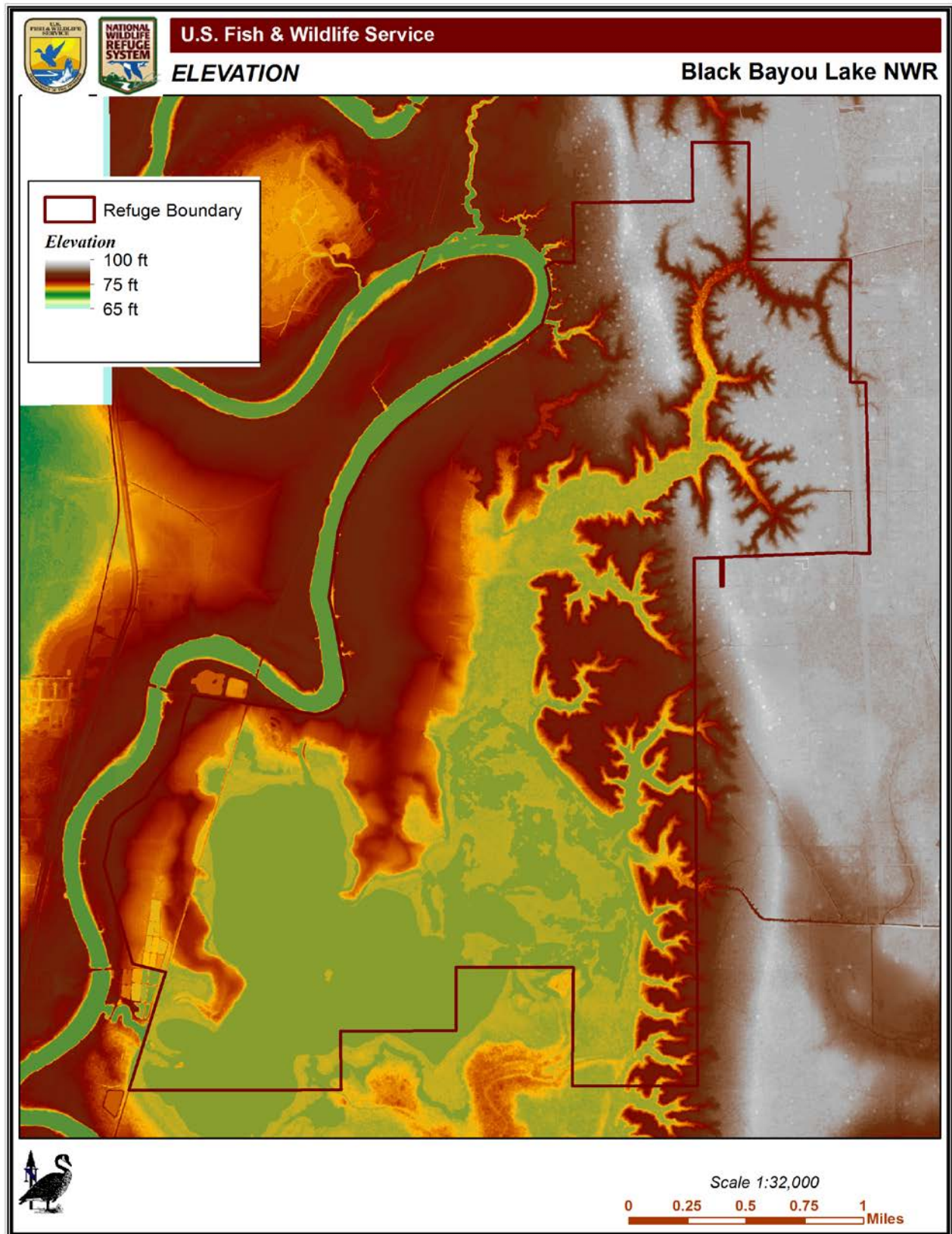
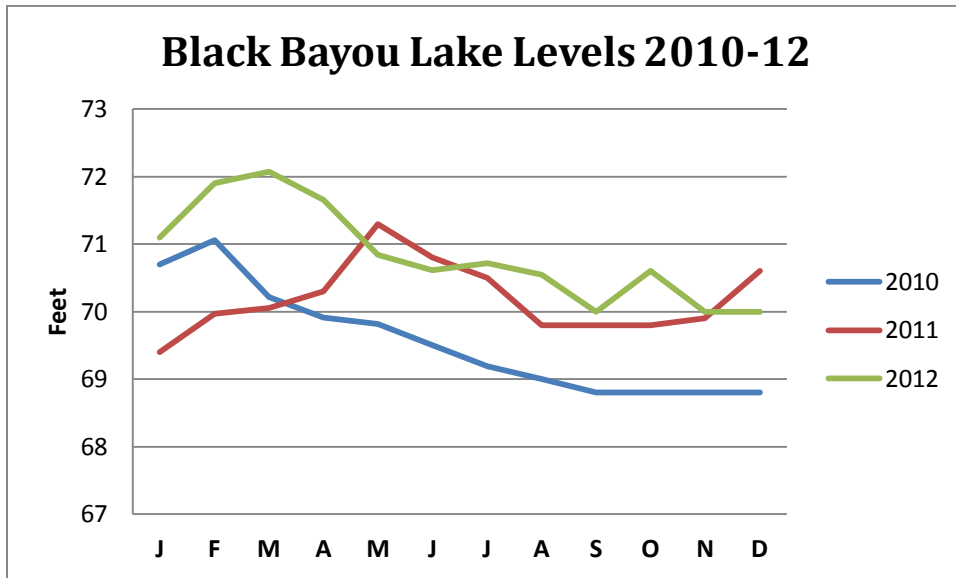


Figure 4. Water levels for Black Bayou Lake, 2010-2012.



Fish and Wildlife Service met with the City of Monroe in an attempt to change the lake's water management regime. The City compromised and tries to manage the water levels closer to the natural hydrology, with lower levels in the summer and fall and higher levels in the winter and spring. Even if the lake was allowed to rise and fall with Bayou Desiard, it would not be a natural hydrological regime. Bayou Desiard has been dammed from the Ouachita River.

SOILS

Nine soil types are found on the refuge (USDA 1974) (Figure 5). The Providence, Frizzell, and Muskogee soils represent the most acreage. The Providence soils (740 acres) are found on the northeast corner of the refuge along the lake. They are strongly acidic, moderately well-drained loamy soils. Pine forest is found on most Providence soils in the parish.

Frizzell soils (700 acres), also found on the northeast corner of the refuge, are poorly drained, low in fertility, strongly acidic, and silty. These soils support mostly pine and hardwood forests.

Muskogee soils (430 acres) are found on the east and southeast portions of the refuge against the lake. These soils are well-drained and loamy. They are gently sloping, acidic, and usually support second-growth pine forests and some hardwoods.

Much of the reforestation area has Sterlington, Rilla and Hebert soils. The prairie demonstration area is on Rilla and Hebert soils. Rilla soils are well-drained and loamy, occurring on natural levees of the Ouachita River. They are strongly acidic and most of these soils are used for crops in the parish. Hebert soils are more poorly drained, loamy, acidic, and mostly support row crops or pasture. Sterlington soils are well drained and loamy, and occur on natural levees of the Ouachita River and along Bayou Desiard.

Table 1. Description of six management units on Black Bayou Lake NWR.

Management Unit	Size (ac)	Soil Type	Current Condition	Refuge Treatment History
1	242	Sterlington, Hebert, Portland, Rilla	92% Reforested hardwoods, 13 yrs old; 8% Demonstration Moist-soil	Reforested in 2000 with cow oak, cherrybark oak, shumard oak, sweetgum, green ash, American elm, sweet pecan, hackberry, sycamore, water oak, nuttall oak, overcup oak, willow oak, baldcypress, persimmon. Moist soil is disturbed and flooded annually.
2	657	Sterlington, Rilla, Portland, Hebert	90% Reforested hardwoods, 12 yrs old; 2% Mature upland hardwoods; 7% Refuge facilities; 1% Demonstration Prairie	Reforested in 2001 with cow oak, cherrybark oak, shumard oak, sweetgum, green ash, American elm, sweet pecan, hackberry, sycamore, water oak, nuttall oak, overcup oak, willow oak, baldcypress, persimmon
3	635	Providence, Frizzell, Perry	60% mature loblolly pine-hardwood; 17% Baldcypress/water tupelo; 22% Bottomland hardwood	119 acres thinned in 2003.
4	728	Providence, Frizzell, Guyton	90% mature loblolly pine-hardwood 10% Baldcypress/water tupelo	304 acres thinned in 2003.
5	743	Muskogee, Providence, Perry, Frizzell	73% loblolly pine-hardwood; 27% Baldcypress/water tupelo	None

Management Unit	Size (ac)	Soil Type	Current Condition	Refuge Treatment History
6	1479	Perry, Portland, Sterlington	48% open water; 34% Baldcypress/water tupelo; 18% Bottomland hardwood	None

HISTORIC HABITAT CONDITIONS

Geomorphology

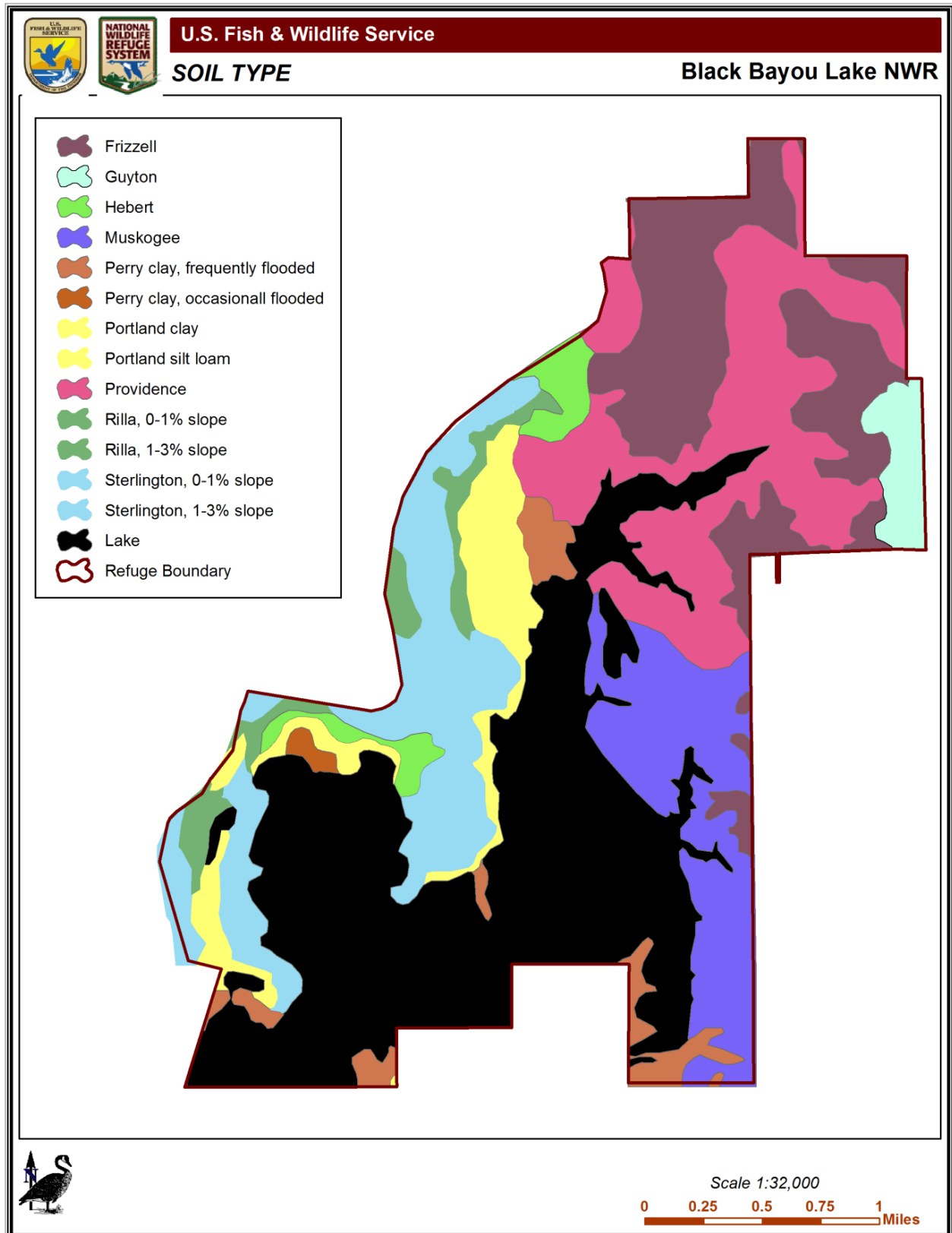
As the climate has changed on the Earth, marine and deltaic sediments have been deposited in alternating cycles in Louisiana. The eastern half of Ouachita Parish is an alluvial floodplain except for a level, well-drained terrace standing about 20 to 30 feet above the surrounding recent floodplain area at approximately 95 feet above mean sea level (MSL) (Figure 4). This terrace begins on the east side of Black Bayou Lake and is made of materials brought in by the Ouachita River and deposited as an alluvial fan. Later this alluvial fan was partly removed by an early Arkansas River, leaving the extensive remnant known today as the Flatwoods terrace (Wang 1952).

History of Refuge Lands

The purpose of habitat management is often to restore an area to the historical conditions that were present before the land was substantially altered by European settlement. Most habitat loss in northern Louisiana occurred within the last 100 years when development, especially in the past 40 years, increased. There are other human effects on the environment that are less conspicuous than development but can result in severe degradation of habitat. For example, alterations to the natural hydrology, such as levees, channelization of rivers, locks and dams, etc., have severe negative effects on bottomland hardwood systems and other wetlands. Lands managed for timber are harvested at an early age. When the forest is not allowed to mature, the ecosystem does not function naturally. Introduction of exotic plants and animals can and do alter habitats. Although these factors do not cause the dramatic die-off of animals that can be readily observed, the subsequent gradual downward trend in wildlife reproduction can result in the extirpation of a species from its native range.

In order to define objectives for habitat management on the refuge, a substantial effort was made to determine the historical condition of the refuge lands and their surrounding areas. Historical literature, aerial photographs, and consultations with state agency biologists were used during the development of this HMP.

Figure 5. Soil types on Black Bayou Lake NWR.



Cultural and Refuge Land History

Between 10,000 BC and 1400 AD, Native Americans inhabited northeastern Louisiana. The Paleo-Indian people developed regional culture groups; along the Ouachita River, the Caddo people were becoming defined. French explorers, hunters, and trappers traveled through the areas in the 16-1700s. By 1769, the area later known as the city of Monroe, called Prairie des Canots, had become a place of trade. In its place, Fort Miro was constructed in 1791 by Spain, later being incorporated as the City of Monroe by the State of Louisiana in 1820 (Louisiana entered the Union in 1812).

The cultivation of cotton began as early as 1800 in Ouachita Parish. By the mid-1800s, cotton had changed the nature of the parish. Steamboats plied the Ouachita River and the city of Monroe had a steam-powered cotton gin. Circa 1885, Lemuel Dawson McLain and his wife Ann "Mattie" Crosley McLain built a house on Richland Plantation, part of the larger Cottonport Planation estate owned by J.P. and Martha Crosley. Richland Plantation was a 900-acre cotton farm located on what is now Black Bayou Lake NWR. This house is now the refuge's visitor center.

By the turn of the century, West Monroe had become a paper mill town fed by the abundant timber in surrounding areas. In 1910, the Arkansas, Louisiana and Gulf (AL&G) Railroad was completed across the western portion of Black Bayou Lake, cutting the lake off from Bayou Desiard at Hannah's Run (where a water control structure exists today). In 1935, Bayou Desiard was dammed (cut off) from the Ouachita River. An historical aerial photograph of Black Bayou Lake from the 1950s shows all of the land on both sides of Bayou Desiard cleared of trees for agriculture (Figure 6). Black Bayou Lake National Wildlife Refuge was established on June 16, 1997, when approximately 1,700 acres of the lake proper were leased (free) from the City of Monroe for 99 years. The 900-acre cotton plantation that had been continuously farmed for over a century was purchased along with 1,300+ acres in 2000 by the Service. Another 600 acres were purchased from Louisiana Department of Wildlife and Fisheries in 2005. Approximately 1,700 acres remain to be acquired within the 6,200-acre acquisition boundary.

Pre-European Settlement Conditions

Bottomlands

The bottomlands in northern Louisiana consist of bottomland hardwood forest, baldcypress/tupelo swamps, sloughs, shrub-scrub wetlands, forested and emergent lakes, ponds, rivers, and bayous. Because the area's rivers, bayous and lakes are not generally managed, this section focuses on bottomland hardwood forests. These forests are forested wetlands that are found along rivers and streams. The extent of impact on bottomland forests by Native Americans is disputed. Early explorers, such as DeSoto, reported extensive tracts of forest with cleared fields and villages dispersed unevenly in the Lower Mississippi Alluvial Valley (King et al. 2005). Generally, the first terrace was cleared for agriculture by natives, but the backswamps were left untouched. Although Native Americans had altered the forest somewhat, many European explorers, such as Bartram and Nuttall, described the area as having vast tracts of pristine, untouched forest.

U.S. Fish & Wildlife Service

1950s AERIAL IMAGERY

Black Bayou Lake NWR

Legend

Refuge Boundary

Black Bayou Lake

Scale 1:60,600

0 0.9 1.8 2.7 3.6 Miles

Bottomland hardwood forest composition is driven by hydrology. Very slight changes in elevation result in different plant communities. Prior to Europeans making drastic alterations to the hydrology of these forests in an effort to drain them, these forests were intact, pristine wildernesses.

Researchers have studied General Land Office surveys in an attempt to characterize the bottomland hardwood forests before European settlement. Ouchley et al. (2000) found that oaks were not the dominant species during presettlement times on nearby Bayou Cocodrie NWR. Rather, sweetgum made up the largest amount of basal area, was the dominant species, and had the second largest trees, next to baldcypress. In another study, Ouchley et al. (1999) synthesized three studies conducted by the U.S. Forest Service during the early 1900s that described these forests in Louisiana. Two of these early reports were conducted within 60 miles of Black Bayou Lake NWR, where Tensas River NWR is located. The results showed that bottomland forests during the early 1900s had 75 to 150 trees per acre. Sweetgum was the dominant species, but there was a high tree diversity present including 25 other species. Sweetgum lived longer (up to 350 years), was larger in diameter, and was taller than the oaks that were present. Ouchley et al. (1999) described these old-growth forests in Louisiana as being diverse in species, size, and age, with 2-3 trees per acre being extremely large. Ouchley et al. (1999) also found that small gaps created by single trees falling were distributed across the landscape, causing a mosaic of different age- and size-classed trees.

Uplands

Bragg (2003) analyzed General Land Office surveys from 1818-1855 in Ashley County, Arkansas, which is just north of the refuge. He found that pine was often underrepresented in the GLO records by surveyors, probably because their large size was not favored as a witness tree. The surveyors often described the forests as open pine with grassy understories that were subject to flooding. Several surveyors' descriptions included observations of areas burned over by fire. The pine flatwoods adjacent to the Ouachita River were extensive, and the largest pine recorded in the GLO surveys was a loblolly pine with a diameter at breast height (dbh) of 72 inches (Bragg 2003).

Catastrophic events, such as tornadoes, created openings where loblolly pine would come into a disturbed area. If that area burned regularly, then the loblolly pines overtook the hardwoods; or if it burned frequently and intensely, shortleaf pine would overtake the loblolly. The land could stay in this state for a few hundred years, but eventually hardwoods would succeed. Hardwood trees would then remain in the stand until another catastrophe occurred, causing disturbance that allowed loblolly pine to reestablish. If fire was frequent, the loblolly pine would stay dominant and keep reestablishing itself. However lower, wetter areas would not have burned as frequently, allowing hardwoods to establish. Therefore, these uplands contained both hardwoods and pine, with the mix depending on fire frequency. These forests were dynamic, changing spatially and temporally across the landscape due to the influence of disturbance, mostly fire (Tom Foti, personal communication, Arkansas Natural Heritage).

CURRENT HABITAT CONDITIONS

The refuge is situated on the western edge of the Mississippi Alluvial Valley. In this region, hydrology plays a very important role in determining the composition and character of floodplain plant communities because each species has a different level of tolerance to flooding.

Black Bayou Lake NWR currently consists of 1,653 acres of upland mixed pine-hardwood; 1,231 acres of bottomland hardwood forest, of which 766 acres have been reforested; 825 acres of baldcypress-water tupelo; 717 acres of open water; 4 acres of demonstration prairie, and 15 acres of demonstration moist soil impoundments. The refuge's remaining acreage consists of buildings, trails, roads, rights-of-way, and other facilities (Figure 7).

Bottomlands

Within the bottomland forest, small patches of giant cane are present, particularly along rights-of-way where sunlight penetrates the canopy. Reforestation efforts in 2000 and 2001 involved the planting of a wide variety of species, depending on the elevation at each location. The species planted included overcup oak, baldcypress, water tupelo, mayhaw, and green ash in the lowest areas. The ridges along Bayou Desiard had Nuttall oak, sycamore, and sweet pecan planted. As the elevation increased, the species planted were willow, cow, cherrybark, and shumard oaks, sweetgum, American elm, hackberry and persimmon. Bottomland hardwood forest can be classified into four primary habitat types: (1) Baldcypress-Water Tupelo, (2) Overcup Oak-Water Hickory, (3) Sweetgum-Willow Oak, and (4) Cherrybark Oak-Cow Oak (Eyre 1980).

Baldcypress-Water Tupelo

Baldcypress and water tupelo together make up the majority of stocking in this forest type, which occurs in swamps, deep sloughs, and very low, poorly drained flats. The sites are always very wet, and surface water stands well into or throughout the growing season. Soils are generally mucks, clays, or fine sand. Common trees associated with this type are black willow (*Salix nigra*), water locust (*Gleditsia aquatica*), overcup oak (*Quercus lyrata*), green ash (*Fraxinus pennsylvanica*), and persimmon (*Diospyros virginiana*). Among the shrub species are swamp privet (*Forestiera acuminata*), buttonbush (*Cephalanthus occidentalis*), and planertree (*Planera aquatica*). Woody vines include red vine (*Brunnichia ovata*). A variety of herbaceous plants will be commonly seen and take the form of flotants, emergents, and submergents. Frequently, a variety of mosses and lichens adorn the exposed tree trunks, and the crowns may be draped with Spanish moss (*Tillandsia usneoides*).

The majority of this type is in the lake itself and is permanently flooded. The eastern portion of the lake is largely forested with cypress and tupelo. These trees are in different stages of stress due to constant inundation (Figure 8). The western portion of the lake once was forested with cypress and tupelo, but those trees have long since died and fallen over. The few trees in the middle of the open lake are dying.

Figure 7. Vegetation types present on Black Bayou Lake NWR.

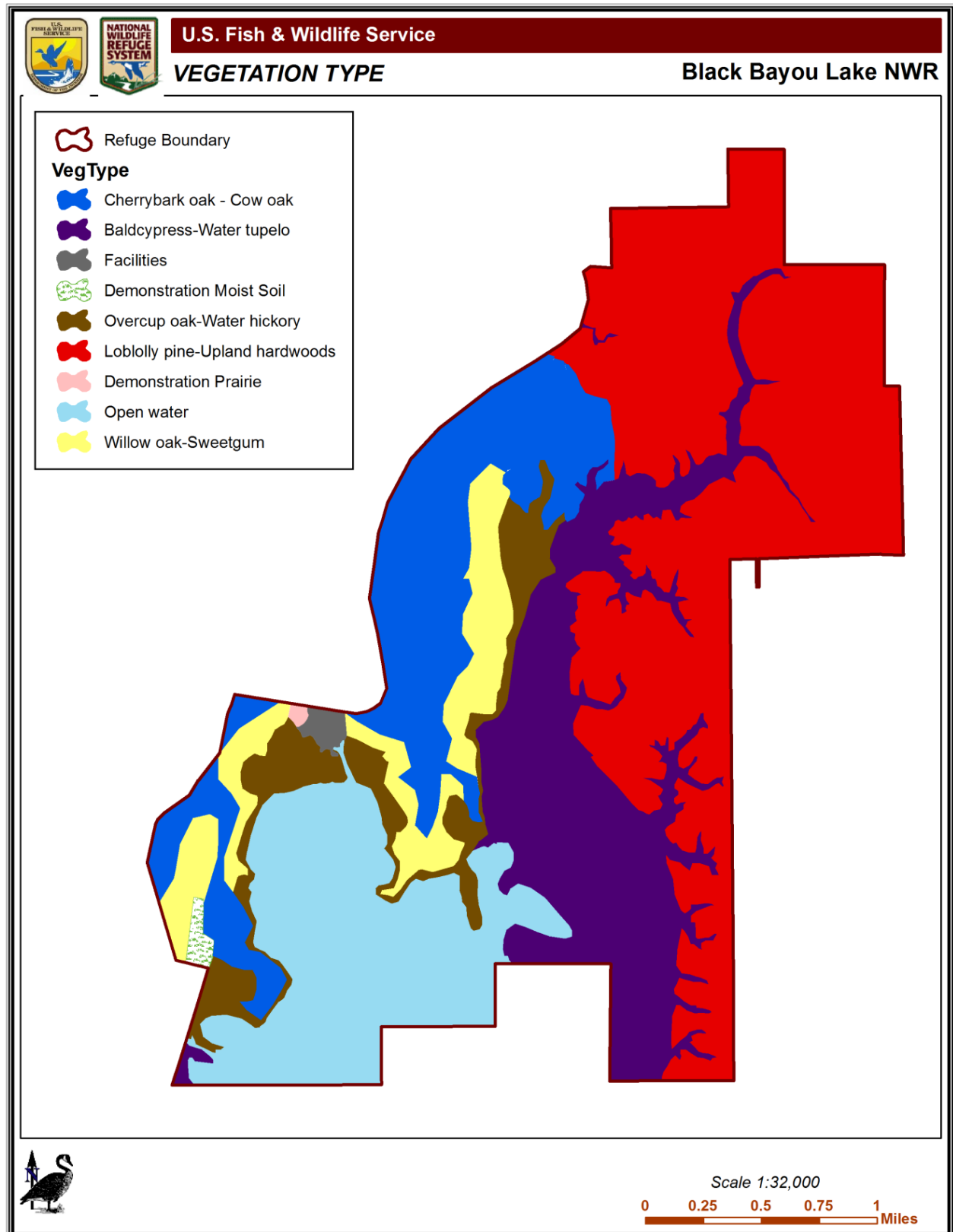


Figure 8. Baldcypress trees showing signs of stress due to constant inundation.



Overcup Oak- Water Hickory

This type usually occurs in low, poorly drained flats and sloughs with tight clay or silty clay soils. These sites are the lowest within the first bottoms and are subject to late spring inundations. Overcup oak and water hickory (*Carya aquatica*) together constitute the majority. Associates include willow oak (*Quercus phellos*), Nuttall oak (*Q. nuttallii*), cedar elm (*Ulmus crassifolia*), green ash, and water locust. Minor associates include black willow, persimmon, and sweetgum (*Liquidambar styraciflua*). Common shrub species include swamp privet, hawthorn (*Crataegus* spp.), buttonbush, planertree, and deciduous holly (*Ilex decidua*). Woody vine species often associated include red vine, peppervine (*Ampelopsis arborea*), trumpet-creeper (*Campsis radicans*), and possibly greenbrier (*Smilax* spp.). Panicums, asters, annual grasses, and cocklebur may occur in openings within the stand.

Sweetgum-Willow Oak

The low ridges in the broad slackwater areas of the first bottom are typically occupied by this forest type. Willow oak and sweetgum comprise the largest proportion of the stocking in stands of this type. There are extensive areas of this type on the poorly drained willow oak flats on the refuge. These stands are strongly dominated by willow oak because of the heavy clay soils. Sweetgum often forms only a minor proportion of the stocking. A major associate on higher clay

ridges and flats is nuttall oak, which may represent 30-50 percent of the composition. Other trees associated with this forest type are sugarberry (*Celtis laevigata*), green ash, overcup oak, water oak (*Q. nigra*), water hickory, cedar elm, persimmon, and sometimes baldcypress. Common shrubs include swamp privet, American snowbell (*Styrax americanus*), deciduous holly, hawthorn, and dull-leaf indigo (*Amorpha fruticosa*). Woody vines occasionally present are greenbrier, peppervine, and redvine.

Cherrybark Oak-Cow Oak

This forest type occurs on the best, most mature, fine sandy loam soils on the highest of the first bottom ridges and hammocks, and on the second bottoms or terraces down from the ridges. These well-drained sites are seldom covered with standing water and only rarely overflow. The species composition of this habitat type varies widely, though cherrybark oak (*Quercus pagoda*) will most likely be much more common than cow oak (*Q. michauxii*). Many other species contribute to a well-stocked stand: white oak (*Q. alba*), post oak (*Q. stellata*), sweetgum, blackgum (*Nyssa sylvatica*), hickory, willow oak, water oak (*Q. nigra*), southern red oak (*Q. falcata*), winged elm (*Ulmus alata*), sassafras (*Sassafras albidum*), delta post oak (*Q. similis*), American beech (*Fagus grandifolia*), slippery elm (*Ulmus rubra*), shumard oak (*Q. shumardii*), black oak (*Q. velutina*), black cherry (*Prunus serotina*), white ash, red maple (*Acer rubra*), and loblolly (*Pinus taeda*) and shortleaf pines (*Pinus echinata*).

Common midstory plants include eastern redbud (*Cercis canadensis*), flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), red mulberry (*Morus rubra*), eastern hop-hornbeam (*Ostrya virginiana*), ironwood (*Carpinus caroliniana*), and witch-hazel (*Hamamelis virginiana*). Shrub species usually include red buckeye (*Aesculus pavia*), devil's walkingstick (*Aralia spinosa*), sweetleaf (*Symplocos tinctoria*), and *Viburnum* spp. Often included in this habitat type are grape vines (*Vitis* spp.), Alabama supplejack (*Berchemia scandens*), Carolina jessamine (*Gelsemium sempervirens*), trumpet creeper, and greenbrier.

Upland Pine-Hardwood

The upland forest on the refuge currently is composed of upland mixed pine-hardwoods. Most of these uplands are a mix of loblolly pine and hardwoods, with some pure pine stands and some pure hardwood stands.

Upland hardwood forests are rare today and greatly diminished from their historic distribution in north Louisiana. Unfortunately, little attention seems to be given to their decline (mostly due to the focus on bottomland hardwood forested wetlands), even though the upland hardwood forests in Louisiana are threatened (Lester et al. 2005). The fauna associated with this habitat type include the wood thrush (*Hylocichla mustelina*), worm-eating warbler (*Helmitheros vermivorum*), eastern spadefoot toad (*Scaphiopus holbrookii*), Louisiana slimy salamander (*Plethodon kisatchie*), Louisiana waterthrush (*Seiurus motacilla*), and chuck-will's-widow (*Caprimulgus carolinensis*). Conversion of hardwood forest into pine plantations by commercial timber companies is the number one threat (Lester et al. 2005). For these reasons, the upland hardwood forest type will be retained and promoted as much as possible on Black Bayou Lake NWR.

When the refuge was established, one endangered red-cockaded woodpecker (*Picoides borealis*) (RCW) was found on the east side. The bird was never seen again after 2001. Habitat conditions were very poor at the time for RCWs. Service personnel installed artificial cavities and removed the midstory, but the bird disappeared soon after. The adjacent lands are

in suburban development. After 5 years of a cluster being inactive, the site can be considered abandoned and no longer needs to be managed for RCWs (USFWS 2003, 2010).

An attempt could be made to manage the upland pine forest on the refuge for the red-cockaded woodpecker, but it would be doomed to fail. Demographic stochasticity is a threat for RCW populations of less than 25 groups. Populations of less than 50 individuals are vulnerable to inbreeding (USFWS 2003). About 1,700 acres of upland habitat would have to be converted to mostly pure pine stands, removing most hardwood trees. At any one time, 30% of those trees should be under the age of 30 years, making that habitat unsuitable for RCWs. (The forest has to be regenerated to ensure old trees in the future for the RCW). This leaves, at most, about 1,200 acres of potential RCW habitat available and due to its linear shape, at most it could support 6 or 7 groups. The habitat would have to be burned on a 2-3 year rotation, which would prove to be extremely difficult. Besides the fact that the refuge does not have a fire crew or qualified burn boss, the surrounding residential neighborhoods would pose a safety concern due to smoke management issues and potential out-of-control burns. In addition, red-cockaded woodpeckers would have to be introduced back into the population. This is logistically expensive and would take many years to achieve. At the expense of upland hardwood habitat, in the end, even if successful, the refuge would only have a population of 7 RCW groups that will not contribute to recovery efforts, and this number is not even considered viable.

Loblolly Pine

This forest type is dominated by loblolly pine as the overstory with sweetgum associated with it, as well as shortleaf pine, southern red oak, and post oak. On moderately to poorly drained sites, common associates include red maple, blackgum, and water oak. Midstory trees include flowering dogwood, American holly, black cherry, hawthorn, eastern hophornbeam, sassafras, and red mulberry. Common woody vines include Carolina jessamine, Alabama supplejack, greenbrier, grape, Japanese honeysuckle (*Lonicera japonica*), and blackberry (*Rubus argutus*). Among the shrubs associated with this type are American beautyberry (*Callicarpa americana*) and *Viburnum* spp.

Loblolly Pine/Hardwood

Hardwoods are predominant in this type, with loblolly pine making up at least 20 percent of the stocking. On wet sites, loblolly pine is associated with blackgum, sweetgum, water oak, willow oak, red maple, and American elm. Species associated on drier sites are southern red oak, white oak, post oak, hickory, shortleaf pine, and persimmon. Generally, many of the same shrub, vine, and herb species found with the loblolly pine type are also common associates in stands of the loblolly pine/hardwood type.

Invasive Species

As a routine part of general forest management, foresters eliminate scattered clumps of invasive plants such as Chinese privet, mimosa, tree-of-heaven, etc. Two terrestrial species that have moved northward into this area and are of primary concern are the Chinese tallow tree (*Triadica sebifera*) and Japanese climbing fern (*Lygodium japonicum*). The Japanese climbing fern can increase in cover to form mats, smothering shrubs and trees (Miller 2003). The Chinese tallow tree is increasing rapidly in north Louisiana and is an imminent threat to wetland and upland habitats. This species causes large-scale ecosystem disruption by replacing native vegetation, which reduces native species diversity, which in turn has a negative impact on wildlife. The

tallow can quickly become the dominant plant in disturbed areas and invade bottomland forests, so much so that it has earned a spot on the “America’s Least Wanted – The Dirty Dozen” list of The Nature Conservancy (Flack and Furlow 1996).

Water hyacinth is a problem in the lake itself. Annually, Service and LDWF personnel chemically treat the lake to control hyacinth. The refuge staff is aware that another aquatic invasive, more noxious than hyacinth, is likely to appear in the lake—salvinia. The hopes are that it will be detected early and treated quickly. *Salvinia* can double in area within a week, eventually covering the entire waterbody and choking out native vegetation.

Feral hogs are just beginning to appear on the refuge. This exotic species has the potential to completely destroy ecosystems. Feral hog populations are growing and expanding in Louisiana and throughout the southeastern United States. Hogs are becoming one of the most serious concerns for wildlife managers. They root up soil, cause erosion, destroy native plants, transmit disease to native wildlife including the threatened Louisiana black bear, compete with native wildlife for food, and depredate reptiles, amphibians, birds and their nests. Feral hogs are the most prolific exotic mammal in North America with the population able to double in four months.

Demonstration Prairie and Rights-of-way

The refuge has a small 4-acre demonstration prairie located just outside of the visitor center. The Service planted many species of prairie plants in the fallow cotton field shortly after acquiring the refuge. Seeds of coneflowers (*Echinacea* spp.), Coreopsis, indian blanket (*Gaillardia* spp.), *Liatris*, winecup (*Callirhoe involucrata*), *Rudbeckia*, big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), eastern gama grass (*Tripsacum dactyloides*), switchgrass (*Panicum virgatum*), and indiangrass (*Sorghastrum nutans*) were planted by hand.

Some species of prairie plants exist along powerline rights-of-way on the east side of refuge.

Demonstration Moist Soil Area

Fifteen acres are currently managed as a demonstration moist soil area for the public to learn about this wildlife management technique, which is aimed at providing food and habitat for shorebirds and wintering waterfowl.

HABITAT CHANGES FROM HISTORIC TO CURRENT CONDITION

The Monroe Gas Field (MGF) underlies portions of Ouachita, Union, and Morehouse parishes in northeast Louisiana. A total of 105 natural gas wells exist on the refuge, with the vast majority being active. At the time of its initial discovery and development during the second decade of the 1900s, the MGF was the largest known gas field in the U.S., with gas pressures initially exceeding 1,000 pounds per square inch (psi). Unlike other Louisiana gas fields, the Office of Conservation, the state regulatory agency, never promulgated minimum spacing requirements for the wells in the MGF. The average well depth is around 2,300 feet, and most wells could be drilled within 36 hours. The size of the drilling pads varied from one company to another, but approximately ½ acre would be cleared for each well. This allowed room for the drilling rig, mud pits (bentonite clay/water slurry), and service vehicles. Following well completion, only a small area around the well head would be maintained by the gas company. Brine, which contains about three times as much salt as sea water, is a by-product of most gas wells.

Until the mid 1970s, economics generally restricted the number of wells to one per 40 acres. However, tax laws and a dramatic, though short-lived, increase in natural gas prices combined to spur a rash of drilling which lasted until about 1986. During this period, the number of wells in the MGF more than doubled. In some instances, wells were drilled within 600 feet of each other. This rapidly depleted the gas reserves, reduced the average gas pressure to about 30 psi, and caused production at many wells to cease.

Mineral rights were not obtained when the lands for the refuge were acquired. From a refuge management standpoint, the main problems associated with natural gas production have been (1) habitat and wildlife disturbance; (2) improperly covered mud pits; (3) abandoned or poorly maintained wells and facilities; (4) mercury contamination; and (5) brine. Prior to 1991, there were no regulations relating to pit closure. Often, the soil was pushed into the mud pits, leaving several feet of mud under a thin shell of soil. Such pits are a hazard because equipment, once it breaks through the soil layer, will sink to the bottom of the pit, a distance of up to seven feet.

Until the 1970s, most of the gas meters used to measure gas production contained mercury. Often the mercury in these meters was carelessly handled, and significant amounts of mercury could be found below about 80% of the mercury-type meters. All known refuge mercury meter sites have been remediated and the meters replaced with those that do not contain mercury. High levels of mercury have been documented in the refuge's fish and fish-eating wildlife. However, it is likely that this contamination is related to the levels of methyl mercury in the Ouachita River and its tributaries.

In addition, many of the gas well sites and areas adjacent to them have been sterilized by the release of brine. This has been caused by poorly maintained or abandoned wells, the use of salt water disposal pits (which are now prohibited), and ruptured brine pipelines.

Historical information on the area which is now the refuge is not readily available. However, it is generally known that the early 1800s was a period of settlement by pioneers, and the latter part of the century was a period of reconstruction and industrial development. Steer (1948) indicated that Louisiana's lumber production went from the lowest in the South in 1869 to the greatest in the nation in 1914. It is evident that the forest resources of Louisiana were much exploited during this time. Sawmills would spring up where timber was in great abundance, then move on after the timber had been exhausted from an area. It was this period of exploitation which led to the cutting of the last virgin timber in the early 1900s.

The refuge's bottomlands were largely cleared for agriculture, in particular cotton farming. Although it is unknown when clearing on the refuge began, we know that Ouachita Parish was booming in cotton before the Civil War. The plantation home that now serves as a visitor center was built sometime in the 1880s. The lowest elevations along the lakeshore are still forested today, although no virgin timber is known to occur on the refuge as most was cut by the early 1900s. The AL&G railroad was built in 1910 to take advantage of the vast timber resources in north Louisiana. Historical photographs show that the lands on both side of Bayou Desiard were cleared for agriculture in the 1950s. When the refuge was established in 1997, cotton farming was still in production. The Service reforested these bottomland areas in 2000-2001.

When the AL&G railroad was built across the lake, the natural hydrology was altered. The railroad acts as a levee or dam, cutting the lake off from Bayou Desiard and the Ouachita River. When river levels rose in the past, the lake levels would have risen also; and vice versa, when dry summers ensued, the lake would have drained. Consequently this altered

hydrological regime has affected the lake in several ways. Under normal circumstances, hot dry summers would have exposed the aquatic vegetation, speeding up plant decomposition. Today, due to stable water levels, accretion (filling in) is occurring to the point that much of the lake is essentially becoming land with trees growing on it. Other effects from the altered hydrology include less fish spawning habitat, lower water quality, and baldcypress dieoff. Currently the City of Monroe manages the lake's levels using the water control structure located on the railroad track at Hannah's Run. Hannah's Run is where Black Bayou Lake used to connect to Bayou Desiard.

During high Ouachita River stages, the higher elevation bottoms where crops were growing would have flooded as Bayou Desiard overflowed its banks. However, after the 1927 flood, levees were built along the Ouachita River to protect Monroe and West Monroe. Then Bayou Desiard was dammed and disconnected from the Ouachita River in 1935. These changes created a situation where the refuge's bottomlands no longer flood during high water events.

The surrounding landscape is of course changed within northern Louisiana. Development and population spread from Monroe has caused habitat conversion from forests to residential neighborhoods and businesses. The landscape is almost entirely urban to suburban, with a small amount of undeveloped lands south and east of the refuge.

As mentioned earlier, invasive species are present on the refuge that would not have been present or as well established in the past.

CHANGES ASSOCIATED WITH GLOBAL CLIMATE CHANGE

In the future, the effects of global climate change will gradually increase at Black Bayou Lake NWR over the next 100 years. Within the 15-year timeframe of this HMP, smaller impacts may be seen. According to the report *Global Climate Change Impacts in the United States* (Karl et al. 2009), it is expected there will be higher temperatures and less rainfall, particularly in the winter and spring; increased storm intensity and frequency; and more drought throughout the Southeast. It is anticipated that temperatures will increase by at least 4.5°F by 2080, and fire severity will increase 10 to 30 percent within the next 50 years. Within the next 15 years, increasing impacts of higher temperatures will likely cause the spread of invasive species and small changes to native plant and animal distributions. Migratory birds will probably breed and winter a little further north. More southern, tropical species (i.e. black-bellied whistling ducks, wood storks, etc.) will extend their ranges into Louisiana. Invasive species such as salvinia, water hyacinth, tallow tree, etc. will become more established and extend their ranges further north. The source of these impacts are difficult to isolate as caused either in part or in full by global climate change, but they are anticipated nevertheless. This HMP addresses these short-term anticipated impacts of invasive species and community shifts through habitat management objectives. Impacts including increased drought, fire severity, and storm intensity cannot be influenced by the scope of this plan.

Table 2. Historical timeline of the area before Black Bayou Lake National Wildlife Refuge was established.

1541–1542 Hernando de Soto followed the Ouachita River in his exploration of the southern United States. He found Ouachita Indians living along the river. A village site or sites may have existed on the refuge area.	1812 Territory of Orleans became the State of Louisiana. The parish of Ouachita was established.
1682 La Salle claims lower Mississippi Valley area for France.	1820 Fort Miro is incorporated as the City of Monroe.
1718 Several French settlements established along the Ouachita River. Trappers, hunters, and traders probably utilized the refuge area.	1840–1845 This was the period of influx of settlers from Alabama, Georgia, and Mississippi. Most of these people disembarked at Alabama Landing, located on the present refuge. Towns of Marion, Haile, and Linville resulted from this wave of immigration. Most of these people were small farmers—not slaveholders.
1729 Natchez uprising disrupts French control of northeast Louisiana; French settlements along the Ouachita abandoned.	1861 Louisiana secedes from the United States. Cotton farming is booming and the city of Monroe had a steam-powered cotton gin
1734 Most of the Ouachita Indians had been decimated by European diseases and raids by Chickasaw war parties from Mississippi.	Circa 1885 Lemuel Dawson McLain and his wife Ann “Mattie” Crosley McLain built a planter’s house on present day refuge that now serves as Visitor Center. This 900-acre cotton farm was named Richland Plantation
1762 France loses French and Indian War. Louisiana Territory is ceded to Spain.	1910 AL&G Railroad built across Black Bayou Lake cutting it off from Bayou Desiard which is cutoff from the Ouachita River in 1935.

1791 Fort Miro was established at a small Spanish settlement that would eventually become the city of Monroe. European trappers and hunters lived in the refuge area.	Mid-1800s to 2000 900-acre Richland Plantation farmed in cotton and sometimes corn
1803 Louisiana was re-acquired by France. The United States bought it from France. Choctaw Indians from Mississippi replaced the Ouachita Caddoans along the river. Congress established Territory of Orleans south of 33° N latitude.	1997 Black Bayou Lake NWR was established.

III. RESOURCES OF CONCERN

The priorities associated with wildlife and habitat management on national wildlife refuges are determined through directives, policies, and legal mandates. Resources of concern include species, species groups, and/or communities that support the purpose(s) of a refuge, as well as the Service's trust resource responsibilities (including threatened and endangered species and migratory birds). Resources of concern are also native species and natural, functional communities such as those found under historic conditions that are to be maintained and, where appropriate, restored on a refuge (601 FW 3.10B[1]).

The resources of concern for Black Bayou Lake NWR were selected after taking into account the conservation needs identified within international, national, regional, or ecosystem goals and plans; state fish and wildlife conservation plans; recovery plans for threatened and endangered species; and previously approved refuge resource management plans as identified in the Comprehensive Conservation Planning Process policy [602 FW 3.4C[1][e]], as well as Chapter I of this HMP. The species and communities selected as resources of concern from these plans support the following mandates of the National Wildlife Refuge System (NWRS):

- Support refuge purposes and the NWRS mission;
- Conserve biological integrity, diversity, and environmental health (giving special consideration to rare, declining or unique natural communities, species, and ecological processes within the refuge boundary and the Mississippi Alluvial Valley); and
- Fulfill the Service's trust resource responsibilities.

The resources of concern identified for Black Bayou Lake NWR include:

- Breeding wood ducks
- Forest interior songbirds
- Rafinesque's big-eared bat and southeastern myotis
- Upland hardwood forest
- Alligator snapping turtle
- Wading birds

Although the demonstration prairie and moist soil units do not merit being listed as resources of concern, they are managed for environmental education purposes; thus, they have management objectives and strategies typical for those habitat types.

BREEDING WOOD DUCKS

SIGNIFICANCE

Wood ducks (*Aix sponsa*) are year-round residents in the forested wetlands of the United States, including Black Bayou Lake NWR. Although wood duck numbers declined to drastically low numbers in the early 20th century due to market hunting, liberal hunting seasons, and habitat loss, today's wood duck populations appear to be stable (Dugger and Fredrickson 2001). However, our grasp on the population status of this species is shaky. Population estimates are inaccurate because aerial surveys are ineffective in forested habitats. Wood ducks rank high

among species harvested in the Mississippi Flyway and are popular with hunters, especially when other waterfowl species are not present in large numbers (Dugger and Fredrickson 2001).

Because wood ducks depend upon forested wetlands for breeding and wintering habitat (Dugger and Fredrickson 2001), Black Bayou Lake NWR has the opportunity to provide excellent habitat for breeding wood ducks. The Wildlife and Habitat Review (USFWS 2008) for Black Bayou Lake NWR suggests wood ducks are an important resource of the refuge.

IDENTIFICATION OF HABITAT REQUIREMENTS

Preferred habitats for the wood duck include forested wetlands, wooded and shrub swamps, tree-lined rivers, streams, sloughs and beaver ponds. Wood ducks seek food in the form of acorns, other soft and hard mast, weed seeds and invertebrates found in shallow flooded timber, shrub swamps and along stream banks. They loaf and roost in more secluded areas and dense shrub swamps (Dugger and Fredrickson 2001).

Wood ducks are cavity nesters, seeking cavities in trees within a mile of water. Brood survival is higher in situations where nests are close to water. Due to the loss of forested wetlands and competition for nest sites from a host of other species, natural cavities are the primary limiting factor to reproduction. Nest boxes are commonly used to supplement natural cavities and increase the local production of wood ducks. Nest box programs are not an end to all nesting problems, however. The nest boxes require time to clean and repair at least annually. Production can be increased by more frequent checks and cleaning of boxes, but this must be weighed with other time constraints.

Recent guidelines entitled, "Increasing Wood Duck Productivity: Guidelines for Management and Banding, USFWS Lands (Southeast Region) 2003 (update)" by the Service's Division of Migratory Birds, provide direction for the use of wood duck nest box programs on refuges. The boxes should be placed in, or adjacent to, good brood habitat in areas where they are not subject to flooding. It is critical that the boxes have functional predator guards and that they are checked and repaired annually; otherwise, the boxes are considered traps for the hen and her clutch. Conical predator guards should be maintained on all of the boxes to more effectively keep rat snakes from climbing into the boxes. Some reports indicate that if rat snakes learn there is a meal of eggs in the nest box, it becomes very difficult to exclude them from the boxes. If the boxes cannot be properly maintained, they should be boarded up until sufficient effort can be put toward operating an effective nest box program. Cleaning the boxes after the initial peak of nesting (about mid-April) will significantly improve annual production if competition for nest sites increase.

Adequate brood habitat can seriously affect duckling survival and reproductive success. McGilvrey (1968) described preferred brood habitat as 30 to 50% shrubs, 40 to 70% herbaceous emergents, and 25% open water. Overhead cover within 1 to 2 feet of the water surface is vital for wood duck broods. Optimum habitat should have 75% cover and 25% open water, with a minimum of 1/3 cover to 2/3's open water. Placement of boxes in or adjacent to good brood cover will significantly improve duckling survival to flight age.

Wood ducks depend heavily on acorns during winter, even up to 75% of their diet (Dugger and Fredrickson 2001). During the spring, an increase in animal foods can be seen in both sexes. Aquatic insects become an important part of the egg-laying female's diet (Dugger and Fredrickson 2001).

FOREST INTERIOR SONGBIRDS

SIGNIFICANCE

Due to the loss of approximately 80% of the bottomland hardwoods in the Lower Mississippi River Alluvial Valley (Tiner 1984), Black Bayou Lake NWR can play an important role in providing bottomland hardwood habitat for forest interior songbirds. The Lower Mississippi Valley Joint Venture (LMVJV 2007) considers forest interior songbirds that use bottomland hardwood forests a priority resource, particularly the Kentucky (*Geothlypis formosa*), Swainson's (*Limnothlypis swainsonii*) and prothonotary warblers (*Protonotaria citrea*). All three of these species have been recorded on the refuge.

The Louisiana Comprehensive Wildlife Conservation Strategy (Lester et al. 2005) lists the following bird species of conservation concern for upland mixed pine/hardwood forest: the yellow-throated vireo (*Vireo flavifrons*), wood thrush (*Hylocichla mustelina*) and worm-eating warbler (*Helmitheros vermivorum*), among others. These species are also considered priority songbirds that use mixed pine-hardwood forests in the West Gulf Coastal Plain (Taulman et al. 1999). All three of these species have been recorded in the upland mixed pine/hardwood forests on the refuge.

The priority Partners in Flight species in the Mississippi Alluvial Valley and West Gulf Coastal Plain are listed under those subsections in Chapter I.

IDENTIFICATION OF HABITAT REQUIREMENTS

Priority species such as the Swainson's, hooded, and Kentucky warblers and the white-eyed vireo require dense understory growth (Rich et al. 2004) that is often associated with tree fall gaps (Pashley and Barrow 1993), in forests with large block sizes (> 5,200 acres) in a largely forested landscape (>60%) (LMVJV 2007). Timber thinning can increase canopy gaps, thereby increasing understory and midstory growth (Robinson and Robinson 1999). Thatcher (2007) found that most Partners in Flight priority species had higher densities in thinned hardwood forest than unthinned. Heltzel and Leberg (2006) also found that Swainson's, Kentucky and hooded warblers (*Setophaga citrina*) increased by 200% in bottomland hardwood forest where a selective timber harvest had occurred. However, this study also showed that the Acadian flycatcher (*Empidonax virescens*) and prothonotary warbler declined in abundance in harvested stands. Timber harvests can have negative effects on canopy-dwelling and forest interior songbirds (Pashley and Barrow 1993) when forests are fragmented. Nest parasitism by brown-headed cowbirds (*Molothrus ater*) and predation can occur at higher rates in fragmented forests (Brittingham and Temple 1983). Norris et al. (2009) found that individual selection and group selection harvests benefitted most avian species in a bottomland hardwood forest in Louisiana.

The Acadian flycatcher and prothonotary, Kentucky, and hooded warblers use Black Bayou Lake NWR within the small amount of mature bottomland hardwood forest available. Most of the refuge's bottomland forest consists of young, reforestation tracts that are approximately 12 years old. As the forest ages, silvicultural treatments will be necessary to maximize diversity and structure to support a variety of songbirds and other wildlife (LMVJV 2007). The management challenge, of course, will be to provide the correct balance of closed canopy forest and harvested stands that allow for denser understory growth.

Fortunately, the LMVJV (2007) has already incorporated the different needs of forest interior songbirds along with other priority wildlife species (i.e., bears, bats, waterfowl) into the desired forest guidelines for bottomland hardwood forests. These guidelines recommend a reduction in canopy cover, the retention of snags and den trees, and an increase in understory vegetation. Twedt and Somershoe (2008) conducted a study on nearby Tensas River NWR to test the effects of selective harvesting that followed the LMVJV guidelines on priority forest birds. They found that the priority species—the eastern wood-pewee (*Contopus virens*), Kentucky warbler, orchard oriole (*Icterus spurius*), red-headed woodpecker (*Melanerpes erythrocephalus*), white-eyed vireo (*Vireo griseus*), hooded warbler, and Swainson's warbler—were present in higher densities in thinned stands than unthinned. No significant difference was found in the densities of prothonotary warblers between the two treatments. The densities of Acadian flycatchers were less in treated stands than in untreated; however, the flycatchers were present in treated stands and overall remained one of the most abundant species in the forest.

In upland pine-hardwood forests, much of the same holds true for area-sensitive species. The worm-eating warbler prefers hardwood forests with steep slopes and dense understories (Gale et al. 1997). Wenny et al. (1993) found these warblers to be area-sensitive, requiring at least 300 hectares (ha) of forest to be present, but they were not breeding even in 340-ha tracts. Yellow-throated vireos prefer edge habitat within mature hardwood and mixed pine hardwood forests, specifically canopy gaps within the forest (Rodewald and James 2011). They are also known to have a positive correlation with canopy height (Robbins et al. 1989). The wood thrush is an area-sensitive species that uses hardwood and mixed hardwood-pine forests with moderate to dense understories, with lots of shade and decaying leaf litter (Rosenberg et al. 2003; Roth et al. 2011).

RAFINESQUE'S BIG-EARED BAT AND SOUTHEASTERN BAT

SIGNIFICANCE

Bottomland hardwood systems seem to be important as both roosting and foraging habitat for the Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) (Clark 1990; Clark et al. 1998; Cochran 1999) and the southeastern myotis (*Myotis austroriparius*) (Cochran 1999; Hoffman 1999). Due to the loss of approximately 80% of the bottomland hardwoods in the Lower Mississippi River Alluvial Valley (Tiner 1984), both bat species have probably been negatively affected. Declines in the numbers of southeastern bats (Harvey et al. 1999) might be due to the loss of bottomland hardwood forests, and populations of the Rafinesque's big-eared bat might be declining in Arkansas (Cochran 1999). Both species are designated as federal species of concern (Martin et al. 2002). The southeastern bat is listed as a state species of concern (Lester et al. 2005).

Again, with its extensive baldcypress-water tupelo stands, Black Bayou Lake NWR has an opportunity to provide important habitat for these two species of bats.

IDENTIFICATION OF HABITAT REQUIREMENTS

Rice (2009) conducted research on both the Rafinesque's big-eared bat and the southeastern myotis on nearby Upper Ouachita NWR. All but two of the 33 roost trees of both bat species on the refuge were found in water tupelo (*Nyssa aquatica*) (Rice 2009). At the nearby D'Arbonne NWR, Gooding and Langford (2004) found that all 44 roost trees of both bat species were in water tupelo. Apparently, water tupelos are important roost trees for these species (Mirowsky and Horner 1997; Clark et al. 1998; Cochran 1999; Hoffman 1999; Hofmann et al. 1999;

Gooding and Langford 2004; Rice 2009). However, both bat species have also been found to use other species of trees, such as black gum (*Nyssa sylvatica*) (Mirowsky and Horner 1997); swamp tupelo (*Nyssa nigra*) (Hobson 1998); baldcypress (*Taxodium distichum*) (Clark 1990); water hickory (*Carya aquatica*) (Hoffman 1999); American beech (*Fagus grandifolia*) (Mirowsky and Horner 1997); sycamore (*Platanus occidentalis*) (Clark 1990); and others.

Large diameter trees with large interior cavities within mature bottomland hardwood forests have been found to be important to both bat species as roost habitat (Gooding and Langford 2004; Rice 2009). Management should be directed toward the retention of large snags; the promotion and regeneration of baldcypress/tupelo stands (see Table 3); and management for mature bottomland hardwood forests (LMVJV 2007).

Table 3. Baldcypress and tupelo old-growth attributes (modified from Devall 1998).

Species	Attribute	Reference
	<u>Stand Density</u>	
Baldcypress	≥ 1 in d.b.h. target 240 live trees /ac	Hall and Penfound 1939
Tupelo	> 10 cm d.b.h. target 7-12 live trees/ha	Martin and Smith 1991
	<u>d.b.h. of largest trees</u>	
Baldcypress	35- 60 in	Sargent 1965; Harlow and Harrar 1969
Tupelo	25- 48 in	Martin and Smith 1991; Sargent 1965
	<u>Stand basal area</u>	
Baldcypress	33.5 ft ² /ac.	Hall and Penfound 1939
Tupelo	30 ft ² /ac.	
	<u>Height</u>	
Baldcypress	100-120 ft.	Harlow and Harrar 1969
Tupelo	80-90 ft.	Harlow and Harrar 1969
	<i>Need several standing snags and downed logs of baldcypress and tupelo</i>	Martin and Smith 1991

The foraging habitat characteristics for these bats is less understood. There is ample evidence that the Rafinesque's big-eared bat is a moth specialist (Lacki and LaDeur 2001; Lacki et al. 2007). Medlin and Risch (2008) studied foraging bats in bottomland hardwood forests in Arkansas. They found the southeastern myotis to be strongly associated with a high percentage presence of oaks, while Rafinesque's big-eared bats were correlated with high percentages of ground cover.

UPLAND HARDWOOD FOREST

SIGNIFICANCE

The upland hardwood forests in Louisiana are a threatened community, given an S3/S4 rank (Lester et al. 2005). The primary threat to these forests is conversion to pine plantation. Between 1991 and 2005, over 600,000 acres of mixed pine/hardwood forest was converted to loblolly pine plantation (LAAF 2005). Little focus has been given to this declining community due to it not being a wetland habitat in an area where wetlands are given primary attention. Timber companies and private landowners have been stripping away upland hardwoods in favor of the more profitable loblolly pine. Pine monocultures lack the species and structural diversity of an upland hardwood forest.

Black Bayou Lake NWR still has intact mature upland hardwood forest. The refuge has the opportunity to provide this declining habitat type that may in the future be gone.

IDENTIFICATION OF HABITAT REQUIREMENTS

Lester et al. (2005) describe this type of community as a hardwood slope forest. These forests were estimated to have occupied 100,000 to 500,000 acres historically, with only 25-50% remaining today (Smith 1993).

In a hardwood slope forest, the canopy dominants are American beech (*Fagus grandifolia*), water oak (*Quercus nigra*), white oak (*Q. alba*), swamp chestnut oak (*Q. michauxii*), sweetgum (*Liquidambar styraciflua*), mockernut hickory (*Carya tomentosa*), cherrybark oak (*Q. pagodifolia*), black gum (*Nyssa sylvatica*), and southern red oak (*Q. falcata*). Understory and midstory associates include the silverbell (*Halesia diptera*); bigleaf snowbell (*Styrax grandifolia*); sweetleaf (*Symplocos tinctoria*); flowering dogwood (*Cornus florida*); black cherry (*Prunus serotina*); ironwood (*Carpinus aroliniana*); holly (*Ilex americana*); Elliott's blueberry (*Vaccinium elliotii*); hoary azalea (*rhododendron canescens*); witch hazel (*Hamamelis virginia*); huckleberry (*Vaccinium arboreum*); eastern hophornbeam (*Ostrya virginiana*); and service-berry (*Amelanchier arborea*). Herbaceous plants found in this community type include the broad beech-fern (*Phegopteris hexagonoptera*), Christmas fern (*Polystichum acrostichoides*), jack-in-the-pulpit (*Arisaema* spp.), violets (*Viola* spp.), and may-apple (*Podophyllum peltatum*).

The primary threat to this community is invasion by invasive species, particularly Chinese tallow tree, Chinese privet, and Japanese climbing fern. On private lands, conversion to pine plantation is another major problem. However, on the refuge, the focus should be on promoting biological integrity, environmental health, and diversity by maintaining a high diversity of native plant species and by minimizing invasive species.

ALLIGATOR SNAPPING TURTLE

SIGNIFICANCE

The alligator snapping turtle (*Macrochelys temminckii*) (AST) is the largest freshwater turtle in North America. Population declines prompted the U.S. Fish and Wildlife Service to include ASTs in Appendix III of the CITES in 2005 (*Federal Register* Doc. 05-24099, December 15, 2005). Louisiana ranks the species as S3, designating it as rare and restricted. Several factors have contributed to the declines in ASTs, including habitat destruction, overhunting, and low recruitment. Although these turtles have been harvested for centuries, population numbers have suffered extensively due to commercial harvest, especially in the 1960s and 1970s when the demand for turtle meat increased (Reed et al. 2002). New Orleans, Louisiana, was one of the highest-demand areas for snapping turtle meat.

Alligator snapping turtles do not reach sexual maturity until 11-17 years. Individuals have low survivorship in their early years, but once they reach maturation they can live many decades. Therefore, populations are extremely sensitive to mortality of adult females. Reed et al. (2002) showed that an adult female harvest rate of less than 2% is unsustainable. This study went on to say that if adult survivorship is reduced by a quarter of one percent, the population could be reduced by half within 410 years. Commercial harvest was banned in many states due to this increased concern. Louisiana was the only remaining state that still allowed commercial harvest, until 2004 when it was finally outlawed. Louisiana now allows only the recreational take of one turtle per boat per day.

Black Bayou Lake NWR has been the primary center of wild AST research in the country. More than 10 publications exist on AST research conducted on the refuge. Professor John Carr of the University of Louisiana at Monroe (ULM) is the leading herpetologist of most of these studies. Another factor contributing to the decline of this species is their low reproductive success. Nest searching on the refuge occurs every spring, and the results show that the vast majority (>90%) of AST nests are depredated (USFWS 2008). Essentially little to no natural recruitment of ASTs is occurring on the refuge. Presently, the AST eggs are removed from the nest, incubated at the ULM until they are hatched, and then the hatchlings are released into the lake; or exclusion devices are installed over the nests to keep predators out.

IDENTIFICATION OF HABITAT REQUIREMENTS

The habitat requirements of alligator snapping turtles are not well known. ASTs are the most aquatic of all turtles in North America (Reed et al. 2002) in that only nesting females and hatchlings are known to move over land. These turtles are known to inhabit freshwater river systems and associated habitats such as lakes, bayous, canals, and swamps. On Black Bayou Lake, Ray (2010) found ASTs selected for vegetation mats the most and emergent trees secondly, much more so than open water. Harrell (1996) on nearby Bayou Desiard studied subadults, finding over 99% of telemetry fixes were in baldcypress forest. Microhabitat selection was structure such as logs, stumps, and underwater branches and stems (Harrell 1996).

WADING BIRDS

Black Bayou Lake provides wading bird habitat throughout the year. A major rookery was discovered on the refuge in 2000 and was active for three years. Small rookeries of herons still exist. The species that nest include the white ibis (*Eudocimus albus*); anhinga (*Anhinga*

anhinga); great blue heron (*Ardea herodias*); little blue heron (*Egretta caerulea*); great egret (*Ardea alba*); cattle egret (*Bubulcus ibis*); green heron (*Butorides virescens*); snowy egret (*Egretta thula*); and night-herons. American bitterns (*Botaurus lentiginosus*), roseate spoonbills (*Platalea ajaja*), and wood storks (*Mycteria americana*) have been recorded on the refuge usually during migration or post-breeding dispersal. Large concentrations of double-crested cormorants (*Phalacrocorax auritus*) use the refuge during winter. American white pelicans are sometimes seen floating on the lake. The Southeast U.S. Regional Waterbird Conservation Plan (Hunter et al. 2006) calls for the increase of many wadingbird species. The Mississippi Alluvial Valley (MAV) has the greatest conservation responsibility for the little blue heron, white ibis, and yellow-crowned night-heron. All three species are present on the refuge and have been documented nesting.

IDENTIFICATION OF HABITAT REQUIREMENTS

The Southeast U.S. Regional Waterbird Plan (Hunter et al. 2006) recommends the implementation of habitat management guidelines for wadingbirds. Two habitats listed in the plan that the refuge can provide are emergent wetlands and bottomland hardwood forest. Conversion of habitat to agriculture and development are the biggest threats in the MAV to wading birds. Besides protecting existing wetlands, other recommendations include controlling exotic species and careful regulation of water levels. The plan states that forested habitats require little management. Protecting the forests from exotics is important, as is maintaining the natural hydrology and integrity of the forest.

Some literature is available that describes the general habitat characteristics for species of concern such as the little blue heron, white ibis and yellow-crowned night-heron, but not much. The white ibis is known to forage in shallow water and prefers water of < 20 cm in depth (Kushlan and Bildstein 2009). In forested landscapes, yellow-crowned night-herons nest in trees with open understories or over water (Watts 1989). Because the refuge has no control over the lake's water levels, management for wading birds will be directed toward the protection of bottomland hardwood and lake habitat from threats such as habitat degradation, hydrological alterations, pollution, and disturbance.

IV. HABITAT GOALS AND OBJECTIVES

For habitats that require active management, the goals and objectives that were developed in the refuge's CCP are expanded upon or combined in this HMP to fulfill the refuge's purposes. A habitat management goal is a broad, qualitative statement that is derived from the established purposes and vision for the refuge. The goals and objectives pertain to the resources of concern identified in Chapter III.

GOAL

The habitat goal from the refuge's CCP is to "restore, enhance, and maintain healthy wetlands and associated bottomland hardwood and upland forests to support a natural diversity of plant and animal species and to foster the ecological integrity of the Black Bayou Lake Watershed."

OBJECTIVE 1.1. BOTTOMLAND HARDWOOD HABITAT

In bottomland hardwood forest, implement adaptive management to maintain and work toward 35-50 percent of 1,231 acres of bottomland hardwood forest at any given time at a basal area of 60-90 ft²/acre, for a canopy cover between 60-80 percent, a 30-60 percent midstory cover, a 30-40 percent understory cover, and a 20-50 percent ground cover, promoting giant cane whenever possible; with regeneration of hard mast-producing species (e.g., oaks and water hickory) present on 30-50 percent of the inventory plots, and <10% cover of exotic plants (LMVJV 2007), supporting CCP Objectives B-1, B-2, B-4, and B-5.

Resources of Concern: Forest interior songbirds, breeding wood ducks, bats, wading birds, and alligator snapping turtles.

Rationale: This objective will achieve a diverse forest with a thick understory, well developed midstory, and plenty of canopy dominants to produce hard and soft mast, provide snags, and regeneration. Forest interior songbirds will benefit from the vertical structure provided. Wood ducks will benefit from the mast produced. Bats will be provided foraging and roost habitat. Snapping turtles and wading birds will benefit from the protection of forest surrounding the lake for nesting and foraging habitat.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Forest overstory structure and composition Forest mid- and understory structure Bottomland hardwood forest health and productivity for wildlife	Forest cruise/inventory sampling (traditional parameters, e.g., BA, overstory CC, stocking, species composition, midstory cover) Annual hard mast survey
Primary Wildlife Response Variables	Probable Assessment Methods
Forest breeding bird species composition and abundance	Breeding landbird survey (point counts)

OBJECTIVE 1.2. *BOTTOMLAND HARDWOOD HABITAT*

In bottomland hardwood forest, where regeneration is highly likely due to the presence of seedlings, maintain < 60 percent canopy cover on 5-10 percent of the bottomland hardwood forest at any point in time to allow regeneration of shade-intolerant trees (e.g., sweetgum, nuttall oak, and willow oak); and leave 4 to 6 super-emergent trees per acre as a seed source (LMVJV 2007), supporting CCP Objectives B-1 and B-2.

Resources of Concern: Forest interior songbirds, breeding wood ducks, bats, alligator snapping turtles, and wading birds.

Rationale: Promoting regeneration of the forest ensures the perpetuity of bottomland hardwood forest for the resources of concern.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Forest overstory structure Area (acres) in condition Hardwood regeneration within target treated areas	Forest cruise/inventory sampling (traditional parameters, e.g. BA, overstory CC, stocking) GIS stand maps and harvest records Regeneration sample plots
Primary Wildlife Response Variables	Probable Assessment Methods
Forest breeding birds (species composition and abundance)	Breeding landbird survey (point counts)

OBJECTIVE 1.3. *BOTTOMLAND HARDWOOD HABITAT*

In bottomland hardwood forest, maintain and work toward 2 to 4 logs/acre to provide coarse woody debris, 4 to 6 cavity trees >4" in dbh per acre, and 1 to 4 large den trees or "unsound cull" trees per 10 acres in bottomland hardwood forest to increase habitat for resident wildlife, such as amphibians, reptiles, bats, bears, and cavity-nesting birds (LMVJV 2007), supporting CCP Objectives B-1 and B-2.

Resources of Concern: Forest interior songbirds, breeding wood ducks, bats, and alligator snapping turtles.

Rationale: Tree cavities are important for breeding wood ducks, bats, and some species of forest interior songbirds, such as the prothonotary warbler and great crested flycatcher. Coarse woody debris is important to reptiles and amphibians including the alligator snapping turtle.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Forest structure components (snag, CWD, cavities)	Forest cruise/inventory sampling (including target parameters)
Primary Wildlife Response Variables	Probable Assessment Methods
Forest breeding birds (species composition and abundance) Reptile and amphibian community (species composition and abundance)	Breeding landbird surveys (point counts) Anuran call surveys (3 times/year/every 3 years) Herpetofauna surveys (1/x years, drift fence or cover board methods)

OBJECTIVE 1.4. BOTTOMLAND HARDWOOD HABITAT

In bottomland hardwood forest, retain and enhance all baldcypress and water tupelo stands toward old-growth attributes, including a basal area of >30 ft²/acre, a dbh of >25 inches, and >80 feet tree height; and in mixed hardwood bottomland habitat favor baldcypress and tupelo, supporting CCP Objectives B-1 and B-2.

Resources of Concern: Bats, alligator snapping turtles, and wading birds.

Rationale: Bats such as the Rafinesque's big-eared bat and southeastern bat roost in large trees, particularly water tupelo and baldcypress (Clark et al. 1998; Gooding and Langford 2004). Alligator snapping turtles use inundated baldcypress forest, and wading birds also use these forests for nesting and foraging.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Area (acres) in cypress/tupelo stands Tree size distribution within stand	GIS stand maps (GPS stand edges 1/x years) Stand inventory (1/x years)
Primary Wildlife Response Variables	Probable Assessment Methods
Bat use of cavity trees Wading bird rookeries	Cavity checks (note high variability in response variable may limit interpretation) Annual rookery counts by species

OBJECTIVE 1.5. *BOTTOMLAND HARDWOOD HABITAT*

Protect the integrity of the 1,500-acre Black Bayou Lake by treating aquatic invasive plants, providing a buffer of forest surrounding the lake, and working with the City of Monroe to manage the lake's water levels to mimic the natural hydrology as much as possible, supporting CCP Objectives B-4 and C-4.

Resources of Concern: Breeding wood ducks, bats, alligator snapping turtles, and wading birds.

Rationale: Wood ducks, alligator snapping turtles and wading birds benefit from the protection of forested wetlands. A more natural hydrological regime, along with native plants, provides more food resources for wood ducks, snapping turtles and wading birds. Although the refuge cannot control the lake's water levels, the Service continues to collaborate with the City of Monroe. Bats use the hollow tupelo and cypress trees for roosts.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Aquatic invasive plant spread	GIS mapping (annual records)
Primary Wildlife Response Variables	Probable Assessment Methods
Snapping turtle nests	Nest surveys from late April-early May

OBJECTIVE 2.1. *UPLAND PINE-HARDWOOD HABITAT*

In upland pine-hardwood forest, maintain 1,653 acres with loblolly pine composing 20-40 ft²/ac and hardwoods composing 80-120 ft²/ac of the total basal area. Hardwoods should have a high species diversity, including sweetgum, blackgum, swamp chestnut oak, water oak, cherrybark oak, southern red oak, post oak, white oak, and mockernut hickory; with midstory species including flowering dogwood, persimmon, eastern hophornbeam, ironwood, and hawthorne; with a total basal area for pine and hardwoods at 80-120 + 10 ft²/ac; with an understory that is > 30% cover and includes woody shrub and vine species such as American beautyberry, serviceberry, red buckeye, rusty blackhaw, sumac, Carolina jessamine, blackberry, and poison ivy; and <10% cover of exotic plants, supporting CCP Objectives B-3 and B-4.

Resources of Concern: Upland hardwood forest, forest interior songbirds.

Rationale: Upland hardwood forests are diverse in species and structure. Very little of this forest type still exists today in Louisiana due to conversion to pine plantation. The refuge has the opportunity to increase biological integrity by managing for this habitat type. Many species of songbirds use these forests.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Forest overstory structure and composition Forest mid- and understory structure Forest health and productivity for wildlife	Forest cruise/inventory sampling (traditional parameters, e.g., BA, overstory CC, stocking, species composition, midstory cover) Hard mast survey
Primary Wildlife Response Variables	Probable Assessment Methods
Forest breeding birds (species composition and abundance)	Breeding landbird survey (point counts)

OBJECTIVE 3.1. DEMONSTRATION PRAIRIE

Manage the demonstration prairie for environmental education purposes by using controlled burns to diversify herbaceous prairie plants, supporting CCP Objective B-5.

Resources of Concern: Not applicable.

Rationale: Maintain biological integrity, diversity, and ecological health, and provide for interpretive visitor use.

Adaptive Management Monitoring Elements: Not applicable.

OBJECTIVE 3.2. DEMONSTRATION MOIST SOIL UNITS

Manage the demonstration moist soil units for environmental education purposes by manipulating water levels and promoting preferred moist soil plants (with <20% cover of undesirable plants), supporting CCP Objective B-6.

Rationale: Maintain biological integrity, diversity, and ecological health, and provide for interpretive visitor use.

Resources of Concern: Not applicable.

Adaptive Management Monitoring Elements: Not applicable.

V. HABITAT MANAGEMENT STRATEGIES

POTENTIAL MANAGEMENT STRATEGIES

STRATEGY A. POTENTIAL MOIST SOIL MANAGEMENT STRATEGIES

Preferred moist soil plants for foraging waterfowl are typically heavy seed-producing annuals, such as wild millets, smartweeds, sprangletop, other grasses, and sedges. Soil disturbance and moisture are critical for the production of these desirable plants. Failure to disturb the soil (i.e., disking) will allow the invasion of perennials, both herbaceous and woody, that outcompete annual plants and greatly reduce waterfowl food production (Strader and Stinson 2005).

Moist soil habitat management generally requires active management of soil and hydrology to promote productive and diverse stands of moist soil plants. Management actions include the timing of drawdowns and their duration, and mowing, disking or chemicals to keep the units in early successional stages (Strader and Stinson 2005). These actions are used to maximize waterfowl food production and usage. Desirable moist soil vegetation at Black Bayou Lake NWR consists mostly of *Leptochloa*, *Echinochloa*, toothcup, and some *Cyperus* species.

Drawdowns and flooding should be spaced out over time across the impoundments in order to provide habitat for shorebirds and waterfowl throughout the fall and winter. This variable timing of drawdowns will also produce different moist soil plants. Some impoundments should be flooded from late August through early September to provide water for migrating blue-winged teal, pintails, and shorebirds. The drawdowns should be conducted by April 15th; however, later drawdowns may be necessary to control unwanted vegetation (Strader and Stinson 2005). Ideal depths for foraging dabbling ducks are less than 12 inches; if the water depths exceed 18 inches, food will be out of reach (Strader and Stinson 2005).

STRATEGY B. POTENTIAL CHEMICAL MANAGEMENT STRATEGIES

The presence of exotic and invasive plants can alter the function of ecosystems by causing the loss of wildlife habitat; the displacement of native species; changes in carrying capacity due to reductions of native forage production; lower plant diversity; and increases in soil erosion and soil sedimentation. These negative effects decrease the biological integrity, diversity, and environmental health of the refuge. Therefore, a management strategy is required to control, and if possible, eradicate the exotic species.

Three invasive species of plants are on the verge of significantly impacting the biological integrity of the refuge: the Chinese tallow tree, Japanese climbing fern, and water hyacinth. The Chinese tallow tree is a small, fast-growing tree with high reproductive capability. It grows in a variety of habitats, is extremely invasive, and can quickly form monocultural stands that displace native vegetation.

The Japanese climbing fern is a fast-growing woody vine that can completely shroud everything in its path. It has the ability to kill trees directly by blocking sunlight and adds extra mass to the trees, acting as a sail to uproot the trees during high winds. This species is a relatively new invader in the United States, and is now becoming widespread throughout Louisiana and the southeast. It is fairly dense in the uplands on the refuge and does not respond well to control methods.

The water hyacinth is an invasive aquatic plant that multiplies quickly on water bodies. It is often spread by boat trailers.

These three invasive plant species will not be eradicated from the refuge, but extensive measures should be made to control their spread. Other invasive species that the refuge has a good opportunity to control with conventional methods are Chinese mimosa, royal palownia, Chinese privet, and chinaberry.

Invasive plant control is a common management action on many national wildlife refuges, but it is labor-intensive and costly. Significant resources should be focused on determining the extent of each invasive species on the refuge and to controlling their spread. Successful control requires careful planning, implementation, and monitoring.

Chemical pesticides will be used primarily to supplement, rather than act as a substitute for, practical damage control measures of other types. Whenever a chemical is needed, the most narrowly specific pesticide available for the target organism in question should be chosen, unless considerations of persistence or other hazards would preclude that choice (7 RM 14). All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1).

The refuge has aggressively been treating exotic plants in the past few years. The mechanical removal of exotic trees has shown to be very ineffective due to stump sprouting, and in the case of climbing fern, promoting its spread by machinery. Monitoring efforts have shown some chemicals to be more effective than others. The Global Species Invasive Database (<http://www.issg.org/database/species/ecology.asp?si=999&fr=1&sts=sss&lang=EN>) recommends using Rodeo for treatment of climbing fern, reporting an efficacy of 95% compared to 0% for Garlon 3A, Garlon 4, and Pathfinder II. The refuge has been using this technique for two growing seasons and has been seeing a 95% efficacy. Element 4 has been 97% effective against the Chinese tallow tree, using proper applications. Rodeo, Galleon, and 2-4, D have been extremely effective on water hyacinth. Management of the demonstration moist soil units may require the use of chemicals periodically to control undesirable vegetation, such as red vine, buttonbush, *Sesbania*, alligator weed, etc.

Although these chemicals have proven to be effective, the refuge is always striving for better methods. In addition to chemicals, the refuge manages undesirable plants using water manipulation, such as drawdowns and flooding (see Strategy A). However, over time, if these chemicals are shown through monitoring to lose their efficacy, other chemicals will be tried through the adaptive management process.

STRATEGY C. POTENTIAL PRESCRIBED FIRE MANAGEMENT STRATEGIES

Prescribed burns can be applied in multiple ways by varying the season and intensity of the burns. The intensity of a burn can be manipulated by using flanking, backing or head fires. Other variables that can affect the results of a burn include weather, fuel loads, fuel type, and fuel moisture.

The use of prescribed fire is the most cost-effective method of setting back woody succession, promoting native warm-season grasses and promoting native cane. Fire was the natural ecological process that created and maintained prairie habitat in North America, and prescribed fire will be used to promote cane and herbaceous plants where appropriate habitat exists on the

refuge. Fire management on the refuge will be applied according to protocols established in the refuge's Fire Management Plan (2011).

STRATEGY D. POTENTIAL BEAVER AND FERAL HOG MANAGEMENT STRATEGIES

Beavers have the potential to significantly adversely affect bottomland hardwood forests by damming sloughs and brakes (Mahadev et al. 1993). Forests inundated into the growing season quickly show signs of stress and trees eventually die. Beavers also kill trees by girdling and felling. One study in Mississippi showed that beavers on average damaged \$164/ac (1985 values) of timber by girdling and felling (Bullock and Arner 1985).

During pre-European times, beavers had a less significant impact on the extensive intact forests that were not fragmented and had not been hydrologically modified. Since European settlement, beaver numbers were controlled by trapping for the demanding fur trade. In the 1980s, annual harvests exceeded 1 million beaver pelts across the nation (Hill 1982). Recently, however, due to cultural and societal changes, beaver furs are no longer in great demand. Therefore, little trapping is conducted, causing beaver numbers to increase (Hill 1982).

Methods for control include removing beaver dams manually, with heavy equipment or by explosives, and trapping and shooting by Service employees. Dams that are small enough to remove by hand within an hour can be removed manually. Also, when trapping, the dams can be broken by hand to provide locations for trap sites. If a dam is so large that it cannot be removed manually within an hour, it can either be removed by machinery or explosives. If the surrounding area is too wet for the use of heavy equipment such as an excavator, then explosives can be used. Explosives should be used only by certified employees, and all state and local laws should be followed.

Feral hogs are one of the most invasive and destructive exotic species in North America. Feral hogs compete with turkeys, deer, and squirrels for mast (Seward et al. 2004). The hogs depredate birds and their nests, reptiles and amphibians, and deer fawns (Hellgren 1993). Their rooting activity causes widespread damage to ecosystems including plant trampling, spread of exotic plants, erosion, and water pollution (Mungall 2001). Feral hogs are known to carry brucellosis and pseudo rabies, both of which can be transmitted to native wildlife and humans (Witmer et al. 2003). Because they are prolific, feral hog populations grow at an explosive rate (Seward et al. 2004).

Methods for control and/or eradication include trapping and shooting by Service employees, permitted individuals, and/or contractors (USFWS 2012).

STRATEGY E. POTENTIAL FOREST MANAGEMENT STRATEGIES

In this section, the methods and procedures for implementing strategies to harvest timber are specified. This HMP now incorporates what was formerly considered the Forest Management Plan.

The purpose of the forest habitat management strategy is to establish and maintain the desired forest conditions specified in the objectives (Chapter IV). Both commercial and noncommercial silvicultural treatments can be used to produce the desired forest conditions. Commercial timber harvest operations are more economical and will be used to meet the forested habitat objectives of the refuge. The cost to the refuge associated with noncommercial treatments is

higher than commercial treatments in terms of manpower and funding. However, noncommercial treatments will be used when commercial operations cannot meet the refuge's objectives and sufficient funding is available. The forest management strategy details associated specifically with the administration of commercial timber removal are addressed in Appendix A.

A combination of silvicultural methods will be used to meet the uneven-aged forest management objectives described in the refuge's CCP and HMP for bottomland hardwood forest. The silvicultural methods are:

1. **Thinning.** Thinning involves intermediate cuttings that are aimed primarily at controlling the growth of stands by manipulating stand density. The objective of thinning on the refuge will be to open the forest canopy, release trees from competition, improve regeneration, and improve the species composition within a stand.
2. **Single-tree Selection.** This is the removal of a single mature individual tree or small clumps of several such trees. Openings created with this method are generally about ¼ acre in size. This is an uneven-aged silvicultural method that will allow for the development of a new age class of trees within the forest structure. This method favors the regeneration and development of plant species with higher shade tolerances.
3. **Group Selection.** This method refers to the removal of trees from a stand in groups to create openings in the forest canopy. These openings are generally about ½ acre in size. The increased size of the openings will encourage the regeneration of more shade-intolerant plant species such as sweetgum, red oaks, pecan, green ash, etc.
4. **Patchcuts.** Patchcuts are small clearcuts that vary in size from 1 to 3 acres. Dependent upon the shape of the patchcuts, forest openings of this size will eliminate the effects of shading throughout most of the opening. This will benefit the regeneration of even the most shade-intolerant plant species. A few cavity trees may be left within each patchcut to provide perches and nest locations for some species of birds. Patchcuts will provide small areas of even-aged forest scattered across an uneven-aged forested landscape that will benefit many species that need even-aged stand conditions to regenerate successfully, such as sweetgum, red oaks, cottonwood, sycamore, pecan, etc.
5. **No Cut.** This method would be equivalent to passive management. Areas under this management would be left to grow without silvicultural manipulations. The bottomland forest guidelines (LMVJV 2007) recommend 5-35% of the forest to be passively managed. Baldcypress and water tupelo stands will be passively managed in this HMP.

In addition, a different combination of silvicultural methods will be used to meet the forest management objectives described in the refuge's CCP and HMP for upland pine-hardwood forest. These are:

1. **Thinning.** This method involves intermediate cuttings aimed primarily at controlling the growth of stands by manipulating stand density. The objective of thinning on the refuge will be to open the forest canopy, release trees from competition, improve regeneration, and improve the species composition within a stand.

-
2. **Single-tree Selection.** This is the removal of a single mature individual tree or small clumps of several such trees. Openings created with this method are generally about ¼ acre in size. This is an uneven-aged silvicultural method that will allow for the development of a new age class of trees within the forest structure. This method favors the regeneration and development of plant species with higher shade tolerances.

MANAGEMENT STRATEGY PRESCRIPTIONS

STRATEGY A. MOIST SOIL MANAGEMENT STRATEGY PRESCRIPTION

To meet Objective 4.3.2 in the demonstration moist soil units, the following strategies will be used to manage moist soil habitat:

- Every 2-5 years, disk the impoundment (when sufficiently dry to drive the tractor) to reduce succession by woody plants and other undesirable vegetation.
- Annually, place boards in the water control structures in August-October to hold the water, or if rainfall is not sufficient, pump water to achieve a depth of < 18 inches.
- Draw down the impoundment during the spring/summer.
- Monitor the vegetation growth for percent cover of undesirable plants. If undesirables exceed 20% cover, manipulate the vegetation through mechanical (disking) or chemical means, as previously described in the Potential Moist Soil Management Strategies section.
- Maintain records by date for water management actions, water elevations, and vegetation and wildlife response.
- Use the sampling techniques of Strader and Stinson (2005) to determine percent cover of plant species and seed production, to determine if management actions need to be changed to meet the objectives.

STRATEGY B. CHEMICAL MANAGEMENT STRATEGY PRESCRIPTION

To meet all objectives in all management units for all resources of concern, the following strategies will be used to control invasive plants:

- Map new areas of infestation by exotics annually.
- Treat new or re-sprouted Japanese climbing fern with a foliar spray of Rodeo or other approved chemical once per year from May-October.
- Treat Chinese tallow tree, mimosa, chinaberry, royal palownia, Chinese privet, and other woody exotics once per year anytime except during leaf-out with 20% Element 4 with surfactant to trees > 8 in. dbh by cut-spray application. Treat trees < 8 in. dbh but taller than 5 ft, with basal spray application 12-18 in. from ground. Treat trees shorter than 5 ft with a foliar spray of 5% glyphosate.
- Treat water hyacinth throughout growing season with Rodeo, 2, 4D or other approved chemical.
- Treat other invasive plants with appropriate chemicals.
- If the current processes become ineffective, use the adaptive management process to find more efficient ways of treating the invasives.

To meet Objective 4.3.2 in the demonstration moist soil units, the following strategies will be used to control undesirable vegetation in moist soil habitat:

- When red vine covers greater than 20% of the management unit, treat it with RoundUp® or other suitable approved herbicide after disking in late fall.
- When *Sesbania* covers greater than 20% of the management unit, treat it with 0.5 qts/acre of Blazer® or other suitable approved herbicide before the plants flower and/or when they reach 3 ft. in height.

Other undesirable plants such as cocklebur and buttonbush are to be treated with 2-4D or other suitable approved herbicide when coverage exceeds 20% of the management unit.

STRATEGY C. PRESCRIBED FIRE MANAGEMENT STRATEGY PRESCRIPTION

To meet Objective 4.3.1 in the demonstration prairie, the following strategies will be used:

- Burned every 1-3 years during the growing season using backing and flanking fires to allow slow, low-intensity burns.
- Vary the timing of the burns from February through October

To meet Objective 4.3.2 in the demonstration moist soil units, the following strategies will be used:

- Burn using backing and flanking fires to set back the moist soil vegetation as needed.
- Vary the timing of the burns.

STRATEGY D. BEAVER AND FERAL HOG MANAGEMENT STRATEGY PRESCRIPTION

To meet all objectives in all management units for all resources of concern, the following strategies will be used to control beaver damage in bottomland hardwood forest:

- In the summer, inspect the refuge for areas where water is impounded, including all areas known to have had beaver dams in the past.
- Fix GPS locations of all beaver dams for future reference.
- Determine the best method for the removal of located beaver dams, and remove them immediately.
- If time permits, set traps for beavers.

To meet all objectives in all management units for all resources of concern, the following strategy will be used to control feral hog damage:

- Remove all feral hogs at every opportunity by using trapping and shooting by Service employees, permitted individuals, and/or contractors (USFWS 2012).

STRATEGY E. FOREST MANAGEMENT STRATEGY PRESCRIPTION

To meet all objectives on all units:

- The forester will cruise management units according to the entry schedule (Appendix A) to assess the conditions, and a site- and time-specific forestry prescription (as per Appendix A) will be written.
- The timber harvest operations can occur anytime of the year. However, logging will be restricted to dry periods of the year to keep soil disturbance and damage to residual vegetation at a minimum.
- Permanent roads for commercial timber harvest operations will be limited to existing roads only. This will help reduce fragmentation of the habitat and limit the disturbance to soil and plants throughout the refuge. Road edges that receive direct sunlight may provide substantial amounts of soft mast (fruit), where otherwise closed canopy forests make this important food source rare (Perry et al. 1999). Edge habitats along roads may be important for the reasons stated above, but should still be limited because of concerns of increased predation and parasitism of bird nests (Robinson et al. 1995), and effects of roads on amphibian movements (Gibbs 1998; DeMaynadier and Hunter 2000).
- Upon the completion of prescribed timber harvest operations, each treatment area will be monitored the next year and every 5 years thereafter to see if the desired results of the management unit prescription have been met.
- To monitor the impact of timber management activities on migratory birds, a bird monitoring program has been developed in cooperation with the Lower Mississippi Valley Joint Venture office.
- All forest management operations on the refuge will leave a 200-foot buffer along the banks of Black Bayou Lake and Bayou Desiard.
- Logging is restricted to dry times of the year to reduce soil compaction and erosion potential. Logging access roads will be limited to existing roads left over from previous ownership whenever possible. New road construction will be kept to a minimum and must be approved by the refuge manager.
- The 200-foot buffer along major waterways and permanent water areas will help keep logging debris out of the water channels. These buffer areas will also serve as filtration strips to reduce sediment loads that may be caused by logging activities. Treetops and other logging debris will be kept out of brakes and swales to minimize any impacts that logging activities may have on drainage. The number of crossings through swales and brakes will be kept at a minimum to prevent damage to the natural drainage of water. These crossings will be maintained, and any structures such as culverts will be removed as soon as the logging activities are completed.
- Loader sets are areas opened up by the logging contractor for the loading of forest products onto trucks. Loader sets usually range in size from $\frac{1}{4}$ to $\frac{1}{2}$ acre. Soil disturbance is greater in these areas than any other areas within the timber sale. In an effort to lessen the risk of soil erosion during wet periods in loader sets, these areas may be planted with winter grasses to serve as a temporary vegetative cover until normal vegetation has a chance to reclaim the site.

Additional constraints on commercial timber management can be found in Appendix A.

To meet Objective 4.2.1 in Management Units 3, 4 and 5 for upland pine-hardwood forest, the following forest management strategy will be used:

- Thin accordingly to meet the parameters specified in Objective 4.2.1.

To meet Objectives 4.1.1, 4.1.2, 4.1.3, and 4.1.4 in Management Units 1, 2, 3, 4 and 5 for breeding wood ducks, bats, alligator snapping turtles, and forest interior songbirds within bottomland hardwood forests, the following forest management strategies will be used:

- Apply 1- to 3-acre patchcuts on 5 to 10 percent of the management unit, leaving 4 to 6 large trees per acre within the small clearcuts (LMVJV 2007).
- Apply thinnings in the bottomland hardwood forest to meet the parameters specified in Objectives 4.1.1, 4.1.2, and 4.1.3 by reducing the basal area by 40 to 50 percent, with a variable rate of removal throughout the management units to allow significant sunlight penetration to the understory (LMVJV 2007).
- No timber removal or management should be conducted in pure baldcypress and water tupelo stands. This would be a passive management strategy.
- Release baldcypress in spots of regeneration.
- Conduct light thinning of small (14-inch dbh) baldcypress trees when mixed in hardwood stands to create larger (24-inch dbh) trees, and select thinning of hardwoods to release baldcypress to grow to old, large trees.
- Favor the retention of snags and cavity trees.

VI. LITERATURE CITATIONS

- Bolen, E.G. and W.L. Robinson. 1995. Wildlife Ecology and Management. Prentice Hall, Inc. 620 pp.
- Bragg, D. 2003. Natural presettlement features of the Ashley County, Arkansas area. *American Midland Naturalist* 149(1): 1-20.
- Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? *BioScience* 33:31-35.
- Bullock, J.F and D.H. Arner. 1985. Beaver damage to nonimpounded timber in Mississippi. *Southern Journal of Applied Forestry* 9: 137-140.
- Clark, M.K. 1990. Roosting Ecology of the Eastern Big-eared Bat, *Plecotus rafinesquii*, in North Carolina. M.S. Thesis. N.C. State University, Raleigh, North Carolina. 110 pp.
- Clark, M. K., A. Black and M. Kiser. 1998. Draft Report C7745.11: Roosting and Foraging Activities of *Corynorhinus rafinesquii* and *Myotis austroriparius* within the Francis Beidler Forest, South Carolina. North Carolina State Museum of Natural Sciences, Raleigh.
- Cochran, S.M. 1999. Roosting and Habitat Use by Rafinesque's Big-eared Bat and other Species in a Bottomland Hardwood Forest Ecosystem. M.S. Thesis. Arkansas State University. 50 pp.
- DeMaynadier, P.G. and M.L. Hunter, Jr. 2000. Road effects on amphibian movements in a forested landscape. *Natural Areas Journal* 20(1): 56-65.
- Devall, M.S. 1998. An Interim Old-growth Definition for Cypress-Tupelo Communities in the Southeast. General Technical Report SRS-19. Asheville, North Carolina: U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 pp.
- Dugger, K.M. and L.H. Fredrickson. 2001. Life history and habitat needs of the wood duck. Pages 53-59 in K.D. Nelms (ed.), Wetland Management for Waterfowl Handbook.
- Eyre, F.H. (Ed.). 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.
- Flack, S. and E. Furlow. 1996. America's least wanted "purple plague," "green cancer" and 10 other ruthless environmental thugs. *Nature Conservancy Magazine*, Vol. 46, No. 6 November/December.
- Gale, G.A., L.A. Hanners and S.R. Patton. 1997. Reproductive success of worm-eating warblers in a forested landscape. *Conservation Biology* 11(1): 246-250.
- Gibbs, J.P. 1998. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. *Journal of Wildlife Management* 62(2): 584-589.

-
- Karl, Thomas R., Jerry M. Melillo and Thomas C. Peterson (Eds.). 2009. Global Climate Change Impacts in the United States. Cambridge University Press.
- Gypsy Gooding and James R. Langford. 2004. Characteristics of tree roosts of Rafinesque's big-eared bat and southeastern bat in northeastern Louisiana. *The Southwestern Naturalist* 49(1): 61-67.
- Hall, T.F., and W.T. Penfound. 1939. A phytosociological study of a cypress-gum swamp in southeastern Louisiana. *American Midland Naturalist* 21(2): 378-395.
- Harlow, W.M. and E.S. Harrar. 1969. Textbook of Dendrology. McGraw-Hill, New York. 510 pp.
- Harrell, J.B. 1996. Movements and habitat use of subadult alligator snapping turtles (*Macrolemys temminckii*) in Louisiana. *American Midland Naturalist* 135(1): 60-67.
- Harvey, M.J., J.S. Altenbach and T.L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission and U.S. Fish and Wildlife Service. 64 pp.
- Hellgren, E.C. 1993. Biology of feral hogs (*Sus scrofa*) in Texas. Pages 50-58 in C.W. Hanselka and J.F. Cadenhead (eds.), Feral Swine: A Sheep and Goat Research Journal. Volume 19, 2004 39 compendium for resource managers. Texas Agricultural Extension Service, Kerrville, Texas, USA.
- Heltzel, J.M. and P.L. Leberg. 2006. Effects of selective logging on breeding bird communities in bottomland hardwood forests in Louisiana. *Journal of Wildlife Management* 70(5): 1416-1424.
- Hill, E.P. 1982. Beaver. Pages 256-281 in J.A. Chapman and G.A. Fledhamer (eds.), Wild Mammals of North America: Biology, Management and Economics. Johns Hopkins University Press, Baltimore, Maryland, USA.
- Hoffman, V.E. 1999. Roosting and Relative Abundance of the Southeastern Myotis, *Myotis austroriparius*, in a Bottomland Hardwood Forest. M.S. Thesis, Arkansas State University, Jonesboro, Arkansas.
- Hoffman, V.E., J.E. Gardner, J. K. Krejca and J.D. Garner. 1999. Summer records and a maternity roost of the southeastern myotis (*Myotis austroriparius*) in Illinois. *Illinois State Academy of Science* 92: 95-107.
- Hunter, W.C., W. Golder, S. Melvin and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. U.S. Fish and Wildlife Service, Southeast Regional Office, Atlanta, Georgia. 131 pp.
- King, S.L, J.P. Shepard, K. Ouchley, J.A. Neal and K. Ouchley. 2005. Ecology and management of bottomland hardwood systems: the state of our understanding. L.H. Fredrickson, S.L. King and R.M. Kaminski, editors. University of Missouri-Columbia. Gaylord Memorial Laboratory Special Publication No. 10. Puxico.

-
- Kushlan, J.A. and K.L. Bildstein. 2009. White Ibis: The Birds of North America. Cornell Lab of Ornithology and American Ornithologists' Union. Issue 009.
- Lacki, M.J. and K.M. LaDeur. 2001. Seasonal use of lepidopteran prey by Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). *American Midland Naturalist* 145: 213-217.
- Lacki, M.J., S.K. Amelon and M.D. Baker. 2007. Foraging ecology of bats in forests. Pages 83-128 in M.J. Lacki, J.P. Hayes and A. Kura (eds.), *Bats in Forests: Conservation and Management*. Baltimore, Maryland: The Johns Hopkins University Press.
- Lester, G.D., S.G. Sorensen, P.L. Faulkner, C.S. Reid and I.E. Maxit. 2005. Louisiana Comprehensive Wildlife Conservation Strategy. Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana. 455 pp.
- LMVJV Forest Resource Conservation Working Group. 2007. Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt. 88 pp.
- McGivrey, F.B. 1968. A Guide to Wood Duck Production Habitat Requirements. U.S. Fish and Wildlife Service, Research Publication 60. 32 pp.
- Mahadev, G.B., R.G. Huffaker and S.M. Lenhart. 1993. Controlling forest damage by dispersive beaver populations: centralized optimal management strategy. *Ecological Applications* 3(3): 518-530.
- Martin, D.L. and L.M. Smith. 1991. A Survey and Description of the Natural Plant Communities of the Kisatchie National Forest, Winn and Kisatchie Districts. Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana. 372 pp.
- Martin, C. D., W. A. Mitchell and M. S. Wolters. 2002. Eastern Cave- and Crevice-dwelling Bats Potentially Impacted by USACE Reservoir Operations. EMRRP Technical Notes Collection (ERDC TN EMRRP-SI-34). United States Army Corps of Engineers Research and Development Center, Vicksburg, Mississippi.
- Medlin, R.E., Jr. and T.S. Risch. 2008. Habitat associations of bottomland bats, with focus on Rafinesque's big-eared bat and southeastern myotis. *American Midland Naturalist* 160(2): 400-412.
- Miller, J.H. 2003. Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control. General Technical Report SRS-62. Asheville, North Carolina: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 pp.
- Mirowsky, K. and P. Horner. 1997. Roosting Ecology of Two Rare Vespertilionid Bats, the Southeastern Myotis and Rafinesque's Big-eared Bat, in East Texas. 1996 Annual Report (20 June 1997). Texas Parks and Wildlife Department, Resource Protection Division, Austin, Texas.

-
- Mungall, E.C. 2001. Exotics. Pages 736-764 in S. Demarais and P. R. Krausman (eds.), *Ecology and Management of Large Mammals in North America*. Prentice Hall, Upper Saddle River, New Jersey, USA.
- Ouchley, K., W.C. Barrow, K. Ouchley and R.B. Hamilton. 1999. Characteristics of old-growth bottomland hardwood forests of the Lower Mississippi River Alluvial Valley in Louisiana. *Forest Management and Ecology*.
- Ouchley, K., R.B. Hamilton, W.C. Barrow and K. Ouchley. 2000. Historic and present-day forest conditions: implications for bottomland hardwood forest restoration. *Ecological Restoration* 18(1): 21-25.
- Pashley, D.N. and W.C. Barrow 1993. Effects of land use practices on Neotropical migratory birds in bottomland hardwood forests. Pages 315-320 in D.M. Finch and P.W. Stangel (eds.), *Status and Management of Neotropical Migratory Birds*. U.S. Forest Service, General Technical Report RM-229. Washington, D.C., USA.
- Paulus, S.L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. *Journal of Wildlife Management* 48: 371-380.
- Perry, Roger W., Ronald E. Thrill, David G. Peitz and Philip A. Tappe. 1999. Effects of different silvicultural systems on initial soft mast production. *Wildlife Society Bulletin* 24(4): 915-923.
- Ray, M.J. 2010. Spatial Ecology of Adult Alligator Snapping Turtles (*Macrochelys temminckii*) in Northern Louisiana. M.S. Thesis. University of Louisiana at Monroe, Monroe, Louisiana. 63 pp.
- Reed, R.N., J. Congdon and J.W. Gibbons. 2002. The Alligator Snapping turtle (*Macrochelys temminckii*): A review of Ecology, Life History, and Conservation, with Demographic Analyses of the Sustainability of Take from Wild Populations. Savannah River Ecology Laboratory and University of Georgia. Aiken, South Carolina. 17 pp.
- Rice, C.L. 2009. Roosting Ecology of *Corynorhinus rafinesquii* (Rafinesque's big-eared bat) and *Myotis austroriparius* (southeastern myotis) in Tree Cavities Found in a Northeastern Louisiana Bottomland Hardwood Forest Streambed. M.S. Thesis. University of Louisiana at Monroe, Monroe, Louisiana. 124 pp.
- Robbins, C.S., D.K. Dawson and B.A. Dowell. 1989. Habitat are requirements of breeding forest birds of the Middle Atlantic states. *Wildlife Monographs* 103.
- Robinson, W.D. and S.K. Robinson. 1999. Effects of selective logging in forest bird populations in a fragmented landscape. *Conservation Biology* 13: 58-66.
- Robinson, S.K., F.R. Thompson, T.M. Donovan, D.R. Whitehead and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* 267: 1987-1990.
- Rodewald, P.G. and R.D. James. 2011. Yellow-throated Vireo: The Birds of North America. Cornell Lab of Ornithology and American Ornithologists' Union. Issue 247.

-
- Rosenberg, K.V., R.S. Hames, R.W. Rohrbaugh, Jr., S. Barker Swarthout, J.D. Lowe and A.A. Dhondt. 2003. A Land Manager's Guide to Improving Habitat for Forest Thrushes. The Cornell Lab of Ornithology, Ithaca, New York.
- Roth, R.R., M.S. Johnson and T.J. Underwood. 2011. Wood Thrush: The Birds of North America. Cornell Lab of Ornithology and American Ornithologists' Union. Issue 246.
- Sargent, C.S. 1965. Manual of the Trees of North America. Dover Publishing, Inc., New York.
- Seward, N.W., K.C. VerCauteren, G.W. Witmer and R.M. Engeman. 2004. Feral swine impacts on agriculture and the environment. *Sheep and Goat Research Journal* 19: 34-40.
- Smith, L.M. 1993. Estimated Presettlement and Current Acres of Natural Plant Communities in Louisiana. Louisiana Natural Heritage Program, Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana.
- Steer, H.B. 1948. Lumber Production in the United States, 1799-1946. USDA Miscellaneous Publication No. 669. Washington, D.C. 233 pp.
- Taulman, J.F., W. Vermillion and R.P. Ford. 1999. Bird Conservation Plan: West Gulf Coastal Plain. Partners in Flight. 69 pp.
- Thatcher, B.S. 2007. Evaluation of Forest Management to Improve Breeding Habitat for Songbirds in Oak Hickory Forests at Tennessee National Wildlife Refuge. Ph.D. Dissertation. University of Tennessee, Knoxville, Tennessee. 256 pp.
- Tiner, R. W., Jr. 1984. Wetlands of the United States: Current Status and Recent Trends. U.S. Fish and Wildlife Service, National Wetlands Inventory Office, Washington, D.C.
- Twedt, D.J. and S.G. Somershoe. 2008. Bird response to prescribed silvicultural treatments in bottomland hardwood forests. *Journal of Wildlife Management* 73(7): 1140-1150.
- Twedt, D, D. Pashley, C. Hunter, A. Mueller, C. Brown and B. Ford. 1999. Partners in Flight Bird Conservation Plan for the Mississippi Alluvial Valley. Partners in Flight website: http://www.partnersinflight.org/bcps/plan/MAV_plan.html (VERSION: 1.0).
- U.S. Department of Agriculture, Soil Conservation Service. 1974. Soil Survey of Ouachita Parish, Louisiana. U.S. Government Printing Office, Washington D.C. 80 pp.
- U.S. Fish and Wildlife Service. 2003. Recovery Plan for the Red-cockaded Woodpecker (*Picoides borealis*): Second Revision. U.S. Fish and Wildlife Service, Atlanta, Georgia. 296 pp.
- U.S. Fish and Wildlife Service. 2008. Biological Review Report, Black Bayou Lake National Wildlife Refuge. U.S. Fish and Wildlife Service. Atlanta, Georgia. 50 pp.
- U.S. Fish and Wildlife Service. 2010. Comprehensive Conservation Plan for Black Bayou Lake National Wildlife Refuge. Atlanta, Georgia. 207 pp.

-
- U.S. Fish and Wildlife Service. 2011. Fire Management Plan, North Louisiana Refuges Complex. Farmerville, Louisiana. 112 pp.
- U.S. Fish and Wildlife Service. 2012. Nuisance Animal Plan, North Louisiana Refuges Complex. Farmerville, Louisiana.
- U.S. Forest Service (USFS). 2004. Final Environmental Impact Statement for the Revised Land and Resource Plan, National Forests in Alabama. U.S. Department of Agriculture, Atlanta, Georgia. 510 pp.
- Wang, K.K. 1952. Geology of Ouachita Parish. Department of Conservation, Louisiana Geological Survey, Baton Rouge, Louisiana. 126 pp.
- Watts, B.D. 2011. Yellow-crowned Night-heron: The Birds of North America. Cornell Lab of Ornithology and American Ornithologists' Union. Issue 161.
- Wenny, D.G. R.L. Clawson, J. Faaborg and S.L. Sheriff. 1993. Population density, habitat selection and minimum area requirements of three forest-interior warblers in central Missouri. *Condor* 95(4): 968-979.
- Witmer, G.W., R.B. Sanders and A.C. Taft. 2003. Feral swine: are they a disease threat to livestock in the United States? Pages 316-325 in K.A. Fagerstone and G.W. Witmer (eds.), Proceedings of the 10th Wildlife Disease Management Conference.

APPENDICES

APPENDIX A. THE COMMERCIAL SALE OF TIMBER

EXECUTION OF TIMBER HARVEST

CRUISING AND MARKING TIMBER

Each management unit is assigned a year of entry. The year of entry is assigned to distribute forest management activities across the refuge throughout the duration of this habitat management plan. Following the Order of Entry (Table 4), a habitat and timber cruise will be conducted for each management unit. The cruise may be conducted using fixed plot and point sampling techniques. Most cruise sampling will be done using a fixed radius plot of 1/5th acre for saw timber, 1/20th acre plots for pulpwood, and 1/100th acre plots for regeneration and herbaceous ground cover; however, conditions may arise that require different sampling methods. Point samples utilizing 10, 15, or 20 factor prisms may be used at various times for collecting timber volumes. The following data will be collected during each management unit cruise:

1. Timber volumes including basal area for sawtimber and pulpwood
2. Species composition of woody vegetation
3. Canopy conditions (dominant, intermediate, suppressed)
4. Presence of Spanish moss, and switchcane
5. Presence of vines (sparse, moderate, heavy)
6. Herbaceous ground cover
7. Number and size of den, cavity, and cull trees per acre
8. Tree and shrub species regeneration
9. Species composition of each canopy layer (overstory, midstory, understory, and ground cover)

Volume tables for each management unit will be expressed in 2-inch diameter classes for both sawtimber and pulpwood. Doyle form class 80 will be used to express volume sawtimber (MBF) and pulpwood (cords) volumes for pine. Doyle form class 76 will be used to express volume sawtimber (MBF) and pulpwood (cords) volumes for bottomland hardwoods. The exception will be green ash and water tupelo volumes, which will utilize Doyle form class 70.

Table 4. Order of Entry 2013-2025

Year to Enter	Management Unit
2013	Management Unit 1
2014	Management Unit 2
2015	Management Unit 3

Year to Enter	Management Unit
2016	Management Unit 4
2017	Management Unit 5
2018	Allow for Backlog/Revisits
2019	Allow for Backlog/Revisits
2020	Allow for Backlog/Revisits
2021	Evaluate additional acreages added to Refuge during HMP
2025	Write new CCP and HMP

** Acreage values expressed in this table are GIS acreage estimates.*

Cruise data will be compared to target conditions (habitat objectives) for the unit, and a condition specific treatment prescription will be developed. Treatment prescriptions will contain the following information:

1. Management Unit map
2. Stand map designating various timber stands within the management unit
3. Description of management unit including vegetation profile, soil types, hydrology, and other physiological features
4. Timber data including tree species composition, sawtimber and pulpwood volumes, stocking, age, condition, and basal area.
5. Wildlife habitat parameters including plant composition of overstory and understory; number of cavity and den trees; presence of vines, Spanish moss, and switchcane; number of dead snags; presence of woody debris; and evidence of wildlife activity (e.g. bird nests, browsing of plants, wildlife tracks, etc.)
6. Composition of woody plant regeneration
7. Prescription of silvicultural treatment to be conducted in the management unit
8. Description of desired results
9. Map of Treatment Area
10. Timber data for the Treatment Area showing what is to be removed during treatment
11. Management of roads, invasives and hydrological conditions will be addressed

After the Prescription is written, it will be submitted to the Regional Office for approval. Copies of Prescriptions and all other information will be kept on file in the refuge office.

During the timber marking activities, many factors are considered before selecting a tree for removal. These include species composition of the management unit, tree health and vigor, present regeneration, potential regeneration, canopy structure, number of cavities within the area, habitat value of the tree, mast production, and objectives of the management unit prescription. The management unit prescription designates how much timber volume or basal area to remove during a treatment, but the application of the prescription occurs during timber marking.

To determine which trees are designated for removal, the forester will follow sound silvicultural procedures prescribed in the management unit prescription. As the forester determines which trees are to be removed, paint will be applied at breast height and at the base of trees to be removed. These two marks allow for the contractor to distinguish which trees are designated for removal during logging operations and help the forester identify the stumps of marked trees during administration of the logging contract.

Timber marking is very subjective and varies from one timber marker to another. Though the management unit prescription gives the timber marker guidelines to follow, each individual timber marker has a different opinion on how to reach the desired results of the management unit prescription. To ensure forest diversity and avoid bias, more than one person should be involved with the timber marking of treatment areas on the refuge.

The timber sale must satisfy certain conditions to be operable by a contractor. For present market conditions, the following guidelines apply to timber sales open to formal competitive bidding; adjustments may be necessary if significant changes in the economy occur. Total sale volumes could be less in the case of a negotiated sale; however, the average volumes per acre would remain essentially unchanged.

Pine saw timber must have a minimum DBH of 11.0 inches and a minimum merchantable length of 12 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 7.0 inches, or
2. The point in the upper stem at which excessive taper occurs.
Excessive taper is generally associated with these limits:
 - a. A stem defect
 - b. A limiting whorl. A limiting whorl is branches, at least 1 inch in diameter, radiating from 3 or more faces and situated within a 6-inch vertical span, where the sum of their diameters equals or exceeds $\frac{1}{2}$ of the outside stem diameter at the point of occurrence. The term "branch" shall mean live branches or dead branches that still show remnants of branch endings
 - c. If a usable 8-foot or longer section occurs above either (a) or (b), take the merchantable height to the top of this section. A usable section is one not having the characteristics of (a) or (b) and not limited by diameter.
 - d. Occasionally, there may be two limiters with a usable 8-foot or longer section above them. If the two limiters occur within a vertical 4-foot span, take the merchantable height to the top of the next usable section. Otherwise, measure to the first limiter.

Hardwood saw timber must have a minimum DBH of 11.0 inches and minimum merchantable length of 12 feet. The diameter of swell-buttressed species, such as baldcypress and water tupelo, shall be measured 1-½ feet above swell, when the swell is more than 3 feet high, instead of at DBH.

The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 8 inches, or
2. The point at which the tree breaks into forks containing no merchantable saw logs, or
3. One or more live limbs occurring within a vertical span of 1 foot, whose sum of diameter equals or exceeds 1/3 of the stem diameter outside the bark at that point, or
4. A stem deformity.

Pine pulpwood must have a minimum DBH of 5.0 inches and a minimum merchantable length of 10 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 3.0 inches, or
2. That point at which stem deformity prevents utilization. If at least a full 5-foot usable section occurs above this point, take the merchantable height to the top of this section. A usable section is one that is reasonably straight and sound and whose small-end diameter equals or exceeds 3.0 inches inside bark.

Hardwood pulpwood must have a minimum DBH of 7 inches and minimum merchantable length of 10 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark (DIB) of 4.0 inches, or
2. That point at which stem deformity prevents utilization. If at least a full 5-foot section occurs above this point, take the merchantable height to the top of this section. A usable section is one that is reasonably straight and sound and whose small end diameter equals or exceeds 4.0 inches diameter inside bark.

Trees that fork immediately above DBH will be measured below the swell resulting from the double stem. The longest utilizable stem shall be measured for the merchantable height. Trees that fork below DBH shall be considered as two separate trees, and the diameters shall be measured or estimated 3 ½ feet above the fork.

Timber harvest operations can occur anytime of the year. However, logging will also be restricted to dry periods of the year to keep soil disturbance and damage to residual vegetation at a minimum.

LOGGING OPERATIONS

Permanent roads for commercial timber harvest operations will be limited to existing roads only. Temporary roads will be abandoned and rehabilitated if required. Rehabilitation can include the installation of water bars and/or the redistribution of disturbed soil. This will help reduce fragmentation of the habitat and limit disturbance to soil and plants throughout the refuge. Road edges that receive direct sunlight may provide substantial amounts of soft mast (fruit), where

otherwise closed canopy forests make this important food source rare (Perry *et al.* 1999). Edge habitats along roads may be important for reasons stated above, but should still be limited because of concerns of increased predation and parasitism of bird nests (Robinson *et al.* 1995), and effects of roads on amphibian movements (Gibbs 1998, deMaynadier and Hunter 2000).

Logging operations will be allowed to use skidders, crawler tractors, and wheeled tractors to skid logs to loading areas where they are loaded onto trucks. Tree-length skidding will be allowed, but the trees must have the tops and all limbs removed before skidding. Removal of tops and limbs will reduce chances of damage to residual trees. If possible, harvest should be conducted outside of breeding season for birds (April-June), but management can be conducted during this period if necessary. Other special conditions and/or restrictions, as determined by refuge staff, may be stated in the Timber Sale Bid Invitation (Exhibit 3) and Special Use Permit awarded to the highest bidder for the Timber Sale Bid.

In order to confirm harvest procedures and address any questions, a pre-entry conference will be held between the Refuge Manager and/or Refuge Forester, Permittee, and the logging contractor, if different than the Permittee. The Permittee is to notify the Refuge when harvesting operations begin and are completed.

Close inspection and supervision of all timber sales is necessary to ensure that harvesting operations meet the conditions of the Special Use Permit and refuge objectives. Frequent inspections of harvesting operations will ensure that only designated trees are cut, and problems are rectified before becoming major issues. Timber harvesting operations may be suspended or restricted any time that continued operation might cause excessive damage to the forest stands, soil, wildlife habitat, or cultural resources. Reasons for suspension or restriction may include, but are not limited to: periods of high wildfire potential, insects or disease hazard, times when harvesting may interfere with essential refuge operations, during periods of heavy rains or wet conditions which may cause rutting and erosion of soils, when harvesting operations present a safety hazard, or when harvest operations reveal new or may damage existing cultural resources. Furthermore, operations may be suspended or terminated if the Permittee violates the conditions of the Special Use Permit.

When harvesting is complete, the Refuge Forester or designated Refuge Staff will inspect the site for compliance with all requirements of the contract. If any deficiencies are found, the Permittee will be notified and given reasonable time to achieve compliance. If full compliance is achieved, the Permittee's performance deposit will be returned in full. If not, an amount to mitigate damages will be deducted from the performance deposit and the remaining amount returned.

MONITORING

Upon completion of prescribed timber harvest operations, each treatment area will be monitored the next year and every 5 years after to see if desired results of the management unit prescription have been met. Monitoring will consist of the forester walking through the treated area and taking basal area measurements at several points. This will help the refuge staff to determine what changes, if any, may be needed for future forest management prescriptions.

To monitor the impact of timber management activities on migratory birds, a bird-monitoring program has been developed in cooperation with the Lower Mississippi Valley Joint Venture office. The information gathered from the bird-monitoring system assists in identifying the

impacts of timber harvest on bird populations, as well as other wildlife species, before and after treatment. This information will help adapt timber management activities to the needs of the many plant and animal species utilizing the forested habitat of the refuge.

A Geographical Information System (GIS) and Global Positioning System (GPS) database is currently being developed on the refuge. The current refuge GIS database consists of various image files including Digital Orthophoto Quarter Quads (DOQQ's), Digital Raster Graphs (DRG's) of USGS topographic quad maps, and 10- 15- 30-meter resolution satellite images. Feature classes, from a variety of different state and federal agencies provide mapping layers for federal and state highways, local roads, parish boundary lines, powerline and pipeline rights-of-way, reforestation projects on private and public lands, public land boundaries, and various other layers providing information about the area surrounding the refuge.

For this plan, GIS data have been developed on a local scale to reflect the refuge management activities. To enhance the development of a GIS database that is specific to the refuge, GPS technology has and will continue to be used to establish management unit boundaries, maps, cruise lines, treatment area maps and boundaries, monitoring programs, refuge roads, beaver activity, forest cover types, and all other management activities related to the refuge.

To ensure the refuge is in compliance with the Forestry Best Management Practices (FBMP) manual regulations (<http://www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMP.pdf>) concerning Natural and Scenic Rivers, all forest management operations on the refuge will leave a 200-foot buffer along the banks of the Black Bayou Lake and Bayou DeSiard. Logging occurs only when soils are dry to reduce soil compaction and erosion potential. Logging access roads will be limited to existing woods roads left over from previous ownership whenever possible. New road construction will be kept to a minimum and must be approved by the refuge manager.

The 200-foot buffer along major waterways and permanent water areas will help keep logging debris out of water channels. These buffer areas will also serve as filtration strips to reduce sediment loads that may be caused by logging activities. Treetops and other logging debris will be kept out of brakes and swales to minimize any impacts that logging activities may have on drainage. The number of crossings through swales and brakes will be kept at a minimum to prevent damage to the natural drainage of water. These crossings will be maintained and any structures, such as culverts, will be removed as soon as logging activities are completed.

ARCHEOLOGICAL AND CULTURAL RESOURCES

The Archeological Resources Protection Act of 1979 obligated the refuges to protect all sites of archeological and historical significance. It is possible that forest management activities on the refuge could disturb some unknown archeological site. Thus to minimize the chance of such disturbances the following actions will be taken:

1. All forest management prescriptions will be submitted to the Regional Archeologist for approval prior to the start of any logging activities.
2. Logging will be limited to dry soil conditions, thus limiting soil disturbance and erosion.
3. Limit new road construction to reduce the chance of disturbance.
4. Cease logging operations and flag any suspected archeological sites that may be discovered during logging operations

-
5. Contact the Regional Archeologist if any suspected archeological sites are discovered and follow instructions given by the Regional Archeologist to protect the site until a thorough investigation of the site can be conducted.

AESTHETICS

Aesthetic values are important to wildlife-dependent recreation, especially wildlife observation and photography, which are two of the six priority public uses of refuges designated in the National Wildlife Refuge System Improvement Act of 1997. Although aesthetic values vary from person to person, forest management activities will use the following guidelines to ensure that wildlife-dependent recreation opportunities for the public are not impeded:

1. Keep logging loader sets at least 100-feet away from designated hiking trails.
2. Maintain a 200-foot buffer along the boundary of all major waterways where logging will not be allowed. Road construction, loader sets, and skidding of logs will also be prohibited within this buffer. All logging debris will be removed from within the buffer boundary.
3. Keep logging slash piles away from designated hiking trails.
4. Limit height of slash piles to less than 4 feet in logging areas and loader sets, unless otherwise directed for wildlife habitat improvement purposes.
5. Ensure all logging access roads are maintained and free of litter and debris while logging activities are in progress.

FOREST OPENINGS

Forest openings on the refuge will be managed as temporary openings. These are openings created during logging operations either as patchcuts or loader sets. The patchcuts, 1-3 acres in size, are designated during timber marking to develop temporary openings in the forest canopy large enough to encourage the development of shade intolerant plant species. Loader sets are areas opened up by the logging contractor for the loading of forest products onto trucks. Loader sets usually range in size from $\frac{1}{4}$ to $\frac{1}{2}$ acre in size and soil disturbance is greater in these areas than any other areas within the timber sale. In an effort to lessen the risk of soil erosion during wet periods in loader sets, these areas may be planted with winter grasses to serve as a temporary vegetative cover until normal vegetation has a chance to reclaim the site. Rotation of timber harvest areas between the forest management units will allow for temporary openings to be created throughout the refuge on a continual basis to replace older forest openings as they close up.

INSECTS AND DISEASE

Insects and diseases that may affect the forested habitat on the refuge can be most effectively controlled by promoting stand conditions favoring healthy vigorous trees. Trees stressed by overstocking, flooding, drought, overmaturity, fire, etc., have an increased susceptibility to insects and diseases. Forest management activities such as thinnings and group selection cuts will help promote tree health and vigor by reducing competition and stocking as well as maintaining tree species diversity.

Most of the disease and insect damage found on the refuge presently is limited to individual trees or small groups and should not pose a threat to the health of the forest. The presence of tree diseases and insects is a normal occurrence in the forest. Many Neotropical bird species

forage on insects that damage trees, while other wildlife species forage on the conks and other fruiting bodies of various diseases. Portions of trees damaged by insects and diseases may eventually develop into cavities available for wildlife use.

Upon entry into a management unit, insect and disease damage will be evaluated and taken into consideration as part of the management unit cruise. In situations where insect and/or disease conditions are considered severe, the refuge forester will try to identify the problem and consult with the Forest Health Unit of The United States Forest Service Southern Region State and Private Forestry Division in Pineville, Louisiana for advice on how to effectively control the problem.

In the event of extensive disease or insect infestation, the refuge manager or forester may request an expedited treatment. This request must be approved at the Regional level and should eliminate most of the formal prescription approval process, though sound biological and silvicultural principals will still apply. The formal bidding process for such treatments may be scaled back in order to expedite the treatment.

TIMBER SALVAGE AND UNSCHEDULED HARVESTING

Salvaging damaged timber, dead, or down trees following natural events such as ice storms, tornadoes, disease/insect outbreaks, windstorms, wildfires and etc. is a common practice in forest management. Forest management on Black Bayou Lake NWR will only consider salvaging timber to reduce fire hazards or prevent the likelihood of insect or disease outbreaks. These natural events usually provide wildlife species with many habitat needs such as snags for cavities, new denning locations, diversifying the canopy structure, increased plant diversity on the forest floor, etc. Unscheduled harvesting may need to occur to prevent the loss of timber due to outbreaks of insects or disease. If an outbreak of insects or diseases should occur, it may be necessary to enter into a management unit ahead of the entry cycle to stop or slow the outbreak.

ADMINISTRATION OF SALES

CONDITIONS APPLICABLE TO TIMBER HARVESTING PERMITS

1. A pre-entry conference between the Refuge Forester and the designated Permittee representative will be a requirement before the purchaser starts logging operations. The purpose of the pre-entry conference is to ensure that the purchaser completely understands what is expected of him, thus avoid misunderstanding or serious conflict.
2. If requested, satisfactory scale tickets for timber products shall be submitted to the Refuge Forester.
3. Bottomland hardwood species will be cut so as to leave a stump not more than 18 inches high for sawtimber and pulpwood. Upland hardwood stump height shall not exceed 18 inches for sawtimber and 12 inches for pulpwood. Stump height for pine shall not exceed 12 inches for sawtimber and 6 inches for pulpwood-sized trees. All stump heights are measured at the side adjacent to the highest ground. In the case of swell-butted species or trees with metal objects in the butt, stumps may be higher.

-
4. Whole tree skidding in sawtimber sales is prohibited, unless special conditions are permitted.
 5. Ground level paint spots must remain visible after the tree has been cut. All marked trees are to be cut, unless otherwise approved by the Refuge Forester.
 6. Trees and tops shall not be left hanging or supported by any other tree and shall be pulled down immediately after felling.
 7. Tops and logging debris shall be pulled back 20 feet from public roads and lopped within 150 feet.
 8. All roads, right-of-ways, fields, openings, streams, and firebreaks must be kept clear of tops and debris. Permittee shall also repair all damage to same resulting from operations conducted under this permit.
 9. Littering in any manner is a violation of the Code of Federal Regulations. The entire work area shall be kept free of litter at all times. Repairs and cleanup work will be accomplished to the satisfaction of the Refuge Manager and/or Refuge Forester.
 10. Additional trees removed to prepare loading sites will be paid for at bid prices. Unmarked trees, which are cut or injured through carelessness, shall be paid for at **double** the bid price.
 11. The Permittee will remove temporary plugs, dams, and bridges, constructed by the Permittee, upon completion of the contract. There are areas on the refuge where temporary plugs or dams in an intermittent stream would not be allowed. These areas will be indicated on sale maps.
 12. Loading sets will be determined cooperatively between the Refuge Forester and Permittee.
 13. Ownership of all products remaining on a sale area will revert to the U.S. Government upon termination of the permit.
 14. The Refuge Manager and/or Forester shall have authority to temporarily close down all or any part of the harvest operation during a period of high fire danger, wet ground conditions, or for any other reason deemed necessary. An equal amount of additional time will be granted to the Permittee.
 15. The U. S. Government accepts no responsibility to provide right-of-way over private lands for materials sold under this contract.
 16. The Permittee and his employees will do all within their power to prevent and suppress wild fires.
 17. The decision of the Refuge Manager shall be final in the interpretation of the regulations and provisions governing the sale, cutting, and removal of the timber covered by this permit.

18. When a timber sale area is adjacent to private land, all logging debris will be pulled back onto the refuge to avoid damage to private property.

20. Permittee and his employees shall not build fires on the refuge.

CONTROL RECORDS

The primary purpose of records is to show progress made in fulfilling the habitat management plan objectives. These records include but are not limited to: management unit prescriptions, management unit geographical information system (GIS) maps, sale area GIS maps, timber sale contracts and special use permits, management unit timber volume tables, order of entry plan and progress reports, non-commercial treatments, wildlife information gathered by management unit, and data collected from bird counts conducted throughout the length of the HMP.

SALE FOLDERS

A sale folder will be prepared and maintained for each individual timber sale. The folder shall contain copies of all data collected for the sale. This includes tally sheets, volume estimates, maps, bid invitation, Special Use Permits, payment records, correspondence with permittee, sale compliance inspection notes, copies of deposit checks, payment transmittal forms, etc. The sale folder shall be kept in a separate folder within the management unit folder for each individual management unit, thus keeping all information pertaining to a management unit within a single file.

BID INVITATIONS

Commercial timber sales are the most practical method available for creating and maintaining desired forest habitat conditions. All timber sales will be conducted in accordance with the requirements listed in the Refuge Manual, and the guidelines and specifications detailed in the Black Bayou Lake NWR CCP, Black Bayou Lake NWR Habitat Management Plan, and management unit prescriptions.

Small sales (estimated receipts less than \$2,500) will be negotiated as authorized by U. S. Fish and Wildlife Service policies. The Refuge Forester will make a reasonable effort to obtain at least three bids from potential buyers. These bids will be documented and a permit will be issued to the successful bidder.

Larger timber sales (estimated receipts more than \$2,500) will be conducted through a formal bid procedure. Invitations to bid will be prepared and administered by refuge personnel. Formal bid invitations will be mailed to all prospective bidders (Exhibit 2). Bid invitations will contain the following information:

1. A Formal Bid Information Form containing sales and estimated volume information.
2. A bid form, which the bidder fills out, signs, and returns to the refuge.
3. Maps giving general sales location information and detailing all sales units.
4. General conditions applicable to harvest of forest products.
5. Special conditions applicable to the timber sale.
6. Certificate of Independent Price Determination.

-
7. Equal Employment Opportunity Clause (Form 3-176).
 8. Information on dates when prospective bidders can evaluate sales areas before bid opening.

BIDS AND PERFORMANCE DEPOSITS

For all bid sales, a bid opening date and time will be set to occur at the refuge headquarters. All bids received prior to the opening time will be kept, unopened and locked in the Refuge Cashier's safe until the specified opening time. Any bids received after the specified opening time will not be accepted. The refuge retains the right to reject any and all bids, particularly those that are incomplete or otherwise unacceptable.

A deposit of \$5,000 to \$10,000 in the form of a cashier's check or money order made out to the U. S. Fish and Wildlife Service, must accompany all bids received through the formal bid process. The deposit amount will reflect the size of the sale and potential for damage. The amount of the deposit will be stipulated in the bid invitation. This deposit is to ensure the sincerity of the bidder's intention to purchase the offered sale at the bid price. In the event the successful bidder chooses not to purchase the offered timber, the bid deposit will be forfeited to the government. When the successful bidder is named, all unsuccessful bidders' deposits will be immediately returned. The successful bidder's deposit will then become his performance guarantee deposit and will be retained by the government as such. Before the completion of the operation, the successful buyer will repair any and all damages caused by his operation. The performance guarantee deposit may be used to cover any un-repaired damages caused by the successful bidder, their agents, employees, or their contractors. The balance of the deposit will be refunded to the successful bidder when the sale and all related repairs are completed.

Small sales through the negotiated process will also require a performance guarantee deposit to be received by the government prior to any timber harvest.

SPECIAL USE PERMIT

Upon selection of a successful bidder by the Refuge Manager or designated representative, a Special Use Permit will be issued containing information relevant to the timber sale, such as terms of payment, authorized activities, General and Special Conditions, and location map. The Refuge Manager or designated representative, upon receipt of payment, signs the Permit, if the value is within their warranted authority. If the value is above that amount, an authorized representative of the Regional Director signs the Special Use Permit.

PAYMENT FOR FOREST PRODUCTS AND ADMINISTRATION OF RECEIPTS

The permittee will have 10 business days after notification of award of bidding to make total or partial payment (according to what is specified in the Special Use Permit). Under no circumstances will harvest operations begin prior to receipt of payment. The purpose of an advance payment is to encourage the permittee to begin harvesting operations as quickly as possible. All payments will be in the form of a cashier's check or money order payable to the U. S. Fish and Wildlife Service.

For pay-as-cut sales, the buyer shall provide weekly scale totals and/or scale tickets along with a weekly payment. All receipts for forest products along with proper documentation will be

forwarded the same day received to the Fish and Wildlife Service Finance Center. Any receipts, that cannot be processed the same day received, will be stored in the Refuge Cashier's safe until processing can be completed. Presently, receipts for the sale of products of the land are deposited into the Revenue Sharing account at the Finance Center. Other arrangements can only be made in accordance with policy, regulations, and laws.

Refuges are authorized to enter into Timber for Land Exchanges. In this process, land within the approved Refuge Acquisition Boundary may be purchased indirectly through exchange of normal timber sale volumes. Requirements for timber for land exchange sales are as follows:

1. Authority, which allows the Service to exchange timber for lands: National Wildlife Refuge System Administration Act of 1966 (16 USC 668dd-ee).
2. Lands acquired must be located within the approved refuge acquisition boundary. No Preliminary Project Proposal or any other studies are required. The merit of the acquisition is a judgment call by the Refuge Manager.
3. Forest management plans are followed, and no deviation from planned schedules should be considered. No additional timber harvest is considered for the sole purpose of acquiring land.
4. The land is conveyed to the United States in exchange for refuge timber or other refuge products. The timber is transferred via Special Use Permit, much the same as a timber sale. If timing requires the timber to be harvested prior to closing on the land, the permittee can make a performance deposit equal to the value of the deed. That deposit is refunded upon completion of the deed transfer.
5. The Service receives compensation for the timber when the third party acquires the subject property and conveys it to the United States.
6. The value of the land to be acquired, and the timber exchanged should be approximately equal or the value of the timber higher than the land. Any excess value of the timber can be made as a payment to the Service for the difference.
7. The Division of Realty will be responsible for land appraisals, title insurance, reimbursement of relocation costs, and recording fees resulting from the conveyance of the property to the United States. These miscellaneous costs will be paid from Division of Realty funds.

A sequence of steps for a hypothetical timber for land exchange is as follows:

1. Refuge Manager identifies areas within the approved refuge acquisition boundary for acquisition.
2. Refuge Manager and Division of Realty determine if landowner(s) are willing sellers.
3. If seller is willing to sell, the Refuge Manager notifies the Regional Office (District Manager and Division of Realty).

-
4. Division of Realty contacts the landowner, orders the appraisal, and makes an offer to the landowner.
 5. If the landowner is willing to sell, Realty advises the Refuge Manager.
 6. The Refuge Manager and refuge staff shall determine which upcoming timber sales, awaiting the timber sale bid process, to use in the exchange.
 7. Timber Sales bids are sent out with a description of the responsibilities of the winning bidder pertaining to the timber for land exchange. This gives the bidders an opportunity to determine if they are willing to participate in the timber for land exchange. This also ensures that bidding for the timber is competitive.
 8. The Refuge Manager selects the winning bidder following the normal timber sale bid process. The winning bidder is now referred to as the third party.
 9. Division of Realty advises the landowner that the third party will intercede to acquire the subject property on the Service's behalf.
 10. Division of Realty obtains an exchange agreement with the third party. The agreement (1) identifies and states the price of the subject property and (2) stipulates the volume and value of timber involved in the refuge's timber sale.
 11. The third party acquires the subject property at the appraised value.
 12. The third party conveys the subject property to the United States via a warranty deed. A Special Use Permit is issued by the Refuge Manager, which specifies the requirements that must be followed by the third party while cutting on the refuge. The Special Use Permit becomes part of the closing documents.
 13. The third party completes logging operation within the specified time frame, as detailed in the Special Use Permit.

Exhibit 1: Black Bayou Lake NWR Timber Sale 200x-xx**SPECIAL CONDITIONS APPLICABLE TO TIMBER HARVESTING**

Before starting logging operations, the refuge forester, the permit holder and his logging contractor will discuss the following special conditions. The goal of the following conditions is to protect the refuge forest from unnecessary damage. If the forest is logged carefully, it will look like a job well done which will in turn lessen the chance of public disagreement with refuge forest management philosophy.

1. All timber marked with two spots of blue paint will be cut, except as otherwise agreed by both parties. The permit holder is subject to paying \$700 per MBF for leave pine saw timber trees which are cut or excessively damaged through carelessness. The penalty for cut or excessively damaged hardwood leave trees will be \$500 per MBF on saw timber and \$25 per cord on pulpwood-sized trees.
2. Trees are to be cut so as to leave a stump not more than 12 inches high. In the case of swell-buttressed trees or trees with metal objects in the butt, stumps may be higher. The lowest practicable stumps that can be left are preferred on all trees.
3. Trees and tops shall not be left hanging or supported by any other living or dead tree and shall be pulled down immediately after felling. This applies especially to pines to lessen the chance for pine beetles.
4. Access roads for the removal of trees shall be coordinated with the refuge forester. See management unit 2 map for present road locations. Roads, rights-of-way, and stream beds must be routinely kept clear of tops and logging debris. The permit holder shall provide and install any necessary culverts in the sale area. Roads will be maintained regularly. To avoid excessive damage following heavy rains, loggers should be prepared to stop all hauling for at least one day. Excessive or extended rains may result in overly wet ground conditions that would prevent logging for an undetermined period of time. The refuge forester expects close cooperation from all logging crews. At the completion of sale, roads will be left in at least as good as original condition. Location of additional roads must be pre-approved by the refuge forester. Leave trees cannot be removed for access or loading sets without prior approval from the refuge forester. The permit holder shall promptly repair all damage resulting from operations conducted under this permit to the refuge forester's satisfaction.
5. There are a significant number of leave trees which can be protected by careful logging activity. Logging will be restricted to ground conditions dry enough to minimize rutting. Besides being unsightly, rutting will often damage the root systems of leave trees. Soft spots (springs, wet creek bottoms, etc.) will be avoided whenever possible. The majority of the area has ample room for skidding between leave trees without damaging leave trees. Skinning butts and damaging roots of all leave trees will be avoided as much as practicable. Whole tree skidding will be allowed where minimal damage to leave trees would be expected. Skidding of hardwoods with large crowns – potentially more damaging to leave trees – will be strictly controlled where excessive damage to leave trees is likely to occur. In general, hardwoods or pines with large crowns will be lopped prior to skidding.
6. The entire work area shall be kept free of litter at all times. Petroleum products must be properly disposed of and may not be dumped on the ground. **Note: The logger agrees to**

remove soil contaminated by petroleum product spills from the refuge when directed by the refuge forester.

7. The refuge forester shall have the authority to temporarily close down all or part of the operation during a period of high fire danger or wet ground conditions. An equal amount of additional time will be given to the permit holder when necessary.

8. Should the permit holder's logging operation expose any archaeological or cultural resources, the logger will immediately cease operations in that area and notify the U.S. Fish and Wildlife Service.

9. Logging contractors will do all in their power to prevent and suppress forest fires, and will be held liable for damages and suppression costs resulting from logging contractor-caused fires, except as may otherwise be allowed under State or Federal laws.

10. Failure by the permit holder to meet any applicable conditions may result in penalties levied against the performance bond. The decision of the Deputy Project Leader shall be final in interpreting regulations and provisions governing the sale, cutting, and removal of forest products under this permit.

Exhibit 2: Bid Form

BID FORM

Black Bayou Lake NWR Timber Sale 200x-xx

The following is my bid for the stumpage offered in this invitation.

Lump sum bid for management unit x \$ _____

Reminder: Don't forget to include the \$10,000 good faith deposit with your bid. Without the good faith deposit, the bid will have to be automatically rejected.

I have inspected the sale area and trees designated for removal. If I am adjudged the successful bidder, I agree to accept the terms and special conditions of the permit-agreement. I also agree to give at least two weeks' notice of my desire to move on site to start cutting. However, entry onto the area with logging equipment will not be allowed until the ground is sufficiently dried out as determined by the refuge forester.

Name of Firm: _____

Address: _____

_____ Zip Code: _____

Signature of Bidder: _____ Date: _____

Telephone: _____

Comments: _____

Exhibit 3: Bid Invitation

North Louisiana Refuge Complex
11372 Highway 143
Farmerville, LA 71241
Telephone: 318-726-4222
FAX: 318-726-4667
[Date]

**Black Bayou Lake National Wildlife Refuge
Management Unit x
Timber Sale 200x-xx**

BID INVITATION

The purpose of this sale is to thin the forested area in a portion of management unit x to promote general forest health and understory/midstory development for wildlife.

To locate the sale area, see maps (Figures x and x). All trees to be cut were marked with blue paint. This will be a general thinning of [insert whether it is for pine or hardwood pulpwood or sawtimber] products on +/- xx acres. [Pine or hardwood] saw timber estimates are xxx MBF and [pine or hardwood] pulpwood estimate is xx cords (not including top wood). Close merchandising of timber products could cause the pine saw timber volume to be greater than the estimate.

NOTE: Much of the sale area has flat woods which are very wet much of the year because of a high water table. Dry ground conditions will be necessary to support logging equipment and log trucks.

A permit will be issued for cutting until [insert date]. Unusually wet summers and falls may allow for an extension. The extension, if granted, would be at the discretion of the Deputy Project Leader and Refuge Forester.

Prospective buyers can contact Refuge Forester [insert forester's name] at the above phone number if they want to arrange a visit to the sale area. There is a parking lot on the western edge of the sale area. **ATV access will be allowed in the sale area for timber inspection purposes only.** Otherwise, buyers are free to go look at the timber unescorted.

Formal sealed bids will be accepted at the refuge office until 3:00 p.m., [date], for the sale of the marked timber. Bids will be opened at 3:05 p.m., [same date] at the refuge office which is located 2.5 miles south of Rocky Branch, Louisiana on HWY 143. The U.S. Fish and Wildlife Service (Service) reserves the right to reject any and all bids. The refuge may take up to five (5) working days before determining whether any of the bids will be accepted.

Each bidder will submit with their bid a CERTIFIED OR CASHIER'S CHECK in the amount of \$10,000 made payable to the U.S. Fish and Wildlife Service as a good faith deposit.

The successful bidder's deposit will be retained by the Service and may be forfeited to the government if that bidder fails to accept and agree to execute the Special Use Permit agreement. After the permit agreement is finalized, the deposit will be retained by the Service

as a performance guarantee to cover any damages or claims the Service may have against the permit holder as a result of the logging operation. The balance will be returned to the permit holder upon satisfactory completion of the operation. In the past most operators have been refunded the entire bond. The Special Use Permit will be issued as a sale document to the buyer. The Service does not issue "timber deeds." All subsequent payments will also be made to the U.S. Fish and Wildlife Service.

Note: The successful bidder will be required to hold 10 percent of the lump sum in reserve for road repairs required by the refuge. The refuge forester will determine where repairs will be done. The timber buyer will pay for road repairs with this set aside money when notified by the refuge forester. As soon as the permit holder is notified that no more of the set aside funds are required for road repairs, the permit holder will be required to promptly submit payment to the U.S. Fish and Wildlife Service for the remaining set aside funds.

Bids mailed or hand delivered must be securely sealed in an envelope plainly marked:

"Bid: Black Bayou Lake NWR Timber Sale 200x-xx"

If you have any questions about this packet, feel free to call [forester's name] (318-726-4222 ext 25) for additional information. If you're not planning on submitting a bid, a negative reply would be greatly appreciated.

Exhibit 4: Certificate of Independent Price Determination

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

CERTIFICATE OF INDEPENDENT PRICE DETERMINATION
(101-45.4926 Fed. Prop. Mgt. Reg.)

- (a) By submission of this bid proposal, each bidder or offerer certifies, and in the case of a joint bid or proposal each party thereto certifies as to its own organization, that is in connection with this sale:
- (1) The prices in this bid proposal have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices, with any other bidder or offeror or with any competitor;
 - (2) Unless otherwise required by law, the prices which have been quoted in this bid or proposal have not been knowingly disclosed by the bidder or offeror and will not knowingly be disclosed by the bidder or offeror prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or offeror or to any competitor; and
 - (3) No attempt has been made or will be made by the bidder or offeror to induce any other person or firm to submit or not to submit a bid or proposal for the purpose of restricting competition.
- (b) Each person signing this bid or proposal certifies that:
- (1) He is the person in the bidder's or offeror's organization responsible within that organization for the decision as to the prices being bid or offered herein and that he has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above; or
 - (2) (i) He is not the person in the bidder's or offeror's organization responsible within that organization for the decision as to the prices being bid or offered herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above, and as their agent does hereby so certify; and

(ii) He has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above.
- (c) This certification is not applicable to a foreign bidder or offeror submitting a bid or proposal for a contract, which requires performance or delivery outside the United States, its possessions, and Puerto Rico.

-
- (d) A bid or proposal will not be considered for award where (a) (1), (a) (3), or (b), above, has been deleted or modified. Where (a) (2), above, has been deleted or modified, the bid or proposal will not be considered for award unless the bidder or offeror furnishes with the bid or proposal a signed statement which sets forth in detail the circumstance of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

Exhibit 5: Equal Employment Opportunity Clause

"During the performance of this contract, the contractor agrees as follows:

"(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

"(2) The contractor will, in all solicitations or advancements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

"(3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

"(4) The contractor will comply with all provisions of Executive Order No. 11246 of Sept. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

"(5) The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

"(6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of Sept. 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

APPENDIX B. ENVIRONMENTAL ACTION STATEMENT

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action is categorically excluded from NEPA documentation requirements consistent with 40 CFR 1508.4, 516 DM 2.3A, 516 DM 2 Appendix 1, and 516 DM 6 Appendix 1.4.

PREFERRED ALTERNATIVE

The preferred alternative is the approval and implementation of the Habitat Management Plan (HMP) for Black Bayou Lake National Wildlife Refuge (NWR). This plan is a step-down management plan providing the refuge manager with specific guidance for implementing goals, objectives, and strategies identified in the Black Bayou Lake NWR Comprehensive Conservation Plan (CCP) (2010).

The Environmental Assessment of the CCP (Draft CCP and EA 2009) considered three alternatives and **Selected X** for the preferred alternative (Final CCP 2010). The CCP was to manage the refuge *"based on sound science for the conservation of a structurally and species diverse bottomland hardwood habitat (along with managed wetlands and associated prairies) for migratory birds and resident wildlife. A focused effort will be put toward reducing invasive species threatening the biological integrity of the refuge"* (Black Bayou Lake NWR CCP 2010).

The CCP has defined goals, objectives and strategies to achieve the stated action. The actions further detailed in the HMP have been identified, addressed, and authorized by the Black Bayou Lake NWR CCP and accompanying Environmental Assessment (2010). These include:

- Moist-soil Management Strategy: Manipulate water levels and vegetative cover in moist-soil habitat as stated in CCP objectives (CCP page 71).
- Chemical Management Strategy: Use approved chemicals according to label specifications and Pesticide Use Proposals to control invasive plant species according to CCP objectives (CCP pages 68-69).
- Fire Management Strategy: Implement prescribed burning to prairie and cane habitat in a way that mimics historic and natural fire regime to achieve desired habitat conditions stated in CCP objectives (CCP pages 70-71).
- Beaver and Hog Management Strategy: Control beaver damage to allow for healthy forests according to CCP objectives (CCP pages 67-68).
- Forest Management Strategy: Selectively thin upland and bottomland forests to achieve desired forest conditions stated in CCP objectives (CCP pages 67-68).

CATEGORICAL EXCLUSION(S)

Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10), which states, *"the issuance of new or revised site, unit, or activity-specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan."*, is applicable to implementation to the proposed action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1 Section 1.4 B (10)) the HMP is a step-down management plan which provides guidance for implementation of the general goals, objectives, and strategies established in the CCP, serving to further refine those components of the CCP specific to habitat management. This HMP does not trigger an Exception to the Categorical Exclusions listed in 516 DM 2 Appendix 2.

Minor changes or refinements to the CCP in this activity-specific management plan include:

- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.
- Habitat management objectives are restated so as to combine appropriate objectives or split complicated objectives to provide improved clarity in the context of the HMP.
- Specific habitat management guidance, strategies, and implementation schedules to meet the CCP goals and objectives are included (e.g. location, timing, frequency, and intensity of application).

All details are consistent with the CCP and serve to provide the further detail necessary to guide the refuge in application of the intended strategies for the purpose of meeting the habitat objectives.

PERMITS/APPROVALS

Endangered Species Act, Intra-Service Section 7 Consultation was conducted during the CCP process. The determination was a concurrence that the CCP is not likely to adversely affect the threatened Louisiana black bear (signed April 30, 2009 within CCP).

Other Items to include that should be listed and can be found in the EAS accompanying the final CCP:

- Executive Orders 11988/11990, 1/15/2009
- Floodplain Management and Protection of Wetlands, 1/15/2009
- Form DI-711, Intergovernmental Notice of Proposed Action, 1/15/2009
- National Historic Preservation Act, Protection of Cultural Resources, 1/15/2009

PUBLIC INVOLVEMENT/INTERAGENCY COORDINATION

The proposed HMP is a step-down of the approved CCP for Black Bayou Lake NWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed (Draft CCP and EA 2009) which proposed and addressed management alternatives and environmental consequences. Public involvement included public notification (Notice of Intent: Federal Register Vol. 73, No. 90, May 8, 2008) and news releases (*Bastrop Daily Enterprise*, *Ruston Leader*, *Farmerville Gazette*, *Monroe The News-star*, *Ouachita Citizen*, KEDM 90.3FM, KXKZ 107.5FM, KNOE 102 FM), public scoping (public meetings May 22, 2008, Monroe, LA) and public review (30-day availability period: Sep 30, 2009-Oct 30, 2009). Approximately 10 members of the public attended the public meetings. Written comments were submitted by two members of the general public. Comments were submitted by Louisiana Department of Wildlife and Fisheries. Please refer to the CCP for specific comments and the Service's responses.

SUPPORTING DOCUMENTS

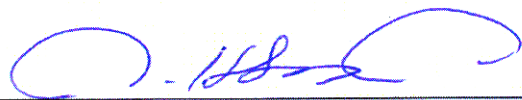
Supporting documents for this determination include relevant office file material and the following key references:

- U.S. Fish and Wildlife Service. 2011. Fire Management Plan, Black Bayou Lake National Wildlife Refuge.
- U.S. Fish and Wildlife Service. 2010. Comprehensive Conservation Plan for Black Bayou Lake National Wildlife Refuge.
- U.S. Fish and Wildlife Service. 2009. Draft Comprehensive Conservation Plan and Environmental Assessment for Black Bayou Lake National Wildlife Refuge.



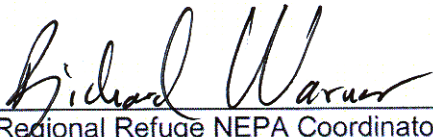
Refuge Manager

4-2-13
Date



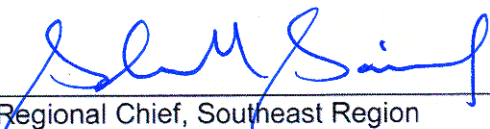
Project Leader

4/2/13
Date



Regional Refuge NEPA Coordinator

11/8/2013
Date



Regional Chief, Southeast Region

12/4/13
Date