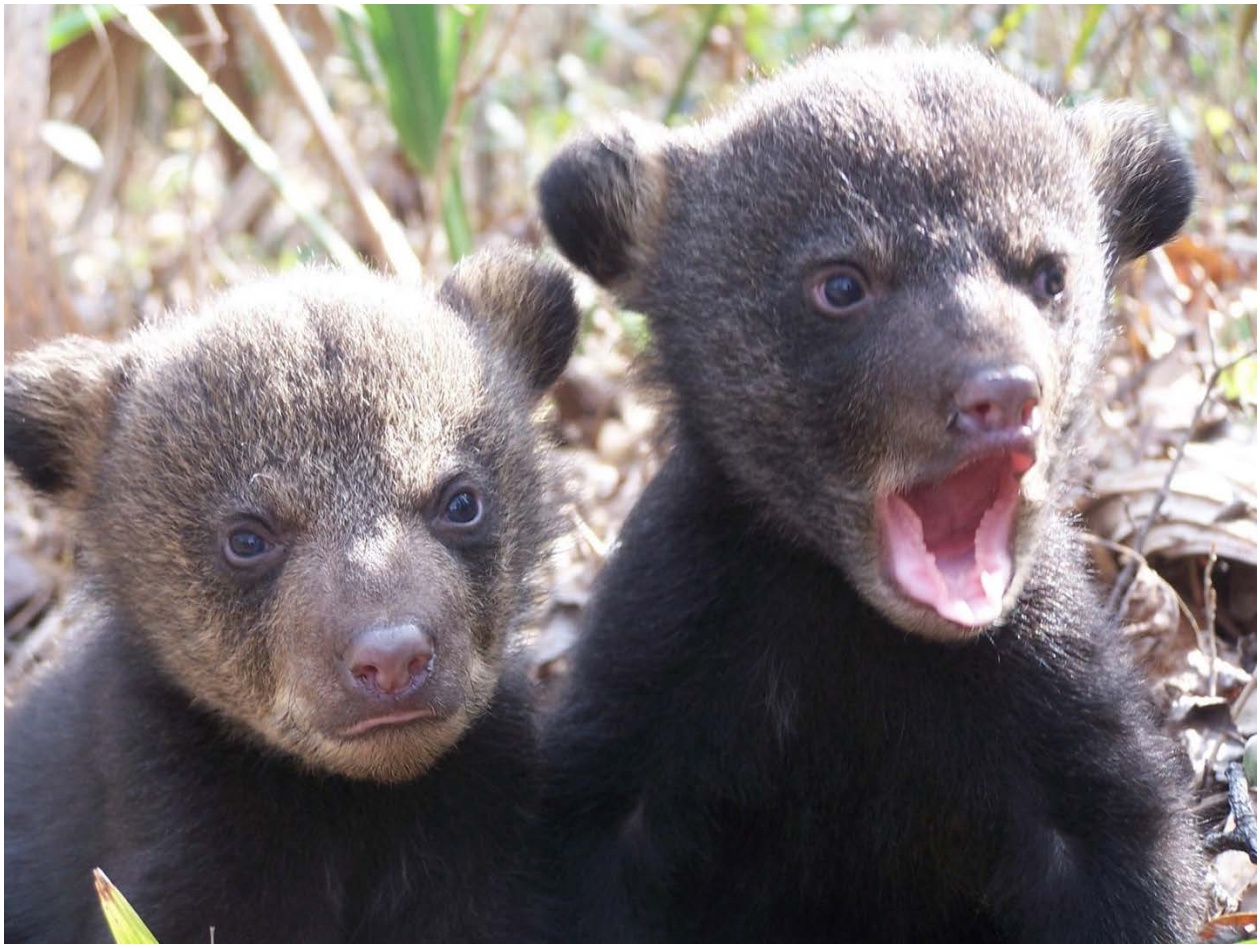
U.S. Fish & Wildlife Service

HABITAT MANAGEMENT PLAN FOR

LAKE OPHELIA
NATIONAL WILDLIFE REFUGE

Avoyelles Parish, Louisiana



Southeast Region

Lake Ophelia National Wildlife Refuge
Habitat Management Plan

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

Chapter I. Introduction....1
Legal Mandates....2
Relationship to Other Plans....2
Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative....3
North American Bird Conservation Initiative....3
North American Waterfowl Management Plan (NAWMP)....3
U.S. Shorebird Conservation Plan....4
Partners in Flight....4
U.S. Woodcock Plan....5
National Fish Habitat Action Plan....5
State Wildlife Plan (Louisiana)....5
Chapter II. Background, Inventory and Description Of Habitat....7
Location....7
Management Unit Descriptions....7
Physical and Geographic Setting....11
Soils....14
Historic Habitat Conditions....18
Current Habitat Conditions....20
Habitat Changes from Historic to Current....25
Chapter III. Resources Of Concern....29
Louisiana Black Bear....29
Significance....29
Habitat Requirements....30
Potential Refuge Contribution to Habitat Needs....31
Wintering Waterfowl....32
Significance....32
Identification of Habitat Requirements....32
Potential Refuge Contribution to Habitat Needs....33
Nesting/Resident Wood Ducks....33
Significance....33
Habitat Requirements....34
Potential Refuge Contribution to Habitat Needs....34

Woodcock 35
Significance 35
Identification of Habitat Requirements....35
Potential Refuge Contribution to Habitat Needs 35
Shorebirds....35
Significance 35
Identification of Habitat Requirements....35
Potential Refuge Contribution to Habitat Needs 36
Fisheries....36
Significance 36
Identification of Habitat Requirements....36
Potential Refuge Contribution to Habitat Needs 37
Reconciling Conflicting Needs 38
Species with Complementary Habitat Requirements 38
Chapter IV. Habitat Goals and Objectives 43
CCP Goals and Objectives 43
Bottomland Hardwood 44
Objective 1.1: Bottomland Hardwood Forest 45
Objective 1.2: Wood Duck Boxes....45
Waterfowl Impoundments—Cropland Habitat 46
Objective 2.1: Floodable Cropland 46
Objective 2.2: Sanctuary....47
Waterfowl Impoundments—Moist Soil Habitat 47
Objective 3.1: Moist Soil Management 47
Non-floodable Cropland....48
Objective 4.1: Non-Floodable Cropland 48
Aquatic Habitats 49
Objective 5.1 Invasive Exotic Plants....49
Objective 5.2 Fisheries....49
Chapter V. Habitat Management Strategies 51
Potential Management Strategies....51
Bottomland Hardwood Forest Management 51
Moist Soil Management....53

Cropland Management....55
Aquatic Habitat Management....57
Sanctuary Management....60
Selected Management Strategies....60
Bottomland Hardwood Forest Management....60
Moist Soil Management....60
Cropland Management....61
Aquatic Habitat Management....61
Sanctuary Management....61
Management Strategy Prescriptions....63
Bottomland Hardwood Prescription....63
Moist Soil Management Prescriptions....64
Cropland Management Prescriptions....65
Aquatic Habitat Management Prescriptions....66
Sanctuary Management Prescriptions....67
Chapter VI. Literature Cited....69
Appendix A. Environmental Action Statement....77
Proposed Action and Alternatives....77
Categorical Exclusion(s)....78
Permits/Approvals....79
Public Involvement/Interagency Coordination....79
Supporting Documents.... **Error! Bookmark not defined.**

LIST OF FIGURES

Figure 1. Location of Lake Ophelia NWR. 8
Figure 2. Management units on Lake Ophelia NWR.....9
Figure 3. Management units on Voinche Brouillette Tract., Lake Ophelia NWR. 10
Figure 4. Elevation map based on LiDAR data for Lake Ophelia NWR.....13
Figure 5. Soil mapping units on Lake Ophelia NWR.....17
Figure 6. Habitat types on Lake Ophelia NWR. 21
Figure 7. Reforestation History on Lake Ophelia NWR.....23
Figure 8. Forested habitat in the vicinity of Lake Ophelia NWR. 40
Figure 9. Sanctuary (Seasonally Closed) Areas of Lake Ophelia NWR. 62

LIST OF TABLES

Table 1. Description of Actively Managed Units on Lake Ophelia NWR. 11
Table 2. Habitat types and acreages on Lake Ophelia NWR.....20
Table 3. Historical timeline of Lake Ophelia National Wildlife Refuge.....28
Table 4. Conservation status and seasons of occurrence for interior forest nesting birds known to breed on Lake Ophelia NWR. 41
Table 5. Moist Soil Total DEDs by Management Unit on Lake Ophelia NWR. 65
Table 6. Cropland Total DEDs by Management Unit on Lake Ophelia NWR. 66

Cover Photo Credit: Dave Telesco, BBCC

CHAPTER I. INTRODUCTION

The processes that shaped habitat features in central Louisiana, including Lake Ophelia National Wildlife Refuge, are complex and dynamic. We developed this habitat management plan to provide a clear, science-based outline for managing the refuge in this challenging environment and as a first step in closing the gap between the needs of refuge wildlife and the knowledge of its stewards.

A habitat management plan is a step-down plan of the Refuge Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a Refuge or planning unit and 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 Lake Ophelia NWR was finalized in 2005 (U.S. Fish and Wildlife Service, 2005).

Habitat Management Plans (HMP) are dynamic working documents that provide Refuge Managers a decision-making process, guidance for the management of Refuge habitat, and long-term vision, continuity, and consistency for habitat management on Refuge lands. The plan incorporates the role of Refuge habitat in international, national, regional, tribal, State, ecosystem, and Refuge goals and objectives, guides 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.

Refuge purposes, as established by Congress or the Executive Branch, are the primary standard by which management actions on the refuge are measured. All programs on the refuge, including habitat management and public use, must fulfill the established purposes of the refuge (U.S. Fish and Wildlife Service, 2005).

Lake Ophelia NWR Refuge Purposes are: “. . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . .” 16 U.S.C. § 742f(a)(4) ". . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . ." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956) ". . . 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), 100 Stat. 3583 (Emergency Wetlands Resources Act) ". . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act).

In addition to the specific purposes that were established for each refuge, Congress passed the NWR 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 NWR System;
- Fulfill the individual purposes of each Refuge;
- Consider the needs of wildlife first;

- Fulfill requirements of CCPs that are prepared for each unit of the Refuge System
- Maintain the biological integrity, diversity, and environmental health of the Refuge System; and
- 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 allow refuge managers authority to determine compatible public uses.

The following vision statement has been developed for Lake Ophelia NWR (U.S. Fish and Wildlife Service, 2005):

> Lake Ophelia National Wildlife Refuge will become a highly productive bottomland hardwood forest and open wetland ecosystem, which will provide a diverse complex of habitats that protect and restore biological diversity for the enjoyment and benefit of present and future generations. Habitat restoration and management activities will be directed toward waterfowl, Neotropical migratory birds the threatened Louisiana black bear and other resident and migratory wildlife. To these ends, the Refuge will foster new partnerships with the community and provide opportunities for wildlife-dependent recreation.

LEGAL MANDATES

The statutory authority for conducting habitat management planning on NWRs is derived from the NWR System Administration Act of 1966 (Refuge Administration Act), as amended by the NWR 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 …" and 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 the authority to establish policies, regulations, and guidelines governing habitat management planning within the System (Service Manual 620 FW 1).

HMPs comply with all applicable laws, regulations, and policies governing the management of the NWR System. The lifespan of an HMP is 15 years and parallels that of refuge CCPs. HMPs are reviewed every 5 years utilizing peer review recommendations, as appropriate, in the HMP revision process or when initiating Refuge CCPs. Annual Habitat Work Plans will contain management specifics and are prepared annually.

RELATIONSHIP TO OTHER PLANS

A CCP was finalized for Lake Ophelia NWR in 2005 which includes goals and objectives for Refuge management over a 15-year period (U.S. Fish and Wildlife Service, 2005). The Biological Review Report was instrumental in the development of the CCP (U.S. Fish and Wildlife Service, 2004b). The purpose of the 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 establish priorities for managing wildlife and habitats on the Refuge, several other planning documents were used in the development of this plan, including the North American Waterfowl Management Plan (NAWMP Committee, 2004), the

North American Landbird Conservation Plan (Rich et al., 2004), U.S. Shorebird Conservation Plan (Brown et al., 2001), North American Bird Conservation Initiative (North American Bird Conservation Initiative, n.d.) and the U.S. Woodcock Plan (Kelley et al., 2008).

This HMP also incorporates the recommendations of other approved station plans including the Refuge Fire Management Plan (U.S. Fish and Wildlife Service, 2010) and the Wildlife and Habitat Biological Review Report (U.S. Fish and Wildlife Service, 2004b).

GULF COASTAL PLAINS AND OZARKS LANDSCAPE CONSERVATION COOPERATIVE

The Service will implement Strategic Habitat Conservation through Landscape Conservation Cooperatives (LCCs), which are landscape-scale partnerships between the Service, other federal agencies, states, tribes, NGOs, and universities (U.S. Fish and Wildlife Service, 2014). These partnerships provide technical and scientific support for conservation planning at landscape scales, and then facilitate conservation actions by partners. Lake Ophelia NWR lies within the Gulf Coastal Plains and Ozarks LCC.

NORTH AMERICAN BIRD CONSERVATION INITIATIVE

Started in 1999, the North American Bird Conservation Initiative is a coalition of government agencies, private organizations, academic institutions, and private industry leaders in the United States, Canada, and Mexico, working to ensure the long-term health of North America's native bird populations by fostering an integrated approach to bird conservation to benefit all birds in all habitats. The four international and national bird initiatives include the NAWMP, Partners in Flight, Waterbird Conservation for the Americas, and the U.S. Shorebird Conservation Plan. The combined effectiveness of these separate programs exceeds the total of their parts.

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN (NAWMP)

The North American Waterfowl Management Plan (NAWMP Committee, 2004) arose out of an agreement between the U.S. and Canada to conserve and restore habitat for waterfowl. The first version of the plan was signed by the two nations in 1986. In 1994, Mexico also signed on, making the effort truly continental in scale.

Joint Ventures, or “self-directed partnership[s] of agencies, organizations, corporations, tribes, or individuals that ha[ve] formally accepted the responsibility of implementing national or international bird conservation plans within a specific geographic area or for a specific taxonomic group, and ha[ve] received general acceptance in the bird conservation community for such responsibility” (U.S. Fish and Wildlife Service, 2011b) were formed under the auspices of the NAWMP to organize the efforts of interested partners and stakeholders in waterfowl conservation within specific regions, including the Lower Mississippi Valley.

Working under the direction of the NAWMP, the Lower Mississippi Joint Venture (LMVJV) strives to provide habitat for migratory waterfowl in the Mississippi Alluvial Valley (MAV) Bird Conservation Region. The LMVJV assumes that the availability of foraging habitat is the most important factor affecting the number of dabbling ducks that can be accommodated during winter. Diving duck habitat is not thought to be limiting in WGCP. Based on a step-down process, the LMVJV established habitat objectives that link continental waterfowl populations to on-the-ground habitat objectives. Habitat objectives are apportioned among three

categories: public managed, private managed, and natural flooding within each state (in the LMVJV administrative boundaries). By doing so, each NWR is responsible for contributing to some portion of the habitat objectives. Lake Ophelia NWR provides protection and enhancement of waterfowl habitat for migratory birds wintering on the Refuge.

U.S. SHOREBIRD CONSERVATION PLAN

The U.S. Shorebird Conservation Plan (Brown et al., 2001) is a partnership effort throughout the United States to ensure that stable and self-sustaining populations of shorebird species are restored and protected. This plan has as its national goal to: "[s]tabilize populations of all shorebird species known or suspected of being in decline due to limiting factors occurring within the U.S., while ensuring that stable populations are secure." Common regional goals across all regions of the U.S. are:

> A. Provide sufficient high quality habitat to ensure that shorebirds in each region are not unduly limited by habitat availability or configuration.
>
> B. Ensure that efforts to provide habitat for shorebirds are integrated into multiple species habitat management initiatives where appropriate.
>
> C. Increase understanding of how local habitat conditions affect shorebird abundance and use of a region and, in turn, how conditions affect hemispheric shorebird populations.

Lake Ophelia NWR is included in the U.S. Shorebird Conservation Plan for the Lower Mississippi/Western Gulf Coast Shorebird Planning Region. This plan (Elliott & McKnight, 2000) has regional goals for habitat: "(1) ensure at least stable populations of beach-nesting shorebird species (Wilson's Plover, Snowy Plover, American Oystercatcher); (2) ensure that habitat is not limiting to non-breeding shorebird species that utilize beach habitats; (3) ensure that habitat is not limiting to non-breeding maritime shorebird species that utilize non-beach habitats; and (4) ensure that habitat is not limiting to populations of shorebird species that utilize non-maritime habitats, especially during southward migration." The plan further recommends that public lands provide as much spring shorebird habitat as possible to meet the goal of 520 ha (1,285 acres) of fall habitat in Louisiana.

Although step-down objectives have not been created for the WGCP, the following species are considered high priority for the region: piping plover *(Charadrius melodus)*, American golden-plover (*Pluvialis dominica)*, marbled godwit *(Limosa fedoa)*, ruddy turnstone *(Arenaria interpres)*, red knot *(Calidris canutus)*, sanderling *(Calidris alba)*, buff-breasted sandpiper *(Tryngites subruficollis)*, American woodcock *(Scolopax minor)*, and Wilson's phalarope *(Phalaropus tricolor).* These species benefit through moist soil management. Lake Ophelia NWR maintains 150 acres of moist soil habitat.

PARTNERS IN FLIGHT

The Partners in Flight Plan (Rich et al., 2004) established avian population goals based on bottomland hardwood forest habitat objectives to support source populations of high priority species of forest breeding birds, and listed a habitat objective to maintain or restore >1,500,000 ha of predominately mature, forested wetlands in 101 patches of contiguous forest. This goal comprises 13 patches of >40,000 ha (100,000 acres), 36 patches >8,000 ha

(20,000 acres), and 52 patches >4,000 ha (10,000 acres) distributed among 87 Bird Conservation Areas. Due to its relatively small size and fragmented habitats, Lake Ophelia NWRhas very little potential to support this plan.

U.S. WOODCOCK PLAN

The American Woodcock Conservation Plan (Kelley et al., 2008) provides detailed goals and calls on managers of federal lands in the Mississippi Alluvial Valley to manage for early-successional bottomland hardwood forest habitat. The plan also provides a detailed assessment of habitat conditions by Bird Conservation Region (BCR).

NATIONAL FISH HABITAT ACTION PLAN

In 2012, the National Fish Habitat Partnership published the second edition of the National Fish Habitat Action Plan (National Fish Habitat Partnership, 2012), whose goals are to "1) protect and maintain intact and healthy aquatic systems, 2) prevent further degradation of fish habitats that have been adversely affected, 3) reverse declines in the equality and quantity of aquatic habitats to improve the overall health of fish and other aquatic organisms, and 4) increase the quality and quantity of fish habitats that support a broad natural diversity of fish and other aquatic species." Lake Ophelia NWR will contribute to these goals by managing its 654 acres of open water habitat to support diverse native aquatic communities.

STATE WILDLIFE PLAN (LOUISIANA)

The Louisiana State Wildlife Plan, formerly known as the Comprehensive Wildlife Conservation Strategy (CWCS) (Lester et al., 2005), identifies Louisiana as providing refuge for 24 million migrant songbirds on a typical spring day and 5 million waterfowl during an average winter. Additionally, Louisiana lands provide habitat for some 200 rookeries of wading birds and seabirds, some arguably the largest in North America. The Louisiana State Wildlife Plan reviewed the status of all fish and wildlife species known in Louisiana, and has identified 240 species of concern that need specific conservation attention. The list contains 173 vertebrates and 67 invertebrates. The list encompasses both game and non-game species and includes several species known to occur on Lake Ophelia NWR such as Bald Eagle *(Haliaeetus leucocephalus)*, Northern Pintail *(Anas acuta)* and American Woodcock (*Scolopax minor*) and Louisiana black bear *(Ursus americanus luteolus)*. Aquatic species of concern in the Red River basin include 4 species of crawfish, 9 fish, 2 mussels, and 2 turtles. This plan specifically states that take from hunters is not the cause of waterfowl declines, but that habitat loss is the true cause. Lake Ophelia NWR's geographical position in the state combined with its habitat management and restoration efforts allow it to serve as a positive influence in the overall goal of the Louisiana State Wildlife Plan which is to stop the declines of the species and habitats that are critical to wildlife in Louisiana.

CHAPTER II. BACKGROUND, INVENTORY AND DESCRIPTION OF HABITAT

Lake Ophelia National Wildlife Refuge encompasses a range of habitat types common to the Lower Mississippi Alluvial Valley. In keeping with the purposes of the refuge, management focuses on providing habitat for migratory and resident birds and for listed species, particularly the Louisiana black bear. In this chapter, the refuge's habitats will be described and placed in geographic and historical context.

LOCATION

Lake Ophelia National Wildlife Refuge is located in northern Avoyelles Parish, Louisiana, about 15 miles northeast of the city of Marksville (population 6,087) and 30 miles southeast of Alexandria (population 46,000) (Figure 1). The Refuge covers a total of 18,399 acres within the 38,000-acre acquisition boundary and lies approximately eight miles northwest of the confluence of Red River and the Atchafalaya River. This region is part of the Mississippi Alluvial Valley.

MANAGEMENT UNIT DESCRIPTIONS

The Refuge is divided into 8 agricultural management units (Figures 2, 3, Table 1) of which 4 (and a small part of a fifth) function as impoundments. There are 6 permanent lakes and 13,600 acres of bottomland hardwoods and reforestation areas that are passively managed. In addition to the main refuge tract, there are 963 acres of disjunct land located approximately five miles southwest of the main part of the refuge. This area is referred to as the Voinche Brouillette Tract. Two small areas on this tract, totaling 150 acres, can be flooded by rainfall and are managed as moist soil areas. The balance of the tract was reforested in 2001 to bottomland hardwoods and is passively managed. Management objectives will be developed specifically for each unit in this plan. The habitat type, size, soil type, current condition and past management history for each actively managed unit is described in Table 1.

Figure 1. Location of Lake Ophelia NWR.

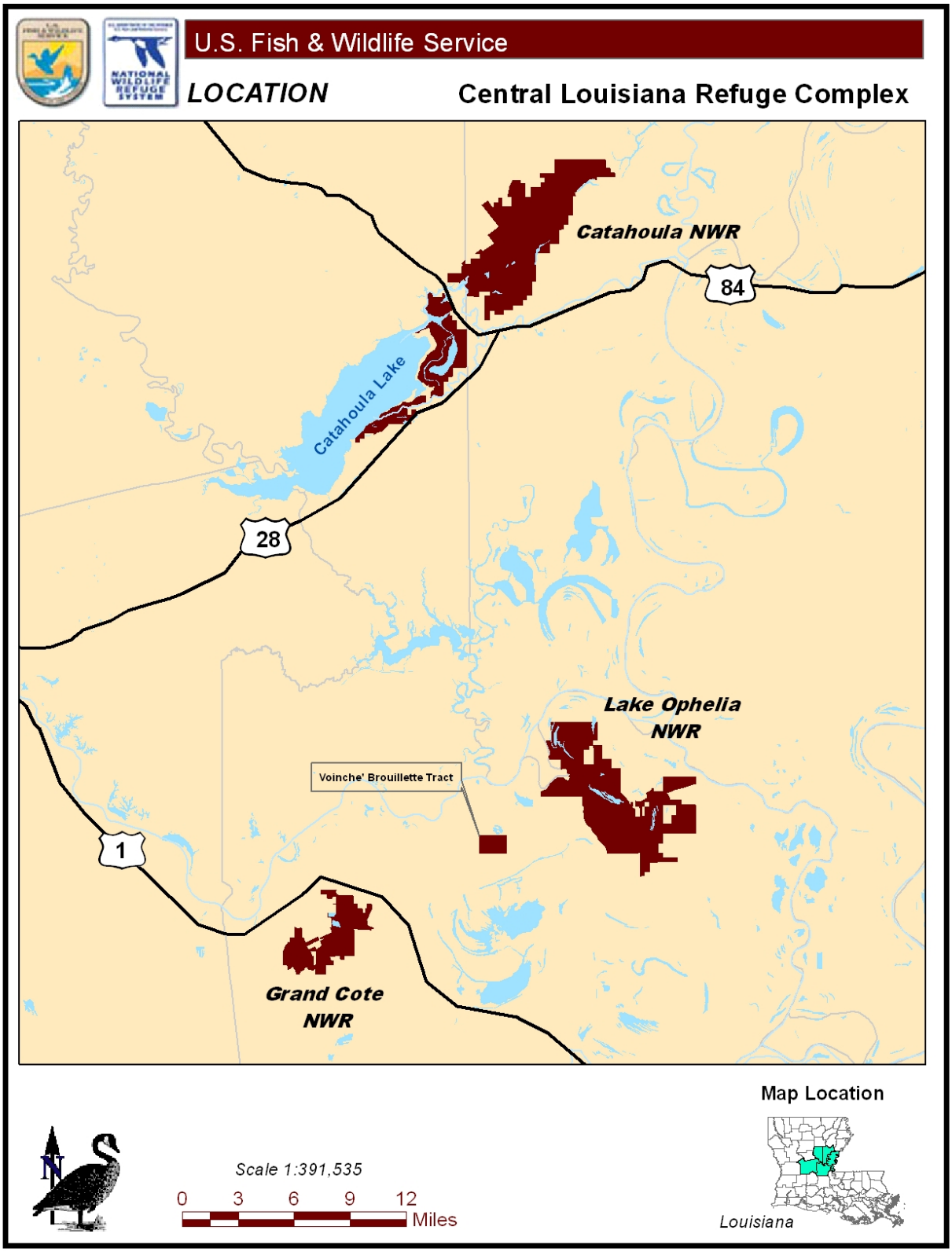


Figure 2. Management units on Lake Ophelia NWR.

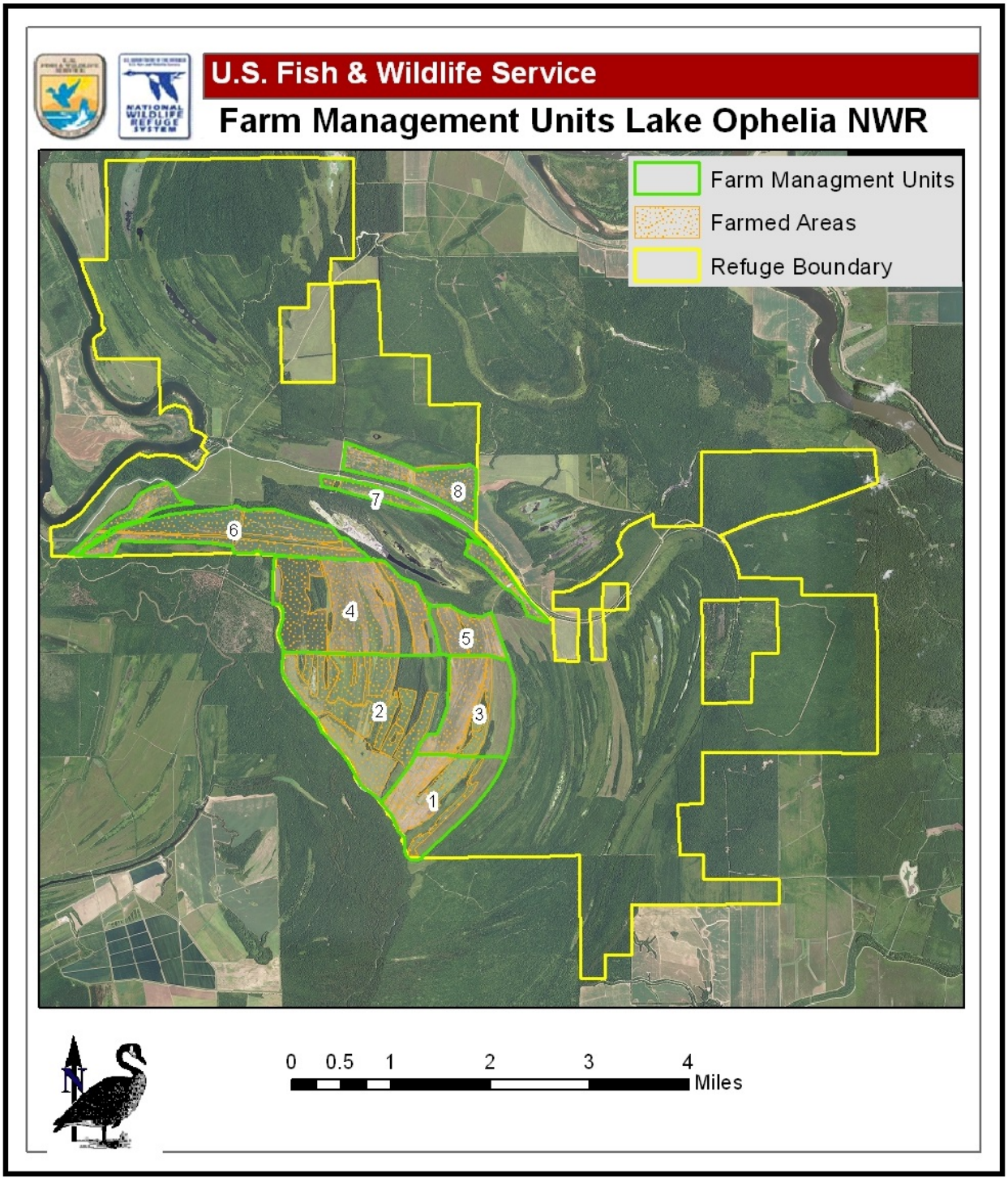


Figure 3. Management units on Voinche Brouillette Tract., Lake Ophelia NWR.

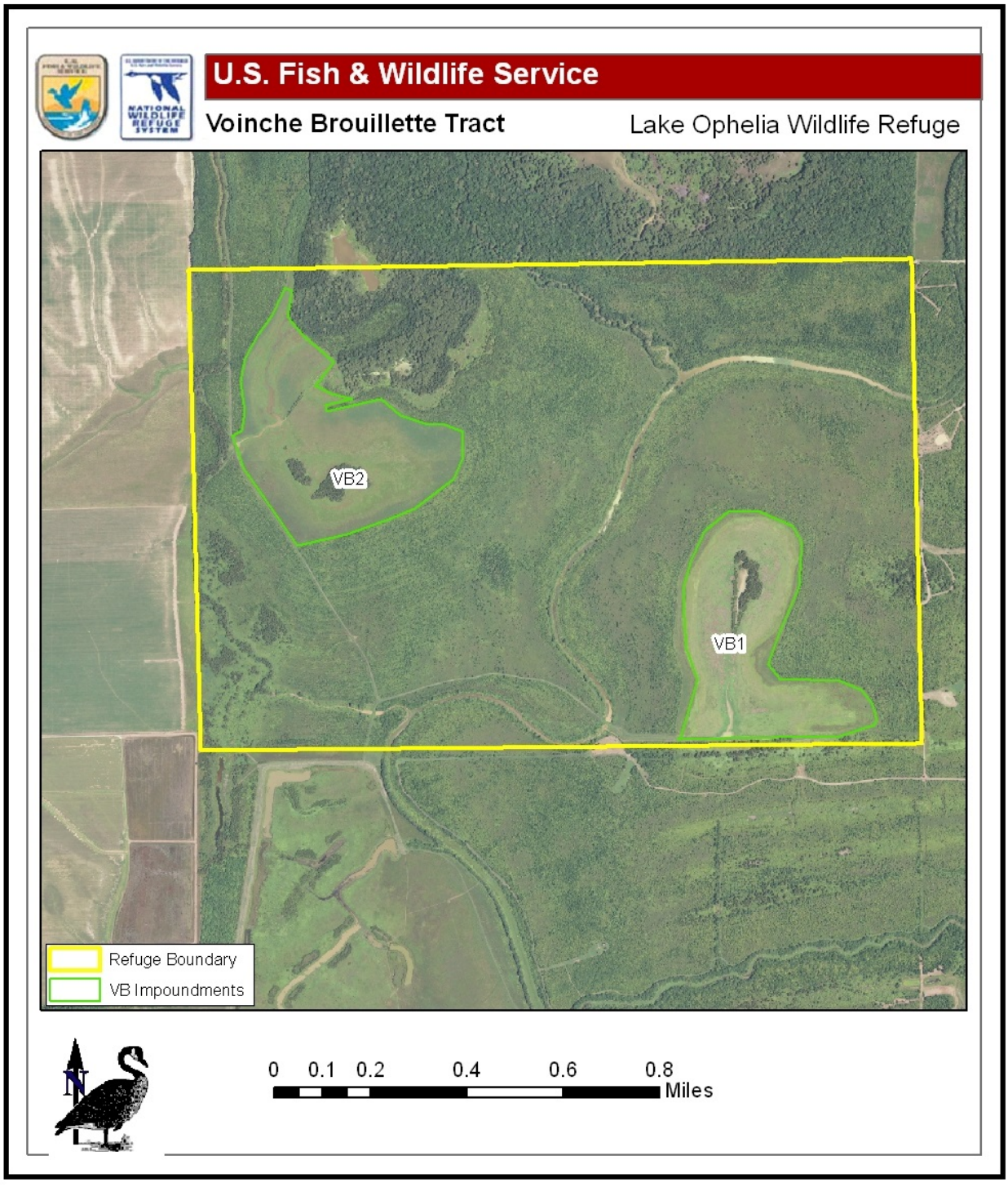


Table 1. Description of Actively Managed Units on Lake Ophelia NWR.

Management Unit	Cultivated Acres	Soil Type	Habitat Type	Current Condition
1	360	Tensas- Sharkey	Agriculture/Moist soil	Milo/Soybeans
2	666	Tensas- Sharkey	Agriculture/Moist soil	Milo/Soybeans
3	260	Tensas-Sharkey	Agriculture/Moist soil	Milo/Soybeans
4	700	Tensas-Sharkey	Agriculture/Moist soil	Milo/Soybeans
5	140	Tensas-Sharkey	Agriculture/Moist soil	Milo/Soybeans
6	580	Sharkey/Dundee	Agriculture/Moist soil	Milo/Soybeans
7	150	Norwood	Agriculture/Moist soil	Milo/Soybeans
8	240	Norwood	Agriculture/Moist soil	Milo/Soybeans
VB 1	70	Sharkey	Moist Soil	Moist Soil
VB 2	80	Sharkey	Moist Soil	Moist Soil

PHYSICAL AND GEOGRAPHIC SETTING

The climate at Lake Ophelia NWR is humid subtropical with extended hot, and humid summers and moderately cool winters. The average annual temperature is 65°F with average summer and winter temperatures of 81°F and 50°F, respectively. Mean annual precipitation is 60 inches with half of this rainfall (30 inches) occurring between April and September. Average annual snowfall is less than one inch. Lake Ophelia NWR has a growing season of 235 days which extends from mid-March to early November.

Lake Ophelia NWR lies within the Lower Mississippi River Alluvial Plain (LMRAP) section of the Coastal Plain Province (Beccasio et al., 1983), to the west of the confluence of the

Atchafalaya and Red Rivers in Avoyelles Parish. The topography of the Refuge has been greatly influenced by the aggrading Mississippi and Red Rivers. During flood periods prior to recent human influence, stream channels within the LMRAP overtopped their banks and flood waters left alluvial deposits across the flooded landscape. The deposits resulted in the formation of natural levees and lowland areas prone to flooding. The formations of alluvium described above compose the entire land base of Lake Ophelia NWR. Relict channels and natural levees are often referred to as ridge and swale topography (Figure 4). Human disturbances, including the construction of artificial levees and channelization projects, have drastically altered these natural alluvial processes within the Mississippi and Red River floodplains.

The Refuge lies within the Bayou Natchitoches basin and the Red River alluvial cone, in an area commonly referred to as the Red River backwater area. During flood periods, the Mississippi and Atchafalaya Rivers reach levels that significantly slow and even back up the discharges from the Red River. This water enters the basin and occupies the lowland areas that dominate the Refuge. Statistical analysis (based on river stage and precipitation data for the period from 1929 to 1975) indicates that somewhat more than half of the tract, at elevations up to 45.8 feet above mean sea level, is subject to the average annual flood, with an average duration of 13 percent of the year, with the entire tract flooding about once a decade (Combs, U.S. Army Corps of Engineers, in U.S. Court of Appeals Briefing, 1982).

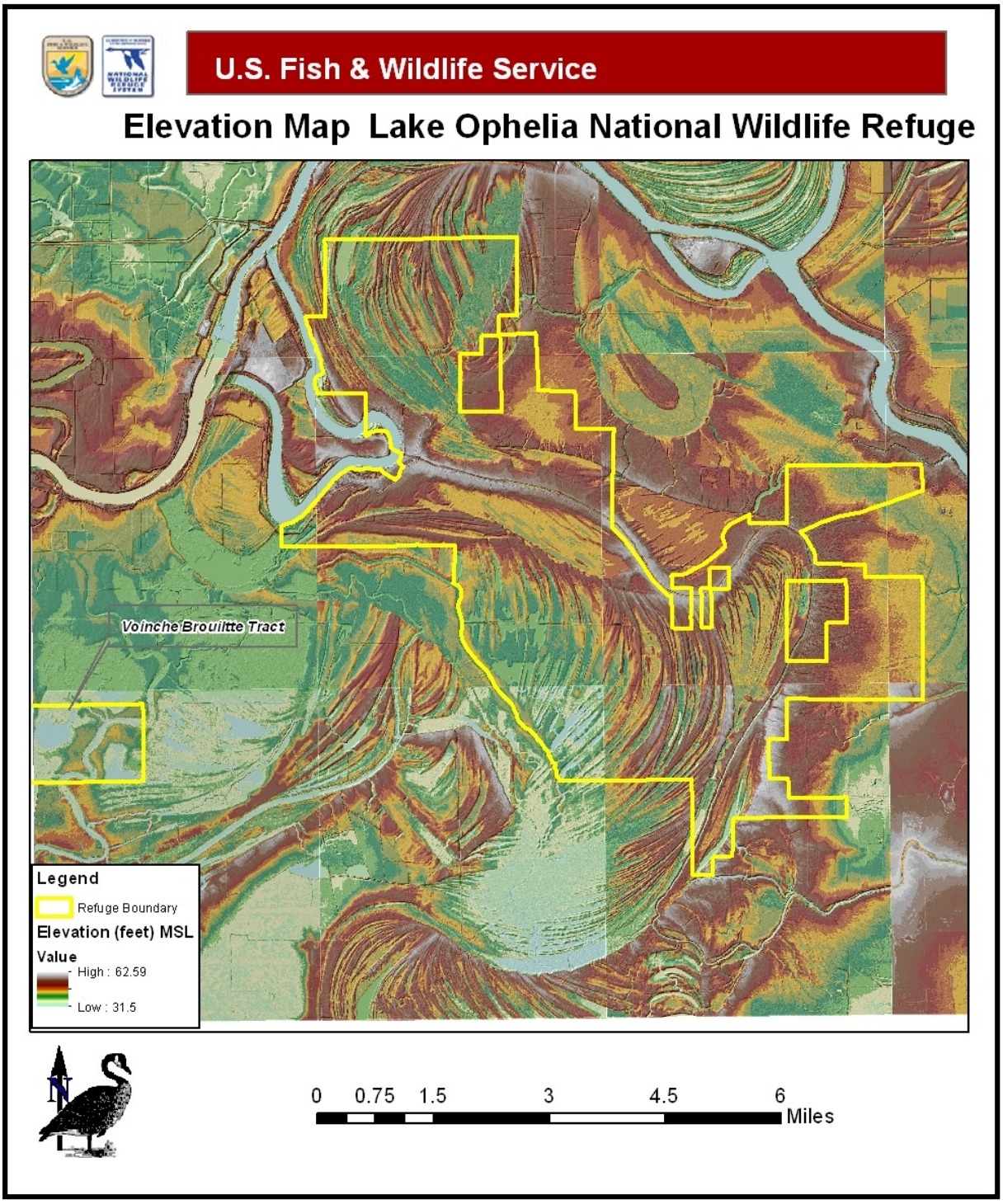
The Red River borders the Refuge on the north. The main drainages within the Refuge include Lake Long, Possum Bayou, Palmetto Bayou and Bayou Jeansonne. Numerous lakes are present, including Nicholas, Duck, Long, Ophelia, and West Cut. Numerous unnamed sloughs and seasonal or ephemeral drainages are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

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

In an effort to mimic the area's historical hydrology, the Service is manipulating the Refuge's hydrology in some areas through the use of levees, ditches, wells, and water control structures. These areas include approximately 1,100 acres of floodable cropland habitat that can serve as moist soil, if conditions prevent farming, 1,950 acres of upland farm ground, 13,600 acres of forested habitat, and 654 acres of permanent water.

Prior to refuge establishment, the land was intensively farmed, and a series of man-made levees, irrigation ditches, pumps, and water control structures were constructed to facilitate farming. Most of these features still occur on the Refuge and are currently used to manage water levels within impoundments for waterfowl and shorebirds. While these structures have altered the area's natural hydrology, removal or modification of structures to restore the natural hydrologic regime could impact other refuge management, such as cooperative farming for waterfowl, shorebird, and wading bird management.

Figure 4. Elevation map based on LiDAR data for Lake Ophelia NWR.



SOILS

Soils on the refuge reflect the influence that the Mississippi and Red Rivers have had on the terrain. The Refuge contains mostly hydric soils (Figure 5). The following descriptions of soil mapping units occurring on the refuge are taken directly from the Avoyelles Parish soil survey (Soil Conservation Service, 1986).

Dundee Series

Dundee silty clay loam, occasionally flooded (Dn)

This a level, somewhat poorly drained soil on the natural levees of old distributary channels of the Mississippi River. It is occasionally flooded subject to long to very long periods of flooding. The soil is moderately well suited to cultivated crops and well suited to the production of southern hardwoods.

Fausse Series

Fausse clay (Fa)

This is a level, very poorly drained soil in depressional areas of the alluvial plain. It is subject to ponding and frequent flooding. This Fausse soil has high fertility. Water and air move through it at a very slow rate. It is subject to brief to long periods of ponding and flooding during any season of the year, but it is generally flooded continuously from late fall to early summer. It is not suited to cultivated crops and poorly suited to the production of commercial timber.

Moreland Series

Moreland clay, occasionally flooded (Mt)

This is a level, somewhat poorly drained soil in low positions on the natural levees of the Red River and its distributaries. It is subject to occasional flooding for brief to long periods. This Moreland soil has high fertility. This soil is well suited to the production of southern hardwoods. This soil is moderately well suited to cultivated crops

Moreland clay, gently undulating occasionally flooded (Mu)

This is a gently undulating, somewhat poorly drained soil on low ridges and in swales of the Red River alluvial plain. This Moreland soil has high fertility.

This soil is well suited to the production of southern hardwoods. This soil is moderately well suited to cultivated crops. It is limited mainly by flooding, wetness, poor tilth, and short choppy slopes.

Moreland clay, frequently flooded (Mw)

This is a level, somewhat poorly drained soil in low positions on the natural levees of former and present day distributary channels on the Red River. It is subject to frequent flooding for brief to long periods. This Moreland soil has high fertility. Water and air run through it at a very slow rate. This soil is moderately well suited to woodland. This soil is poorly suited to cultivated crops. It is limited mainly by wetness and frequent flooding. Crops are damaged by flood waters in most years.

Norwood Series

Norwood silt loam, occasionally flooded (No)

This is a level, well drained soil in high positions on the natural levees of the Red River and its distributaries. It is subject to occasional flooding. This Norwood soil has high fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods

Norwood silty clay loam, occasionally flooded (Nw)

This is a level, well drained soil in high positions on the natural levees of the Red River and its distributaries. It is subject to occasional flooding. This Norwood soil has high fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Roxana Series

Roxana very fine sandy loam, gently undulating, occasionally flooded (Ru)

This is a gently undulating, well drained soil on low, parallel ridges and in swales on the natural levees of the Red River and its distributaries. This soil is well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Roxana very fine sandy loam, frequently flooded (Rx)

This is a level, well drained soil adjacent to the Red River. It consists of recent depositions. Areas are subject to frequent flooding, scouring, and further deposition. This Roxana soil has high fertility. It is poorly suited to cultivated crops. This soil is moderately well suited to woodland.

Sharkey Series

Sharkey Clay, overwash, occasionally flooded (Se)

This is a level, poorly drained soil in low positions on the natural levees of the Mississippi River and its distributaries. It is subject to occasional flooding for brief to very long periods. This Sharkey soil has high fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Sharkey clay, over wash gently undulating, occasionally flooded (Sh)

This is a gently undulating, poorly drained soil on low ridges and in swales on the Mississippi River alluvial plain. This Sharkey soil has high fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Sharkey clay, overwash, frequently flooded (Sk)

This is a level, poorly drained soil in low positions on the natural levees of old distributary channels of the Mississippi River. It is subject to frequent flooding.

This Sharkey soil has high fertility. This soil is poorly suited to woodlands. This soil is poorly suited to cultivated crops.

Solier Series

Solier clay, occasionally flooded (Sr)

This is a level, poorly drained soil on low stream terraces. It is subject to occasional flooding for long periods. This Solier soil has high fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Tensas Series

Tensas silty clay, overwash occasionally flooded (Te)

This is a level, somewhat poorly drained soil on the natural levees of old distributary channels of the Mississippi River. It is subject to occasional flooding for brief to long periods. This Tensas soil has medium fertility. This soil is moderately well suited to cultivated crops. This soil is well suited to the production of southern hardwoods.

Tensas-Sharkey complex, overwash, undulating, occasionally flooded (Ts)

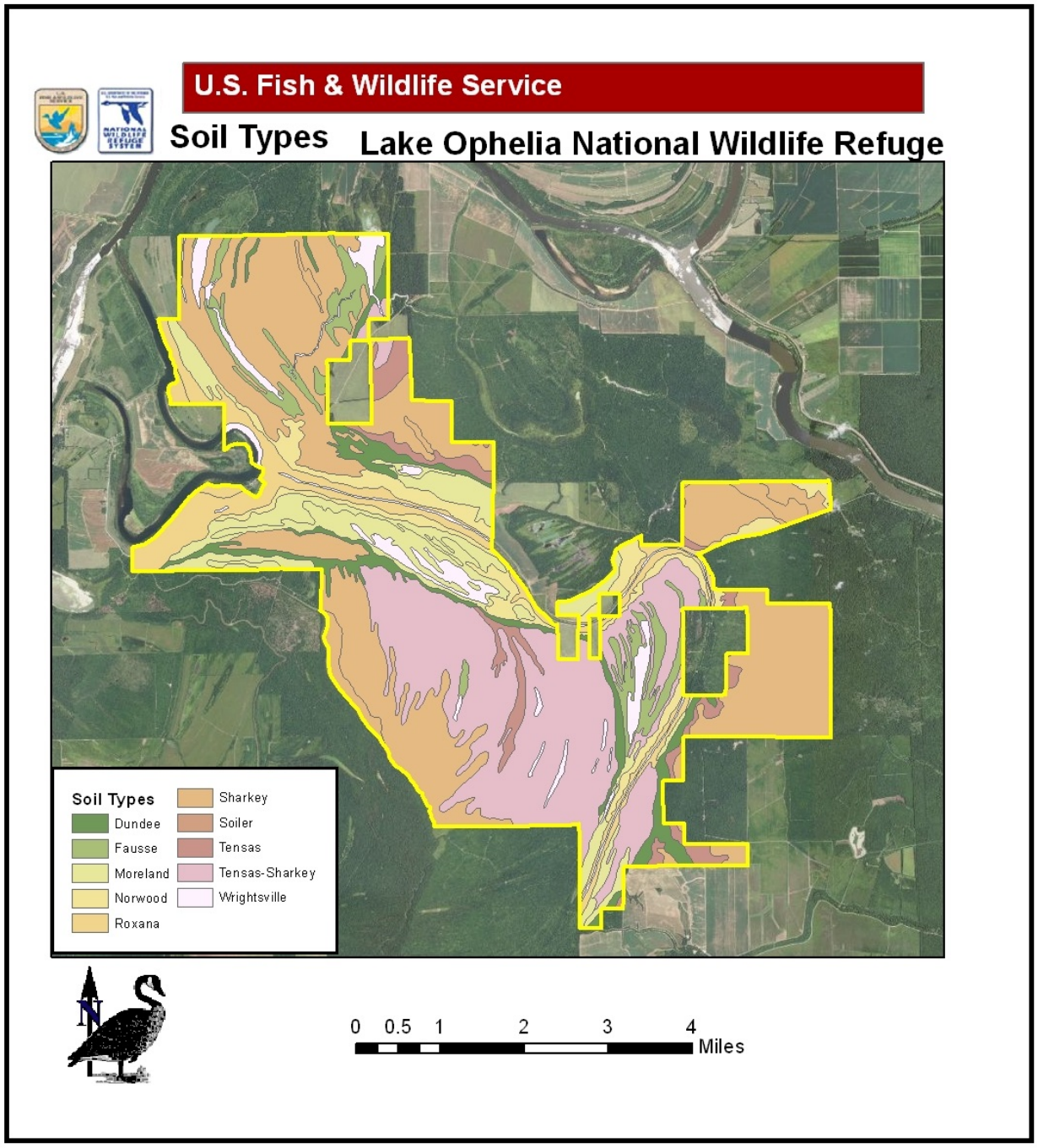
These undulating somewhat poorly drained and poorly drained soils are on the natural levees of old distributary channels of the Mississippi River. The Tensas soil has medium fertility. This soil is moderately well suited to the production of southern hardwoods. These soils are moderately well suited to cultivated crops.

Wrightsville silt loam (Wr)

This is a level, poorly drained soil on flats and in slight depressions in the terrace uplands. This Wrightsville soil has low fertility. This soil is moderately well suited to Woodland. This soil is moderately well suited to cultivated crops.

Figure 5. Soil mapping units on Lake Ophelia NWR

(Natural Resources Conservation Service, 2012)



Lake Ophelia NWR is located within the Lower Mississippi River Alluvial Plain (LMRAP) section of the Coastal Plain Province (Beccasio et al., 1983), to the west of the confluence of the Mississippi and Red Rivers in Avoyelles Parish. These rivers have influenced much of the landscape over the past 300,000 years (Jones & Shuman, 1989; Saucier, 1994). The topography of the refuge and much of the geology is from Quaternary (2.6 million years ago to present) alluvial deposits. During flood periods prior to human influence, stream channels within the Mississippi Alluvial Valley overtopped and spilled onto adjacent floodplains. As the velocity of these waters decreased rapidly, the coarsest particles were deposited closest to the stream channel and the finer particles were deposited farther away. These deposits formed natural levees, which gained elevation closer to the river channel. Such deposits also created lowlands at the foot of natural levees which meander parallel to streams. These alluvium formations compose the entire Lake Ophelia NWR. Relict channels and natural levees are often referred to as ridge and swale topography. Human disturbances, including the construction of artificial levees and channelization projects, have drastically altered these natural alluvial processes within the Mississippi and Red River floodplains.

HISTORIC HABITAT CONDITIONS

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 central Louisiana occurred within the last 100 years when agriculture and development, especially in the past 40 years, increased. There are other human effects on the environment that are less conspicuous than development and clearing but which 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. Although such factors do not usually cause dramatic die-offs of animals, the subsequent gradual shifts in habitat and 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 Refuge lands and their surrounding areas. Plan development involved extensive research utilizing Refuge documents, external literature, and personal communications.

Cultural and Refuge Land History

Lake Ophelia NWR is located within Avoyelles Parish, which received its name from the tribe of Avoyelles Indians that resided there prior to European settlement. The first European settlers to arrive in Avoyelles Parish were French. They settled the prairie land and were primarily self-sufficient with plentiful game, fish, livestock, and food (corn, rice, and fruit) and cash crops (indigo and tobacco). Around 1780, the area became known as Avoyelles Post. Areas along streams were settled later, where the land was very fertile and the streams provided a means of transportation. In the early 1800s, cotton began to replace indigo as the main money crop. At this time, cotton was primarily grown on small farms in the highlands. In 1815 the first steamboat navigated up the Red River, and by 1875 there were 52 boats traveling the river to transport goods.

The area has always had an abundance of fish and game, due to its diversity of lands and waters. As early as 1939, a sportsmen's club was created for the purpose of protecting game and wildlife in Avoyelles Parish (Saucier, 1943).

Clearing of mature bottomland hardwoods for agriculture began in the late 1970s on what was to become Lake Ophelia NWR. To facilitate drainage, a system of levees was subsequently constructed. In addition to the loss of forested wetlands, there have been significant alterations in the region's hydrology due to urban development, river channel modification, flood control levees, reservoirs, and deforestation. The refuge was established in 1989 under the authority of the Fish and Wildlife Act of 1956 [16 USC 742f(a)(4)], the Emergency Wetlands Resources Act of 1986 (16 USC 3901 (b), 100 Stat. 3583), and the Migratory Bird Conservation Act as amended in 1989 (USC 715d).

Pre-European Settlement Conditions

Bottomlands

Prior to settlement, the Lower Mississippi River Alluvial Plain (LMRAP) was a 25 million acre forested wetland complex that extended along both sides of the Mississippi River from Illinois to Louisiana.

Bottomlands in central Louisiana consisted of bottomland hardwood forest, baldcypress/tupelo swamps, sloughs, forested and emergent lakes, ponds, rivers and bayous. Because rivers, bayous and lakes are not generally managed, this section will focus on bottomland hardwood forests.

As stated in "Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat" (LMVJV Forest Resource Conservation Working Group, 2007): "[b]ottomland hardwood systems are described as among the most productive and diverse ecosystems in North America (Klimas et al., 2004). They are maintained by the natural hydrologic regime of alternating wet and dry periods and historically these forests served as an integrated system linked by flood waters to import, store, cycle and export nutrients (Wharton et al., 1982; Klimas et al., 2004) . These bottomland hardwood forests contain a diversity of overstory species, are characteristically rich in woody vines and shrubs and may feature an understory with large monocots such as cane (*Arundinaria gigantea*) and palmetto (*Sabal minor*) (Gardiner & Oliver, 2005; Klimas et al., 2004; Wharton et al., 1982). Natural regeneration within bottomland hardwood stands is typically initiated by localized damage to overstory trees such as single tree snapping or wind throw (Johnson & Deen, 1993; King & Antrobus, 2001), periodic catastrophic fire, windstorm damage, or prolonged growing season flood water. (Dickson, 1991)."

These forests are forested wetlands that are found along rivers and streams. Bottomland hardwood forest composition was historically driven by hydrology. Even subtle changes in elevation are reflected in the native plant community.

The extent of impact on bottomland forests by Native Americans has long been disputed. 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. Generally, these forests remained intact wilderness until Europeans began changing the hydrology and changing the structure of the landscape with practices like draining sites for agriculture and timber harvest.

Moist Soil

Prior to European settlement moist soil habitats on Lake Ophelia NWR were intact mature bottomland hardwood forests with the same characteristics as described in the previous section titled Bottomlands. Moist soil habitats were historically found in areas where openings were created from natural disturbances such as periodic catastrophic fire, windstorm damage, or prolonged growing season flood water.

CURRENT HABITAT CONDITIONS

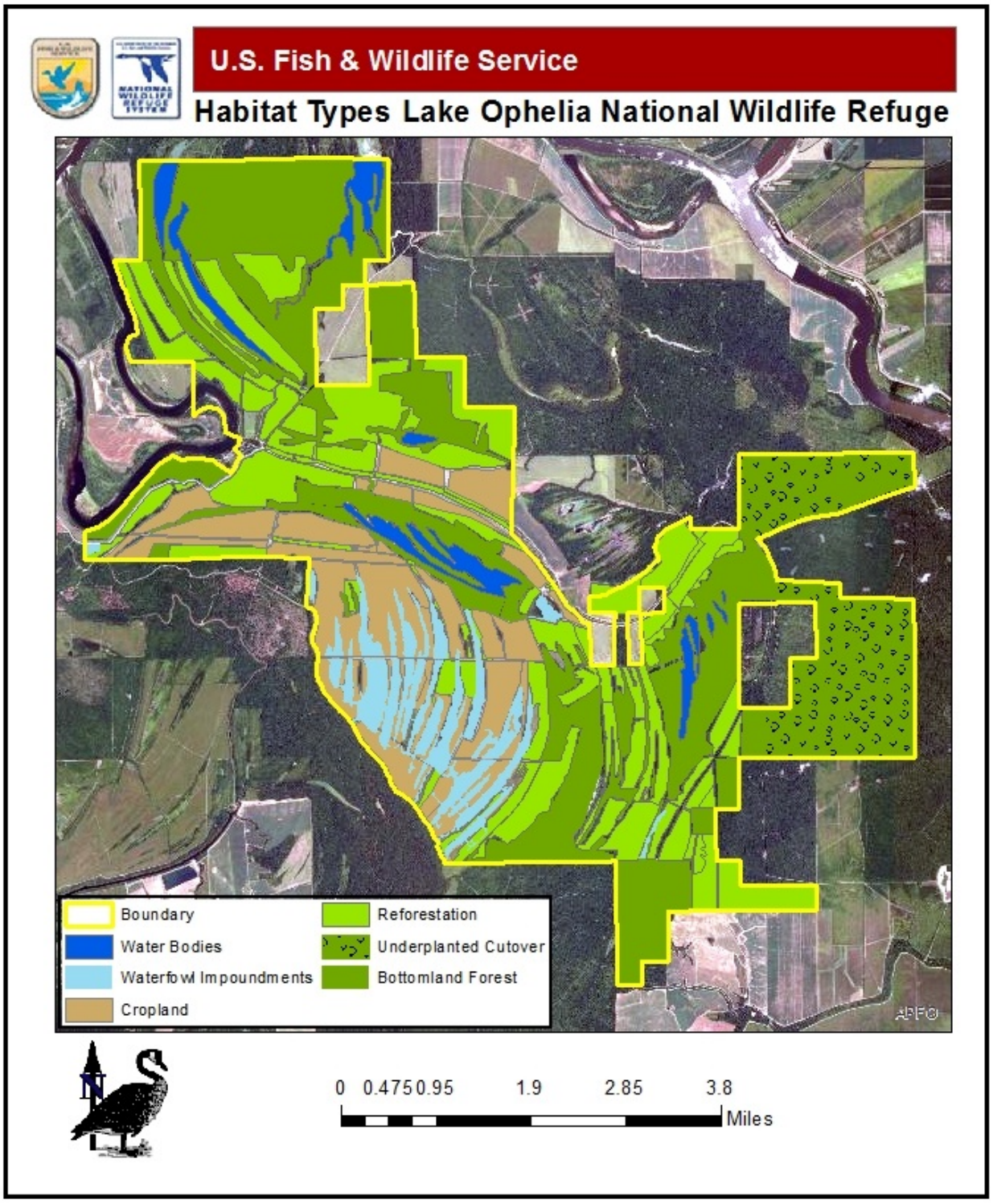
The Refuge consists of a mix of habitat types (Figure 6, Table 2) primarily resulting from a ridge and swale topography, including small remnant pieces of mature bottomland hardwood forests, reforested areas, cropland habitats, moist soil habitats, and permanent water (aquatic) habitats.

Table 2. Habitat types and acreages on Lake Ophelia NWR

Habitat Type	Acres[1]	Description/Comments
Open Water	654	Lake Ophelia, Duck, West Cut, Point Basse, and Nicholas lakes
Waterfowl Impoundments	1,100	Main refuge units 1-5; floodable cropland *(flooded acreage varies with rainfall and pumping capabilities)*
Non-floodable Cropland	1,950	Main refuge units 6-8 plus non-floodable fields in units 1-5
Moist Soil	150	On units VB1 and VB2; WCS but no pumping capacity
Reforested Bottomland Hardwoods	5,734	4,921 acres on the main tract of Lake Ophelia NWR and 813 on the Voinche Brouillette tract
Bottomland Hardwood Forest	7,866	Remainder of Lake Ophelia NWR

[1]Acreages were determined by geographic information systems software and are therefore approximate.

Figure 6. Habitat types on Lake Ophelia NWR.



Bottomland Hardwood Forests

As described in the refuge history, the bottomland hardwood forests on Lake Ophelia NWR have been reduced significantly due to clearing of land for agriculture. However over 70% of the refuge is classified as bottomland hardwood forest with approximately 5,000 of that being reforested (Figure 7). In 1988 efforts began to reforest many areas of Lake Ophelia NWR. Initial plantings were conducted by refuge staff using a modified soybean planter to direct-seed acorns. Between 1988 and 1990 Refuge staff planted over 2,000 acres using this method. Species planted were, water oak, (*Quercus nigra*), willow oak, (*Quercus phellos*) and Nuttall oak (*Quercus texana*) (U.S. Fish and Wildlife Service, 1990). Between 1997 and 2002 approximately 3,600 acres were reforested using carbon sequestration dollars from Dynegy Energy Corporation. This included approximately 1,900 acres of interseeding/underplanting of two areas that had recently undergone a high-grade timber harvest and 1,700 acres of former agriculture lands. However 330 of the acres of the agriculture lands that were reforested were classified as failures due to low survival. In 2010, 150 of those 330 failed acres were replanted by Dynegy as well. An additional 375 acres were reforested in 2010 by the Conservation Fund utilizing their Go Zero program. Part of these acres included roadside buffer plantings to shield wildlife from disturbances along Lake Long road and other secondary roads in the refuge. These plantings as well as the Dynegy plantings include a wide variety of both hard and soft mast species

Bottomland Hardwood Forest Regeneration

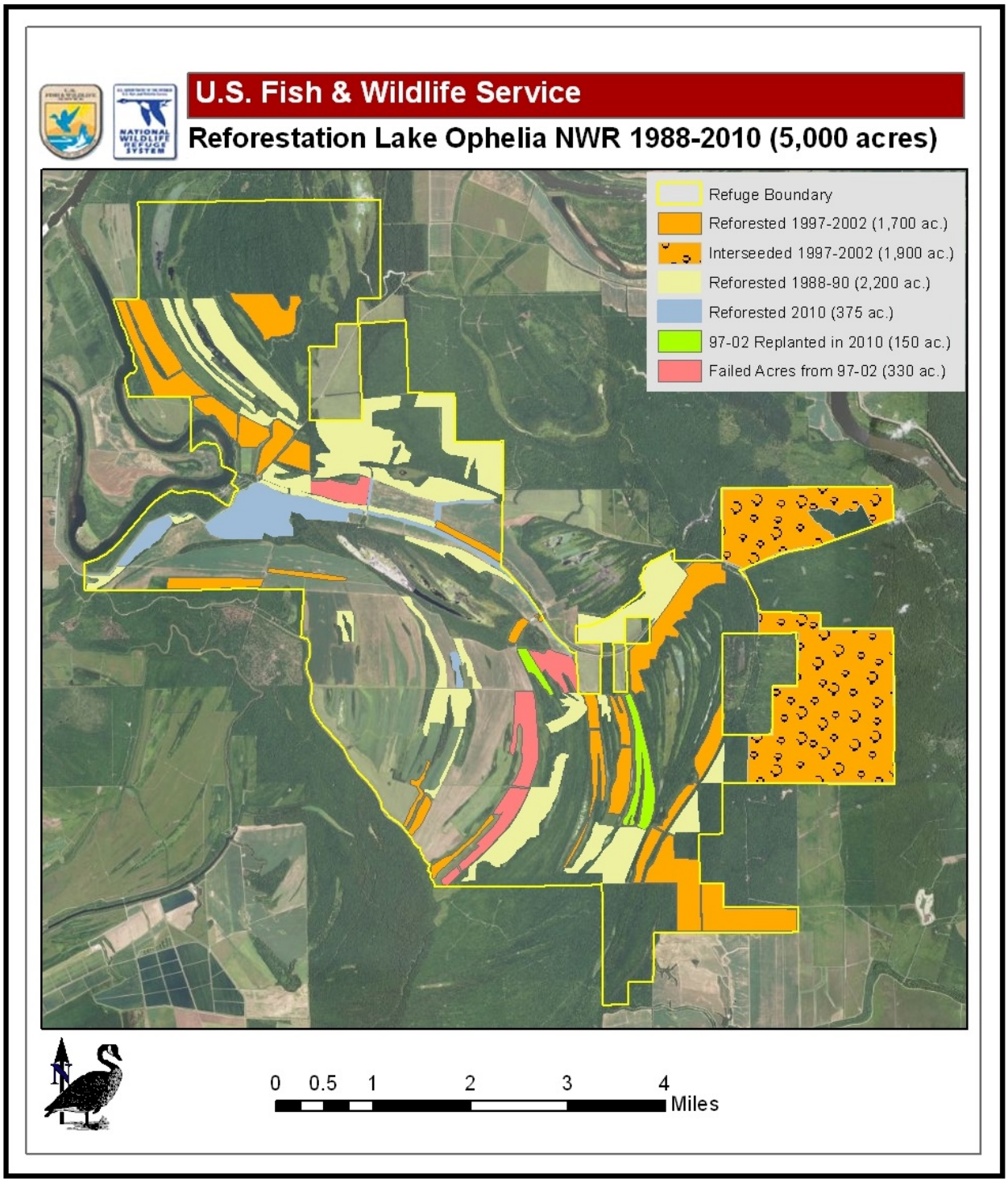
Reforestation efforts have been possible because of refuge staff and cooperation with other organizations. Although tree planting and direct seeding have been successful and contributed to the conservation of habitat, management beyond the initial planting stage is not expected due to the lack of a Refuge Forester, Forestry Technician, or sufficient funding within the Central Louisiana Complex.

Croplands

The refuge currently contains about 3,050 acres of cropland (Figures 2, 6), of which approximately 1,100 acres are within floodable impoundments. These acres are managed under a cooperative farming program, currently yielding approximately 600 acres of un-harvested crops annually to provide food resources for wintering waterfowl. There are 36 individual fields that range in size from less than 20 acres to over 300. The average size per field is approximately 90 acres. The 1,950 acres of upland provide most of the cooperative farmers' share, while the refuge draws its share from the lower lying areas of the refuge. Crop rotations are adjusted from year to year in most fields; however, the refuge tries to avoid planting soybeans in floodable acres, and because of this crop rotation schedules can be challenging.

To manage the cropland program more efficiently and in conjunction with the cooperative farming program on Grand Cote NWR, the Refuge is presently divided between two farmers. Within these units, cooperative farmers operate within distinct boundaries. The Northern Farm Unit is located on lands adjacent to Lake Ophelia proper and the Southern Farm Unit comprises the remaining agriculture lands on the Refuge.

Figure 7. Reforestation History on Lake Ophelia NWR.



The Refuge has been planting primarily milo and soybeans; however, corn and wheat could be planted as well. The cooperative farmers usually plant a particular crop such as milo or soybeans and then rotate that crop every 2-3 years. The reason this practice is done is to keep the soil conditions within balance (put organic matter back in soil). If the same crop is planted year after year the soil becomes poor, which in turn affects the crop production/yield.

Moist Soil

The timing of drawdown in waterfowl impoundments on Lake Ophelia NWR's Voinche Brouillette Tract to propagate moist soil plants has ranged from mid-May to late-June to maximize sprangletop, panic grass and wild millet production. Water depth in the surrounding bayous and drainages is another factor that determines the drawdown schedules. However timing of crop plantings in neighboring fields must be considered as well. Most drawdowns conducted are considered slow, at approximately three inches per week.

Some common desirable moist soil plants found in impoundments on the refuge are sprangletop, red-rooted sedge, panic grass, and wild millets. Estimated pounds/acre of seeds for these moist soil plants (Kross, 2006) have ranged from 496 to 530 kg/ha in moist soil sites on the Refuge during 2002 and 2003. Red vine (*Brunnichia cirrhosa*), alligator weed (*Alternanthera philoxeroides*), coffeeweed (*Sesbania* spp.), trumpet creeper (*Campsis radicans*), cocklebur (*Xanthium strumarium*), buttonbush (*Cephalanthus occidentalis*), and willow (*Salix* spp.) trees are some common nuisance plants found in moist soil units on the refuge. Disking, flooding, and applying herbicides are common practices used when nuisance plants become a problem. Generally units are disked and planted in millet at least once every three years for nuisance plant control and to set-back natural succession.

Levees and water control structures allow for water level manipulation in the moist soil units. Fall flooding for wintering waterfowl, in a typical year, begins around early November to December and is somewhat rainfall-dependent. Impoundments are generally flooded to full capacity during this time, making food available to waterfowl. Moist soil impoundments are generally de-watered during late May to early June. Water is removed slowly in order to conserve nutrients, and concentrate invertebrates for wading birds and other wildlife.

Permanent water bodies (lakes)

Lake Ophelia NWR contains 6 permanent water bodies that are generally referred to as lakes. These are Lake Ophelia, Nicholas, Duck, Westcut, Dooms and Point Basse. Combined acreage of these lakes is approximately 654. Lake Ophelia, after which the refuge was named due to its prominence and centralized location, is approximately 200 acres. For many years it was an extremely popular destination for anglers. However due to alterations to the hydrology of the Red River (construction of levees) and drought-like conditions that persisted for several years in early 2000s, refuge management was forced to close Lake Ophelia to fishing. If rainfall patterns allow water levels to return to normal and stabilize, the refuge management plans to reopen the lake for public use. Nicholas Lake is located in the northeast section of the Refuge, and is approximately 75 acres. Duck Lake is located in the northwest section of the Refuge and is approximately 70 acres. To the south of Duck Lake is Westcut Lake, which is approximately 45 acres. Dooms Lake is near the center and is the smallest of the named

lakes, and is about 18 acres. Point Basse is a series of small, inter-connected lakes that are a result of the ridge and swale topography that is common on Lake Ophelia NWR. Point Basse lakes comprise approximately 120 acres. These are generally shallow lakes surrounded by forested areas and lined with cypress and tupelo trees. These shallow lakes are ideal for producing copious amounts of aquatic vegetation. It is this vegetation that often makes them very attractive to migratory waterfowl and waterfowl hunters as well. Unfortunately this aquatic vegetation often consists of invasive and exotic plants. Impacts from these unwanted vegetative species create multiple management issues ranging from restricting public access to biological issues such as low levels of dissolved oxygen, which can hinder fisheries productivity.

HABITAT CHANGES FROM HISTORIC TO CURRENT

Invasive Species

Feral hogs (*Sus scrofa*) are an invasive exotic species which creates management problems on the Refuge. Like many invasive species, feral hogs reproduce rapidly and can reduce the success of native wildlife populations by predating juveniles, destroying nests, and consuming food resources. On Lake Ophelia NWR, feral hogs damage levees, roads, moist soil habitats, and cropland habitats through intense rooting activity. Trapping and free shooting are the primary means of controlling these animals on the Refuge.

Nutria (*Myocastor coypus*) is another invasive species found on the Refuge. These aquatic rodents can cause damage to levees and water control structures, but these effects have been minor on Lake Ophelia NWR.

Invasive aquatic plants are a major issue on the open water habitats of the refuge as well. Lakes on the refuge have silted in significantly and are now relatively shallow. Hydrilla (*Hydrilla verticillata*) is prevalent in most of the permanent water bodies, and species like water hyacinth (*Eichhornia crassipes*), salvina (*Salvinia minima*), and Cuban bulrush (*Oxycaryum cubense*) form dense floating mats of vegetation that not only block out sunlight and compete with native plant communities but also block access for Refuge visitors and staff.

Land Use/Habitat Conversion

Prior to acquisition by the U.S. Fish and Wildlife Service, Refuge lands were privately owned by multiple landowners. Land use was predominantly agriculture, which resulted in the deforestation of Lake Ophelia NWR and surrounding lands during the 1960s and 1970s. As the land was cleared, an extensive network of levees was constructed to protect farm fields from flooding. These levees are still used to protect farm fields during specific times of the year, but they also serve as a means to impound water and maximize shallow water habitat. The Refuge provides waterfowl with loafing/shelter/feeding areas by holding water within approximately 1,100 acres of impoundments. Currently, the Refuge maintains 7 miles of levees, 17 water control structures, and 4 irrigation wells which provide the infrastructure for all water management activities within impoundments on the Refuge.

The Service's interest in the Lake Ophelia area began in 1977. With support from the Louisiana congressional delegation, the State of Louisiana, and several conservation groups, the Service's Southeast Regional Director approved the first land acquisition for the Refuge in August 1978. At that time the property was rated by the Service as one of the five most

important bottomland hardwood tracts for wintering waterfowl in Louisiana, and it was in imminent threat of being cleared for agriculture. Before the Service could begin acquisition, a core 20,000-acre tract was purchased by a private party and 13,000 acres were cleared for soybean production. Toward the end of the clearing operation, the Avoyelles Sportsman's League and Environmental Defense Fund filed suit to have the wetland clearing operation stopped. The lawsuit, which was successful, provided the precedent for the regulation of wetland clearing operations under Section 404 of the Clean Water Act.

The Service's interest in acquiring the property continued with the first land acquisition, which was scheduled for fiscal year 1982. However, the loss of the core tract, the unwillingness of some landowners to sell, and funding limitations, coupled with an emphasis on purchasing intact bottomland forest and other factors, relegated the project to a lower priority. In 1987, the cleared 13,000-acre tract was conveyed to the Federal Land Bank for indebtedness. At that time, poor agricultural prices made selling farmland attractive, and the Service had refocused its attention on acquiring waterfowl habitat (particularly for northern pintails and mallards) in the MAV. In April 1988, the Service's Southeast Regional Director approved a Preliminary Project Proposal to acquire 38,000 acres for the establishment of Lake Ophelia National Wildlife Refuge. The first 1,536 acres were purchased in June 1988. With the aid of The Nature Conservancy, the Refuge grew to almost 15,000 acres within a few years. The last sizable addition (2,200 acres) was purchased in 1998 (U.S. Fish and Wildlife Service, 2005).

The landscape surrounding the refuge has also changed within central Louisiana. Historically, the Mississippi Alluvial Valley was an extensive 25 million acre forested wetland complex. Like the Refuge lands, most of the surrounding areas were also cleared for agriculture, rural home sites, and flood control projects. Such practices left the landscape severely fragmented with scattered small patches of forest ranging in size from small sites with limited functional value to large sites that have maintained many of their original functions. This fragmentation has created the opportunity for invasive species to become established and has reduced biological diversity. Intensive agriculture has also reduced connectivity between patches, as more efficient farming practices have further reduced the number of remnant forest patches.

Habitat Fragmentation

Habitat fragmentation occurs when large blocks of continuous habitat are broken up into smaller blocks by the creation of breaks consisting of different kinds of habitat. In the area surrounding Lake Ophelia NWR, habitat fragmentation is obviously a consequence of habitat conversion, but its effects are distinct, and the difference is important to conservation efforts. Fragmentation affects ecosystem structure and function in a number of ways, and the effects depend on the pattern and spatial properties of the remaining fragments, as well as their size. For example, blocks of forest which are separated by a road or pipeline right-of-way may retain much of their shared function as habitat for wide-ranging species such as Louisiana black bear, which are able to cross short distances of inhospitable habitat, while similar-sized blocks that are separated by large distances may effectively isolate those same wide-ranging species.

Habitat fragmentation can result in decline or loss of wide-ranging and interior-dependent species (U.S. Fish and Wildlife Service, 1995), increased invasion by exotic plants and animals, decreased (or increased) species diversity (Rudis, 1995), and changes in predator, parasite, and pathogen populations and effects. In bottomland forests, documented effects of fragmentation include declines in forest interior breeding bird species such as swallow-tailed

kite, prothonotary warbler, and Acadian flycatcher (Rich et al., 2004). In the area surrounding Lake Ophelia NWR, habitat fragmentation is a threat to Louisiana black bear (U.S. Fish and Wildlife Service, 1995). Habitat restoration in existing habitat breaks or creation of corridors of hospitable habitat to reconnect fragments can restore much of the function of these habitats without requiring wholesale re-conversion to forest. (Figure 6).

Hydrology

Other changes at the landscape level include alteration to hydrology and proliferation of aquatic nuisance species. The natural hydrology of a region is directly responsible for the connectedness of forested wetlands (Fredrickson & Heitmeyer, 1988). Large-scale, anthropogenic alterations have changed the natural flooding regime, reducing both the extent and duration of the annual seasonal flooding. These changes, which include levees, ditching and drainage, land leveling, flood control, etc., have altered the processes that form wetland communities and their function. (Fredrickson et al., 2005) Lack of annual flooding and reduced water depths have created conditions favorable for the establishment and proliferation of several species of invasive aquatic plants. This vegetation threatens aquatic systems by choking waterways and reducing native floral and faunal diversity. Most of the hydrologic changes which impact the aquatic habitats on Lake Ophelia NWR are the result of large-scale engineering projects on the Red River and are not under the control of refuge managers. Opportunities for restoration of natural hydrology on the refuge are therefore limited.

Changes Associated with Global Climate Change

The effects of global climate change may gradually increase at Lake Ophelia NWR over the next 100 years. Within the 15 year time-frame of this plan, 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, less rainfall, particularly in 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, (e.g. black-bellied whistling ducks, wood storks, etc.) will extend their ranges into more northern parts of Louisiana. Invasive species such as salvinia (*Salvinia minima*), water hyacinth (*Eichhornia crassipes*), Chinese tallow (*Triadica sebifera*), 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 are anticipated nevertheless. This plan 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. (Karl et al., 2009) Actions to control invasive species, habitat management, enhancement, and reforestation of some refuge lands may help to offset some of these anticipated changes.

Summary of Refuge History

Historical highlights for the area and the refuge are summarized in Table 3.

Table 3. Historical timeline of Lake Ophelia National Wildlife Refuge

Date	Event
Before mid-1700s	Avoyelles Indians inhabit the region.
1780	French settlers established Avoyelles Post locally and settlement of the prairie land continued. The French explored and settled prairie land and began to develop agricultural lands.
1803-mid 1800s	The United States acquired Louisiana. American settlers established farms and cotton became the dominant cash crop in the region.
1815-1875	Steamboats traveled up the Red River, transporting goods and crops, including cotton bales. By the end of this period as many as 52 boats were navigating the river.
1939	Avoyelles Parish established a sportsman's club to protect local game and wildlife.
1960-1970s	Mature bottomland hardwoods were cleared to create agricultural fields. Levees were constructed to facilitate drainage.
August 1978	USFWS Southeast Regional Director approved the first land acquisition for the Refuge. However a core 20,000 acre tract was purchased by a private party and 13,000 acres were cleared for farming. A section 404 of the Clean Water Act suit followed and halted further wetland clearing.
1987	The cleared 13,000 acre tract was conveyed to the Federal Land Bank for indebtedness.
April 1988	USFWS Southeast Regional Director approves a preliminary project proposal to acquire 38,000 acres for the establishment of Lake Ophelia National Wildlife Refuge
June 1988	The first 1,536 acres were purchased. With assistance from the Nature Conservancy the refuge grew to almost 15,000 acres by the early 1990's
1998	An additional 2,200 acres were purchased.

CHAPTER III. RESOURCES OF CONCERN

Priorities associated with wildlife and habitat management for the NWR System are determined through directives, policies, and legal mandates. Resources of Concern are defined by the Policy on Habitat Management Plans (620 FW 1) as ”all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts.“ The NWR System has further outlined a process for refuges to identify and prioritize Resource of Concern for management purposes which uses a focal resource approach (U.S. Fish and Wildlife Service, 2010).

Resources of concern for Lake Ophelia NWR were selected after taking into account the conservation needs identified within international, national, regional, or ecosystem goals/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]), input from partners and Service staff through the Biological Review as well as Section 1.3 of this HMP. The species/communities selected as resources of concern from these plans support the following NWRS mandates:

- Support refuge purposes and the NWR System 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 West Gulf Coastal Plain); and
- fulfill Service trust resource responsibilities (see Section 1.2)

Resources of concern identified for Lake Ophelia NWR are:

- Louisiana Black Bear (*Ursus americanus luteolus*)
- Wintering waterfowl
- Nesting/Resident Wood Ducks (*Aix sponsa*)
- Woodcock (*Scolopax minor*)
- Shorebirds
- Fisheries

LOUISIANA BLACK BEAR

SIGNIFICANCE

The Louisiana black bear is a threatened species protected under the Endangered Species Act. As a part of the Recovery Plan for the bear (U.S. Fish and Wildlife Service, 1995), the Service and other partners developed plans and began relocation efforts in order to establish a new breeding population of bears in the State. The initial relocation effort took place in March 2001, when four female bears with cubs were relocated from existing breeding populations in north and south Louisiana to the Red River WMA, located directly across the Red River from Lake Ophelia National Wildlife Refuge. During the spring of 2003 and 2004,

11 adult female bears (radio-collared) with cubs were successfully relocated to Lake Ophelia NWR. Since that time other bears have been relocated to Lake Ophelia NWR, including nuisance bears from the coastal population. Bear sightings among hunters are now quite common at Lake Ophelia NWR.

HABITAT REQUIREMENTS

Louisiana black bears formerly ranged through eastern Texas, Louisiana, and western Mississippi. They are able to use a variety of bottomland and upland habitats, but bottomland hardwood forests are preferred because of their higher production of hard and soft mast (U.S. Fish and Wildlife Service, 1995). Requirements for food, water, cover, and denning sites are best met in large, relatively remote blocks of bottomland forest habitat. Each of these habitat factors will be discussed individually.

Black bears are omnivorous, opportunistically consuming soft and hard mast, grass and other vegetation, invertebrates, carrion, and agricultural crops such as wheat, oats, and corn (U.S. Fish and Wildlife Service, 1995). In bottomland hardwood forest habitat, hard mast consists mostly of acorns (seed of *Quercus spp.*) and pecans (*Carya illinoensis*), while soft mast comes from a variety of understory plants including mulberries (*Morus spp.*), pawpaw (*Asimina triloba*), plums (*Prunus spp.*), blackberries (*Rubus spp.*), elderberry (*Sambucus canadensis*), pokeweed (*Phytolacca americana*), devil's walkingstick (*Aralia spinosa*), and palmetto (*Sabal minor*) (LMVJV Forest Resource Conservation Working Group, 2007). Most of these understory plants produce significant quantities of fruit only when they receive direct sunlight, although many can persist vegetatively in shaded understory conditions. Working in the Tensas River bottom in northeastern Louisiana, (Benson & Chamberlain, 2006) reported that Louisiana black bears consumed mainly beetles, blackberries, and corn during the summer and subsisted mostly on acorns and herbaceous vegetation during the winter. During the fall, the bears' diet was dominated by palmetto fruit and acorns. Interestingly, they also found that a subpopulation of bears which inhabits managed, commercial forest blocks (the "Deltic" population) had smaller home ranges and a more diverse diet than those on Tensas River NWR, which had had no timber harvesting for the preceding two decades. The authors speculated that this difference was caused by a relative paucity of understory vegetation on the refuge as compared to the managed timberlands, a condition that may be related to management differences as well as the fact that the commercial timberlands are subject to less frequent flooding. (Hellgren et al., 1991), working in Virginia, found that disturbed areas in the Great Dismal Swamp were heavily used by black bears for feeding because of availability of soft mast-producing plants in the understory. Likewise, (Mitchell & Powell, 2003) found that timber harvesting on the Pisgah National Forest in North Carolina increased soft mast production, but noted that in a managed forest there is a trade-off between increased soft mast from early-successional plants and decreased hard mast and den sites produced by the overstory trees, and increased risk of human contact due to road construction.

Open water influences the quality of black bear habitat in a number of ways. Dependable sources of drinking water are important for black bear habitat. In Louisiana, open water is rarely limiting, but flooding can limit options for den sites (Black Bear Conservation Committee, n.d.; White et al., 2001) and may reduce understory food plants (Benson & Chamberlain, 2007). Rivers may serve as barriers to movement for bears. (White et al., 2000) reported that in Arkansas, the Mississippi River (approximately 1600 m wide) effectively deflected bear movement, while the White River, which is approximately 200 m wide, was less

of a barrier. Male bears were more likely to cross than females, and all bears were less likely to cross in the winter.

Escape cover is an important feature of black bear habitat. In hunted populations in North Carolina, dense underbrush associated with Carolina bays was critical for concealment and escape from hunters and dogs (Landers et al., 1979). Likewise, large swamps in northern Florida are important for escape cover for Florida black bears because human access is limited (Mykytka & Pelton, 1990). Although bears use roads for travel corridors in dense vegetation, they risk vehicle strikes and detection by hunters by doing so. Hunted populations tend to avoid roads for this reason (Hellgren et al., 1991). (Mitchell & Powell, 2003) also noted the high value of dense vegetation in recently harvested forest stands for escape cover.

Louisiana black bears require secure denning sites for wintering and day use. In northeastern Louisiana, most bear dens are in tree cavities which are elevated above flood levels (Weaver & Pelton, 1994). Bears may also use brush piles or other sites on the ground, but these sites are more susceptible to human disturbance (Weaver & Pelton, 1994) and more vulnerable to flooding (Hightower et al., 2002; White et al., 2001). (Hightower et al., 2002) reported that black bears in the Atchafalaya River corridor used tree dens and ground dens in about equal proportions, except for areas along the coast, where mostly ground dens were used. They concluded that concealment is the most important factor related to den sites, and that reproductive status of the female bears they studied did not affect den choice. Dens in their study were preferentially in areas of dense understory cover. They found that although den sites did not appear to be limiting, den trees should be protected in bear habitat so that den sites which are less susceptible to flooding will be available. (White et al., 2001), working in the White River and the Mississippi River bottom in eastern Arkansas, reported that black bears selected elevated tree dens in flood-prone habitat, and recommended that in areas where tree-cavity dens were unavailable, that logging slash piles (used as den sites in the absence of suitable tree cavities) should be preferentially left on higher ground to reduce litter losses from den flooding.

Black bears tend to avoid human contact, although they are attracted to human-influenced areas where garbage and other edible material is available. Remoteness of habitat, influenced by forest block size and degree of fragmentation, is therefore an important habitat variable (Rudis & Tansey, 1995). Bears have large home ranges (20-60 sq. miles for males and 4-30 sq. miles for females), and require large areas for genetically viable populations to persist (U.S. Fish and Wildlife Service, 1995). Landscape-scale considerations for black bear habitat are also important, specifically block size and connectivity (U.S. Fish and Wildlife Service, 1995; Benson, 2005).

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

The Refuge can continue to support the recovery of this species by providing suitable habitats (including the interior forest and forest corridor) and by providing personnel to monitor the bears, conduct education programs, and handle nuisance complaints. In order to ensure the success of local recovery efforts, an effective public outreach program aimed at educating the local community about the black bears needs to be conducted.

WINTERING WATERFOWL

SIGNIFICANCE

Lake Ophelia NWR is located in the Mississippi Flyway, which is a critically important region for migrating waterfowl in North America (Reinecke et al., 1989), as well as southern breeding populations of wood ducks. Infrastructure to provide intensive and highly productive management of moist soil, cooperative farming and Lake Ophelia's geographical location in the Mississippi flyway combine to attract thousands of mallards *(Anas platyrhynchos),* pintail (*Anas acuta*), teal (*Anas* spp.), gadwall *(Anas strepera)* and wood ducks (*Aix sponsa*) during the winter.

IDENTIFICATION OF HABITAT REQUIREMENTS

Most North American waterfowl species migrate long distances to satisfy their annual cyclic habitat needs. Habitat requirements vary with the breeding cycle, and habitats all along the flyways are critical links in a chain which sustains waterfowl populations. Strategic conservation of habitat, including planning, protection, and management, is the primary way that humans can ensure healthy populations of waterfowl (or any wildlife) (Reinecke et al., 1989). For wintering habitat, dabbling ducks need a diversity of wetlands including the following: (1) flooded crop land, (2) natural wetlands, and (3) refuge (i.e., sanctuary) (Reinecke et al., 1989).

Two natural wetland habitats that ducks have used historically in the Lower Mississippi Valley are bottomland hardwood forests and moist soil habitats (i.e., early successional grass-sedge and other herbaceous vegetated wetlands). Moist soil habitats provide critically important foraging and resting areas for waterfowl. Hardwood bottomland and moist soil habitats are both rich in high-energy natural seeds (acorns in oak bottomlands; grass-sedge seeds, roots, tubers, etc. in moist soil areas) and aquatic invertebrates (Kaminski et al., 2003; Heitmeyer, 1988; Wehrle et al., 1995). Wintering waterfowl satisfied their nutritional and other physiological needs in these wetlands before large-scale conversion of the MAV to agriculture.

The high seed production of moist soil plants and their value as waterfowl foods have been known since at least the 1940s (Low & Bellrose, 1944). However, managing seasonally flooded herbaceous wetland impoundments or "moist soil units" only became a widely accepted practice after many years of research in southeastern Missouri (Fredrickson & Taylor, 1982; Fredrickson, 1996). Today, more than 20,000 acres of moist soil habitat are managed in more than 300 impoundments on state and federal lands in the LMV (LMVJV, 2010).

Although geese sometimes use moist soil impoundments and eat shoots of germinating plants, rhizomes, roots, or tubers, the primary emphasis of moist soil management is to produce seeds that will provide food for ducks. Most research has focused on estimating seed production, and studies have shown that, under intensive management, species of barnyard grass (*Echinochloa* spp.), sprangletop (*Leptochloa* spp.), flatsedge (*Cyperus* spp.), smartweed (*Polygonum* spp.) and panic grasses (*Panicum* spp.) can produce more than a 1,000 lbs./ac of seed (Fredrickson & Taylor, 1982). However, we know far less about production that may be occurring under current conditions in the Lower Mississippi Valley. (Reinecke et al., 1989) suggested an average of 450 kg/ha (400 lb./ac) of seed might be reasonable because of site and staff limitations. More recently, the LMVJV Waterfowl Working Group used available moist

soil seed estimates of nearly 500 pounds per acre reported by (Kross, 2006) to increase the value of this habitat to 1,883 Duck Energy Days (DEDs) per acre. Regardless of the quantity of seed produced, moist soil impoundments are highly recommended as a means of diversifying habitat (Fredrickson & Taylor, 1982; Reinecke et al., 1989) and supplying food with nutrients not generally available in agricultural grains.

Several species of waterfowl heavily utilize flooded habitat in winter for resting and foraging for acorns, other fruits, various seeds, and invertebrates. Mallards, gadwalls, and wigeon all utilize flooded forested habitat as one of the complex of preferred habitats (Fredrickson & Heitmeyer, 1988). Wood ducks seek these habitats almost exclusive of other habitats. These areas are vital to waterfowl for pair bonding, loafing, sanctuary, thermal cover and feeding (Reinecke et al., 1989). Ducks like openings in forests, which provide them easy access. Small groups of trees that dominate canopy coverage can be removed to provide the openings that ducks prefer for landing (U.S. Fish and Wildlife Service, 2004a).

The remaining essential component of the waterfowl wintering habitat complex is sanctuary. The Refuge provides approximately 5,800 acres of sanctuary within the “closed” area which includes willow swamps, cypress-tupelo swamps, buttonbush sloughs, flooded agriculture land and moist soil. In addition, another 2,500 acres has restricted public access during the winter. Winter is an important season in the annual cycle of waterfowl during which many ducks and geese pair and perform other life functions. Females of some species (e.g., mallard) undergo a prebasic molt to acquire their breeding-season plumage in readiness for reproduction. Disturbance-free habitat enables some species of waterfowl to prepare biologically for spring migration and reproduction (Reinecke et al., 1989; Strickland & Tullos, 2009). Disturbance can interrupt resting and feeding bouts resulting in a loss of energy and lowering of body weight (Henry, 1980; Heitmeyer & Raveling, 1988; Kahl, 1991). (Paulus, 1984) found in Louisiana that increased foraging time by gadwalls was insufficient to counter-balance disturbance factors.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Lake Ophelia NWR has 654 acres of open water, 1,100 acres of floodable cropland, 1,950 acres of cropland which is not floodable, 150 acres of moist soil impoundments, and 13,600 acres of bottomland hardwoods, including mature and reforested stands. Most of this area is potentially usable by waterfowl, with the possible exception of the non-floodable cropland.

NESTING/RESIDENT WOOD DUCKS

SIGNIFICANCE

Wood ducks are year round residents in the forest lands of the eastern United States, including Lake Ophelia 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 wood duck populations appear stable (Dugger & Fredrickson, 2007). However, our understanding of the population status of this species is uncertain. Population estimates are inaccurate due to aerial surveys being ineffective in forested habitats (Dugger & Fredrickson, 2007). 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 & Fredrickson, 2007).

Because the Refuge has a considerable amount of forested wetland habitats, there is substantial opportunity to provide quality habitats for breeding wood ducks. The Wildlife and Habitat Review (U.S. Fish and Wildlife Service, 2004b) for Lake Ophelia NWR suggests wood ducks are an important resource for the Refuge

HABITAT REQUIREMENTS

Preferred habitats of wood ducks 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, plant seeds and invertebrates found in shallow flooded timber, shrub swamps and along stream banks. They loaf and roost in more secluded areas, such as dense shrub swamps (Dugger & Fredrickson, 2007).

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 local production of wood ducks. Box programs are not an end to all nesting problems. They 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.

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 emergent plants and 25% open water. Overhead cover within one to two 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 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. Research has documented that acorns comprise 75% of their diet during the winter. (Dugger & Fredrickson, 2007). During the spring, an increase in animal foods can be seen in both sexes. Aquatic insects become an important part of the female's diet during egg-laying (Dugger & Fredrickson, 2007).

At the turn of the century wood duck populations had drastically dropped to a level that many feared their extinction. (Bellrose, 1976) The wood duck population rebounded through the implementation of harvest regulations, however researchers realized the lack of nesting habitat would limit the population growth. (Hawkins & Bellrose, 1940; McLaughlin & Grice, 1952). To help compensate for the lack of natural nesting cavities, nest boxes have been shown to be an effective method to provide nesting habitat for wood ducks (Hawkins & Bellrose, 1940). Nest boxes have become a regular part of wood duck management in many locations throughout North America.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Lake Ophelia NWR currently has nearly 100 nest boxes located throughout the Refuge; boxes are located adjacent to suitable brood habitat and a monitoring program is in place. Objective 1.2 in this plan calls for maintenance of at least 75 of these boxes through the planning period. The refuge also controls exotic nuisance plants in lakes and bayous, improving habitat for wood duck broods.

WOODCOCK

SIGNIFICANCE

American Woodcock, (*Scolopax minor*), is a shorebird in the sandpiper family (Scolopacidae), which is adapted to forested habitats. Populations of American Woodcock have declined in North America (Krementz & Jackson, 1999), and they are listed as a species of concern by Partners in Flight (Rich et al., 2004). American Woodcock winter in Louisiana, including Lake Ophelia NWR, and utilize habitats on the refuge for feeding and roosting.

IDENTIFICATION OF HABITAT REQUIREMENTS

Woodcock winter in the southeastern United States, and utilize both open habitat and densely wooded, shrubby habitat. During the day, they forage underneath dense shrub cover in areas where some bare ground exists (Straw et al., 1986; Horton & Causey, 1979; Krementz & Pendleton, 1994). At night they venture into the open to forage in fields and meadows. Nocturnal habitat often includes fallow fields and clearcuts. They prefer fields and openings larger than 5.5 ha (13.6 ac.) with a high percentage of bare soil and foliar cover between 0.8 and 2m (2.6-6.6 ft.) high. Nocturnal and diurnal habitat should be less than 0.5 mile apart (Berdeen & Krementz, 1998; Krementz & Jackson, 1999). They forage almost exclusively on earthworms, so the population and availability of these animals is critical to habitat quality for woodcock. They are unable to forage in frozen soil (Stribling & Doerr, 1985).

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Lake Ophelia NWR will provide agricultural field habitat in close proximity to early-successional bottomland hardwood forest habitat. Agricultural fields will not be cultivated in the fall after harvest to promote earthworm populations.

SHOREBIRDS

SIGNIFICANCE

Lake Ophelia NWR provides habitat for many species of migrating shorebirds as well as the year-round resident killdeer, wintering greater yellowlegs, least sandpiper, American woodcock, and Wilson's snipe. Black-necked stilts may breed on the refuge. Conservation of this suite of birds is integral to the purpose of the refuge and is a focus of refuge management. Specific actions, described in this plan, are taken to provide habitat for shorebirds, including retention of water on moist soil units during shorebird migration and maintenance of open fields in proximity to bottomland hardwood tracts.

IDENTIFICATION OF HABITAT REQUIREMENTS

Present CCP objectives for Lake Ophelia NWR call for 50 acres of shallow moist mud flats for shorebird habitat during southbound migration (Aug-Oct). These mudflats need to be 3-4 inches in depth and have exposed mudflats within the units. This may actually involve up to 200-300 acres over a season with flooding and drawdowns over any one season allowing for approximately 50 acres of suitable habitat to be available throughout the migration period. The

CCP suggests providing habitat for northbound migrants as well, but as with fall habitat provision, habitat should be made available in concert with moist soil management where there is a waterfowl focus.

For southbound migration, specific measures need to be employed for shorebirds. One approach would be to hold water in some impoundments in August and September, then gradually draw down. September habitat would overlap needs of southbound migrating blue-winged teal and northern pintail. Holding water in these areas until March would also benefit the northbound migration.

Opportunities exist for managing shorebirds in moist soil units and farm fields. Providing suitable conditions would include disking vegetation and a subsequent schedule of flooding and prolonged draw downs. Alternative management would involve flooding a field from winter through the summer months to provide preferred water depths during the late July to early October period. Exposed mudflats grading into 3-4 inches water depth capture the needs of all species.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Lake Ophelia NWR can play an important role in providing shallow water habitat for shorebirds. Where opportunities exist, managing shorebird habitat should be focused during both northbound and southbound movement periods. For areas designated for managing shorebird habitat, consideration for flooding and gradual drawdown should be undertaken between late February to early May and again from late August to early September. Refuge personnel need to conduct shorebird surveys in order to assess shorebird populations.

FISHERIES

SIGNIFICANCE

The refuge has 654 acres of open or potentially open freshwater habitat. Managing this resource to benefit the ecosystem and provide a freshwater sport fishery is an objective in the refuge CCP and in this Habitat Management Plan. Of the total, Lake Ophelia (200 acres) is the most suitable for management inputs like stocking because it does not go dry during drought periods. Other lakes on the refuge, while part of the refuge's freshwater resource, are less suitable for fisheries management because their levels fluctuate and they occasionally dry out. Management of these areas for nongame aquatic species is still feasible and would consist mainly of exotic plant control. Freshwater fish species suitable for freshwater fisheries management in the MAV include several species of sunfish (Centrarchidae), notably largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), white crappie (*P. annularis*), bluegill (*Lepomis macrochirus*) and redear sunfish (*L. microlophus*), as well as channel catfish (*Ictalurus punctatus*).

IDENTIFICATION OF HABITAT REQUIREMENTS

Freshwater sport fish require the following habitat elements for survival, reproduction, and growth: adequate populations of prey species (small fish, invertebrates), temperature within tolerance limits, including the existence of thermal refugia during periods of extreme heat or cold, good water quality (adequate oxygen levels, turbidity at acceptable levels, absence of toxins, proper pH), adequate cover and structure, and proper substrate. These habitat

elements fall into three categories of variables under at least partial control of managers: water quality, water depth, and substrate type. Each of these will be discussed below.

Water Quality

The main element of water quality which is under the partial control of managers is adequate dissolved oxygen (DO) in the water column. Oxygen levels decrease during the summer, when temperatures are highest (reducing O_2 solubility) and decomposition of organic matter is accelerated. Control of aquatic plants with herbicides can reduce water quality by creating large amounts of decaying organic matter which releases N and P (Reddy & Sacco, 1981) and can result in transitory decreases in DO (Chilton, n.d.). However, allowing unchecked growth of aquatic vegetation, especially floating exotic weeds like water hyacinth and salvinia which completely cover the surface of the water, can shade the water column and block gas exchange at the surface, creating hypoxic conditions as well (Villamagna & Murphy, 2010). Managing DO levels involves striking a balance between these two extremes by preventing wholesale colonization of the water surface by exotic weeds but at the same time avoiding large-scale (over the whole lake) herbicide treatments, especially during the hottest part of the summer.

Water Depth

The depth of the water influences several habitat variables of importance to fish survival and reproduction. First, maintaining adequate depth assures a temperature gradient which allows fish to select optimum temperature environments, both diurnally and annually. Second, adequate depths (> 8 ft./2.4 m) prevent the establishment of rooted submerged aquatic vegetation and rooted emergent vegetation, because light levels at that depth are typically too low to support establishment of rooted plants. Maintaining the water column free of submerged aquatic plants in the deeper portions of the lake provides open water areas for fish and also reduces organic matter inputs from decomposing plant material. However, it should be noted that floating vegetation and rootless, submerged plants like coontail (*Ceratophyllum demersum*) are able to spread independent of water depth.

Substrate

Substrate material is important for spawning and reproduction for the largemouth bass (Bruno et al., 1990), bluegill (Stevenson et al., 1969), and redear sunfish (Twomey et al., 1984). These fish require or prefer a sandy or gravelly bottom in shallows for nest construction, which is performed by the males. Largemouth bass, in the absence of sandy or gravelly bottom, can utilize patches of emergent vegetation like maidencane (*Panicum hemitomon*) and spatterdock (*Nuphar lutea*) for spawning (Bruno et al., 1990), apparently because these plants provide a firm surface composed of rhizomes. Because of their spawning habitat requirements, channel catfish are less dependent on hard substrates. These fish spawn in bank cavities under tree root systems, flooded burrows, or other such structures.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

The 200-acre Lake Ophelia is infested with hydrilla, water hyacinth, salvinia, and other exotic weeds. Fishing is currently closed on this lake due to access issues and low fish populations. Restoration of a sustainable recreational fishery in Lake Ophelia may be possible with an integrated and adaptive approach to weed management coupled with fish stocking.

RECONCILING CONFLICTING NEEDS

Habitat requirements of the refuge resources of concern are in tension on Lake Ophelia NWR. Two basic types of terrestrial habitat, open, intensively managed cropland and moist soil habitats ("field"), and passively or extensively managed, bottomland hardwood forest habitats ("forest"), constitute a direct, one-to-one acreage trade-off for refuge land area. Each type of habitat can be converted into the other; however, the conversion from open land to mature forest takes decades, while converting forest to field is quick, if expensive. On Lake Ophelia NWR, wintering waterfowl and shorebirds depend mostly on open habitats, while Louisiana black bears and wood ducks depend primarily on the forested habitats, which are themselves, of course, also a resource of concern. Woodcock depend on both types of habitat in close proximity. Aquatic habitats are less convertible, but are directly dependent on surrounding land use (field or forest) for their quality.

Beyond the one-to-one acreage trade-off, field and forest habitats interact in different ways depending on their geographic configuration. Cleared land necessarily fragments forested land and can disconnect travel corridors used by bears and other wide-ranging wildlife. See the discussion of habitat fragmentation in Chapter II for more detail.

In order to fulfill the purposes of Lake Ophelia NWR and resolve conflicts between competing habitat uses, refuge managers have taken the following approach:

- Allocate acreage for open habitats based on LMVJV step-down requirements for Duck Energy Days, as described below in Chapter IV;
- Group like habitats together in large blocks by strategically allocating forest restoration activity (see Figure 6);
- Consider contiguity both of forested habitats within the refuge as well as connections to protected forested habitats outside the refuge (on WMA lands);
- Consider adjacency of reforested blocks to fields which will be kept open and available for woodcock foraging habitat;
- Maintain or restore forested habitat as buffer surrounding permanent aquatic habitats.

Land use configuration on the refuge reflects these priorities; two large forested blocks, connected by a corridor consisting of Lake Ophelia itself and its forested buffers, surround a central area of the refuge which is kept in field and waterfowl impoundments. Forested blocks are contiguous with forested lands outside the refuge on the northeast, east, and southwest sides (Figure 6).

SPECIES WITH COMPLEMENTARY HABITAT REQUIREMENTS

Habitat management objectives and strategies in this plan are focused on the habitat needs of the priority resources of concern. However, an ecosystem management approach to habitat management will result in overall improvement in the health and function of the ecosystem on the refuge (i.e. Biological Integrity, Diversity, and Environmental Health), benefitting many other species, including those for which the Service has legal responsibility under Federal law.

Migratory land birds are declining at alarming rates, and much of the decline has been attributed to habitat fragmentation and loss. Protection of large contiguous blocks of habitat will be necessary to slow and reverse negative trends in migratory bird populations in the Mississippi Flyway (Rich et al., 2004). Lake Ophelia NWR currently has 13,600 acres of

relatively contiguous bottomland hardwood habitat in two blocks connected by a corridor. These blocks are adjacent to larger areas of forested habitat outside the refuge on state Wildlife Management Areas and private lands totaling approximately 200,000 acres (FIG 8) .

Surrogate species have not yet been identified for the LMAV by the GCPO-LCC. However, Twedt et al. (1999), suggested the use of three migratory bird species to represent other area-sensitive breeders in the LMAV. These are Swainson's warbler, which represents a suite of birds with recommended habitat patch size of 4,700 ha (11,600 acres), cerulean warbler, which represents a suite of birds with recommended patch sizes between 4,700 ha and 8,000 ha (19,760 acres), and swallow-tailed kite, which represents a suite of birds with patch size requirements up to 40,000 ha (98,800 acres).

Rich et al. (2004) listed bird "Species of Continental Importance" and prioritized them by "Action Category," as a guide for conservation efforts in the region. Many of the interior forest-breeding birds which occur on Lake Ophelia NWR are included in that list. Forest interior breeding birds known to occur on Lake Ophelia NWR, and their Action Categories are presented in Table 4.

A prioritized list of bird species was provided by (Twedt et al., 1999) for the Mississippi Alluvial Valley. Conservation priorities (PIF scores) were determined by evaluating 7 conservation criteria including relative abundance, size of breeding range, size of non-breeding range, threats during breeding and non-breeding seasons, trends in population, and relative density (Twedt et al., 1999). Fourteen species were identified at that time as having the highest level of conservation priority ("Category I"). These species, with their PIF scores were: Swainson's warbler (29), swallow-tailed kite (28), cerulean warbler (28), prothonotary warbler (24), painted bunting (24), red-headed woodpecker (23), Bell's vireo (23), northern parula (23), worm-eating warbler (23), Kentucky warbler (22), orchard oriole (22), yellow-billed cuckoo (22), wood thrush (22), and white-eyed vireo (22).

Partners In Flight has produced an updated priority list for the Mississippi Alluvial Valley Bird Conservation Region (BCR 26) (Partners In Flight, 2012). Species on this list identified as needing immediate action include swallow-tailed kite, prothonotary warbler, and Swainson's warbler. These species, along with red-shouldered hawk and broad-winged hawk, are also identified in the refuge CCP as high priorities for management actions and as specific surrogates for bottomland hardwood forest conservation (U.S. Fish and Wildlife Service, 2005).

Figure 8. Forested habitat in the vicinity of Lake Ophelia NWR.

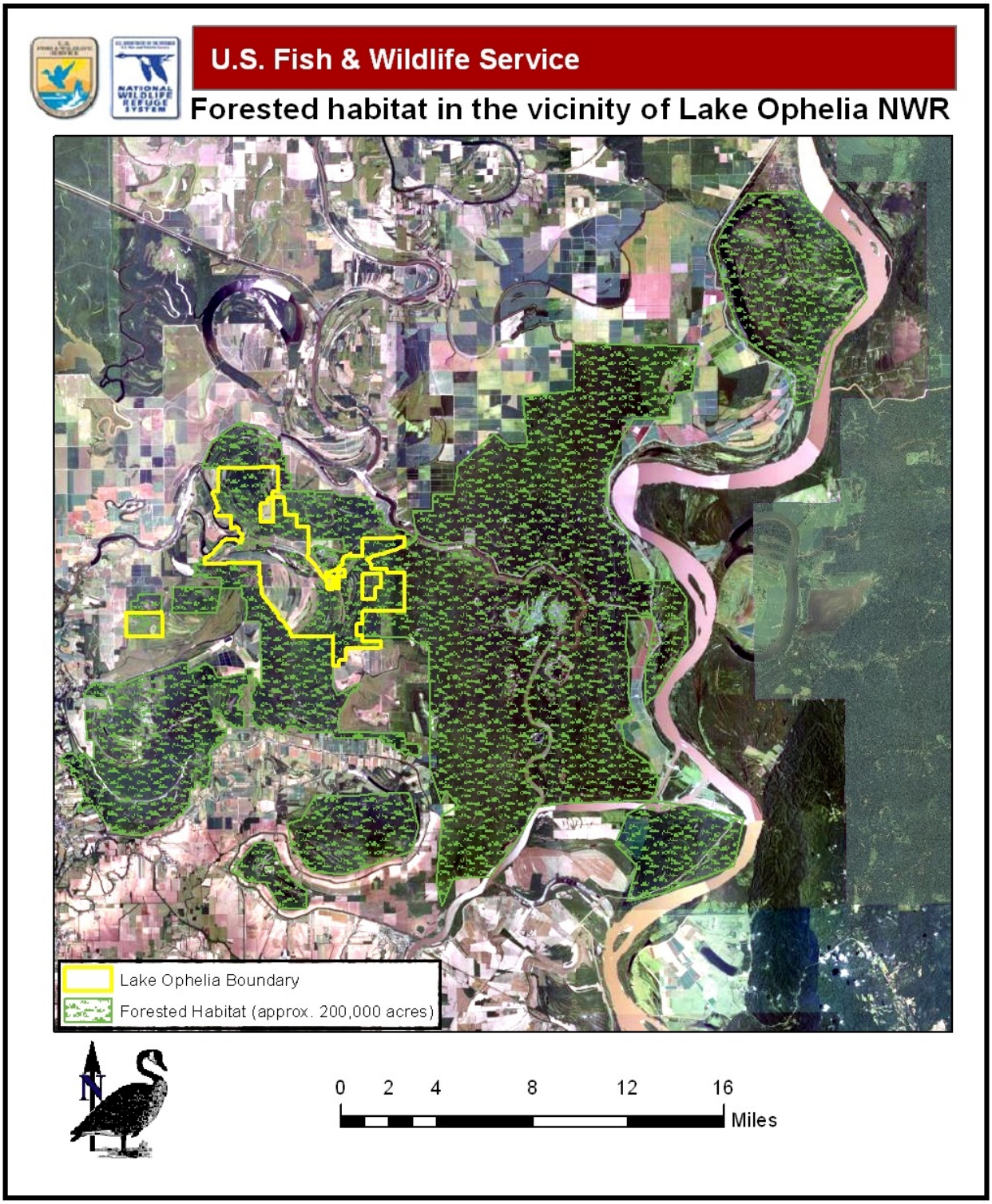


Table 4. Conservation status and seasons of occurrence for interior forest nesting birds known to breed on Lake Ophelia NWR.

Common Name	Action Category[1], Continental (Rich et al., 2004)	Action Code[2], BCR 26 (Partners In Flight, 2012)	PIF Score[3]	Refuge Occurrence[4]			
				SP	S	F	W
Red-shouldered Hawk	PR		17	c	c	c	c
Yellow-billed Cuckoo		PR	22	c	c		
Pileated Woodpecker			16	c	c	c	c
Prothonotary Warbler	MA	IM	24	c	c	c	r

[1]**Action Categories: IM=Immediate Action** is recommended for 28 species in North America which have undergone significant declines; **MA=Management** is prescribed for 44 more species which have undergone declines but which are still relatively common; **PR=Long Term Planning and Responsibility** is called for in the case of species which have stable or increasing populations but which need attention to maintain their relatively healthy status .

[2]**Action Codes: CR=Critical Recovery**—"Critical recovery actions are needed to prevent likely extirpation or to reintroduce a species that has been extirpated;" **IM=Immediate Management**—"Conservation action is needed to reverse or stabilize significant, long-term population declines in species where lack of action may put species at risk of extirpation;" **MA=Management Attention**—"Management or other on-the-ground conservation actions are needed to reverse or stabilize significant, long-term population declines where threats are moderate, or to reverse high threats in species that are not currently experiencing steep long-term declines;" **PR=Long Term Planning and Responsibility**—"Long-term Planning actions are needed to ensure that sustainable populations are maintained in regions with high responsibility for these species." (Panjabi et al., 2012)

[3]from (Twedt et al., 1999).

[4]Data from (U.S. Fish and Wildlife Service, n.d.). a=abundant; c=common; u=uncommon; r=rare.

Although aquatic habitats on Lake Ophelia are compromised by hydrologic modifications, they are an important resource for the refuge. Fish species which may inhabit these open water habitats include crappie, largemouth bass, sunfish, and alligator gar. Maintaining and restoring healthy native aquatic communities is a priority for the refuge as articulated in the CCP, and habitat management strategies in this plan will contribute to those objectives.

CHAPTER IV. HABITAT GOALS AND OBJECTIVES

CCP GOALS AND OBJECTIVES

A number of habitat management-related goals and objectives were established in the refuge CCP (U.S. Fish and Wildlife Service, 2005). CCP Goals 1 and 2 are reproduced below for reference; this Habitat Management Plan supports and is the primary vehicle through which they will be achieved. Objectives below, quoted directly from the refuge CCP, are applicable to habitat management, and are addressed in this Habitat Management Plan.

GOAL 1. Fish and Wildlife populations

Maintain viable, historically diverse populations of native fish and wildlife species consistent with sound biological principles.

Objective 1: Work with partners in the Three Rivers SpOA [source population objective area] to contribute to the creation of a 100,000-acre forest block to provide sufficient habitat to support 80 nesting pairs of swallow-tailed kites, 7,000 nesting pairs of prothonotary warblers, 3,000 nesting pairs of Swainson's warblers, 350 nesting pairs of red-shouldered hawks, and 200 pairs of broad-winged hawks.

Objective 2: provide 50 acres of shallowly flooded mudflat habitats to support 4,000 shorebird forage use-days during the period of fall migration, July 15 through October 15.

Objective 3: Support the North American Waterfowl Management plan and Louisiana Step-down plan by providing habitat capable of supporting a minimum of 2.5 million duck-use days in the core waterfowl sanctuary area each year for dabbler species including mallards, pintails, and wood ducks.

Objective 4: provide wintering habitat for woodcock in support of the National Woodcock Management plan, and for other bird species preferring shrub habitat.

Objective 5: provide quality bottomland hardwood forest, scrub-shrub, and open agricultural areas in addition to lakes and bayous to sustain balanced resident wildlife populations.

Objective 7: Reduce nonnative invasive plants such as water hyacinth and hydrilla and animal populations such as feral swine to minimize negative effects to native bottomland hardwood forest and wildlife.

Objective 8: Inventory the distribution and habitat use of all threatened and endangered species, especially the bald eagle, pallid sturgeon, and Louisiana black bear, on the Refuge and follow appropriate management/recovery plans to contribute to their recovery.

Objective 10: protect and promote self-sustaining fish populations such as crappie, largemouth bass, and bream fish in Lake Ophelia, Duck Lake, Westcut Lake, and possum Bayou for the benefit of the ecosystem and public within five years of the plan’s approval.

GOAL 2. Habitats

Conserve, restore, and manage the functions and values associated with diverse bottomland hardwood forest and open wetland systems in order to achieve Refuge purposes and wildlife population objectives.

Objective 1: In cooperation with private, State, and federal partners, assemble a 100,000-acre block of contiguous bottomland hardwood forest and forested corridors between existing forest blocks in the Three Rivers SpOA.

Objective 2: protect, restore, and manage the functions and values on 11,678 acres of current Refuge bottomland hardwood forests and reforested land as well as any future acquired forests to support viable populations of native flora and fauna consistent with sound biological principles and other objectives of this plan.

Objective 3: Conserve, restore, and manage up to 850 acres of open water wetlands (lakes, sloughs, and bayous) in areas such as Lake Ophelia, Westcut Lake, Duck Lake, Nicholas Lake, and Doom's Lake to provide resting, foraging, and breeding habitats for resident and migratory wetland-dependent wildlife species.

Objective 4: Manage 1,155 acres of prior-converted agricultural lands and 345 acres of bottomland hardwood forest as a wetland complex to provide variable water depths and vegetative composition capable of supporting the foraging, resting, pairing, and breeding requirements of a diverse suite of wildlife species.

Objective 5: Manage 2,500 acres of Refuge cooperative farming agreements, of which 500 acres (or 20 percent) will be left as Refuge share to support Louisiana Step-Down plan and Mississippi flyway objectives stemming from the North American Waterfowl Management plan.

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

Lake Ophelia NWR was established under the authorities listed in section 1.2 and are further identified to provide wintering habitat for mallards, pintails, blue-winged teal, and wood ducks, and to provide production habitat for wood ducks. DEDs are calculated for all waterfowl habitats occurring on Lake Ophelia NWR. DEDs provide an estimate of the number of waterfowl that these habitats can support based on available food resources. (Kross, 2006) The Refuge goal is to provide approximately 10,000,000 DEDs per year within the wetland impoundments occurring on the Refuge. This will provide enough food resources to support 100,000 waterfowl per day for a 100 day period during the winter (See Table 4 for DEDs per management unit).

BOTTOMLAND HARDWOOD

Bottomland hardwood forests function as high quality habitat for refuge resources of concern including Louisiana black bear, wood ducks, and American woodcock, as well as Neotropical migratory birds and other trust species. In addition, forested habitats reduce erosion and sedimentation in aquatic environments in the MAV, contribute to aquatic habitat during flood periods, and store atmospheric carbon. Restoring and protecting these habitats is a high priority for Lake Ophelia NWR.

OBJECTIVE 1.1: BOTTOMLAND HARDWOOD FOREST

Each year for the duration of this planning period, provide 13,600 acres of passively managed bottomland hardwood forest, including 5,734 acres of artificially regenerated forest less than 33 years old and 7,866 acres of mature second-growth naturally regenerated and/or underplanted forest. Forest habitat will have the following characteristics:

- Regenerated forest areas will function as scrub-shrub habitat for wintering American woodcock and other wildlife which depend on this habitat type;
- Exotic invasive animals (especially feral swine) and exotic invasive plants including Chinese tallow, will be maintained at levels at which they do not significantly impact the healthy functioning of the forest system or compete with desirable species;
- Mature second-growth and underplanted bottomland hardwood forest will be allowed to develop old-growth characteristics including the presence of snags, coarse woody debris, cavity trees (small and large), and naturally occurring canopy gaps.
- Connections to forested areas within and adjacent to refuge lands will be maintained and, if possible, enhanced, to ensure habitat connectivity, minimize fragmentation, and maintain wildlife travel corridors for Louisiana black bear and other wide-ranging wildlife species.

Resources of Concern: Louisiana black bear, wintering waterfowl, nesting/resident wood ducks, woodcock.

Rationale: Bottomland hardwood forest on Lake Ophelia NWR provides habitat for a host of wildlife species, including most of the refuge resources of concern as well as many other trust species. Much of this forest habitat has been restored recently. The ultimate objective will be to achieve conditions described in (LMVJV Forest Resource Conservation Working Group, 2007); however, active management toward this objective will commence after the current planning period.

CCP Objectives: 1-1,1-3, 1-4, 1-5, 1-7, 1-8, 1-10, 2-1, 2-2, 2-3

Adaptive Management Monitoring Elements:

1^o Habitat Response Variables	Probable Assessment Methods
Cover, species composition, block size, connectivity	informal assessments, timber cruises, remote sensing
1^o Wildlife Response Variables	Probable Assessment Methods
Use by black bear, wood ducks, wintering waterfowl, and woodcock	Census (bears) Waterfowl surveys Annual banding of wood ducks (July-Aug.)

OBJECTIVE 1.2: WOOD DUCK BOXES

Each year of the planning period for this HMP, in all management units maintain 75 nest boxes for wood ducks as follows:

- Each box will be cleaned and checked annually before and after breeding season;
- Each box will have a functioning predator guard;
- Each box will be within 100 ft. of usable wood duck brood habitat;

Resources of Concern: Nesting Wood ducks

Rationale: Young and cutover bottomland hardwood forests on Lake Ophelia NWR do not currently have sufficient natural cavities to provide for breeding wood ducks. Providing supplemental cavities during the planning period of this Habitat Management Plan will help ensure that cavity availability does not limit the breeding population of wood ducks.

CCP Objectives: 1-3, 2-2.

Adaptive Management Monitoring Elements:

1^o Habitat Response Variables	Probable Assessment Methods
Presence and adequacy of artificial nesting sites in lieu of natural cavities.	Pre-nesting season inspection of nest boxes.
1^o Wildlife Response Variables	Probable Assessment Methods
Utilization of nest boxes by Wood ducks Nest success and survival of wood duck broods	Survey during breeding season (??) Maintain database of usage, predation and success/ survival. Post-nesting season inspection of nest boxes

WATERFOWL IMPOUNDMENTS—CROPLAND HABITAT

Lake Ophelia NWR is responsible for producing 10,000,000 Duck Energy Days of forage including high-carbohydrate ("hot") grains and moist-soil plants to provide food resources for migrating and wintering waterfowl to support the North American Waterfowl Management Plan (NAWMP) step-down objectives for Louisiana. This is accomplished on approximately 600 acres of flooded crops each year, combined with moist-soil management on a total of 1,100 acres of floodable cropland on the refuge in units 1-5. The principal crop grown on these areas is milo; the fields are unsuitable for rice because they are not level. Timing and extent of flooding is managed to provide a continuous supply of flooded grain and moist soil vegetation, as well as shallow mud-flat habitat for shorebirds.

OBJECTIVE 2.1: FLOODABLE CROPLAND

In floodable cropland areas of management units 1-5 (1,100 combined acres) provide 10,000,000 DEDs through planting of crops and then flooding from late November to late February. Also provide 50 acres of shallow mudflats 3-4 inches in depth for shorebird use during fall migration.

Resources of Concern: Wintering waterfowl and shorebirds

Rationale: This objective is tied to the refuge's NAWMP goal. Providing agricultural crops for waterfowl helps mitigate historical reductions in habitat and maintain waterfowl populations. Shorebirds are also a trust resource and a resource of concern for this refuge. Maintaining habitat for both of these species groups helps fulfill the refuge purposes.

CCP Objectives: 1-2, 1-3, 2-4, 2-5.

Adaptive Management Monitoring Elements:

1^o Habitat Response Variables	Probable Assessment Methods
Availability of mudflat habitat during fall migration	Staff gauges – water depth Harvest records

Crop productivity for wildlife (DED)	Calculate seed availability/amounts in fields
1° Wildlife Response Variables	Probable Assessment Methods
Wintering waterfowl use Shorebird use	Waterfowl Survey (Sept. 15-Mar. 1) Shorebird Survey

OBJECTIVE 2.2: SANCTUARY

Maintain 8,300 acres of refuge as waterfowl sanctuary, and use adaptive management for yearly regulations, delineations, and modifications.

Resources of Concern: Wintering waterfowl, Louisiana black bear, shorebirds, nesting/resident wood ducks

Rationale: Sanctuary is an integral part of habitat requirements for waterfowl and other wildlife. Closing important feeding and loafing areas to the public during waterfowl wintering assures that waterfowl will have disturbance-free habitat. Disturbance can interrupt resting and feeding bouts resulting in a loss of energy and lowering of body weight. Access to sanctuary allows waterfowl to better meet their winter energetic requirements and prepare for spring migration and the breeding season.

CCP Objectives: 1-3, 2-4

Adaptive Management Monitoring Elements:

1° Habitat Response Variables	Probable Assessment Methods
Acres-area in sanctuary Level (frequency/degree) of disturbance events	Law Enforcement data GIS Mapping
1° Wildlife Response Variables	Probable Assessment Methods
Wintering waterfowl use	Waterfowl Survey (bi-weekly Sept. 15-Mar. 1)

WATERFOWL IMPOUNDMENTS—MOIST SOIL HABITAT

The refuge manages moist soil habitat on the Voinche Brouillette tract to promote natural herbaceous wetland vegetation beneficial for wintering waterfowl to achieve the (NAWMP) step-down objectives for Louisiana. This management complements the moist-soil management done in conjunction with cropland management on the waterfowl impoundments in Units 1-5 of the main refuge. No agronomic crops are grown on the Voinche Brouillette tract.

OBJECTIVE 3.1: MOIST SOIL MANAGEMENT

Each year between late November and late February, provide 282,450 DEDs utilizing a total of 150 acres within management units 1 & 2 on the Voinche Brouillette tract. Cover of desirable herbaceous plants will exceed 75% of total cover in the units. Desirable moist soil vegetation at Lake Ophelia NWR consists mostly of wild millet, (*Echinochloa* spp.). Sprangletop (*Leptochloa* spp.), and panic grass (*Panicum* spp.), which germinate during mid-summer drawdowns. Other common beneficial plants include smartweeds (*Polygonum* spp.), various sedges (*Carex and Cyperus* spp.). and duck potato (*Sagittaria latifolia*).

Resources of Concern: Wintering waterfowl and shorebirds

Rationale: Moist soil management areas provide high quality native food resources for waterfowl that complement those produced in cropland. Native seed and invertebrates provide a high protein resource which allow waterfowl to support molts and other winter preparatory processes for breeding.

CCP Objectives: 1-3, 1-5, 2-4.

Adaptive Management Monitoring Elements:

1^{o} Habitat Response variables	Probable Assessment Methods
% herbaceous cover (desirable/non-desirable)	Herbaceous cover plots(x samples per year) Calculate seed availability/amounts in fields
1^{o} Wildlife Response Variables	Probable Assessment Methods
Wintering waterfowl use	Waterfowl Survey (bi-weekly Sept. 15-Mar. 1)

NON-FLOODABLE CROPLAND

The refuge manages 1,950 acres of "upland" cropland (i.e. not floodable via refuge water control structures) in units 1-8. This acreage is included in the refuge's Cooperative Farming Agreement, and is rotated between milo and soybeans. The cooperative farmer's share is produced on this acreage.

OBJECTIVE 4.1: NON-FLOODABLE CROPLAND

On non-floodable cropland, increase earthworm production for nocturnal foraging habitat for American woodcock.

Resources of Concern: American woodcock

Rationale: Earthworm production has been shown to be critical for American woodcock foraging habitat quality, and fall plowing in soybean fields has specifically been shown to decrease or eliminate use by American woodcock (Stribling & Doerr, 1985). Recent work in the Arkansas Delta has indicated that soybean fields are favored by woodcock, compared with fields of millet or rice (Krementz et al., 2014). The reason for this preference is apparently greater abundance of earthworms in soybean fields (Blackman et al., 2013). Maintaining earthworm production in soybean fields by restricting fall disking should therefore increase habitat quality and use by American woodcock.

CCP Objectives: 1-4, 2-4, 2-5.

Adaptive Management Monitoring Elements:

1^{o} Habitat Response variables	Probable Assessment Methods
Earthworm abundance in upland fields	Shovel samples
1^{o} Wildlife Response Variables	Probable Assessment Methods
Use by American woodcock	Nocturnal surveys during winter

AQUATIC HABITATS

Lake Ophelia NWR contains approximately 654 acres of permanent open water habitat. Conserving this habitat is a priority for the refuge. Freshwater systems are a component of biological integrity, diversity, and ecological health, for which the NWRS is made responsible under the Refuge Improvement Act, section 4(a)(4)(B). Healthy fisheries and aquatic ecosystems are important for maintaining the overall health of the refuge, and to improve the visitor use experience.

OBJECTIVE 5.1 INVASIVE EXOTIC PLANTS

Manage up to 654 acres of open water aquatic habitats including Lake Ophelia, Westcut Lake, Duck Lake, Nicholas Lake, and Doom's Lake to be maintained such that hydrilla, water hyacinth, and other exotic invasive plants do not impair the natural functioning of the aquatic ecosystem, impede visitor use, or negatively affect trust resources. This objective is highly dependent upon budget and personnel resources.

Resources of Concern: wintering waterfowl, wood ducks, fisheries

Rationale: Exotic invasive plants threaten the health of aquatic ecosystems by displacing native vegetation of higher value to wildlife, physically restricting access to the water surface for ducks and other wildlife, and reducing gas exchange with the atmosphere, causing anoxic conditions in the water column. They also restrict human access for management and recreational use.

CCP Objectives: 1-7, 1-10, 2-3.

Adaptive Management Monitoring Elements:

1^o Habitat Response Variables	Probable Assessment Methods
Cover of exotic invasive plants on lakes	Visual estimates, transects
1^o Wildlife Response Variables	Probable Assessment Methods
Use by waterfowl Health of Fisheries	Waterfowl surveys Electro-shocking surveys

OBJECTIVE 5.2 FISHERIES

Manage up to 654 acres of open water aquatic habitats including Lake Ophelia, Westcut Lake, Duck Lake, Nicholas Lake, and Doom's Lake as a healthy aquatic ecosystem that will support self-sustaining populations of native game fishes including crappie (*Pomoxis* spp.), largemouth bass (*Micropterus salmoides*), and sunfish (*Lepomis* spp.) and a range of native nongame aquatic species.

Resources of Concern: Fisheries.

Rationale: Healthy fisheries contribute to diversity and ecological health on the refuge, provide a recreational resource for visitors, and can serve as early warning signs for terrestrial management problems.

CCP Objectives: 1-7, 1-10, 2-3.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
Cover of exotic invasive plants on lakes Water quality (pH, turbidity, dissolved O_2) in lakes and runoff from fields	Visual estimates, transects, remote sensing, water quality monitoring
1^o Wildlife Response Variables	Probable Assessment Methods
Abundance and health of native fishes	Fish community assessments

CHAPTER V. HABITAT MANAGEMENT STRATEGIES

POTENTIAL MANAGEMENT STRATEGIES

BOTTOMLAND HARDWOOD FOREST MANAGEMENT

More than 70% of Lake Ophelia NWR consists of bottomland hardwood forest, either relatively mature second-growth stands or recent plantings. Management of this resource is of critical importance to achieving the refuge purposes, both to ensure adequate habitat for the resources of concern and also to increase and maintain the biological integrity, diversity, and ecological health of the entire refuge. Potential management strategies for bottomland hardwood forests on Lake Ophelia NWR can be categorized into silvicultural treatments, management of nuisance and/or exotic animals, and habitat enhancement strategies. Each of these is briefly discussed below.

Silvicultural Treatments

Hardwood forests can be managed at a range of intensities from passive to active to achieve the objectives described in Chapter IV above and in (LMVJV Forest Resource Conservation Working Group, 2007). On Lake Ophelia NWR, challenges for managers include limited management capability and resources for active management of forest habitat, low near-term economic value of existing timber resources on the refuge, and limited periods of operability due to wet conditions. Passive management options include the current management regime, which incorporates little or no silvicultural manipulation of existing stands and artificial regeneration of newly acquired open lands as needed. A more active approach could incorporate, among other treatments, thinning, group selection, and improvement cuts. Definitions of each follow:

Thinning

This treatment is an intermediate cutting whose primary objective is to control the growth of the stand by adjusting the density of the stand (Smith, 1986). Its application in bottomland hardwood forestry to achieve conditions described in (LMVJV Forest Resource Conservation Working Group, 2007) would primarily occur where dense stands of artificially or naturally regenerated timber required release to concentrate growth on desirable stems. This would occur, for example, if managers wished to accelerate the development of large stems suitable for den trees, or wished to increase the vigor of mast-producing stems in a stand. Thinning also can increase the amount of light reaching the forest floor, which will stimulate the growth of understory vegetation, including plants valuable for wildlife habitat.

Group Selection

Group selection cuts are regeneration cuts made in small areas to create or maintain an uneven-aged stand (Smith, 1986). Cutting small gaps in a bottomland hardwood forest canopy (0.5-2 acres) stimulates growth of understory plants and allows regeneration of desirable, hard mast-producing tree species, while creating structural diversity important for many species of Neotropical migrant songbirds.

Improvement

Timber stand improvement cuts are those which are conducted in mature stands to improve species composition and/or quality of the remaining stand (Smith, 1986). This type of treatment is useful where stands have been high-graded and consist of low-value species and stems, whether value is counted in economic or wildlife terms. On Lake Ophelia NWR, improvement cuttings could be used to favor oak stems in stands with too much sugarberry, sweetgum, or elm, or to favor the development of large hollow stems for den trees.

Artificial Regeneration

Newly acquired lands which have been cleared and are slated for restoration to bottomland hardwood forest are usually artificially regenerated so that managers can have greater control over the species composition of the resulting forest, and to move the stand quickly into a later seral stage which is more useful for wildlife habitat. In the MAV, early successional forests are often dominated by cottonwood (*Populus deltoides*) and/or sycamore (*Platanus occidentalis*) and other light-seeded species. More desirable species including oaks and other hard mast-producing species, as well as understory soft mast-bearing trees and shrubs, will eventually succeed the pioneer forest, but that natural process takes decades. Planting oaks and other mid-successional forest tree species is a way of speeding up succession to a more useful seral stage for wildlife.

Nuisance animal control

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 beavers on average damaged $164/ac (1985 values) of timber by girdling and felling (Bullock & Arner, 1985).

Historically, beaver numbers were controlled by trapping for the fur trade. In the 1980s, annual harvests exceeded 1 million beaver pelts across the nation (Hill, 1982). Recently due to cultural and societal changes, furs are not in demand and therefore, little trapping is conducted causing beaver numbers to be high (Hill, 1982).

Methods for control include removing beaver dams manually, with heavy equipment or by explosives along with trapping and shooting by Service employees.

Invasive exotic animal control

Management of feral hogs is a long-term control program aimed at reducing population size. Feral hogs are very prolific and become wary with hunting pressure; once populations are established, they are difficult to control (Dickson 2001). (Synatzske, 1993) explains that feral hogs are opportunistic omnivores with diets that may include oak mast, soft mast, succulent grasses and forbs, fungi, roots, tubers and animal matter, depending on availability. They are considered potential direct competitors with native species such as deer, turkey, bear, squirrel, skunk, raccoon, opossums, fox and bobcats and waterfowl. Identified animal components in the diet of hogs have included lizards, frogs, mice, birds, and deer fawns. They are also known predators of ground nests including birds, rabbits and turtles. Feeding

behavior by hogs causes indirect impacts due to rooting and digging activities. Rooting and digging behaviors can contribute to erosion and destruction of native plant species, resulting in changes in successional patterns and soil properties. Control methods include trapping, snares, shooting, recreational hunting by the public, and hunting with dogs.

Artificial nesting cavities

Wood duck nest box management is a method used to compensate for a limited supply of natural nest cavities to support wood duck reproduction. Recent guidelines (U.S. Fish and Wildlife Service, 2003) provide direction for the use of Wood Duck nest box programs on Refuges. Boxes should be placed in, or adjacent to, good brood habitat in areas where they are not subject to flooding. It is critical that boxes have functional predator guards and are checked and repaired annually; otherwise, boxes are considered death 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 boxes cannot be properly maintained, they should be boarded up until sufficient effort can be put toward operating an effective nest box program. Success of an artificial cavity program depends on proper placement of the boxes, proper design (including adequate predator guards), and timely and sufficient maintenance. Pragmatic requirements of maintenance may mean that boxes are not placed in the most ideal location from a habitat standpoint. However, placement considerations can mean the difference between success and failure of a program. In particular, nests should be placed in secluded locations near good brood habitat and not be visible from each other. Having too many boxes can be counterproductive, leading to overpopulation, density strife, and reduced nesting efficiency (Haramis & Thompson, 1985). Recommended use of duck boxes is as a supplement to natural cavities (Dugger & Fredrickson, 2007). Thus, a properly designed artificial cavity program will include a monitoring element which yields data on the density and use of natural cavities in the habitat. Cleaning the boxes after the initial peak of nesting (about mid-April) will significantly improve annual production if competition for nest sites increases.

MOIST SOIL MANAGEMENT

The following section outlines potential moist soil management strategies for the Voinche Brouillette Tract. Active moist soil management is not practiced on the main refuge except in flood years because budgetary constraints require that cooperative farming be used to achieve DED goals for the refuge. Were force-account farming a viable option, part of the acreage which currently is used for producing the cooperative farmer's share would be available for moist soil management. In flood years, when high water prevents the establishment of row crops, or in the event of future funding availability, similar strategies will be employed on the main refuge. Passive moist soil management does occur in and around the seasonal and ephemeral wetlands and around the shallow edges around the lakes, bayous and sloughs. These areas are included when calculating the annual DED goal on the Refuge.

Moist soil management is the practice of modifying soil conditions to stimulate the production of preferred early-successional plants in an open impoundment. It is typically used to produce high quality food resources for wintering and migrating waterfowl, including plant seeds and parts as well as invertebrates. Refuge Annual Habitat Work Plans (620 FW1, Exhibit 2) are

used to apply adaptive management to moist soil management each year. The Moist soil Management Guidelines for the U.S. Fish and Wildlife Service Southeast Region (Strader & Stinson, 2005) provide information on application of moist soil management for refuge managers.

Moist soil management involves using some or all of the following techniques: management of water levels; mechanical plant control; mechanical soil disturbance; chemical plant control; and prescribed fire. The most important factors that determine plant responses to moist soil manipulation are: 1) the amount of sunlight; 2) soil temperature; 3) soil moisture; 4) soil chemistry; 5) seed bank; and 6) successional stage of the plant community. By strategic application of prescriptions to affect these factors, moist soil management can produce an optimally productive community of early successional herbaceous plants for target wildlife species (Strader & Stinson, 2005). Modifications to prescriptions to meet various objectives can be used to provide optimal conditions for a range of species groups including waterfowl, shorebirds, and marsh birds.

In addition to the target species, the conditions provided by moist soil management benefit a variety of other groups of species including invertebrates, reptiles and amphibians, small mammals, and non-target migratory birds. The prolific invertebrate community can include isopods, amphipods, fingernail clams, aquatic and terrestrial earthworms, leeches, shrimp, mayflies, midge larvae, dragonflies, beetles, butterflies and moths, and snails, providing a variety of food resources for higher order species such as herpetofauna and birds.

Water Manipulation

Water manipulation is one of the most essential management techniques for moist soil management. Strategic application and removal of water is critical in determining soil moisture, enhancing desirable plant species germination, and control of non-desirable vegetation. Drawdowns are the removal of water. Variations in application of timing and duration of water removal can be used to manage for a variety of effects which vary with site conditions. Timing of drawdowns can be used to affect the species of plants that germinate. Common timing variations in the southeast include ‘early’ or during the first 45 days of the growing season, ‘late’ or during the last 90 days of the growing season, or ‘mid-season’ during the intervening period between ‘early’ and ‘late’. A slow drawdown is an effective way to conserve soil moisture and partial re-flooding can maintain high soil moisture content. Year round retention of water (flooding) can be used to periodically set back succession but at the cost of a year of moist soil plant production. Seasonal water control is a critical aspect, as timing and depth are key factors in making plant seed and invertebrate resources available to target migratory wildlife (Fredrickson, 1991).

Mechanical Treatments

Mechanical control can be applied to periodically set back succession and maintain desirable plant communities. Prescription variations include method of treatment (either disking or mowing), annual timing, rotation frequency, and application degree (i.e. depth of disk, height of mow, strip mow). Mechanical control most commonly includes disking of the soil under condition-specific variations of depth and timing and is applied on a rotational basis. Common rotations in the Southeast are 2 to 4 years depending on site-specific objectives and conditions. A variety of soil disturbance tools may be used for application of a similar treatment. Disking may be combined with other manipulations such as deep disking to

improve soil fertility or smoothing to improve soil moisture conditions (Strader & Stinson, 2005). Mowing of existing vegetation can be used to set back succession and modify vegetation structure as well. This method may be sufficient in some sites based on conditions (Fredrickson & Reid, 1988; Strader & Stinson, 2005)

Chemical Treatments

Chemical control, or use of herbicides, is used to set back succession or exclude undesirable or invasive plants, particularly when conditions are not appropriate to apply mechanical control. A variety of Service approved herbicides may be used, dependent on the site-specific objectives and conditions. Whenever a chemical is needed, the most narrowly specific chemical available for the target organism in question should be chosen, unless considerations of persistence or other hazards 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).

Prescribed Fire

Prescribed fire is yet another method used to set back succession. Application of fire removes surface vegetation and encourages increased soil temperatures. Prescribed fire is applied according to site-specific objectives and conditions, with variations in percent of area burned and intensity of treatment possible within, or between, applications. Annual timing, rotation, and intensity can also be prescribed to meet specific habitat objectives. Prescribed fire is applied according to protocols established in the refuge Fire Management Plan. Application of fire requires significant management resources that are not available at all stations, such as Lake Ophelia NWR, including specialist staff such as a fire boss and fire qualified crew, equipment, funding and an approved fire plan.

Cropping

Crop farming is commonly used in conjunction with moist soil management. This combination allows the refuge to provide a more diverse food source for wintering migratory birds. However, the cooperative farming program cannot be used to maintain moist soil units unless the moist soil units are rotated to agricultural crops every other year only. Un-harvested crops provide high carbohydrate ‘hot’ foods, particularly beneficial to the needs of wintering waterfowl and also used by resident species such as white-tailed deer, bear, raccoon, and small mammals. Acres in crop farming are non-productive as natural habitat and so are a trade-off with other land uses. Crop farming can be applied through cooperative farming or force-account farming programs.

CROPLAND MANAGEMENT

Un-harvested grain crops are a critical ingredient of waterfowl foraging habitat needs, and if they are not available, the attractiveness of a refuge for waterfowl is decreased. This also goes hand-in-hand with refuges providing adequate sanctuary from disturbance along with the grain crops. It is important to manage the cropland program to provide a good diversity of waterfowl foods. Rice, corn, and milo, are top choices as grain crops for ducks. Rice is particularly resistant to decomposition even under flooded conditions and is high in calories;

however, the ridge and swale topography of Lake Ophelia is not suitable for rice. The unevenness of the swales prevents consistent water levels required for successful rice farming. Corn and milo also provide high energy resources for waterfowl and can generally be kept above the water surface, but problems often arise from depredation prior to flooding as well as seed degradation after flooding. Soybeans and milo are the main crops grown on the Refuge. These two crops are rotated a minimum of every three years; the refuge share is always grown in the swales (where flooding is possible) and is always taken in milo.

Soybeans are grown by the refuge cooperative farmer(s) for their share however; the refuge does not take soybeans as refuge share because of its low nutritional value as well as its rapid decomposition after flooding. Soybeans will not be planted by Refuge staff and the Refuge share from the cooperative farmer(s) will never be taken in soybeans.

Refuges have two potential methods to produce crops for waterfowl. A common method is cooperative farming, in which a (typically local) farmer agrees to farm the refuge crop units, with a certain percentage of the total crops planted by that farmer to be left un-harvested in the refuge farm fields as refuge share. A cooperative farming agreement is written that covers the specific details of the farming activities for each farmer that year and is signed/dated by both parties. The standard crop share split for farming on refuges nation-wide is 75% farmers share and 25% refuge share. However, the share split at Lake Ophelia refuge is presently 80% refuge farmer and 20% refuge share. Due to local rental rates, soil types and flooding potential the refuge determined that a reduced crop share split would be justified. The other alternative, commonly called force account farming, is for refuge staff to farm the crops using refuge staff time, equipment and budget to support the costs of management. In general, cooperative farming is more efficient on an acre by acre basis, in that professional farming methods generally produce higher seed loads per acre while force account farming generally is less professionally applied and often produces significantly less seeds/acre. Based upon refuge-grown rice at Morgan Brake NWR in 2007, production under force account farming is expected to be about 50% of commercial yields. Conversely however, cooperative farming requires a proportion of acres (usually 75:25) which are used to produce crops which do not contribute resources to wildlife, while force account farming allows all farmed acres to be used to provide wildlife resources and is therefore more efficient in use of refuge land. Both methods are viable on refuges, and may be the chosen method depending on a variety of factors, including the acres available for crop management, availability of a skilled farmer, refuge staffing levels, equipment resources, and primarily, the budget.

Cooperative Farming

Cooperative farming is critically important for the Refuge to meet its waterfowl foraging habitat objective. At this time, cooperative farming is the only option available for producing all the necessary agricultural crops on Lake Ophelia NWR.

Currently, cooperative farmers perform some legitimate in-kind services and leave a percent of the crops unharvested in the field for wildlife as payment for growing grain crops on Refuge lands. Utilizing farmer services achieves one major objective: 1) provides food resources that are necessary to achieve Louisiana step down objectives for waterfowl. Importantly, the cooperative farming program also 1) helps maximize waterbird management overall on non-forested lands; 2) improves water management capabilities; and 3) allows diversification of habitat across the refuge, such as millet, soybeans, rice, milo, sunflowers, corn, etc. The refuge farming program provides a unique opportunity to achieve a diverse food base,

produce a large quantity of highly nutritious food, and make foods available for a diverse group of organisms. The presence of the farming program also provides critical shallow water habitat for waterfowl and shorebirds.

Cooperative farming has been and will continue to be a cost-effective mechanism to provide the high-quality “hot foods” required by wintering waterfowl. Management of a cooperative farming program reduces dependence on refuge staff, station funds, and equipment.

Force-Account Farming

Force-account (Refuge-conducted) farming is an option on Lake Ophelia NWR, but current and expected resources do not allow management in this way. Force-account farming must be used if rotational crops are used in moist soil units at an interval of more than every other year. The express benefit to this method is the 100% usage of refuge crop acres for wildlife. Force account crops would be cultivated utilizing standard farming practices such as planting, plowing and herbicide treatments.

AQUATIC HABITAT MANAGEMENT

The refuge’s 654 acres of open water habitat will be managed to achieve the objectives set forth in the CCP and in Chapter IV above. A number of habitat management practices could be used to manage aquatic habitats on the refuge and promote the health of aquatic systems and the fisheries they support. It is important to note that habitat management actions, especially those directed at benefitting fish populations, will be most effective when coupled with effective management of consumptive use of that resource. Potential management strategies for aquatic habitats on Lake Ophelia NWR include aquatic weed control, terrestrial vegetation management within the watershed of the water body for sediment control, and fish stocking programs.

Aquatic Weed Management

The presence of exotics and invasive plant species can alter the function of ecosystems by causing the loss of wildlife habitat, displacement of native species, change in carrying capacity from reducing native forage production, reduced plant diversity, and increased soil erosion and sedimentation. In aquatic systems oxygen depletion, waterway obstructions and displacement of native flora is of great concern. These negative effects decrease the biological integrity, diversity and environmental health of the refuge and therefore require a management strategy that will control, and if possible, eradicate, the exotic species.

On Lake Ophelia NWR the primary focus of exotic/invasive plant management focuses on aquatic systems. Unfortunately the majority of the lakes and bayous on the Refuge contain significant communities of invasive and exotic aquatic plants. The list includes but is not limited to hydrilla (*Hydrilla verticillata),* water hyacinth (*Eichhornia crassipes*), salvinia (*Salvinia minima*), alligator weed (*Alternanthera philoxeroides*), and thick mats of Cuban bulrush (*Oxycaryum cubense*) that often choke waterways to the point of being impassable.

Invasive plant control is a significant issue for many NWRs, but is labor intensive and costly. Significant resources should be focused on determining the extent of each invasive species on the Refuge and developing effective methods to control their spread. Successful control requires careful planning, implementation, and monitoring.

Aquatic weeds can be controlled with an integrated pest management approach incorporating herbicides, mechanical removal, and biological control measures as appropriate. Exotic invasive aquatic weeds on Lake Ophelia NWR include salvinia, water hyacinth, Cuban bulrush, and hydrilla.

Salvinia molesta (giant salvinia) and *S. minima* (common salvinia) are floating ferns native to Brazil. Giant salvinia was introduced in the 1990s as an ornamental through the aquarium trade to the southeastern US where it has escaped cultivation and poses a serious threat to freshwater resources throughout the southern tier of states from Florida to Texas (U.S. Department of Agriculture, 2012). Common salvinia was apparently introduced to Florida early in the 20th Century and has spread westward along the Gulf Coast. The circumstances of the introduction are unclear (Jacono et al., 2001). Both of these species form dense mats of vegetation which impede boat traffic, shade out submerged vegetation, and cause anoxic conditions in aquatic habitat. At this time giant salvinia has not been identified on the refuge.

Control of salvinia with herbicides has been successful. Because of the water-repellent nature of the plant's fronds, the use of proper surfactants is required for efficacy. Herbicides which are labeled and successfully used to control salvinia in the U.S. include glyphosate, fluridone, and diquat (McFarland et al., 2004). Eradication of salvinia with herbicides is rarely possible, so herbicide applications must be repeated to prevent re-establishment.

A biological control agent has been successfully used to control giant salvinia in the United States and other locations in the tropics and subtropics where it is a pest (Diop, 2006). The Curculionid weevil *Cyrtobagous salviniae* feeds on buds and rhizomes of *Salvinia molesta*, causing dramatic declines in cover which have been shown to persist for several years without reintroduction of the weevil in Texas and Louisiana (Tipping et al., 2008). This weevil is apparently also effective against *S. minima* (Jacono et al., 2001). *C. salviniae* was released on Mandalay NWR, which is located in Terrebonne Parish, Louisiana, 132 miles to the southeast of Lake Ophelia NWR, in 2011 and 2012 in cooperation with Louisiana Department of Wildlife and Fisheries and Louisiana State University, and it appears to be surviving and reproducing, although it is too early to evaluate the success of the introduction.

Water hyacinth (*Eichhornia crassipes*) is a floating perennial herb in the monocot family Pontederiaceae. It is native to Brazil and was introduced to the southern United States in 1884 as an ornamental (IFAS, 2012). Water hyacinth cover can double every 11-18 days (Coetzee et al., 2009) and is thus capable of covering large bodies of water quickly. It completely changes the ecology of formerly open-water habitat by shading out rooted submersed vegetation and reducing animal diversity (Coetzee et al., 2009). Heavy infestations choke waterways and interfere with boat traffic.

An integrated approach to controlling this weed includes mechanical or hand removal for small infestations, herbicide applications for larger infestations, and biological control measures consisting of three insects imported from the native range of the plant (Charudattan, 1986). Two weevils (*Neochetina eichhorniae* and *N. bruchi*) were introduced to the southeastern U.S. in 1974 and help suppress water hyacinth by burrowing in and feeding on the plant both as adults and larvae. A moth (*Niphograpta albiguttalis*), introduced from Argentina, also contributes to suppressing water hyacinth. Larvae of this insect burrow into the plant and cause necrosis, wilting, and death of plants in some cases (IFAS, 2012; Charudattan, 1986; Coetzee et al., 2009). However, these biocontrol agents have not been sufficient in themselves for achieving the desired level of control of water hyacinth in many areas of the southeastern U.S. Herbicides effective against infestations of water hyacinth include 2,4-dichlorophenoxyacetic acid (2,4-D), glyphosate, diquat, and paraquat (Coetzee et al., 2009).

Control achieved by herbicides is usually temporary, as propagules usually survive or are readily reintroduced.

Cuban bulrush (*Oxycaryum cubense*) is an exotic weed which can form monospecific or mixed floating mats of vegetation. This species colonizes infestations of salvinia and/or water hyacinth in shallow open-water areas, contributing to the stability and biomass of floating mats. Herbicides which are effective against Cuban bulrush and labeled for aquatic use include 2,4-D, diquat, glyphosate, and imazapyr (U.S. Army Corps of Engineers, 2011). There are no approved biological control agents for this species in the U.S.

Hydrilla (*Hydrilla verticillata*) is a rooted, submersed perennial herb in the Hydrocharitaceae. It reproduces mainly via stem fragments, which can root and produce new plants. Hydrilla perenniates through tubers, which can persist under the substrate for up to 4 years (Langeland et al., 2009). It quickly produces dense stands which completely fill the water column in shallow water, impeding boat traffic, displacing native submersed plants of greater wildlife value, and degrading the aquatic habitat for fish and other animals.

Hydrilla was introduced into the United States from Africa in 1960 for use in the aquarium trade (USDA National Invasive Species Information Center, 2013). It has spread to at least 20 states and the District of Columbia, and is listed by the Federal Government and those of 17 states as either prohibited or a noxious weed (USDA Natural Resources Conservation Service, 2013). It spreads easily by stem fragments; boat trailers and other equipment are common dispersal vectors.

Herbicide active ingredients which are effective against hydrilla include endothall, diquat, 2,4-D, copper, fluridone, penoxsulam, and imazamox (Langeland et al., 2009). Mechanical control measures which can be used against hydrilla include raking, cutting, and, for small areas, physical light barriers installed on the bottom of the water body (Texas A&M Agrilife Extension Service, 2013). Mechanical control measures which involve cutting the stems into pieces are often ineffective because small pieces of stem can root and produce new plants. Biological control measures include the introduction of triploid grass carp, which graze on hydrilla and are very effective at controlling it (Texas A&M Agrilife Extension Service, 2013).

Triploid (i.e., sterile) grass carp (*Ctenopharyngodon idella*) are an effective biological agent for aquatic weed control. They prefer certain aquatic plants and will consume most of the available preferred species before beginning to eat the less preferred species. Exotic weed species present on Lake Ophelia NWR which are preferred by grass carp are hydrilla and salvinia. Less preferred plants include water hyacinth and alligatorweed (South Carolina DNR, n.d.).

Terrestrial Vegetation Management

Sedimentation is a threat to aquatic habitats. Sediment reduces habitat quality when suspended in the water column by reducing light penetration, restricting the development of vegetation, and by interfering with the gills of organisms like mussels and fish. Sediment also fills water bodies over time, reducing depth and changing the character of the substrate in some cases. Sedimentation is the result of erosion, including that which occurs when soil is disturbed during agricultural field management. Sedimentation can be controlled by managing terrestrial environments in the watershed of a water body. Maintaining a vegetated buffer strip around a lake is an effective way to filter sediment out of water flowing into the lake, provided

the flow is overland and not channelized (Muñoz-Carpena, 1993; Agriculture Water Quality Alliance, 2000).

Other ways of reducing sedimentation include no-till farming, in which mechanical cultivation is largely replaced by herbicide application, the construction of field terraces, and the use of contour bedding.

Fish Stocking

Fish stocking is not a habitat management practice, but it may be used in conjunction with habitat management practices to ensure adequate brood stock of desirable species when the objective is a sustainable population where habitat has been adequately restored.

SANCTUARY MANAGEMENT

Sanctuary can be applied to habitats in different ways. Sanctuary can mean that no public use is permitted at any time or that no hunting can occur but other public uses are permitted. For example, some refuges limit waterfowl hunting to only a certain number of days per week to limit disturbance to ducks. The size or percentage of waterfowl habitat that is sanctuary varies also. Sanctuary can be in moist soil habitat, flooded bottomland hardwood forest and/or flooded croplands. (Strickland & Tullos, 2009) recommend 20-25% of waterfowl habitat be in sanctuary to reduce disturbance. Sanctuary should be available in all habitat types, including moist soil, agriculture, and bottomland hardwood forest (USFWS 2004).

SELECTED MANAGEMENT STRATEGIES

The following strategies will be used as appropriate to conduct habitat management to meet objectives under this plan.

BOTTOMLAND HARDWOOD FOREST MANAGEMENT

Artificial regeneration of open land may be used when new land is acquired within the approved acquisition boundary. Other types of silvicultural treatments may be used at the refuge's discretion to achieve the objectives set forth in Chapter IV; however, the refuge does not anticipate either the need or the capacity to carry out any such treatments within the planning period encompassed by the CCP. Existing bottomland hardwood stands will be managed passively unless circumstances change.

Beavers will be managed by trapping and dam removal.

Feral swine will be managed by trapping and shooting.

At least 75 artificial nest cavities will be maintained on the refuge for nesting wood ducks.

MOIST SOIL MANAGEMENT

Moist soil management will be practiced on Units VB1 and VB2. Water management on these units is accomplished by water control structures at the low end of each unit. No pumping capability is currently available on either unit.

Prescribed fire will not be used for moist soil management, largely due to limited management capability and resources.

CROPLAND MANAGEMENT

Cropland management will be practiced on Units 1-8 on the main refuge. Cooperative farming will be used. Although other crops are a possibility, the main crops anticipated on these units are milo and soybeans. Milo (or corn) will always constitute the refuge's 20% share of the crop, and this share will always be produced on floodable portions of the cropland units. Crop rotation will be coordinated with the farmer(s); the rotation system is irregular and flexible.

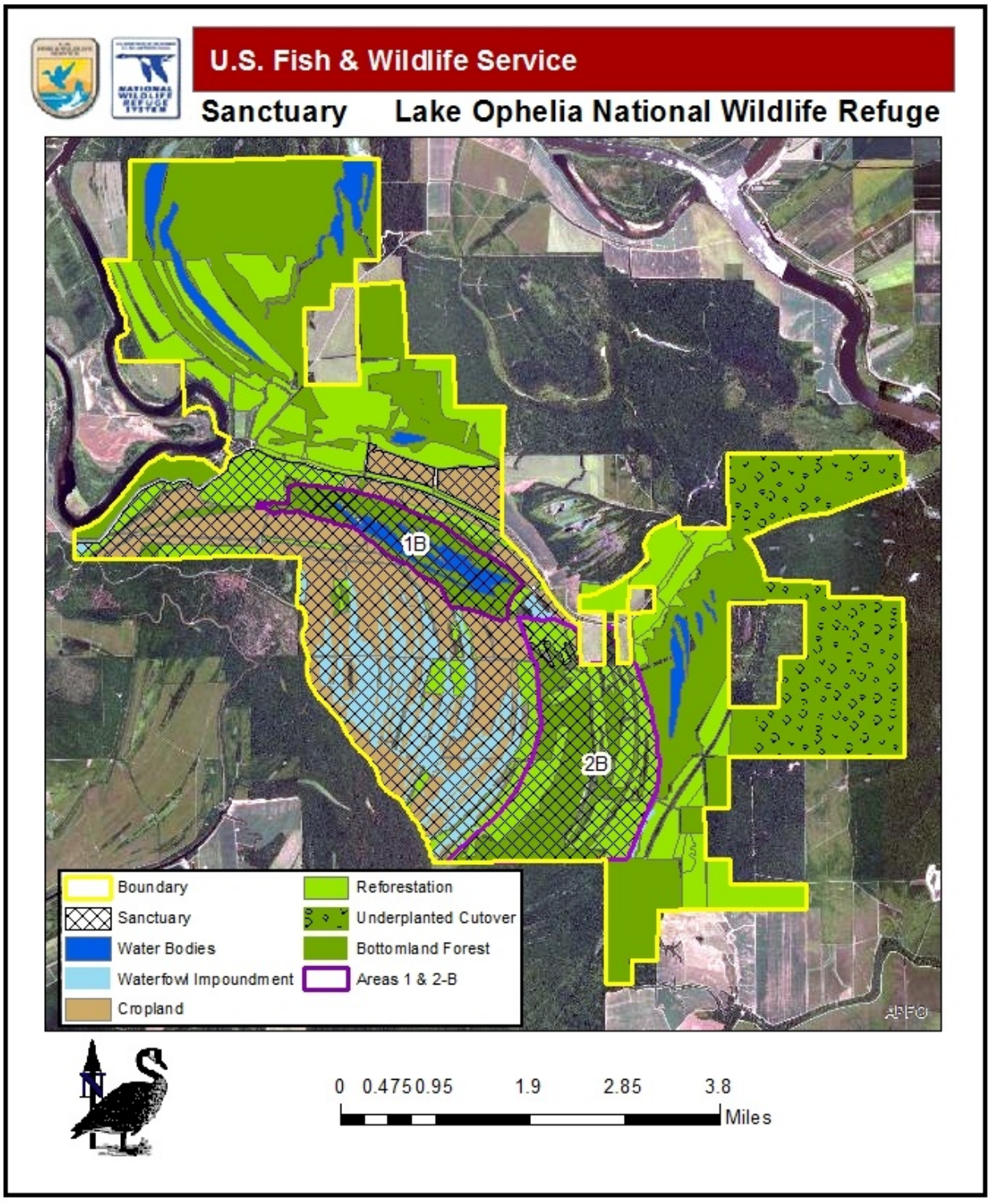
AQUATIC HABITAT MANAGEMENT

Management of aquatic habitats on Lake Ophelia NWR will consist of exotic invasive plant management, and the maintenance, and if needed, establishment, of forested buffer strips around bodies of water. The use of fish stocking will be considered if it is deemed necessary for restoration of sustainable fish populations where habitat is in good condition, and if funds are available.

SANCTUARY MANAGEMENT

Lake Ophelia NWR contains approximately 8,300 acres identified as sanctuary, including two areas (1B & 2B) which have limited access for small game and bow hunting during certain segments of the hunting season but which are closed to waterfowl hunting and to general access during the rest of the year. Area 1B is the 200-acre Lake Ophelia and an additional 500 acres that surrounds the lake. This area is typically open for scouting access on September 1 and archery deer hunting only for the month of November; no small game hunting is allowed in area 1B. Area 2B is approximately 1,800 acres and is typically open for scouting access on September 1 and for small game hunting starting around the first of October and archery deer hunting the first of November. Area 2B is closed to all public use after November 30. The remaining areas identified as sanctuary are closed to all public access year round. These sanctuary areas benefit all wildlife on the Refuge including waterfowl, white-tailed deer and Louisiana black bear (Figure 9).

Figure 9. Sanctuary (Seasonally Closed) Areas of Lake Ophelia NWR.



MANAGEMENT STRATEGY PRESCRIPTIONS

Prescriptions for management will be determined annually based on current unit specific habitat conditions and will be within the sideboards created by the following overall prescriptions for management within the scope of this plan. Annual management prescriptions and outcomes will be incorporated in the Annual Habitat Work Plan as established in the Habitat Management Planning Policy (620 FW1).

BOTTOMLAND HARDWOOD PRESCRIPTION

Beaver Management

To meet Objective 1.1 in all management units for nesting and resident wood ducks, bottomland hardwood forest, and wintering waterfowl, the following strategies will be used to control beaver damage in bottomland hardwood forest and facilitate drainage of croplands:

- When water recedes in spring/summer, inspect Refuge for areas where water is not draining, including all areas known to have beaver dams in the past
- GPS locations of all beaver dams for future reference
- Determine best method for removal of located dams and remove immediately.
- During winter when Refuge is flooded, remove beavers
- If time permits, set traps for beavers

Feral Swine Management

To meet Objectives in all management units the following strategies will be used to control feral hog damage in bottomland hardwood forest and agriculture units:

- Inspect the Refuge/cooperative farming units and locate areas that have increased feral hog activity.
- Transport and set hog traps.
- Determine best method for removal and remove immediately.
- During winter when Refuge is flooded and food is scarce, make an increased effort to remove hogs located in the Refuge through shooting.
- If time permits, obtain funding for building additional traps.
- No hogs will be released or removed alive from Refuge lands.

Wood Duck Boxes

To meet Objective 1.2, the following management prescriptions will be used to provide nesting structures for wood ducks.

- Provide at least 75 wood duck nest boxes
- Maintain structural integrity and predator guards

- Clean old nest material out and fill boxes with clean nest material in late winter.
- Monitor usage, predation, success/survival
- Maintain database of usage, predation, success/survival.

MOIST SOIL MANAGEMENT PRESCRIPTIONS

Moist soil habitat management requires active management of soil and hydrology to promote productive and diverse stands of moist soil plants. Moist soil management will be used on units VB1 and VB2 every year. In addition, in wet years when crop establishment is precluded by late flooding, moist soil management will be used on cropland units on the main refuge. Management actions are categorized into water management and disturbance, and include timing and duration of draw-down, and mowing, disking or herbicide application to keep units in early successional stages (Strader & Stinson, 2005).

Water Management

The impoundment should be flooded from late September through early October to provide water for migrating blue-winged teal, pintail, and shorebirds, and drawdowns should be conducted no later than July 15th (Strader & Stinson, 2005). Ideal depths for foraging dabbling ducks are less than 12 inches; if water depths exceed 18 inches, food will be out of reach (Strader & Stinson, 2005). However the units located on the Voinche Brouillette Tract are dependent upon rainfall, so the exact timing of flooding is not under the control of managers.

- Annually, place stop logs in water control structures in October to hold water.
- Vary drawdown rates to promote diversity of plant species.
- Adjust timing of spring drawdowns for the benefit of shorebirds.
- Manage water levels during growing season to provide for growth and germination of desirable plant species.

Disturbance

To meet Objective 3.1 in management units VB1 & VB2 for wintering waterfowl, the following management prescriptions will be used to manage moist soil habitat (Table 5):

- Mow or plow units VB1 and VB2 at least once every 3 years to set back woody plants;
- Monitor vegetation growth for percent cover of undesirable plants. If undesirables exceed 20% cover, manipulate vegetation through mechanical (mowing) or chemical means.
- Maintain records by date for water management actions, water elevations, vegetation and wildlife response.
- Use published sampling techniques (Strader & Stinson, 2005) to determine percent cover of plant species and seed production to determine if management actions need to be changed to meet objectives.

Table 5. Moist Soil Total DEDs by Management Unit on Lake Ophelia NWR.

Management Unit	Size (ac)	Habitat Type	Desired Condition	DED Objective
VB1	70	Moist soil	Moist soil/millet	131,810 up to 367,150
VB2	80	Moist soil	Moist soil/millet	150,640 up to 419,600

CROPLAND MANAGEMENT PRESCRIPTIONS

Louisiana Step-Down Plan and Mississippi Flyway objectives listed in the CCP (U.S. Fish and Wildlife Service, 2005) states an objective of 2,500 acres of managed croplands for wintering waterfowl habitat. Included in this is up to 500 acres of un-harvested acres. Currently there are approximately 3,000 acres classified as managed croplands on Lake Ophelia NWR and 600 acres of refuge share. However these acres are not static and will change from year to year due to units being rotated between milo, soybeans and possibly corn.

The current share split agreement on the cooperative acreage is 80/20 in which the farmer retains an 80% share and the refuge retains the remaining 20%. Milo and possibly corn are the only acceptable crops for refuge share; soybeans are not allowed to be taken for refuge share.

The current goal for the refuge is to provide approximately 10,000,000 DEDs on of agricultural habitats; however, some DEDs are provided from the permanent and semi-permanent water features on the Refuge. The ridge and swale topography contained within the Refuge lands limits flooding to the swale sections of the lands. By utilizing levees and water control structures these swales can be flooded; therefore crops grown in these low lying areas are left un-harvested. During most years the majority of this goal can be realized from managed croplands contained on the refuge (Table 6). For example, 480 acres of un-harvested milo (18,192 DEDs per acre) would provide 8,732,160 DEDs. However this number can be different from year to year since different crops and combinations will provide different levels of DEDs, and years of high water or flooding can impact the ability to grow crops. It should be noted that while corn is potential crop that could provide much higher DEDs it is rare that soil conditions in the floodable areas would be conducive to planting corn. In the event of late spring/early summer flooding Refuge staff will attempt to manage affected cropland fields as described above in the Moist Soil Management Prescriptions section by holding water and applying appropriate herbicides to eliminate undesirable plants such as cocklebur and coffee weed.

In addition to the floodable croplands contained in the southern portions of the refuge and within the sanctuary area there are approximately 650 acres of non-floodable lands (units 6-8) lying to the north of this location. These acres are farmed annually, and the refuge share for these acres is farmed separately and is transferred to Grand Cote NWR.

To meet Objectives 2.1, 2.2, and 4.1 in management units 1-5 for wintering waterfowl, the following management prescriptions will be used to manage cooperative farming:

- Annually meet with cooperative farmers to sign and review placement of crops and locations of refuge share.

- Maintain a minimum of 2,400 acres in crop production to provide high-energy foods for waterfowl within flooded impoundments.
- Provide up to 480 acres for refuge share of high energy crops.
- Cooperative farmers will be asked to defer fall cultivation of soybean fields to improve habitat for woodcock.

Table 6. Cropland Total DEDs by Management Unit on Lake Ophelia NWR.

Manage-ment Unit	Size (acres)[1]	Habitat Type	Desired Condition	Treatment Plan	DEDs
1	220 acres flooded land	Agriculture	Agriculture (milo, corn[2]) or moist soil if required	Fall flood, spring drawdown, if moist soil, default to moist soil regime	376,600 - 5,764,000
2	550 acres flooded land (max share is 480)	Agriculture	Agriculture (milo, corn[2]) or moist soil if required	Fall flood, spring drawdown, if moist soil, default to moist soil regime	903,840 - 13,833,600
3	110 acres flooded land	Agriculture	Agriculture (milo, corn[2]) or moist soil if required	Fall flood, spring drawdown, if moist soil, default to moist soil regime	188,300 - 2,882,000
4	220 acres flooded land	Agriculture	Agriculture (milo, corn[2]) or moist soil if required	Fall flood, spring drawdown, if moist soil, default to moist soil regime	376,600 - 5,764,000
5	20 acres flooded land	Agriculture	Agriculture (milo, corn[2]) or moist soil if required	Fall flood, spring drawdown, if moist soil, default to moist soil regime	37,660 - 576,400

[1] Flooded acreage varies with rainfall and pumping capabilities

[2] Although possible, it is unlikely that corn will be produced.

AQUATIC HABITAT MANAGEMENT PRESCRIPTIONS

Exotic/Invasive Plant Management

Control of exotic invasive plants will be done to meet objectives 5.1 and 5.2. Chemical pesticides will be used primarily to supplement, rather than 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 (PUP) process and will follow Integrated Pest Management Policy (569 FW 1). The PUP process includes consideration of effects on non-target terrestrial and aquatic organisms and ecosystems.

The Refuge has been aggressively attempting to control exotic plants during the past few years. Monitoring efforts have shown some chemicals to be more effective than others. Refuge staff works closely with representatives from several chemical companies as well as personnel from other governmental agencies such as the Louisiana department of Agriculture and Forestry and the Louisiana Agriculture Extension office to obtain the best and most current types of chemicals to use for controlling aquatic plants. Other sources are also utilized such as the Global Invasive Species Database (http://www.issg.org/database/species/ecology.asp?si=999&fr=1&sts=sss&lang=EN) which recommends using the herbicide 2, 4-D for Cuban bulrush and Diquat, Fluridone, and Glyphosate for controlling salvinia. Unfortunately, due to the extremely large number of individual plants that can be present, applying herbicide to each plant is difficult. The dense pubescence on the leaf surfaces can negatively impact the effectiveness of certain types of herbicide applications. These thick hairs can impede herbicide penetration when using any type of foliar spray application. (McKinney & Durocher, n.d.). Although the chemicals identified above have proven to be effective, the Refuge is always striving for better methods. If over time, these chemicals are shown through monitoring to lose their efficacy, other methods will be investigated/evaluated through an adaptive management process.

SANCTUARY MANAGEMENT PRESCRIPTIONS

To meet Objective 2.2 in management units 1-5 for wintering waterfowl, the following management strategy will be used:

- Keep sanctuary boundary posted and continue to enforce no waterfowl hunting in the sanctuary.

CHAPTER VI. LITERATURE CITED

Agriculture Water Quality Alliance, 2000. *Filter Strip*. [Online] Available at: http://www.awqa.org/pubs/conservation/NRCSPractices/FilterStrip.pdf [Accessed 26 April 2013].

Beccasio, A.D. et al., 1983. FWS/OBS-83-19 *Lower Mississippi Valley ecological inventory user's guide and information base*. U.S. Department of the Interior Fish and Wildlife Service.

Bellrose, F.C., 1976. *Ducks, geese and swans of North America*. Harrisburg, Pennsylvania: Stackpole Books.

Benson, J.F., 2005. *Ecology and conservation of Louisiana black bears in the Tensas River basin and reintroduced populations*. MS Thesis. Baton Rouge: Louisiana State University.

Benson, J.F. & Chamberlain, M.J., 2006. Food habits of Louisiana black bears (Ursus americanus luteolus) in two subpopulations of the Tensas River Basin. *Am. Midl. Nat.*, 156(1), pp.118-27.

Benson, J.F. & Chamberlain, M.J., 2007. Space use and habitat selection by female Louisiana black bears in the Tensas River Basin of Louisiana. *J. Wildlife Manage.*, 71(1), pp.117-26.

Berdeen, J.B. & Krementz, D.G., 1998. The use of fields at night by wintering American Woodcock. *J. Wildl. Manage.*, 62, pp.939-47.

Black Bear Conservation Committee, n.d. *Habitat Requirements*. [Online] Black Bear Conservation Committee Available at: http://www.bbcc.org/habitat-requirements/default.aspx [Accessed 28 March 2011].

Blackman, E.B., DePerno, C.S., Moorman, C.E. & Peterson, M.N., 2013. Use of crop fields and forest by wintering American woodcock. *Southeastern Naturalist*, 12(1), pp.85-92.

Brown, S., Hickey, C., Harrington, B. & Gill, R., 2001. *United States shorebird conservation plan, second edition.* Manomet, Massachusetts: Manomet Center for Conservation Sciences. http://www.manomet.org/usscp.htm.

Bruno, N.A., Gregory, R.W. & Schramm, H.L.J., 1990. Nest sites used by radio-tagged largemouth bass in Orange Lake, Florida. *North American Journal of Fisheries Management*, 10, pp.80-84.

Bullock, J.F. & Arner, D.H., 1985. Beaver damage to non-impounded timber in Mississippi. *South. J. Appl. For.*, 9, pp.137-40.

Charudattan, R., 1986. Integrated control of waterhyacinth (Eichhornia crassipes) with a pathogen, insects, and herbicides. *Weed Science*, 34(suppl 1), pp.26-30.

Chilton, E.W., n.d. *Aquatic vegetation management in Texas: a guidance document*. Austin, TX: Texas Parks and Wildlife Department.

Coetzee, J.A. et al., 2009. Eichhornia crassipes (Mart.) Solms-Laub. (Pontederiaceae). In R. Muniappan, R. G.V.P. & A. Raman, eds. *Biological Control of Tropical Weeds using Arthropods*. Cambridge University Press. pp.183-210.

Dickson, J.G., 1991. Birds and mammals of pre-colonial southern old-growth forests. *Natural Areas Journal*, 11, pp.26-33.

Diop, O., 2006. http://eprints.ru.ac.za/877/1/Diop-PhD-TR07-44.pdf *Management of invasive aquatic weeds with emphasis on biological control in Senegal*. PhD Thesis. Grahamstown, South Africa: Rhodes University.

Dugger, K.M. & Fredrickson, L.H., 2007. Life history and habitat needs of the wood duck. In K.D. Nelms, B. Ballinger & A. Boyles, eds. *Wetland Management for Waterfowl: A Handbook*. Arlington, VA: Mississippi River Trust; Natural Resources Conservation Service; U.S. Fish and Wildlife Service. pp.53-62. Originally published as Fish and Wildlife Leaflet 13.1.6, 1992.

Elliott, L. & McKnight, K., 2000. *U.S. shorebird conservation plan: lower Mississippi/western Gulf Coast shorebird planning region*. Gulf Coastal Prairie Working Group and Mississippi Alluvial Valley/West Gulf Coastal Plain Working Groups. 64 pp.

Fredrickson, L.H., 1991. 13.4.6. *Strategies for water level manipulations in moist-soil systems*. Fish and Wildlife Leaflet. Puxico, MO: University of Missouri--Columbia.

Fredrickson, L.H., 1996. Moist soil management, 30 years of field experimentation. *International Waterfowl Symposium*, 7, pp.168-77.

Fredrickson, L.H. & Heitmeyer, M.E., 1988. Waterfowl use of forested wetlands of the southern United States: an overview. In M.W. Weller, ed. *Waterfowl in winter*. Minneapolis, MN: University of Minnesota. pp.307-23.

Fredrickson, L.H., King, S.L. & Kaminski, R.M., 2005. *Ecology and management of bottomland hardwood systems: the state of our understanding*. Special Publication No. 10. Puxico, MO: University of Missouri-Columbia Gaylord Memorial Laboratory.

Fredrickson, L.H. & Reid, F.A., 1988. 13.4.9. *Preliminary considerations for manipulating vegetation*. Fish and Wildlife Leaflet. Puxico, MO: University of Missouri--Columbia.

Fredrickson, L.H. & Taylor, T.S., 1982. 148 *Management of seasonally flooded impoundments for wildlife*. Resource Publication. U.S. Department of the Interior Fish and Wildlife Service.

Gardiner, E.L. & Oliver, J.M., 2005. Restoration of bottomland hardwood forests in the Lower Mississippi Alluvial Valley, U.S.A. In J.A. Stanturf & P. Madsen, eds. *Restoration of boreal and temperate forests*. Boca Raton, FL: CRC Press.

Haramis, G.M. & Thompson, D.Q., 1985. Density-production characteristics of box-nesting wood ducks in a northern greentree impoundment. *J. Wildl. Manage.*, 49(2), pp.429-36.

Hawkins, A.S. & Bellrose, F.C., 1940. Wood duck habitat management in Illinois. *Trans. North American Wildlife Conference*, 5, pp.392-95.

Heitmeyer, M.E., 1988. Body composition of female mallards in winter in relation to annual cycle events. *Condor*, 90, pp.669-80.

Heitmeyer, M.E. & Raveling, D.G., 1988. *Winter resource use by three species of dabbling ducks in California*. Department of Wildlife and Fisheries Biology Final Report to Delta Waterfowl and Wetlands Research Center, Portage La Prairie, Manitoba, Canada. Davis, CA: University of California.

Hellgren, E.C., Vaughan, M.R. & Stauffer, F., 1991. Macrohabitat use by black bears in a southeastern wetland. *J. Wildl. Manage.*, 55(3), pp.442-48.

Henry, W.G., 1980. *Populations and behavior of black brant at Humboldt Bay, California*. M.S. Thesis. Arcata, CA: Humboldt State University.

Hightower, D.A., Wagner, R.O. & Pace, R.M., 2002. Denning ecology of female American black bears in south central Louisiana. *Ursus*, 55(3), pp.442-48.

Hill, E.P., 1982. Beaver. In J.A. Chapman & G.A. Fledhamer, eds. *Wild mammals of North America: biology, management, and economics*. Baltimore, MD: Johns Hopkins University Press.

Horton, G.I. & Causey, M., 1979. Woodcock movements and habitat utilization in central Alabama. *J. Wildl. Manage.*, 43, pp.414-20.

IFAS, 2012. *Eichhornia crassipes=Biological Control Insects*. [Online] University of Florida, IFAS Available at: http://plants.ifas.ufl.edu/node/144 [Accessed 30 October 2012].

Jacono, C.C., Davern, T.R. & Center, T.D., 2001. The adventive status Salvinia minima and S. molesta in the southern United States and the related distribution of the weevil Cyrtobagous salviniae. *Castanea*, 66(3), pp.214-26.

Johnson, R.L. & Deen, R.T., 1993. Prediction of oak regeneration in bottomland forests. In Loftis, D.L..M.C.E., ed. *Oak regeneration: serious problems, practical recommendations, Gen. Tech. Rep. SE-84*. Knoxville, TN, 1993. USDA Forest Service, Southeastern Forest Experiment Station, Asheville, NC.

Jones, D. & Shuman, M., 1989. *Archaeological atlas and report of prehistoric Indian mounds in Louisiana, Vol. IV, Avoyelles Parish, Part 1*. Baton Rouge, LA: Louisiana State University Museum of Geoscience.

Kahl, R., 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin*, 19, pp.242-48.

Kaminski, R.M. et al., 2003. Waterfowl fall migration. *J. Wildl. Manage.*, 67, pp.542-50.

Karl, T.R., Melillo, J.M. & Peterson, T.C., eds., 2009. *Global climate change impacts in the United States*. New York, NY: Cambridge University Press.

Kelley, J., Williamson, S. & Cooper, T.R., 2008. *American Woodcock Conservation Plan*. Wildlife Management Institute.

King, S.L. & Antrobus, T.J., 2001. Canopy disturbance patterns in a bottomland hardwood forest in northeast Arkansas, USA. *Wetlands*, 21, pp.543-53.

Klimas, C.V. et al., 2004. ERDC/EL-TR-04-16 *A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley.* Technical Report. U.S. Army Engineer Research and Development Center.

Krementz, D.G., Crossett, R. & Lehnen, S.E., 2014. Nocturnal field use by fall migrating American woodcock in the Delta of Arkansas. *J. Wildl. Manage.*, 78(2), pp.264-72.

Krementz, D.G. & Jackson, J.J., 1999. 1183 *Woodcock in the Southeast: natural history and management for landowners*. Bulletin. Athens, GA: University of Georgia College of Agriculture and Environmental Sciences, Cooperative Extension Service.

Krementz, D.G. & Pendleton, G.W., 1994. Diurnal habitat use of American woodcock wintering along the Atlantic coast. *Canadian Journal of Zoology*, 72, pp.1945-50.

Kross, J., 2006. *Conservation of waste rice and estimates of moist soil seed abundance for wintering waterfowl in the Mississippi Alluvial Valley*. M.S. Thesis. Mississippi State, Mississippi: Mississippi State University.

Landers, J.L., Hamilton, R.J., Johnson, A.S. & Marchinton, R.L., 1979. Foods and habitat of black bears in southeastern North Carolina. *J. Wildl. Manage.*, 43(1), pp.143-53.

Langeland, K., Netherland, M. & Haller, W., 2009. SS-AGR-44 *Efficacy of herbicide active ingredients against aquatic weeds*. Gainesville, FL: University of Florida IFAS Extension.

Lester, G.D. et al., 2005. *Louisiana Comprehensive Wildlife Conservation Strategy*. Baton Rouge, LA: Louisiana Department of Wildlife and Fisheries.

LMVJV Forest Resource Conservation Working Group, 2007. *Restoration, management, and monitoring of Forest Resources in the Mississippi Alluvial Valley: recommendations for enhancing wildlife habitat.* Vicksburg, MS: Lower Mississippi Valley Joint Venture. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt.

LMVJV, 2010. *Water Management Tracking System*. [Online] Lower Mississippi Valley Joint Venture Available at: http://www.lmvjv.org/moistsoil_prod/default.aspx [Accessed 12 April 2012].

Low, J.B. & Bellrose, F.C., 1944. The seed and vegetative yield of waterfowl food plants in the Illinois River Valley. *J. Wildl. Manage.*, 8, pp.7-22.

Mahadev, G.B., Huffaker, R.G. & Lenhart, S.M., 1993. Controlling forest damage by dispersive beaver populations: centralized optimal management strategy. *Ecological Applications*, 3(3), pp.518-30.

McFarland, D.G., Nelson, L.S. & Grodowitz, M.J., 2004. ERDC/EL SR-04-2 *Salvinia molesta D.S. Mitchell (giant salvinia) in the United States: a review of species ecology and approaches to management*. U.S. Army Corps of Engineers Engineering Research and Development Center.

McGilvrey, F.B., 1968. 60 *A guide to wood duck production habitat requirements*. Research Publication. U.S. Department of the Interior Fish and Wildlife Service.

McKinney, L.D. & Durocher, P.P., n.d. *Aquatic vegetation management in Texas: a guidance document*. Austin, TX: Texas Parks and Wildlife Department Inland Fisheries.

McLaughlin, C.L. & Grice, D., 1952. The effectiveness of large scale erection of wood duck boxes as a management procedure. *Trans. North American Wildlife Conference*, 17, pp.242-59.

Mitchell, J.S. & Powell, R.A., 2003. Response of black bears to forest management in the southern Appalachian mountains. *J. Wildl. Manage.*, 67(4), pp.692-705.

Muñoz-Carpena, R., 1993. http://abe.ufl.edu/faculty/carpena/files/pdf/software/vfsmod/RMC_Full_Dissertation_sm.pdf *Modeling hydrology and sediment transport in vegetative filter strips*. Ph.D. Dissertation. Raleigh, NC: North Carolina State University.

Mykytka, J.M. & Pelton, M.R., 1990. Management strategies for Florida black bears based on home range habitat composition. *Int. Conf. Bear Res. and Manage.*, 8, pp.161-67.

National Fish Habitat Partnership, 2012. www.fishhabitat.org *National fish habitat action plan, second edition*. Washington, DC: Association of Fish and Wildlife Agencies.

Natural Resources Conservation Service, 2012. *Soil Data Mart*. [Online] Available at: http://soildatamart.nrcs.usda.gov/ [Accessed 28 February 2012].

NAWMP Committee, 2004. *North American waterfowl management plan: strengthening the biological foundation 2004 strategic guidance*. U.S. Fish and Wildlife Service, Secretaría de medio ambiente y recursos naturales [Mexico], Environment Canada.

North American Bird Conservation Initiative, n.d. *nabci-us.org*. [Online] Available at: http://www.nabci-us.org/plans.htm [Accessed 27 APR 2011].

Panjabi, A.O., Blancher, P.J., Dettmers, R. & Rosenberg, K.V., 2012. http://www.rmbo.org/pubs/downloads/Handbook2012.pdf *The Partners in Flight handbook on species assessment*. Technical Series No. 3. Rocky Mountain Bird Observatory (website).

Partners In Flight, 2012. *Partners In Flight Species Assessment Database, BCR 26*. [Online] Available at: http://pif.rmbo.org/ [Accessed 3 January 2013].

Paulus, S.L., 1984. Activity budgets of non-breeding gadwalls in Louisiana. *J. Wildl. Manage.*, 48, pp.371-80.

Reddy, K.R. & Sacco, P.D., 1981. Decomposition of water hyacinth in agricultural drainage water. *J. Environ. Qual.*, 10(2), pp.228-34.

Reinecke, K.J. et al., 1989. Mississippi Alluvial Valley. In R.L. Pederson & R.M. Kaminski, eds. *Habitat management for migrating and wintering waterfowl in North America*. Lubbock, TX, USA: Texas Tech University Press.

Rich, T.D. et al., 2004. *Partners in flight North American landbird conservation plan*. Ithaca, NY: Cornell Lab of Ornithology.

Rudis, V.A., 1995. Regional forest fragmentation effects on bottomland hardwood community types and resource values. *Ecology*, 10(5), pp.291-307.

Rudis, V.A. & Tansey, J.B., 1995. Regional assessment of remote forests and black bear habitat from forest resource surveys. *J. Wildl. Manage.*, 59(1), pp.170-80.

Saucier, R.L., 1943. *History of Avoyelles Parish, Louisiana*. New Orleans, LA: Pelican Publishing Co.

Saucier, R.T., 1994. *Geomorphology and quaternary geologic history of the lower Mississippi Valley, Volume 1*. Vicksburg, MS: U.S. Army Corps of Engineers Waterways Experiment Station.

Smith, D.M., 1986. *The practice of silviculture*. 8th ed. New York, NY: John Wiley & Sons.

Soil Conservation Service, 1986. *Soil survey of Avoyelles Parish, Louisiana*. Washington, DC: U.S. Department of Agriculture Soil Conservation Service.

South Carolina DNR, n.d. *Using triploid grass carp for aquatic plant control in South Carolina small impoundments*. [Online] Available at: https://www.dnr.sc.gov/fish/pdf/GrassCarpFactSheet.pdf [Accessed 27 March 2014].

Stevenson, F., Momot, W.T. & Svoboda, F.J.I., 1969. Nesting success of the bluegill, Lepomis macrochirus Rafinesque, in a small Ohio farm pond. *Ohio Journal of Science*, 69(6), pp.347-55.

Strader, R.W. & Stinson, P.H., 2005. *Moist-soil management guidelines for the U.S. Fish and Wildlife Service Southeast Region*. Jackson, MS: U.S. Department of the Interior Fish and Wildlife Service.

Straw, J.A., Wakely, J.S. & Hudgins, J.E., 1986. A model for management of diurnal habitat for American woodcock in Pennsylvania. *J. Wildl. Manage.*, 50, pp.378-83.

Stribling, H.L. & Doerr, P.D., 1985. Nocturnal use of fields by American woodcock. *J. Wild. Manage.*, 49(2), pp.485-91.

Strickland, B.K. & Tullos, A., 2009. *Waterfowl habitat management handbook for the Lower Miswsissippi River Valley*. Mississippi State, Mississippi: Mississippi State University.

Synatzske, D.R., 1993. The ecological impacts of feral swine. In Hanselka, C.W. & Cadenhead, J.F., eds. *Feral swine: a compendium for resource managers*. Kerrville, Texas, 1993. Texas Agricultural Extension Service.

Texas A&M Agrilife Extension Service, 2013. *Aquaplant, Hydrilla verticillata*. [Online] Available at: http://aquaplant.tamu.edu/management-options/hydrilla/ [Accessed 26 April 2013].

Tipping, P.W., Martin, M.R., Center, T.D. & Davern, T.M., 2008. Suppression of Salvinia molesta Mitchell in Texas and Louisiana by Cyrtobagous salviniae Calder and Sands. *Aquatic Botany*, 88, pp.196-202. Viewed online 04JAN2012 at: http://ddr.nal.usda.gov/dspace/bitstream/10113/32420/1/IND44244538.pdf.

Twedt, D. et al., 1999. *Partners in Flight bird conservation plan for the Mississippi Alluvial Valley*. U.S. Department of the Interior Fish and Wildlife Service. viewed online 12JAN2011 at: http://www.blm.gov/wildlife/plan/MAV_plan.html.

Twomey, K.A., Gebhart, G. & Nelson, P.C., 1984. *Habitat suitability index models and instream flow suitability curves: redear sunfish*. Washington, DC: U.S. Department of the Interior Fish and Wildlife Service Western Energy and Land Use Team, Division of Biological Services Research and Development.

U.S. Army Corps of Engineers, 2011. *Aquatic Herbicides information sheet*. [Online] Available at: http://www.glmris.anl.gov/documents/docs/anscontrol/AquaticHerbicides.pdf [Accessed 04 January 2012].

U.S. Department of Agriculture, 2012. *Aquatic Species--Giant Salvinia*. [Online] Available at: http://www.invasivespeciesinfo.gov/aquatics/salvinia.shtml [Accessed 4 September 2012].

U.S. Fish and Wildlife Service, 1990. *Annual Narrative Report, Central Louisiana National Wildlife Refuge Complex*. Marksville, LA: U.S. Department of the Interior Fish and Wildlife Service.

U.S. Fish and Wildlife Service, 1995. *Louisiana black bear Ursus americanus luteolus recovery plan.* Atlanta, GA: U.S. Department of the Interior Fish and Wildlife Service.

U.S. Fish and Wildlife Service, 2003. *Increasing wood duck productivity: guidelines for management and banding*. Atlanta, GA: U.S. Department of the Interior Fish and Wildlife Service.

U.S. Fish and Wildlife Service, 2004. *Grand Cote National Wildlife Refuge Biological Review*. Biological Review. Atlanta, Georgia: U.S. Department of the Interior Fish and Wildlife Service, Southeast Region.

U.S. Fish and Wildlife Service, 2004. *Lake Ophelia National Wildlife Refuge Biological Review*. Atlanta, GA: U.S. Department of the Interior Fish and Wildlife Service, Region 4.

U.S. Fish and Wildlife Service, 2005. *Lake Ophelia National Wildlife Refuge Comprehensive Conservation Plan*. Atlanta, GA: U.S. Department of the Interior Fish and Wildlife Service, Region 4.

U.S. Fish and Wildlife Service, 2010. *Fire Management Plan, Lake Ophelia National Wildlife Refuge*. Atlanta, GA: U. S. Fish and Wildlife Service Southeast Region.

U.S. Fish and Wildlife Service, 2010. *Identifying refuge resources of concern and management priorities: a handbook*. Arlington, VA: U.S. Department of the Interior Fish and Wildlife Service.

U.S. Fish and Wildlife Service, 2011b. *Joint Ventures*. [Online] Available at: http://www.fws.gov/birdhabitat/JointVentures/DefineJV.shtm [Accessed 12 January 2011].

U.S. Fish and Wildlife Service, 2014. *U.S. Fish and Wildlife Service Strategic Habitat Conservation*. [Online] Available at: http://www.fws.gov/landscape-conservation/lcc.html [Accessed 5 March 2014].

U.S. Fish and Wildlife Service, n.d. *Bird Checklists of the United States: Lake Ophelia National Wildlife Refuge*. [Online] Available at: http://www.npwrc.usgs.gov/resource/birds/chekbird/r4/ophelia.htm [Accessed 1 May 2013].

USDA National Invasive Species Information Center, 2013. *Aquatic Species: Hydrilla*. [Online] Available at: http://www.invasivespeciesinfo.gov/aquatics/hydrilla.shtml [Accessed 26 April 2013].

USDA Natural Resources Conservation Service, 2013. *Plants Profile, Hydrilla verticillata (L. f.) Royle, waterthyme*. [Online] Available at: http://plants.usda.gov/java/profile?symbol=HYVE3 [Accessed 26 April 2013].

Villamagna, A.M. & Murphy, B.R., 2010. Ecological and socio-economic impacts of invasive water hyacinth (Eichhornia crassipes): a review. *Freshwater Biology*, 55, pp.282-98.

Weaver, K.M. & Pelton, M.R., 1994. Denning ecology of black bears in the Tensas River Basin of Louisiana. *Int. Conf. Bear Res. and Manage.*, 9(1), pp.427-33.

Wehrle, B.W., Kaminski, R.M., Leopold, B.D. & Smith, W.P., 1995. Aquatic invertebrate resources in Mississippi forested wetlands during winter. *Wildlife Soc. Bull.* , 23(4), pp.774-83.

Wharton, C.H., Kitchen, W.M., Pendleton, E.C. & Sipe, T.W., 1982. FWS/OBS-81/37 *The ecology of bottomland hardwood swamps of the Southeast: a community profile*. Washington, DC: U.S. Department of the Interior Fish and Wildlife Service Biological Services Program.

White, T.H. et al., 2001. Forest management and female black bear denning. *J. Wildl. Manage.*, 65(1), pp.34-40.

White, T.H. et al., 2000. Influence of Mississippi alluvial valley rivers on black bear movements and dispersal: implications for Louisiana black bear recovery. *Biological Conservation*, 95, pp.323-31.

APPENDIX A. 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.

PROPOSED ACTION AND ALTERNATIVES.

The proposed action is the approval and implementation of the Habitat Management Plan (HMP) for Lake Ophelia 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 Lake Ophelia NWR Comprehensive Conservation Plan (CCP 2005).

The proposed CCP action was the preferred alternative among four alternatives considered in the Environmental Assessment (EA) (Draft CCP and EA 2005). In the CCP, the proposed action was to manage the refuge to “result in restoration of the largest amount of interior bottomland hardwood forest possible, while meeting the refuge's primary purpose of providing habitat for multiple species of migratory waterfowl. Specific results will include increased waterfowl and songbird use and production; enhanced habitat and increased protection for the Louisiana black bear and other forest interior-dependent wildlife; enhanced resident wildlife populations; restored wetlands and hydrology; and greater opportunities for a variety of compatible wildlife-dependent recreational and environmental education activities.” (Lake Ophelia NWR CCP 2005).

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 Lake Ophelia NWR CCP and accompanying Environmental Assessment (2005). These include:

BOTTOMLAND HARDWOOD FOREST MANAGEMENT

Artificial regeneration of open land may be used when new land is acquired within the approved acquisition boundary. Other types of silvicultural treatments may be used at the refuge’s discretion to achieve the objectives set forth in Chapter IV; however, the refuge does not anticipate either the need or the capacity to carry out any such treatments within the planning period encompassed by the CCP. Existing bottomland hardwood stands will be managed passively unless circumstances change.

Beavers will be managed by trapping and dam removal.

Feral swine will be managed by trapping and shooting.

At least 75 artificial nest cavities will be maintained on the refuge for nesting wood ducks.

MOIST SOIL MANAGEMENT

Moist soil management will be practiced on Units VB1 and VB2. Water management on these units is accomplished by water control structures at the low end of each unit. No pumping capability is currently available on either unit.

Prescribed fire will not be used for moist soil management, largely due to limited management capability and resources.

CROPLAND MANAGEMENT

Cropland management will be practiced on Units 1-8 on the main refuge. Cooperative farming will be used. Although other crops are a possibility, the main crops anticipated on these units are milo and soybeans. Milo (or corn) will always constitute the refuge's 20% share of the crop, and this share will always be produced on floodable portions of the cropland units. Crop rotation will be coordinated with the farmer(s); the rotation system is irregular and flexible.

AQUATIC HABITAT MANAGEMENT

Management of aquatic habitats on Lake Ophelia NWR will consist of exotic invasive plant management, and the maintenance, and if needed, establishment, of forested buffer strips around bodies of water. The use of fish stocking will be considered if it is deemed necessary for restoration of sustainable populations of sport fish, and if funds are available.

SANCTUARY MANAGEMENT

Lake Ophelia NWR contains approximately 8,300 acres identified as sanctuary, including two areas (1B & 2B) which have limited access for small game and bow hunting during certain segments of the hunting season but which are closed to waterfowl hunting and to general access during the rest of the year. Area 1B is the 200-acre Lake Ophelia and an additional 500 acres that surrounds the lake. This area is typically open for scouting access on September 1 and archery deer hunting only for the month of November; no small game hunting is allowed in area 1B. Area 2B is approximately 1,800 acres and is typically open for scouting access on September 1 and for small game hunting starting around the first of October and archery deer hunting the first of November. Area 2B is closed to all public use after November 30. The remaining areas identified as sanctuary are closed to all public access year round. These sanctuary areas benefit all wildlife on the Refuge including waterfowl, white-tailed deer and Louisiana black bear.

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 CPP 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 and signed 20JUN2005 during the CCP process. The determination was a concurrence that the CCP may affect, but is not likely to adversely affect the following species: Louisiana black bear, bald eagle, interior least tern, pallid sturgeon, ivory-billed woodpecker.

Other Items to include that should be listed and can be found in the EAS accompanying the final CCP (FONSI September 30, 2005):

Executive Orders 11988/11990

Floodplain Management and Protection of Wetlands

Form DI-711, Intergovernmental Notice of Proposed Action

National Historic Preservation Act, Protection of Cultural Resources

PUBLIC INVOLVEMENT/INTERAGENCY COORDINATION.

The proposed HMP is a step-down of the approved CCP for Lake Ophelia NWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed (Draft CCP and EA 2005) which proposed and addressed management alternatives and environmental consequences. Public involvement included public notification (Notice of Availability: Federal Register (Vol. 70 No. 64 April 5, 2005). The draft plan was made available for public review, beginning April 5, 2005, and ending May 20, 2005. Individuals reviewing this document represented landowners, conservation organizations, and state and local government agencies. A flyer which announced the dates of the comment period, and the dates and locations of the public meetings to discuss the draft, was mailed along with the plans. Public meetings were held on: April 19, 2005 at 6:30 p.m., at the Natural Resources Conservation Service Office, 3737 Government Street, Alexandria, Louisiana; April 20, 2005, at 6:30 p.m., at the Cottonport Bank Camp, Marksville, LA; and April 21, 2005, at 6:30 p.m., at Ecological Services Field Office, 646 Cajundome Blvd., Lafayette, Louisiana. Sixteen individuals were in attendance at all three meetings. Ten individuals presented oral comments and eleven respondents submitted written comments by mail or email. Refer to CCP for specific comments and Service response.

SUPPORTING DOCUMENTS.

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

U.S. Fish and Wildlife Service 2004a, 'Lake Ophelia National Wildlife Refuge Biological Review', Biological Review, U.S. Department of the Interior Fish and Wildlife Service, Southeast Region, Atlanta, GA.

U.S. Fish and Wildlife Service 2005, 'Lake Ophelia National Wildlife Refuge Comprehensive Conservation Plan', U.S. Department of the Interior Fish and Wildlife Service, Region 4, Atlanta, GA.

U.S. Fish and Wildlife Service. 2005. 'Lake Ophelia National Wildlife Refuge, Environmental Assessment for the Draft Comprehensive Conservation Plan', U.S. Department of the Interior Fish and Wildlife Service, Region 4, Atlanta, GA.

U.S. Fish and Wildlife Service 2010a, 'Fire Management Plan, Lake Ophelia National Wildlife Refuge', U. S. Fish and Wildlife Service Southeast Region, Atlanta, GA.

Brett Webb — 5/5/14

Project Leader — Date

Bridget Warner — 07/07/2014

Regional Refuge NEPA Coordinator — Date

[signature] — 7-15-14

Regional Chief, Southeast Region — Date