U.S. Fish & Wildlife Service

HABITAT MANAGEMENT PLAN FOR

TALLAHATCHIE NATIONAL WILDLIFE REFUGE

Grenada and Tallahatchie Counties, Mississippi

Southeast Region

Tallahatchie National Wildlife Refuge

Habitat Management Plan

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

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CHAPTER I. INTRODUCTION

The National Wildlife Refuge System (System) comprises some of the most important areas for the conservation of native flora and fauna within North America. National wildlife refuges are designed to protect and enhance the trust wildlife resources (i.e., migratory birds, endangered and threatened species, and inter-jurisdictional fish) and the habitats on which these trust species are dependent.

The development of Comprehensive Conservation Plans (CCPs) for each refuge or complex has provided a basic framework for habitat management to benefit priority trust species. 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. It helps sulfill the mission of the System; maintains and, where appropriate, restores the biological integrity, diversity, and enfironmental health of each refuge and the System; and meets other mandates. The CCP for North Mississippi Refuges Complex (Complex), which includes Tallahatchie NWR, was approved in 2005.

This Habitat Management Plan (HMP) is a step-down plan from the CCP that aims to refine management, enhancement, restoration, and protection of important habitat for the resources of concern. The HMP relies on the best available scientific information and is designed to be flexibile to change (i.e., adaptive management) based on new information or unanticipated results.

SCOPE AND RATIONALE

Planning Process

Habitat Management Plans are dynamic working documents that provide refuge managers with a decision-making process and guidance for the management of refuge habitat. Their aim is to establish long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan considers the establishing purpose of the refuge and the current habitat conditions, along with international, national, regional, tribal, State, and ecosystem plans, to establish refuge goals and objectives. The HMP planning process guides analysis and selection of specific habitat management strategies to achieve specific habitat and resources of concern goals and objectives by using refuge-level inventory and monitoring data, scientific literature, expert opinion, and staff expertise.

The statutory authority for conducting habitat management planning on National Wildlife Refuges (NWRs) is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (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 [and]...ensure that the biological integrity, diversity, and environmental health of the System are maintained." The Refuge Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the System.

Habitat management plans comply with all applicable laws, regulations, and policies governing the management of the System. The lifespan of an HMP is 15 years and parallels that of refuge CCPs. Habitat management plans are reviewed every five years using peer review recommendations, as appropriate, in the HMP revision process or when initiating refuge CCPs. Additionally, HMPs may be amended as needed to incorporate new management techniques as part of the adaptive management process. Annual Habitat Work Plans (AHWP) contain guidance for implementing specific management prescriptions in a single year to work towards accomplishing management objectives established in the HMP.

This HMP represents a combination of what could be done in an ideal situation tempered by what is likely to be accomplished over the next 15 years, given anticipated staffing and funding. The majority of the listed objectives and strategies require, at a minimum, maintaining the status quo in terms of staffing and funding. In several cases, an increase in staffing and funding will be required to accomplish the stated objectives.

Refuge Vision

The vision for Tallahatchie NWR was developed from the broader vision statement for the North Mississippi Refuges Complex CCP (U.S. Fish and Wildlife Service 2005) which states:

Based on sound science, Tallahatchie NWR will conserve, protect, enhance, manage, and where possible restore the ecological integrity of a bottomland hardwood forest, wetlands, wildlife, fisheries, and other plant communities within upper portions of the Mississippi Alluvial Valley for the benefits of present and future generations of Americans. Bottomland hardwood forest and agricultural/moist-soil habitats will be managed to benefit migratory birds and other indigenous fish, wildlife, and natural vegetative communities. Land resource protection, enhancement, restoration, and acquisition will be identified to support conservation plans and initiatives in the Lower Mississippi River Ecosystem.

LEGAL MANDATES

Tallahatchie NWR was established in 1991 under the Migratory Bird Conservation Act and the Consolidated Farm and Rural Development Act. The federally legislated purposes are: "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds," (Migratory Bird Conservation Act, 16 U.S.C. 715d); and "...for conservation purposes." (Consolidated Farm and Rural Development Act, 7 U.S.C. 1926 et seq.). More specifically, the Tallahatchie NWR Environmental Assessment and Land Protection Plan (U.S. Fish and Wildlife 1991) states the refuge was proposed "…to preserve and manage wintering and migrating habitat for Canada geese, mallard, pintail, blue-winged teal, and wood duck and to provide production habitat for wood duck…" in accordance with the goals in the North American Waterfowl Management Plan (U.S. Fish and Wildlife Service 1986).

In addition to the specific purposes that were established for each refuge, the Improvement Act provides clear guidance for the mission of the System and sets priorities for wildlife-dependent public uses. It states that each refuge will:

- Fulfill the mission of the System;
- Fulfill the individual purposes of each refuge;

- Consider the needs of wildlife first;
- Fulfill requirements of comprehensive conservation plans that are prepared for each unit of the System
- Maintain the biological integrity, biological diversity, and environmental health of the 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.

RELATIONSHIP TO OTHER PLANS

The CCP for the Complex was finalized in 2005 and includes broad goals and objectives for refuge management over a 15-year period. The purpose of the HMP is to provide more specific guidance that will facilitate the selection of prescriptions for implementing the goals and objectives of the CCP. To maintain consistent strategies for managing wildlife and habitats on the refuge, several other planning documents were used in the development of this plan including:

North American Waterfowl Management Plan (NAWMP)

The North American Waterfowl Management Plan contains continent-wide goals and objectives for populations of waterfowl (USFWS 1986). The plan led to the development of Joint Ventures for various eco-regions, and step-down goals and objectives by eco-region. The Lower Mississippi Valley Joint Venture (LMVJV) developed habitat goals for migrating and wintering waterfowl in the Mississippi Alluvial Valley (MAV). Based on a step-down process, the LMVJV established habitat objectives that link continental waterfowl populations to on-the-ground habitat objectives. The habitat objective established in 1996 for Tallahatchie NWR was approximately 852 acres of managed moist-soil vegetation, 80 acres of forested wetlands, and 212 acres of unharvested cropland. This habitat objective was incorporated into the CCP. Much of the management occurring on Tallahatchie NWR relates directly to meeting this habitat goal.

Mississippi Alluvial Valley Bird Conservation Plan Physiographic Area #5

A major initiative of the Service and its partners over the last 10 years is the conservation of forest interior birds. Partners in Flight (PIF) has developed conservation plans for land birds for the different eco-regions throughout the United States, including the MAV. This plan does not have specific objectives for different agencies or public land areas, but it does set some minimum area requirements for breeding populations for many of the species of concern. Based on these requirements, the LMVJV identified Bird Conservation Areas (BCAs) throughout the Delta (Twedt et al. 1999). These areas represent the highest priority areas for forest restoration. Tallahatchie NWR is included in the Malmaison BCA which has a core goal of 5,200 hectares (12,849 acres; core area is that area that is greater than 1000 meters from any edge.) Currently, the core area within the Malmaison BCA is 781 hectares (1,929 acres). Although the core goal has not been met, it is achievable as new lands are acquired within the refuge acquisition boundary. Priority species have been identified within the plan based on species decline. High priority species (scoring 22 or above) that occur within the Malmaison BCA include Swainson's Warbler, Prothonotary Warbler, Red-headed Woodpecker, Painted Bunting, Northern Parula, Kentucky Warbler, Orchard Oriole, Yellow-billed Cuckoo, Wood Thrush, and White-eyed Vireo (Twedt et al. 1999).

Southeast United States Regional Waterbird Conservation Plan

This plan provides a framework for the conservation and management of waterbirds in the Southeast that are not covered by either the NAWMP or the U.S. Shorebird Conservation Plan (Hunter et al. 2006). Threats to waterbird populations include destruction of inland and coastal wetlands, predators, invasive species, pollutants, mortality from fisheries and industries and other disturbances. No wading bird rookeries currently exist on Tallahatchie NWR, although they have been documented in the past. The refuge is typically used heavily by post-breeding wading birds, including wood storks. Several species of secretive marsh birds (sora rails, king rails, American and least bitterns, pied-billed grebes, and American coots) use Tallahatchie NWR for breeding and/or during migration. (Scientific names provided in Appendix B.)

Mississippi's Comprehensive Wildlife Conservation Strategy

In 2005, the Mississippi Department of Wildlife, Fisheries, and Parks developed a comprehensive plan to provide a "conservation blueprint" for agencies, organizations, industries, private landowners and academics across the state to advance sound management of all of the fish and wildlife resources (Mississippi Museum of Natural Science 2005). This broad-based plan is a guide to effective and efficient long-term conservation of Mississippi's biological diversity. This state plan has identified important wildlife species for which population declines have occurred or a significant threat to their habitat exists. These have been developed as a list of Species of Greatest Conservation Need. Many of these species exist presently or historically on Tallahatchie NWR. In addition, the state plan has identified vegetative communities of conservation concern. The state plan has identified the bottomland hardwood system of the MAV as critically imperiled.

Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative

Landscape Conservation Cooperatives (LCC) are public-private partnerships that recognize wildlife conservation challenges transcend political and jurisdictional boundaries and require a more networked approach to conservation—holistic, collaborative, adaptive and grounded in science—to ensure the sustainability of America's land, water, wildlife and cultural resources. The Gulf Coastal Plains and Ozarks LCC encompasses the Delta region and builds on a multitude of other initiatives to achieve common conservation goals; broader in scope than avian conservation driven efforts of the Joint Ventures. Many of the identified Resources of Concern are also identified within the Gulf Coastal Plains and Ozarks LCC.

Southeast Aquatic Habitat Plan

Developed in 2008 by the Southeast Aquatic Resources Partnership (SARP), this plan identifies threats to aquatic resources in the southeast and develops objectives and targets for mitigating or eliminating those threats. The purpose of the plan is "to maintain, restore, and conserve the quantity and quality of freshwater, estuarine, and marine habitats to support healthy, sustainable fish and aquatic communities and sustain public use for the benefit of all in the southeastern region and the entire U.S." (SARP 2008). Several of the stated objectives in this plan, notably Objective 1: Establish, improve and maintain riparian zones; Objective 5: Establish, improve or maintain appropriate sediment flows; Objective 6: Maintain and restore physical habitat in freshwater systems; and Objective 7: Restore or improve the ecological balance in habitats negatively affected by nonindigenous invasive or problem species, are incorporated into the goals and objectives of this HMP.

Other Planning Documents

Other documents reviewed during development of the HMP included the Environmental Assessment and Land Protection Plan for Tallahatchie National Wildlife Refuge (U.S. Fish and

Wildlife Service 1991), the Complex biological review (U.S. Fish and Wildlife Service 2003), the North Mississippi Refuges Complex CCP (U.S. Fish and Wildlife Service 2005), and the CCP pulse check (U.S. Fish and Wildlife Service 2011b).

CHAPTER II. BACKGROUND, INVENTORY AND DESCRIPTION OF HABITAT

LOCATION

Tallahatchie NWR is located in the Delta region of Mississippi in Grenada and Tallahatchie Counties. The refuge contains two tracts: the Walker Tract (557 acres) and the main tract (3,831 acres). A total of 4,388 acres is owned in fee title. The main tract is approximately two miles east of Philipp, Mississippi, on Mississippi Highway 8 (Figure 1). The Walker Tract is located approximately 3.5 miles northeast of the main tract along Brushy Creek. The refuge is administered by the North Mississippi Refuges Complex, with headquarters located in Grenada.

The main tract of Tallahatchie NWR is approximately 16 miles west of the Complex headquarters. It is bounded on the southeast by Tippo Bayou and bisected by Highway 8. The portion south of Highway 8 is open for public use, with access provided seasonally by several gravel roads. At present, roads are closed to the public from April to August.

The Walker Tract of Tallahatchie NWR is approximately 14 miles northwest of the Complex headquarters. It is accessed by a private road and is closed to public use. Staff access is restricted to levee-top roads and is limited in the winter months.

From a planning perspective, the refuge is located within the administrative boundaries of the LMVJV and is part of the Malmaison Bird Conservation Area. It is part of the Gulf Coastal Plains and Ozarks LCC.

MANAGEMENT UNIT DESCRIPTIONS

The refuge is divided into 120 habitat management units. These are based on habitat type, proximity of units to each other, historical management of the units, and logistics (keeping units at a manageable size for the habitat type, splitting fields divided by drainage ditches or other definable borders). See Table 1 and Figure 2. Habitat types include: agricultural, moist-soil, fallow fields, reforestation areas (< 20 year old bottomland hardwood stands), mature bottomland hardwood forest, permanent wetland habitat (bayous, sloughs, ponds/lakes, and ditches), and open right-of-ways.

Table 1: Acreage, habitat type, most recent management, and water control capability for management units on Tallahatchie NWR. (Water control capability: full – well and water control structure; partial – water control structure (WCS) or well; none – no well or water control structure. Units with wells that are known to function are indicated in bold under "Water Control Capability").

Unit	Size (acres)	Habitat Classification	Last Management Activity and Year of Occurrence	Water Control Capability
1	65	Reforestation	Planted 1996, 2000	None
2	12	Reforestation	Planted 1997	None
3	14	Reforestation	Planted 1997	None
4	19	Reforestation	Planted 1997, 1999	None
5	6	Reforestation	Planted 1997, 2000	None
6	15	Reforestation	Planted 1998, 2000	None

Unit	Size (acres)	Habitat Classification	Last Management Activity and Year of Occurrence	Water Control Capability
7	14	Reforestation	Planted 1998, 2000	None
8	21	Reforestation	Planted 1998	None
9	26	Reforestation	Planted 1998	None
10	68	Reforestation	Planted 1998	None
11	8	Slough	None	None
12	13	Reforestation	Planted 1998	None
13	42	Reforestation	Planted 1998, 1999	None
14	24	Reforestation	Planted 1998	None
15	9	Reforestation	Planted 1998	None
16	209	Tippo Bayou	Treated invasives 2010	None
17	76	Reforestation	Planted 1998	None
18	4	Reforestation	Planted 1998	None
19	21	Reforestation	Planted 1998	None
20	26	Reforestation	Planted 1998, 2000	None
21	59	Reforestation	Planted 1998, 2000	None
23	141	Reforestation	Planted 2000	Well
24	12	Reforestation	Planted 1999, 2000	None
25	44	Moist-soil	Drawndown 2012, strip mowed	**Full**
26	47	Moist-soil	Drawndown 2012, strip mowed	**Full**
27	42	Moist-soil	Drawndown 2012, strip mowed	**Full**
28	48	Moist-soil	Drawndown 2012, strip mowed	**Full**
29	67	Reforestation	Planted 2000	Well
30	16	Moist-soil	Drawndown 2011	**Full**
31	18	Moist-soil	Drawndown 2011, partial mow	**Full**
32	126	Reforestation	Planted 1999, 2001	None
33	18	Reforestation	Planted 1999	None
34	8	Reforestation	Planted 1999	None
36	34	Fallow field	Mowed 2013	None
37	16	Reforestation	Planted 1999, 2000	None
38	242	Reforestation	Planted 1999, 2000	Well
39	111	Reforestation	Planted 2000	Well
40	42	Reforestation	Planted 1999	None
41	29	Forest	None	None
42	15	Reforestation	Planted 2001	None
43	19	Reforestation	Planted 2001	None
44	57	Reforestation	Planted 1999	None
45	13	Reforestation	Planted 2001	None
46	61	Agricultural field	Farmed 2012	WCS
47	30	Agricultural field	Farmed 2012	None
48	190	Agricultural field	Farmed 2012	**Full**
49	28	Agricultural field	Farmed 2012	None
50	35	Agricultural field	Farmed 2012	None
51	65	Agricultural field	Farmed 2012	None
52	28	Reforestation	Planted 2001	None
53	26	Agricultural field	Farmed 2012	**Well**
54	54	Agricultural field	Farmed 2012	**Well**

Unit	Size (acres)	Habitat Classification	Last Management Activity and Year of Occurrence	Water Control Capability
55	52	Agricultural field	Farmed 2012	**Well**
56	38	Agricultural field	Farmed 2012	**Well**
58	28	Reforestation	Planted 2008	WCS
59	26	Reforestation	Planted 1999	None
60	29	Agricultural field	Farmed 2012	**Well**
62	13	Reforestation	Planted 2001	None
63	46	Reforestation	Mowed 2007	None
64	12	Reforestation	Planted 2001	None
65	28	Reforestation	Planted 2001	None
66	24	Reforestation	Planted 2001	None
67	15	Reforestation	Planted 2001	None
68	21	Reforestation	Fallow 1998	None
70	23	Forest	None	None
72	17	Reforestation	Planted 2001	None
73	17	Reforestation	Planted 2001	None
74	2	R.O.W.	Mowed 2013	None
75	16	Slough	None	None
76	53	Slough	None	None
77	52	Slough	None	None
78	26	Slough	None	None
79	4	Slough	None	None
80	62	Slough	None	None
81	12	Slough	None	None
82	47	Slough	None	None
84	9	Slough	None	None
85	14	Slough	None	None
86	6	Slough	None	None
88	7	Pond/lake	None	None
89	47	Slough	None	None
90	18	Reforestation	Planted 1999	None
91	12	Reforestation	Planted 1999	None
92	2	Pond/lake	None	WCS
93	7	Slough	None	WCS
94	60	Forest	None	None
95	6	Reforestation	Planted 1999	None
96	71	Long Branch (Lake)	Partially drained 2013	WCS
97	20	Ditch	Annually boarded in winter, unboarded in spring	WCS
98	1	R.O.W.	Mowed 2013	None
99	6	R.O.W.	Mowed 2013	None
101	278	Moist-soil	Drawndown 2014, herbicide application (willow and lotus)	**Full**
102	103	Moist-soil	Drawndown 2008, levee maintenance	**Full**
103	144	Moist-soil	Drawndown 2008, levee maintenance	**Full**
104	34	Fallow field	Mowed 2010	None

Unit	Size (acres)	Habitat Classification	Last Management Activity and Year of Occurrence	Water Control Capability
110	2	Pond/lake	None	None
111	3	Forest	None	None
112	17	Slough	None	None
113	4	Pond/lake	None	None
114	9	Reforestation	None - natural succession	None
115	4	Reforestation	None - natural succession	None
116	17	Reforestation	None - natural succession	None
117	6	Forest	None	None
118	6	Slough	None	None
119	16	Slough	None	None
120	3	Forest	None	None
121	9	Slough	None	None
122	8	Forest	None	None
123	2	Reforestation	None - natural succession	None
124	4	Slough	None	None
125	3	Forest	None	None
126	17	Reforestation	Farmed 2011, natural succession	None
127	27	Reforestation	Farmed 2011, natural succession	None
128	13	Reforestation	Farmed 2011, natural succession	None
129	4	Reforestation	Farmed 2011, natural succession	None
130	7	Reforestation	Farmed 2011, natural succession	None
131	13	Reforestation	Farmed 2011, natural succession	None
132	5	Reforestation	Planted 2009	None
133	3	Forest	None	None
134	139	Reforestation	CRP – acquired in 2013	None
135	18	Slough	Acquired in 2013	None

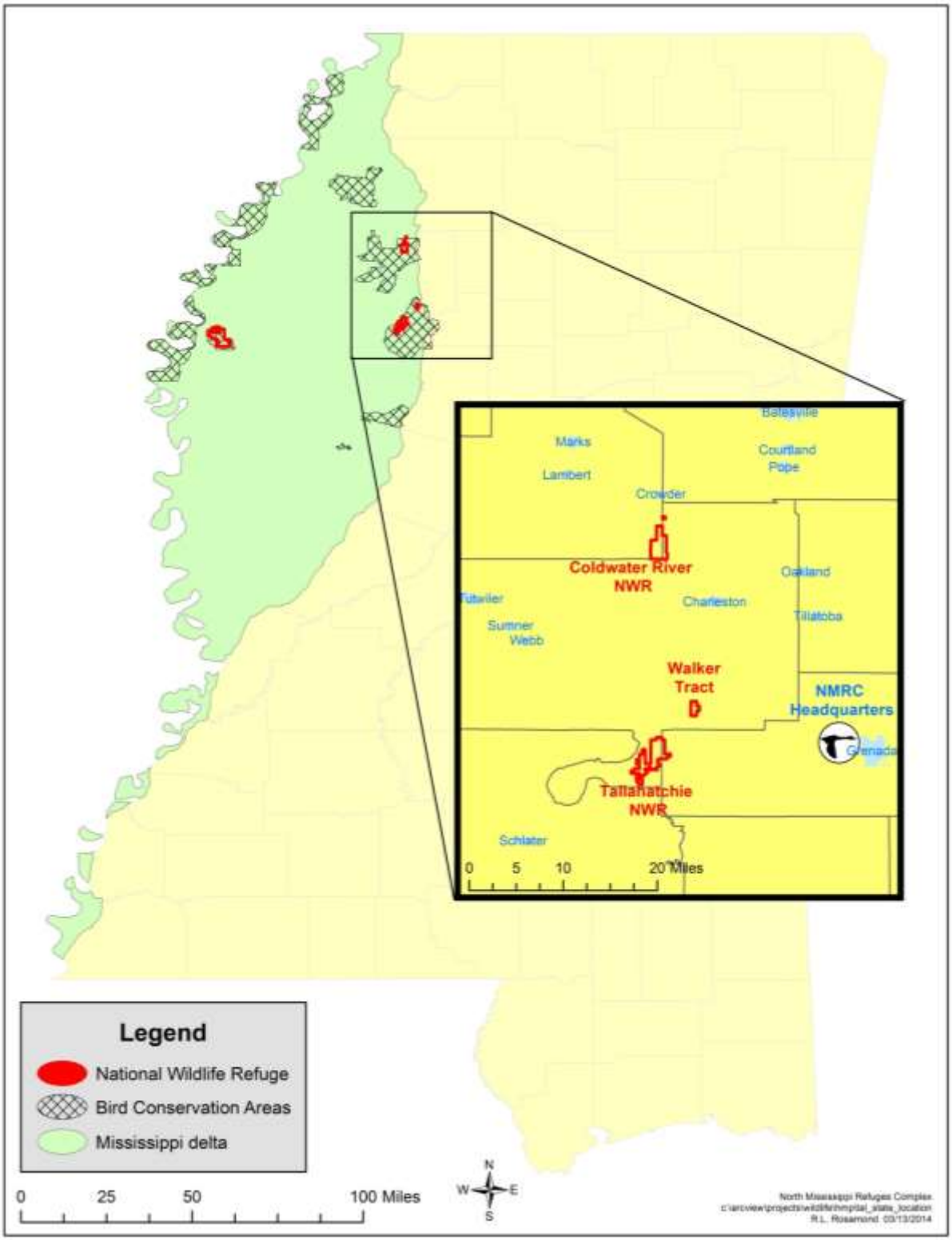

Figure 1: Location of Tallahatchie National Wildlife Refuge (NWR) in the Delta region of Mississippi, in relation to the North Mississippi Refuges Complex office, Coldwater River NWR, and the designated Bird Conservation Areas (Lower Mississippi Valley Joint Venture).

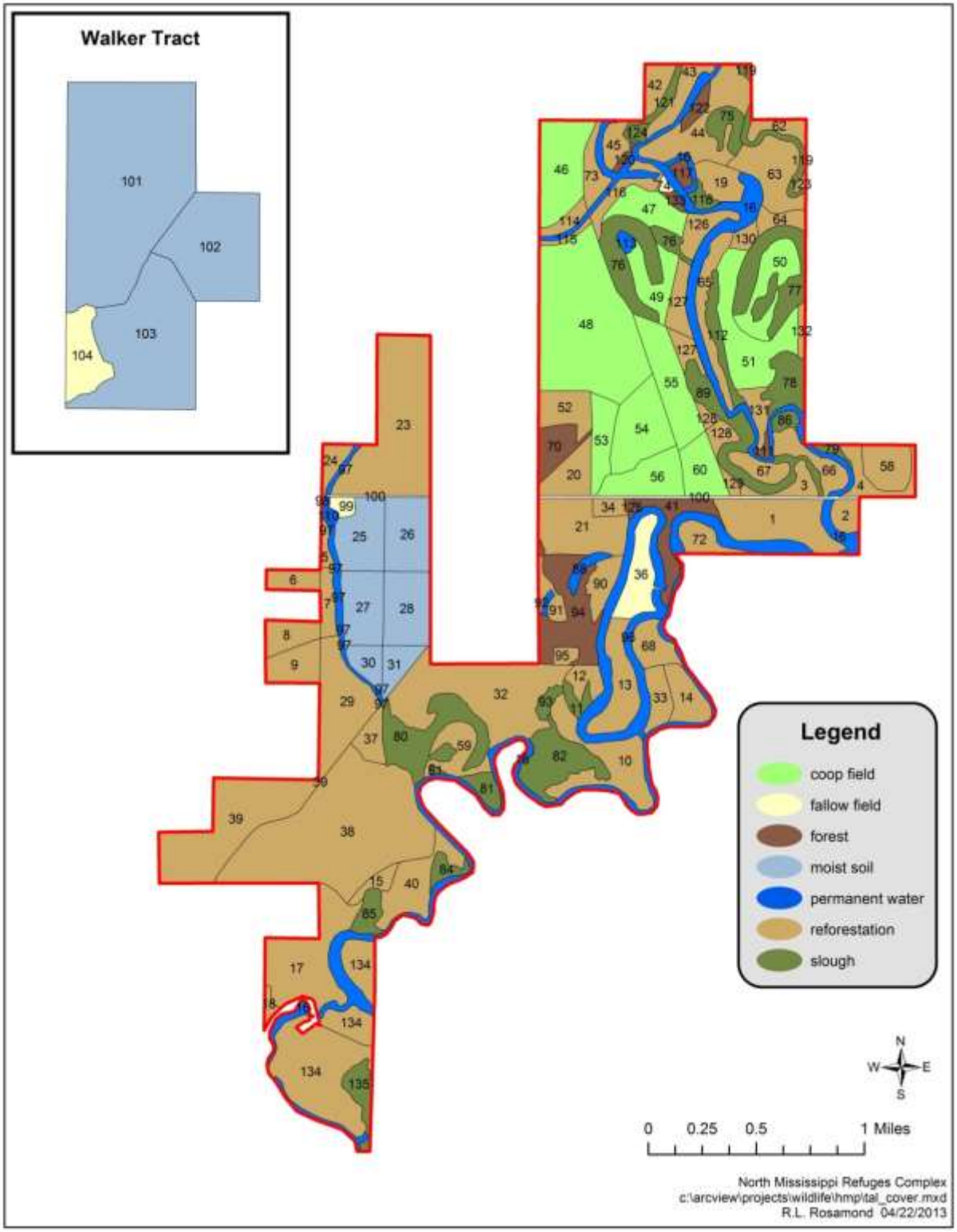

Figure 2: Habitat types present on Tallahatchie National Wildlife Refuge. Inset shows Walker Tract (located 3.5 miles NE of the main tract). (coop field = agricultural field; fallow field – fallow field and R.O.W; permanent water = pond/lake, ditch, Long Branch, and Tippo Bayou)

Physical or Geographic Setting

Tallahatchie NWR is located within the MAV in the Yazoo River drainage basin, a portion of the historic floodplain of the Mississippi River. As such, elevation across the refuge is fairly uniform averaging about 135 feet above MSL (range 129 – 143 feet) (Cascilla, Mississippi Quadrangle 1981; Money, Mississippi Quadrangle 1982; Philipp, Mississippi Quadrangle 1981).

The refuge lies between the Tallahatchie and Yalobusha Rivers (Figure 3). These rivers join just north of Greenwood to form the Yazoo River. Tippo Bayou, the dominant waterway on the refuge, is a tributary of the Yalobusha River, draining a little over 10% of the watershed (Cascilla, Mississippi Quadrangle 1981; Philipp, Mississippi Quadrangle 1981). Although it is a part of the larger Yazoo Headwater Project, to date very little has been done to change the natural course of Tippo Bayou (U.S. Army Corps of Engineers 1993b). Many of its tributaries are also unchannelized, although a few (notably Ascalmore Creek) are highly altered. In spite of the natural stream courses, over the years Tippo has experienced high rates of sedimentation, most likely the result of agricultural practices in the area. As a result, sections of the Bayou have heavy silt deposits and the water typically has a very high turbidity.

Both the Tallahatchie and Yalobusha Rivers have been highly altered as a result of flood abatement and drainage projects (U.S. Army Corps of Engineers 1993a). Both rivers receive outflow from flood control reservoirs constructed in the mid 1900's (Tallahatchie River – Arkabutla, Sardis, and Enid Lakes; Yalobusha River – Grenada Lake), and no longer follow a natural flow regime. Additionally, the Army Corps of Engineers constructed several canals connecting the Tallahatchie River to tributaries of the Yalobusha River. Although water doesn't typically flow through these canals, during periods of high flow on the Tallahatchie River, water may be diverted through these canals and into the Yalobusha to prevent flooding along the Tallahatchie or vice versa. One of those canals passes through the refuge and connects to Tippo Bayou (U.S. Army Corps of Engineers 1992).

Soils in this area reflect the hydrological history of the area, consisting primarily of Alligator-Forestdale and Alligator Associations, which are formed from alluvium from the Mississippi River. In general, these are poorly drained acidic soils that are generally too wet in the winter and spring to be suitable for residential and industrial development. These soils also experience shrinking and cracking as they dry, and swell when wet. They are high in natural fertility and high in available water capacity. However, drainage is necessary in most of these areas to reduce ponding and cultivation is frequently delayed in the springtime (U.S. Dept. of Agriculture 1967, 1970).

The 30-year average temperature (minimum – maximum) ranges between 30 degrees Fahrenheit (^{0}F) and 57^0 F during winter months and between 66^0 F and 91^0 F during the summer (temperatures recorded in Grenada). The relatively warm and humid weather allows for >220 days of agricultural growing in the Delta. Annual precipitation averages 58 inches. Rainfall occurs relatively uniformly throughout the year with slightly more rain during the winter months. Driest conditions occur in August through October. (NOWData for Grenada, MS, http://www.nws.noaa.gov/climate/xmaxis.php?wfo=jan). During the winter and spring, most precipitation falls over an extended period. During the summer months, precipitation is generally in the form of localized thunderstorms with heavy rainfall (U.S. Dept. of Agriculture 1970).

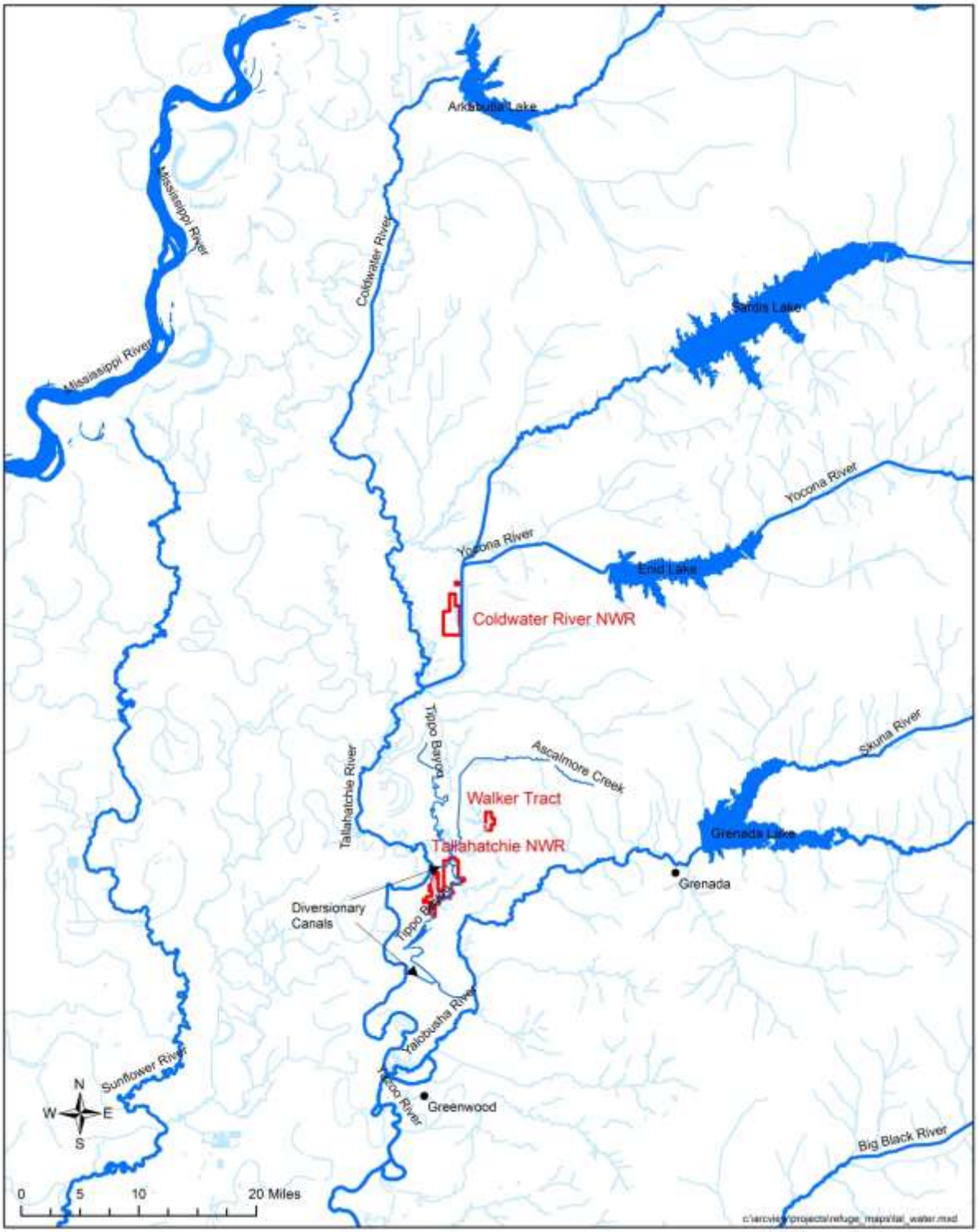

Figure 3: Major bodies of water impacting Tallahatchie National Wildlife Refuge. Altered flow regimes from the four U.S. Army Corps of Engineers flood control reservoirs affect the flow of water through and around the refuge.

HISTORIC HABITAT CONDITIONS

The refuge is located east of the Mississippi River in the area commonly referred to as the Delta. The Delta was formed over millions of years as unconsolidated sediments were deposited and the floodplain shifted. The alluvial soils were the product of sediments from the annual overflow and inundation of the Mississippi River across the Delta. The recurrence of soil deposits created relatively young soils geologically. The Delta is relatively flat with elevation changes of less than 5 feet within a mile and considerably less as one moves further from the river to the Loess Hills. Elevations of 100 to 160 feet typically occur within the region.

The Delta is located within the MAV, a vast floodplain that stretches from southern Illinois down to Louisiana. It covers approximately 25 million acres and, prior to human colonization was covered with an extensive bottomland hardwood forest. The area surrounding Tallahatchie NWR is a part of this system. Historically, the area would have been subject to seasonal flooding from the Tallahatchie and Yalobusha River, as well as Tippo Bayou. This seasonal flooding replenished nutrients in the bottomland area and allowed the formation of a bottomland hardwood forest, probably dominated by sweet gum, green ash, oaks, and sugarberry. The lowest areas were likely flooded most of the year and would have been dominated by cypress and tupelo (Ouchley et al. 2000). In dry years, these areas would have likely supported annual grasses and sedges, which would provide seeds for migrating and wintering waterfowl.

CURRENT HABITAT CONDITIONS

Tallahatchie NWR currently consists of 4,388 acres which includes approximately 750 acres of moist soil units, 80 acres of fallow fields, 800 acres of aquatic habitats (sloughs and permanent water), 610 acres of agricultural fields, 140 acres of forest and 1,989 acres of reforestation areas (Figure 2). Thirteen water wells (one electric, 12 diesel) are present on the property – remnants of its agricultural history. Since the establishment of the refuge, five of those wells have been used to flood agricultural or moist soil units. The condition of the remaining wells is unknown.

Moist-soil units

Tallahatchie NWR has nine areas that have been managed for moist-soil vegetation (grasses, sedges, etc.) in the past. These units range in size from 16 to 278 acres and cover approximately 750 acres. The primary moist-soil units include a series of six impoundments (215 acres), formerly used for rice production, located on the western boundary of the refuge, just south of Mississippi Highway 8. These units range in size from 16 to 48 acres, have water control structures to allow water removal from each unit independently, a single well for refilling the units, and were previously land-leveled. The levees were raised in 2000 and again in 2011 to allow these units to be fully flooded, without the use of an internal levee. These units were transferred to the refuge as part of a mitigation package from the Mississippi Department of Transportation. The mitigation agreement prohibits agricultural use of these units and specifies that they should be managed for more permanent wetland types. As a result of this mitigation agreement, these units will no longer be managed as moist-soil units.

Additional moist-soil units are found on the Walker Tract of the refuge. These three units range from 103 to 273 acres. Although they are equipped with water control structures and diesel-driven wells, they typically have not been actively managed for moist soil. The largest unit (unit 101) was drawn down during the summers of 2006, 2007, 2012, and 2014 to allow approximately 150 acres of brush to be cut/sprayed and to help control the lotus. The control

was somewhat successful, but will be an ongoing challenge in this unit. Current plans call for continuing to manage units 101 and 103 for moist soil, while developing unit 102 into wood duck brood habitat.

Fallow fields

Units classified as fallow fields are those managed to maintain openings without the use of farming. This includes a total of five units (approximately 80 acres). Four of these areas are small fields associated with parking areas or rights-of-way (units 74, 98, 99, and 104). The final unit is a large field located across from a wildlife viewing platform. The area is typically mowed every other year to provide visitors with a scenic overlook. Because these units are managed more in conjunction with public use and not for wildlife habitat, they will not be discussed further in this plan.

Aquatic habitats

Aquatic habitats on Tallahatchie NWR include Tippo Bayou and its associated sloughs and oxbows, man-made ponds, and drainage ditches that total nearly 800 acres (Figure 2). Tippo Bayou is probably the most notable aquatic feature on the refuge, bisecting the northern half of the refuge and then forming the southeastern and extreme southwestern boundary. The refuge portion of Tippo Bayou represents one of the few remaining unchannelized waterways in the state. Numerous oxbows and sloughs are still present, many remaining isolated from Tippo except during periods of high water. One of these, Long Branch (unit 96), has been developed into a lake to provide fishing opportunities on the refuge. It has been stocked with various species of sunfish, largemouth bass, and channel catfish to improve recreational value. The remainder are unmanaged areas dominated by cypress and/or water tupelo and typically are heavily used by waterfowl in the winter.

The Walker Tract contains Brushy Creek, a small stream which crosses the southwest corner of the property. Though typically fairly slow moving, Brushy Creek runs bank full during the winter months and back flows into the moist-soil units. Additionally, the moist-soil units contain old stream channels that rarely completely dry, providing additional year-round open water habitat. As mentioned in the moist-soil section above, unit 102 on Walker Tract will now be managed for permanent water and not for moist-soil vegetation.

Tallahatchie contains four small ponds ranging in size from 2 to 7 acres (Table 1). These are permanent, treeless bodies of water. Currently, they are not managed and three of the four occur south of MS Highway 8. The largest drainage ditch on the property is located along the western boundary of the refuge and passes under Highway 8 to Dummy Line Road. It then passes under Dummy Line Road to join Tippo Bayou. Numerous other ditches bisect the property, the majority associated with agricultural fields (past or present). Many of these ditches require periodic maintenance to allow for draining areas or to prevent backing water onto adjacent landowners.

Agricultural fields

Tallahatchie NWR currently includes 610 acres of agricultural fields, divided into 11 units (Figure 2). In the past, the refuge has partnered with local farmers to plant and harvest crops on the property through the cooperative farming program. The typical cooperative farming agreement calls for 25% of the crops to be left standing as the refuge's share (payment for use of land). Over the last several years, the refuge has taken its share in the form of milo planted in the low-lying areas of several fields. The remainder of the agricultural fields have been planted in

soybeans. During the winter, the standing crop of milo is flooded, either by rainwater, or through pumping. These units are frequently heavily used by waterfowl.

In 2011, refuge staff created a buffer along Tippo Bayou and removed a portion of several agricultural fields from production. It is very possible that in the near future cooperative farming will no longer be a management option for the refuge. If that occurs, these fields may be used for force-account farming, moist soil management, or may be reforested. Table 2 summarizes crops planted for the 2012 growing season (typical distribution of crops) and the management potential for each unit. These fields were not farmed in 2013 or 2014 and a ditch was plugged in fall of 2012 to hold water on units 53, 54, and 56 through the winter months.

Table 2: Acreage and most recent crops (2012) in agricultural fields on Tallahatchie NWR.

Unit	Acreage	Most Recent Crop (2012)	Management Potential
46	61	Milo	Water control structure (WCS)
47	30	Soybeans	None
48	190	Soybeans and 84 acres of milo	WCS (3) and diesel well
49	28	Fallow in 2012	None
50	35	Soybeans	None
51	65	Soybeans	None
53	26	Soybeans	Diesel well, ditch plug
54	54	Soybeans	Diesel well, ditch plug
55	52	Soybeans	Diesel well
56	38	Soybeans	Diesel well, ditch plug
60	29	Soybeans	None

Reforestation areas

When the Service acquired the main tract of Tallahatchie NWR (1992), the bulk of the lands were agricultural fields (Fig. 2). Over the following 10 years, nearly half the acreage was either planted in trees or allowed to regenerate naturally (see Table 1). A mix of hardwoods was planted with additional low-lying areas planted in bald cypress, water tupelo, and buttonbush. Hardwood species planted included sycamore, sugarberry, honey locust, persimmon, sweet pecan, sweetgum, green ash, eastern redbud, black gum, eastern cottonwood, Chickasaw plum, mayhaw, and various species of oak (nuttall overcup willow, water, pin, and cherrybark). Trees were typically planted on a 12 by 12 foot spacing, resulting in approximately 302 trees per acre. Nearly all the agricultural lands south of MS Highway 8 were reforested, the only exceptions being the moist soil units behind the grain bins and the fallow field inside Long Branch (unit 36). North of MS Highway 8, approximately half of the fields have been taken out of agricultural production and either reforested or allowed to go through natural succession. All reforestation units are located on the main tract of Tallahatchie NWR.

Based on general observations, reforestation efforts appear to be successful overall. Although the fields looked unplanted for the first five to ten years after planting, they now are beginning to look well stocked. Nearly 2,000 acres have been reforested or are developing trees through natural succession. Within the next 10 to 15 years, it will be necessary to thin or otherwise manage many of these stands to help shape the developing forest.

Bottomland hardwood forests

The only mature hardwood forest areas on Tallahatchie NWR include a portion of the Sayle Tract (Figure 2) which contains approximately 60 acres of hardwood forest located south of MS Highway 8 (unit 94), an area of approximately 20 acres located due north of this area on the north side of MS Highway 8 (unit 70), and a 30-acre tract located between Long Branch and Tippo Bayou, south of Highway 8 (units 41 and 125) . There are several other forest patches scattered across the refuge, but all are small (< 10 acres). Additionally many of the sloughs are forested in cypress and water tupelo, but those forests do not extend much past the high water mark. Until the reforestation areas mature, bottomland hardwood forests will be very limited on the refuge.

HABITAT CHANGES FROM HISTORIC TO CURRENT CONDITION

Many of the hydrological changes in the area occurred in the early to mid-1900's. The Yazoo Headwater Project (YHP) was developed and approved after the Flood Control Act of 1936. This called for the construction of four flood control reservoirs (Arkabutla, Sardis, Enid, and, Grenada) which would reduce normal peak flows by storing a portion of storm runoff and releasing the stored runoff during normal low flow periods. (USACE 1993a). The YHP also outlined plans for construction of additional levees and floodways and additional channelization of portions of the Tallahatchie and Yalobusha Rivers. Ascalmore Creek (a major tributary of Tippo Bayou) was likely channelized during this time frame (Figure 3). The majority of the tributaries of the Tallahatchie and Yazoo Rivers had already been extensively "improved" through channel straightening, clearing and snagging operations, by local drainage districts during the 1920's (USACE 1993a).

Since the initiation of the YHP to the present, numerous cutoffs have been completed along the Tallahatchie River. In a 1993 report, the U.S. Army Corps of Engineers (USACE) notes that the length of the Tallahatchie River from Sharkey Landing (near the mouth of the Coldwater River) to Greenwood had been reduced from 100 miles in the 1880's to 55 miles (USACE 1993b). As a result of the numerous hydrological projects, the Tallahatchie River, Yalobusha River and many their tributaries have problems with sediment deposition (USACE 1993a). Large sections of the rivers have been dredged to remove sediment. In 1979, the USACE began construction of a control structure that linked the Tallahatchie River to Tippo Bayou, below its confluence with the highly altered Ascalmore Creek on what is now refuge lands (USACE 1992). The structure, completed in 1981, was part of the Tributaries Unit of the Yazoo Basin Project and was designed to divert water from the Tallahatchie River into Tippo Bayou during periods of high flow.

Aerial imagery from 1950 reveals that most of the refuge lands were still forested. The northern half of the Walker Tract was cleared between 1950 and 1962 (U.S. Dept. of Agriculture 1967, 1970). The remaining portion was cleared sometime between 1962 and 1981. On the main tract of the refuge, about 50% of the current agricultural area (units 46 – 51, 53 – 56, 60) was cleared prior to 1950. The remaining acreage was cleared between 1962 and 1981. Similarly, most of units 15, 17, 18, 24, 38, 40, and 90, and portions of units 23 and 36 were cleared before 1950. By 1962, units 23 – 28, 30, 31, and 32 had been entirely cleared. The remaining areas were cleared sometime between 1962 and 1981. By 1981, lands which currently make up Tallahatchie National Wildlife Refuge consisted of approximately 730 acres of aquatic habitats (sloughs and permanent water), 110 acres of forest, and 3,360 acres of agricultural fields (Cascilla, Mississippi Quadrangle 1981; Money, Mississipppi Quadrangle 1982; Philipp, Mississippi Quadrangle 1981).

The first land acquired for Tallahatchie NWR was the 557-acre Walker Tract (Figure 4). This tract was originally purchased by Ducks Unlimited (DU) in 1990, developed jointly with the Service under a DU MARSH Project, and then purchased by the Service in 1991. After being cleared, the property had been farmed in cotton, then rice and contained 3 wells, 3 water control structures, and an extensive levee system. The work completed by DU and the Service involved renovating the levee, raising the low spots, installing emergency spillways, and installing an additional water control structure.

In 1992, two more tracts were added to Tallahatchie NWR. These included 1,138 acres purchased from John Hancock Insurance Company and 509 acres purchased from John Whitten. The majority of this land was located north of MS Highway 8, with approximately 400 acres located south of the highway in the vicinity of Tippo Bayou and Long Branch. These tracts were composed mainly of cropland and led to the initiation of cooperative farming on Tallahatchie NWR.

Beginning in 1993, cooperative farming encompassed about 1,000 acres each year for the next several years (Table 3). Crops were primarily soybeans, rice, milo, and corn, with all the corn planted contributing to the refuge share. During this time frame, the farmers' "rent" consisted of either crops left standing on 25 percent (%) of the acreage farmed, or a combination of standing crops and in-kind services. These services included building and repairing levees, replacing water control structures, installing water distribution pipes, and pumping water for migrating and wintering waterfowl.

In 1997, the refuge acquired an additional 1,656 acres from Mississippi Department of Transportation (MDOT) as part of a wetland mitigation bank. This property was primarily located south of MS Highway 8, contiguous with the existing main tract of the refuge. There was a farming agreement currently in place and, per the acquisition agreement, it was phased out over the course of three years. As a result, the refuge nearly doubled in size and the acreage in agriculture also doubled immediately following this acquisition. Major crops remained the same.

Beginning with the acquisition in 1997, the refuge began reducing the agriculture base and reforesting most of these areas. Prior to this, any agricultural lands that weren't farmed were primarily maintained as fallow fields or managed for moist soil vegetation. Over a 4-year period, nearly 1,300 acres were reforested on Tallahatchie NWR. An additional 580 acres, primarily in smaller or isolated fields were allowed to reforest through natural regeneration, with some planting to supplement the natural regeneration.

In 2003 the refuge acquired a 116-acre parcel purchased from Ike Sayle. This tract was an inholding within the main portion of the refuge and consisted of forested habitat and grasslands enrolled in CRP. The grasslands have been allowed to regenerate naturally.

The refuge began the establishment of vegetative buffers along the north section of Tippo Bayou in 2005 with the removal of unit 65 (28 acres) from the cooperative farming program. This continued in 2012 with the removal of units 126 to 132 (87 acres) from the farming program. These areas are regenerating naturally. During the 2013 and 2014 growing seasons, the refuge did not participate in the cooperative farming program and the agricultural fields remained fallow. It is uncertain at this time whether farming will resume in 2015.

The most recent acquisition was a 189-acre parcel acquired from J.W. Fennell in 2013. This tract contains approximately 118 acres of CRP lands planted in hardwoods, an 18-acre wetland, and a section of Tippo Bayou (approximately 50 acres).

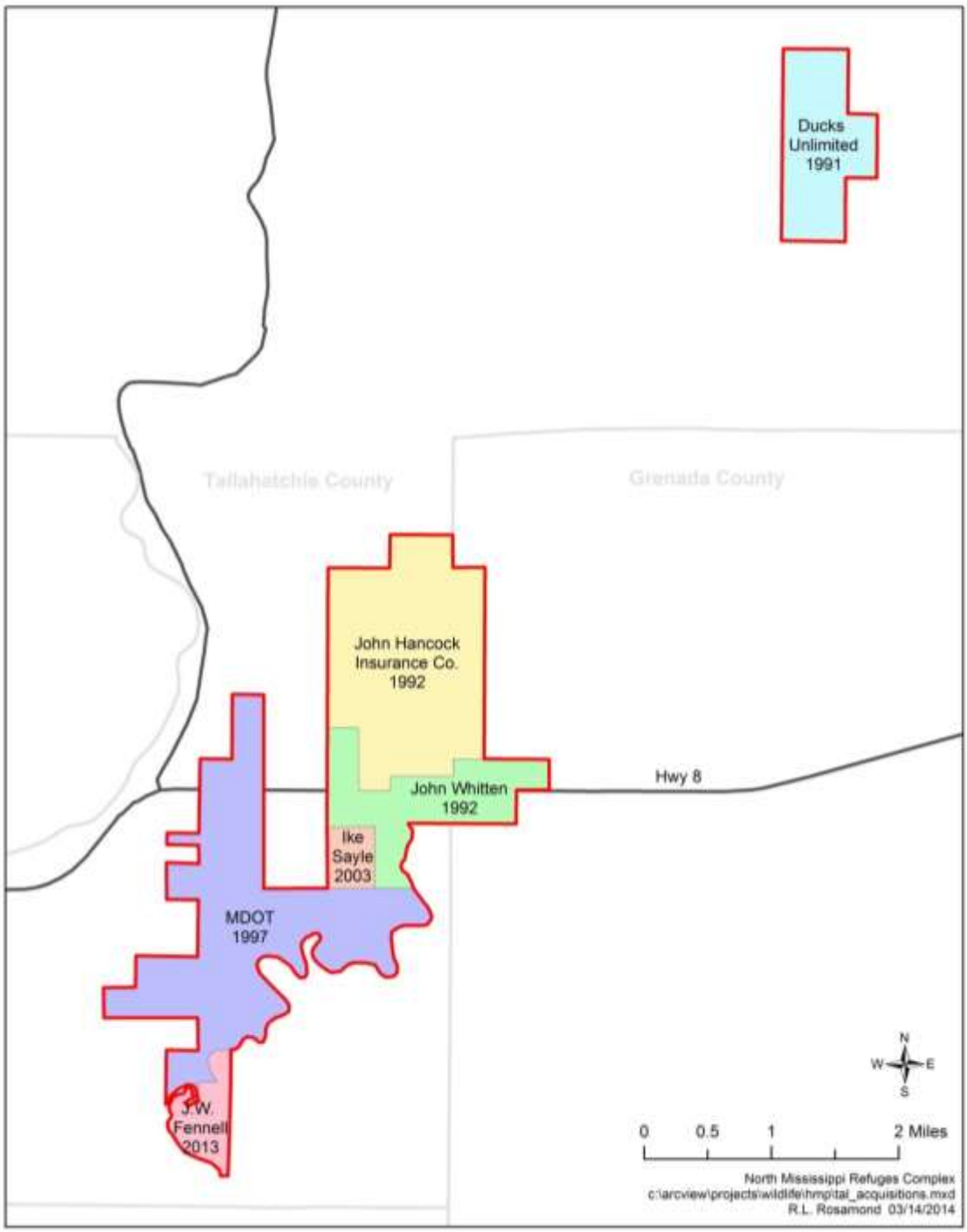

Figure 4: Map depicting the history of land acquisition for Tallahatchie National Wildlife Refuge.

Table 3: Number of acres farmed and reforestated acreage from 1993 to 2013 on Tallahatchie National Wildlife Refuge.

Year	Farmed acres	Crop	Reforested acres (Running Total)	Fee Title Acreage (Running total)
1993	975	Soybeans, rice, milo		2,427
1994	1010	Soybeans, rice, milo, corn		2,427
1995	948	Soybeans, milo, corn		2,427
1996	1061	Soybeans, milo corn		2,427
1997	2,283	Soybeans, rice, corn	140	4,083
1998	1,146	Soybeans, rice, corn, sunflowers	487	4,083
1999	1,020	Soybeans, rice, corn	947	4,083
2000	628	Soybeans, milo, corn	1,282	4,083
2001	628	Soybeans, rice, milo, corn	1,282	4,083
2002	668	Soybeans, corn, millet	1,282	4,083
2003	721	Soybeans, milo, corn, millet	1,282	4,199
2004	741	Soybeans, corn, millet	1,282	4,199
2005	648	Soybeans, corn, millet	1,707 (includes some natural regeneration.)	4,199
2006	680	Soybeans, corn, millet	1,707	4,199
2007	653	Soybeans, corn, millet	1,707	4,199
2008	548	Soybeans, milo, corn	1,735	4,199
2009	706	Soybeans, milo, corn, millet	1,740	4,199
2010	709	Soybeans, milo, corn, millet	1,740	4,199
2011	568	Soybeans, milo	1,740	4,199
2012	608	Soybeans, milo	1,830 (includes additional natural regen.)	4,199
2013	0	None	1,969 (includes new acquisition)	4,388

*Acres removed from agriculture were not always immediately reforested. Some were maintained as fallow fields, converted to moist-soil units, or allowed to regenerate naturally. (Source: U.S. Fish and Wildlife Service, North Mississippi Refuges Complex Annual Narratives and Cooperative Farming Agreements 1991-2013)

POTENTIAL IMPACTS ASSOCIATED WITH GLOBAL CLIMATE CHANGE

Over the last 50 years, researchers have documented an increase in the global annual average temperature (Karl et al. 2009). This observation, coupled with observed increases in sea level, changes in precipitation patterns, and decreases in glacial ice, have led to an increase in research in the field of global climate change. Much of this research involves modelling to predict potential changes in various parts of the country.

In the southeast, and specifically the MAV, most of the models indicate that over the course of the next 70 years, there will be an increase in the number of days each year over 90 degrees Fahrenheit and changing patterns of precipitation (Faulkner 2010). Most predictions support the idea that precipitation events will be heavier and less frequent, resulting in a higher incidence of both flooding and drought. These changes in temperature and precipitation have the potential to have direct impacts on species present on the refuge, as well as affect the phenology of various life history events of various species (Rosenzweig et al. 2007).

If these trends continue as predicted, we are likely to have more difiiculty in managing Tallahatchie NWR for waterfowl. It will be more difficult to produce quality moist-soil habitat or productive stands of grain crops for waterfowl due to more extreme precipitation events. Additionally, drought conditions may make it impossible at times to provide flooded habitat during migration. A decrease in the number of freezing days (another predicted effect) may cause an increase in weeds or other pest species, as they no longer experience winter mortality. Additionally, some species of plants may not be able to germinate, depending on the number of days of cold temperatures required to prepare the seed for germination. Many of the aquatic vertebrates currently present on the refuge, may not be able to persist if the water levels of those units cannot be maintained. Over the last 25 years, over half a million acres of agricultural lands have been reforested within the MAV (Haynes 2004). These trees should increase carbon sequestration which would lessen the impacts of climate change. Whether or not this acreage is sufficient to have a measurable impact, remains to be seen.

CHAPTER III. RESOURCES OF CONCERN

IDENTIFICATION OF REFUGE RESOURCES OF CONCERN

Priorities associated with wildlife and habitat management for the NWRS are determined through directives, policies, and legal mandates. Resources of concern can include individual species, species guilds (e.g., waterfowl, shorebirds), and/or habitat communities that support refuge purposes as well as Service trust resource responsibilities (i.e., threatened and endangered species, and migratory birds). Resources of concern are also native species and "natural" functional communities such as those found under historic conditions that are to be maintained and, where appropriate and possible, restored on a refuge (U.S. Fish and Wildlife Service 2011a).

Resources of concern for Tallahatchie 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; and the goals for the refuge set forth in the North Mississippi Refuges Complex CCP. The CCP specifically identified several priority groups that were grouped into the broad categories of migratory birds, state and federally listed threatened and endangered species, and the overall ecological integrity of bottomland hardwood habitat (U.S. Fish and Wildlife Service 2005). The refuge vision attempts to combine these concerns into an overall direction for the future management of the refuge. While there are other wildlife, fish, and plant resources which the refuge directly or indirectly affects, the resources of concern and the refuge vision determine management actions outlined within the HMP for Tallahatchie NWR.

The species/communities selected as resources of concern from these plans support the following NWRS mandates:

- Refuge Purpose(s);
- Refuge System Mission;
- Conserve Biological Integrity, Diversity, and Environmental Health; and
- Fulfill Service Trust Resource Responsibilities (e.g., migratory birds, threatened and endangered species).

Resources of concern identified for Tallahatchie NWR include:

- Migrating and Wintering Waterfowl;
- Breeding Wood Ducks;
- Birds of Bottomland Hardwood Forests;
- State and Federally Listed Species and Species of Special Concern; and
- Paddlefish.

MIGRATING AND WINTERING WATERFOWL

SIGNIFICANCE

Tallahatchie NWR was one of the five initial refuges acquired to support wintering waterfowl habitat needs within the Lower MAV as outlined in the NAWMP (U. S. Fish and Wildlife Service 1986). The MAV historically provided a vast expanse of flooded forested wetlands for wintering

waterfowl (Reinecke et al. 1989) nearly 80 percent of which has been lost to agricultural conversion and much of the remainder unavailable due to flood abatement practices along the major river systems. The reliance on smaller parcels (i.e., State Wildlife Management Areas and NWRs) to mitigate the losses through intensive habitat management is critical to achieving wintering waterfowl population goals.

IDENTIFICATION OF HABITAT REQUIREMENTS

Waterfowl undergo several physiological processes that result in significant energy and nutrient demands while migrating or wintering in the MAV. Energy requirements are expressed in duck-use days (DUDs) and duck-energy days (DED). Duck-use days represent the number of ducks that can obtain daily energy requirements from an acre (ac) of foraging habitat for a day. A DED is the amount of food necessary to sustain daily energy requirement of one duck for one day.

Waterfowl arrive as early as September (e.g., migrating blue-winged teal) and may stay on the wintering ground through March (Strader and Stinson 2005). Therefore, resources need to be available over an extended period of 120 to 150 days. Energy requirements during fall or spring migration are enormous and must be replenished daily to sustain long-distance flights. In addition, cold weather conditions can significantly increase energy demands, which may affect migration. Finally, waterfowl undergo courtship and molt prior to and during spring migration which requires shifts in diets and habitat requirements. Collectively migrating and wintering waterfowl need a mosaic of habitat conditions consisting of shallow emergent wetlands with an abundance of moist-soil plants, shallow flooded bottomland hardwood forested areas, supplemental agricultural foods, and escape cover or sanctuary from disturbance (Reinecke et al. 1989).

Historically, the MAV provided this diversity of habitats across the vast landscape. The reduction of the forested system by 80 percent (Tiner 1984), has dramatically increased the importance of providing the habitat complex for wintering waterfowl on a very limited conservation footprint. Natural habitats that afford food and cover resources for waterfowl within the Delta consist of naturally flooded or irrigated bottomland hardwood forests and native emergent wetlands (i.e., moist-soil vegetation). Shallow flooded bottomland hardwood forest (less than18 inches) provide food resources in the form of acorns, other soft mast, and aquatic invertebrates. These are heavily used when available by mallards, wood ducks and gadwall. The principle food resource within these areas is small acorns from Nuttall, willow, water, and certain other less common red oaks that are high in energy (Kaminski et al. 2003).

Ducks also use other soft mast tree species like ash, maple, and blackgum. Bottomland hardwood systems also provide an abundance of aquatic invertebrates (Bateman et al. 2005, Heitmeyer 1988) which are an important protein source for female dabbling ducks during late winter as they undergo the prebasic molt. Finally, forested wetlands provide important sources for thermal cover during extreme cold weather, and provide opportunity for isolation of birds for pair bond formation and resting (Reinecke et al. 1989).

Moist-soil habitat provides a 10-fold increase in food resource abundance in comparison to bottomland hardwoods (Strickland et al. 2010). These natural plant communities exist in areas of semi-permanent water that dry during the growing season and stimulate annual plant growth and seed production. When naturally or artificially inundated in fall and winter, dabbling ducks rely extensively on the seeds to meet energy demands (Fredrickson and Taylor 1982, Reinecke

et al. 1989, Strader and Stinson 2005). The seed produced from smartweed, millet, sedges and many other moist-soil plants provide both energy and other nutrients often lacking in cereal grains. Although moist-soil habitats have limited duck-energy days (~1900 DED/acre), this habitat in connection with others provides the complex to support the nutritional requirements of foraging waterfowl.

Agricultural grain crops (rice, corn, milo, and millet) provide much higher DEDs per acre than natural habitats (i.e. moist-soil or bottomland forest). Refuges and State wildlife management areas are much more likely to meet goals of the NAWMP if they are able to provide flooded agricultural grains. These high-energy foods are rich in carbohydrates but lack some of the nutrients available in natural food sources. Therefore, a mixture of natural vegetation and grain crops are best able to meet the nutritional and energy requirements of over-wintering waterfowl.

As previously mentioned, waterfowl during winter are subject to increased energy demands as a function of weather, disturbance from hunting, and other behavioral aspects related to courtship and prebasic molt. Providing opportunities for waterfowl to have access to sanctuary is especially important during this period. With the exception of the boardwalk and viewing tower in unit 76, the portion of Tallahatchie NWR north of MS Highway 8 (approximately 2,250 acres) is currently closed to public use and thus provides a true sanctuary.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

The LMVJV established habitat targets on federal, state, and private conservation areas. In setting habitat objectives, it was agreed that foraging habitat was the limiting factor. Objectives were set based on food production and acres by habitat type for a complex of habitats, including harvested and unharvested cropland, moist-soil areas, and flooded forest land. On Tallahatchie NWR, this represented the annual availability of 80 acres of flooded forested wetlands, 852 acres of moist-soil habitat, and 212 acres of unharvested crops (U.S. Fish and Wildlife Service 2005). However, subsequent field review of those objectives indicates that the moist-soil habitat objective is not achievable based on existing habitat conditions (U.S. Fish and Wildlife Service 2011). That objective has been modified to reflect current refuge capability, and is currently 400 acres of moist-soil habitat. The unharvested crop and forested wetland objects remain the same.

Currently the refuge can provide 50 acres of flooded forested (oak component present) wetlands, 394 acres of moist-soil habitat, and 145 acres of unharvested crops. Combined these habitats can support over 3.4 million DED's, based on the unharvested crop acres being planted to milo (Reinecke and Kaminski 2007). Additional habitat is available on Tippo Bayou and its associated sloughs, though no data is available to calculate the contribution of these habitats to DED's. The mosaic of wetland habitats present on Tallahatchie NWR provides waterfowl with thermal cover, fulfills other food resource requirements, and provides sites for loafing and courtship behavior. During the winter months, the refuge supports thousands of dabbling ducks, diving ducks, and white-fronted geese.

RECONCILING CONFLICTING HABITAT NEEDS

Tallahatchie NWR was established specifically to provide habitat for migrating and over-wintering waterfowl. As such, management for this group will generally be the top priority for the refuge. In many cases, management for waterfowl will also promote other resources of concern and all efforts should be made to provide management that can encompass both. At minimum, the refuge should provide 50 acres of flooded forested wetlands and 400 acres of moist-soil

habitat. Additional acreages of these habitat types may be provided if other resources are available and it is not detrimental to other resources of concern.

BREEDING WOOD DUCKS

SIGNIFICANCE

The wood duck is an iconic waterfowl species of North America. In the Mississippi Flyway the species represents the second most harvested duck. Wood ducks populations were decimated during the late 19th and early 20th century through market hunting and significant modifications to breeding habitat (Bellrose 1990). Within the MAV, agricultural clearing and commercial forestry has drastically reduced the natural availability of cavities for nesting. Additionally, in many areas, good brood rearing habitat is also lacking. Providing breeding habitat for wood ducks is listed as one of the purposes of the establishment of Tallahatchie NWR.

IDENTIFICATION OF HABITAT REQUIREMENTS

Wood ducks require two major habitat components to sustain populations: suitable nest sites in the form of natural cavities or artificial nest boxes and wetlands to provide abundant food resources for brood rearing, concealment from predators, cover from extreme weather, and loafing sites (Bellrose and Holm 1994). The reliance on cavities for nesting makes this species unique among North American waterfowl species.

Within Mississippi bottomland hardwood forested systems, suitable natural cavities have been found to be limited (Lowney and Hill 1989, Lee 1991) and nest box programs may serve as a means to support and expand local wood duck production. If nest box programs are used to supplement natural cavities, boxes should be erected in direct proximity to slow moving rivers and streams with abundant vegetative cover along the banks, scrub-shrub swamps/sloughs, and other wetlands with an abundance of aquatic invertebrates. These areas will provide important brood rearing sites during the first two to four weeks when duckling mortality is highest (Bellrose and Holm 1994). Recommended brood habitat includes 30 to 50 percent shrubs, 40 to 70 percent herbaceous emergent vegetation, 0 to 10 percent trees, and 25 percent open water, containing a minimum of 10 loafing sites (18 inches by 18 inches, 2 to 5 inches above water) per acre (McGilvrey 1968). Protection of nest boxes by installation of a metal shield below is necessary to prevent recurring depredation of nests and hens from raccoons and snakes. After wood duck broods have reached flight stage, dietary shifts begin to influence habitat use. Birds utilize more natural seed production and by fall rely heavily on hard mast (acorns) when hardwoods are shallowly flooded in fall and winter. The retention of shallowly flooded emergent wetlands and forested areas into early spring provides important microhabitats for aquatic invertebrates which are critical to female wood ducks during egg laying.

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Tallahatchie NWR provides suitable brood rearing habitat in the sloughs and various backwater areas associated with Tippo Bayou and Long Branch. Targeted management on several of the units could produce additional brood habitat. Additionally, allowing the development of snags or placing nest boxes adjacent to these habitats would provide both nesting and brood rearing habitat in close proximity to each other.

RECONCILING CONFLICTING HABITAT NEEDS

In addition to providing habitat for migrating and over-wintering waterfowl, Tallahatchie NWR was established to provide breeding habitat for wood ducks. As such, management for this species will also be top priority for the refuge. Management for wood ducks will also provide habitat (in the form of forested wetlands) for migrating and wintering waterfowl. Additionally, it will promote habitat for other resources of concern, specifically several of the state species of concern (Mississippi Museum of Natural Science 2005).

BIRDS OF BOTTOMLAND HARDWOOD FORESTS

SIGNIFICANCE

The decline of many forest interior bird species is of major concern and is the basis for many research and management activities within the MAV and other bottomland hardwood systems in the southeastern United States. Many of the identified species of greatest conservation priority are dependent on a complex understory and vertical structure within a hardwood forest block of sufficient size to support viable source populations (Twedt et al. 1999). Priority bird species for the MAV were identified by Twedt and others (1999) and are listed in Table 4. All of these species are neotropical migrants wintering in Central American and breeding in North America.

IDENTIFICATION OF HABITAT REQUIREMENTS

As a group, hardwood forest birds are extremely diverse. Within the MAV bottomland hardwood forest, well over 100 species can be found including hawks, owls, passerines and many neotropical migratory species. Many of the species are resident, while others are more transient, returning each year either to breed or simply use the area as a temporary stop-over for migration. Because of the high bird species richness within the forested landscape, the habitat requirements for them can be equally diverse. Small separations between niches allow species to minimize competition and coexist. Table 4 summarizes the potential use of Tallahatchie NWR and general habitat requirements for the priority bird species within the MAV.

Table 4: Priority bird species of the Mississippi Alluvial Valley, Partners In Flight rank, potential seasonal use of Tallahatchie NWR and general habitat required (Turcotte and Watts 1999).

Species	PIF Rank	Breeding	Migration	Wintering	Habitat
Swainson's warbler	29	X	X		Nearly closed canopy, dense understory, near water
Cerulean warbler	28		X		Tall deciduous trees
Swallow-tailed kite	28				Restricted to south Delta
Prothonotary warbler	24	X	X		Tree cavities near water
Painted bunting	24	X	X		Scrub-shrub or edge habitat, reforestation areas
Red-headed woodpecker	22	X	X	X	Open habitat with dead trees, wooded swamps

Bell's vireo	23				Only occasional sightings in Mississippi
Northern parula	23	X	X		River swamps and hardwood forests, beard or Spanish moss
Worm-eating warbler	23		X		Forested slopes with dense understory
Kentucky warbler	22	X	X		Moist deciduous forest, with dense understory, along swamp edges and bottoms
Orchard oriole	22	X	X		Edge habitat, reforestation areas
Yellow-billed cuckoo	22	X	X		Wet forests
Wood thrush	22	X	X		Moist hardwoods, dense understory for nesting
White-eyed vireo	22	X	X		Stream bottoms with brushy thickets

The swallow-tailed kite and Bell's vireo are not likely to occur on Tallahatchie NWR or even nearby. Similarly, cerulean warblers and worm-eating warblers would simply use the habitat for migration. Both the orchard oriole and the painted bunting are largely edge or scrub-shrub species. Although habitat is currently present in the form of large areas of reforestation, this habitat is not likely to be perpetuated over the long term. The remaining eight species will be the focal species for management in the remainder of this plan

Priority species such as Swainson's warblers, Kentucky warblers, and white-eyed vireos require dense understory growth that is often associated with tree fall gaps (Pashley and Barrow 1993), in forests with large block sizes (> 5,200 acres) in a largely forested landscape (> 60%) (LMVJV 2007). Forest thinning can increase canopy gaps, thereby increasing understory and midstory growth (Robinson and Robinson 1999). Thatcher (2007) found that most Partners in Flight priority species had higher densities in thinned hardwood forest than unthinned. Heltzel and Leberg (2006) also found that Swainson's, Kentucky and hooded warblers increased by 200 percent in bottomland hardwood forest where selective timber harvest had occurred. However, this study also showed that Acadian flycatcher and prothonotary warbler declined in abundance in harvested stands. Norris et al. (2008) found that both Acadian flycatchers and prothonotary warbers were most abundant in unharvested stands and in those stands with individual selection cuts. Likewise, Nuttle and Burger (2005) found prothonotary warblers primarily in stands that were older than 21 years and most abundant in older natural forest stands (greater than 60 years old). In the same study, they only detected Swainson's warblers in naturally regenerated forest greater than 60 years old.

Twedt and Somershoe (2008) conducted a study on Tensas River NWR in Louisiana to test the effects of selective harvesting on priority forest birds. They found that the priority species Kentucky warbler, orchard oriole, red-headed woodpecker, white-eyed vireo, and Swainson's warbler responded favorably to variable-retention clustered thinning silvicultural treatments, although those responses were often delayed several years post-harvest. In fact, the extrapolated data indicate that Swainson's warblers would likely reach their highest densities approximately 16 years after the thinning operation. Conversely, prothonotary warblers responsed negatively to the same treatments, reaching their lowest population in stands seven years post-harvest and potentially

returning to pre-harvest densities 13 years post-harvest. In addition to direct removal of habitat, timber harvest can have negative effects on canopy dwelling and forest interior songbirds (Pashley and Barrow 1993) by fragmenting forests. Forest fragmentation often increases nest parasitism by brown-headed cowbirds and predation.

Cooper and others (2009) studied prothonotary warblers on White River NWR in Arkansas to test the effects of patch cuts and thinning on breeding success. They found that prothonotary warblers favored areas with a high density of available cavities. Silvicultural treatments reduced the density of available cavities and reduced the density of breeding males. Overall reproductive success (fledlings per plot and fledglings per hectare) was not influenced by treatment but was impacted by hydroperiod. They cautioned that timber harvest should be minimized in areas where prothonotary warblers prefer to nest and that long-term management plans should consider using forest management techniques that mimic natural disturbances. They also suggested that prothonotary warblers are an appropriate indicator species for the bottomland hardwood forest ecosystem.

The PIF Bird Conservation Plan for the MAV proposed minimum forest sizes to support viable populations for priority species (Twedt et al. 1999). For the species listed above, these forest sizes range from 2,700 hectares (6,672 acres) for the prothonotary warbler to over 40,000 hectares 98,842 acres) for swallow-tailed kites. Swainson's warblers are listed as requiring patches of 4,700 hectares (11,614 acres). Additionally, the Bird Conservation Plan identifies the MAV as supporting 34.8 percent of the breeding population of prothonotary warblers and 20.8 percent of the breeding population of Swainson's warblers. While prothonotary warblers are frequently observed on the refuge during the spring and summer months, there are no records of Swainson's warblers over a 15-year period (F. Broerman, B. Rosamond, unpublished data).

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Tallahatchie NWR is included in the Malmaison Bird Conservation Area (BCA) (Twedt et al. 1999). The Malmaison BCA encompasses a total of nearly 85,000 acres and includes both Malmaison Wildlife Management Area (State managed) and Tallahatchie NWR. Approximately 33,000 acres within this area currently contains mature forest. However, the existing "core" forest area (area forested that is not impacted by edge effects) is only about 2,000 acres. As the Tallahatchie NWR reforestation areas mature, they will contribute to the "core" forest goal of 13,000 acres. This area will then potentially be able to support viable populations of several of the priority bird species listed above. Additional efforts should focus on working with landowners between Tallahatchie NWR and Malmaison to reforest the acreage between these two sites and increasing the core area for forest interior birds.

Several of the priority bird species currently use the early successional habitat provided by hardwood reforestation areas, as well as the forested sloughs. The reforested areas presently or in the near future will likely support wintering and breeding woodcock as well. This early successional habitat will eventually disappear as the stands age.

As these reforestation stands mature, it is important to manage them to develop uneven-aged stands with complex vertical structure. This may require thinning the stands. However, many of the stands on Tallahatchie NWR had variable initial survival, so stands will need to be evaluated to determine the extent of thinning necessary. Additionally, the current boundary of Tallahatchie NWR is somewhat linear, primarily following Tippo Bayou. Because of this, there are likely to be extensive "edge effects". This may result in increased brood parasitism by cowbirds as well as increased predation by mesopredators such as raccoons. Once uneven-aged stands are established,

additional forest management should be conducted cautiously to avoid further fragmentation and creation of additional edge habitat.

RECONCILING CONFLICTING HABITAT NEEDS

In general, management for birds of bottomland hardwood forests will occur on the reforestation units. Much of the management that will benefit these species will also be beneficial to wintering waterfowl and wood ducks, although some conflicts could arise. Additionally, some management activities could conflict with management for Indiana bats, northern long-eared bats, and pondberry, all listed as Federally Endangered or Threatened. In these cases, management for birds of bottomland hardwood forests will be considered a secondary priority.

FEDERAL AND STATE LISTED SPECIES AND SPECIES OF SPECIAL CONCERN

SIGNIFICANCE

There are no Federally listed species known to occur regularly on Tallahatchie NWR, although wood stork are currently proposed for downlisting from endangered to threatened and expanding their range to include Mississippi. Additionally, there are several species that are either State listed or are considered by the State as species of greatest conservation need. For the purpose of this plan, we will consider State Species of Special Concern as those species listed as Tier 1 or Tier 2 species in Mississippi's Comprehensive Wildlife Conservation Strategy (Mississippi Museum of Natural Science 2005). Species with incidental occurrences on the refuge (usually due to being at the edge of the current range) will not be considered any further in this plan. Table 5 lists species that are Federal or State listed, or State Species of Special Concern, their conservation status, and their occurrence on Tallahatchie NWR.

Table 5: Species that are Federal or State listed and Species of Special Concern that potentially could occur on Tallahatchie National Wildlife Refuge.

Species	Status*	Occurrence on Tallahatchie NWR
Wood stork	Federal Threatened: GA, FL, SC, AL, MS; State:Tier 2, Endangered	Frequent, post-breeding
Rafinesque's big-eared bat	State: Tier 2	Unknown
Hoary bat	State: Tier 2	Unknown
Southeastern myotis	State: Tier 1	Several roost trees located, refuge likely used by maternal colonies and winter roosting
Northern long-eared bat	Federal Threatened	Unknown
Indiana bat	Federal Endangered	Unknown
American black bear **	State: Tier 2	Incidental
Little blue heron	State: Tier 2	Frequent, post-breeding
White ibis	State: Tier 2	Frequent, post-breeding
King rail	State: Tier 2	Occasional, breeding season
Bald eagle	State: Tier 2	Occasional, nesting nearby
Common ground dove	State: Tier 2	Incidental
Short-eared owl	State: Tier 2	Occasional, wintering

Cerulean warbler	State: Tier 2	Incidental, migration
LeConte's sparrow	State: Tier 2	Frequent, wintering
Grasshopper sparrow	State: Tier 2	Occasional, migration
Painted bunting	State: Tier 2	Frequent, breeding season
Rusty blackbird	State: Tier 2	Occasional, wintering
Alligator snapping turtle	State: Tier 2	Several captured in unit 76 and Tippo Bayou
Prairie kingsnake	State: Tier 2	Unknown
Red milk snake	State: Tier 2	Unknown
Chestnut lamprey	State: Tier 2	Unknown
Blue sucker	State: Tier 2	Unknown
Northern starhead topminnow	State: Tier 2	Captured in several sloughs
Pondberry	Federal Endangered	Unknown

*Tier 1 – Species that are in need of immediate conservation action and/or research because of extreme rarity, restricted distribution, unknown or decreasing population trends, specialized habitat needs and/or habitat vulnerability. Some species may be considered critically imperiled and at risk of extinction/extirpation.
Tier 2 – Species that are in need of timely conservation action and/or research because of rarity, restricted distribution, unknown or decreasing population trend, specialized habitat needs or habitat vulnerability or significant threats.
**Louisiana black bear (*Ursus americanus luteolus*) are federally listed as Threatened, but by definition cannot occur north of Hwy 82 in Mississippi, so therefore cannot occur on Tallahatchie NWR. By definition, the only species which could occur on the refuge is the American black bear (*Ursus americanus americanus*). In 2010, a radio-collared bear from south Mississippi (*luteolus*) moved through north Mississippi crossing the refuge, before returning to south Mississippi.

IDENTIFICATION OF HABITAT REQUIREMENTS

Table 6 shows the general habitat needs for the State and Federal species of special concern that potentially could occur on Tallahatchie NWR. In general, habitat requirements for many of these species overlap with requirements of other resources of management concern. As a result, management objectives targeting habitat for other resources of concern are likely to benefit species listed below as well. These species were taken into account when making the habitat management decisions outlined in this document.

Table 6: General habitat requirements for species that are Federal or State listed and Species of Special Concern that potentially could occur on Tallahatchie National Wildlife Refuge.

Species	Habitat
Wood stork	Foraging only: wetlands with fish, especially small – medium sunfish (Depkin et al. 1992)
Rafinesque's big-eared bat	Bottomland hardwood forests, cavity trees, artificial roosts (Stevenson 2008)
Hoary bat	Hardwood forests (Harvey et al. 2011)
Southeastern myotis	Bottomland hardwood forests, cavity trees, artificial roosts (Stevenson 2008)
Northern long-eared bat	Summer roosts in trees and snags, under loose bark or in cavities or crevices; Winter roosts in caves and mines (Foster and Kurta 1999)

Indiana bat	Summer roosts in snags under loose bark or in crevices; Winter roosts in caves and mines (Carter and Feldhamer 2005).
Little blue heron	Nesting: shrubs/willows over water (Turcotte and Watts 1999); Foraging: wetlands with fish, amphibians, and invertebrates (Smith 1997)
White ibis	Nesting: shrubs/willows over water (Turcotte and Watts 1999); Foraging: wetlands with invertebrates, some fish and amphibians (Kushlan 1979)
King rail	Wetlands with little to no woody vegetation and a high degree of open water/herbaceous vegetation interspersion (Darrah and Krementz 2009)
Bald eagle	Typically forage over water, nest in large trees, in or near sloughs, rivers, etc. (Turcotte and Watts 1999)
Short-eared owl	Winter only: Open areas around sloughs, rice fields, and marshes (Turcotte and Watts 1999)
LeConte's sparrow	Wintering only: rank, tall grasses, damp weedy fields, stands of broomsedge, panicum, cattails (Beadle and Rising 2002)
Grasshopper sparrow	Fallow agricultural fields, pasturelands, dense growths of broomsedge (Turcotte and Watts 1999)
Painted bunting	Thickets, edges of woods, hedgerows, streams, reforestation areas. (Turcotte and Watts 1999)
Rusty blackbird	Wintering only: open swampy woodlands (Turcotte and Watts 1999)
Alligator snapping turtle	Deeper water of large rivers, oxbows, swamps, ponds, and bayous (Ernst and Lovich 2009)
Prairie kingsnake	Grasslands, hardwood forests (Tennant 2003)
Red milk snake	Open woodlands, fallow fields, pastures, farmlands (Tennant 2003)
Chestnut lamprey	Main channel of moderately large rivers. Ammocoetes in swifter water with fine substrata or slower areas with vegetation. (Ross 2001)
Blue sucker	Deep channels of moderate to large, free-flowing rivers. (Ross 2001)
Northern starhead topminnow	Open water in quiet areas of streams or ponds. (Ross 2001)
Pondberry	Bottomland hardwood forests with a seasonal high water table confined to late winter and early spring. (Hawkins et al. 2009)

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Tallahatchie NWR currently provides habitat for many of the above-mentioned species. With proper management, the reforestation areas have the potential to provide important roosting habitat for all five of the mentioned bat species and the bald eagle. They currently provide habitat for painted buntings. Southeastern myotis colonies have been found using tupelo trees in several of the sloughs on the refuge. In the past, white ibis and little blue herons have nested on the Walker Tract of the refuge. The moist-soil units, sloughs, and permanent water currently

provide habitat for wood storks, short-eared owls, LeConte's sparrow, rusty blackbird, little blue herons, white ibis, king rail, grasshopper sparrow, alligator snapping turtles, and northern starhead topminnow. The presence of the remaining species on the refuge has yet to be verified, but the habitat is available.

RECONCILING CONFLICTING HABITAT NEEDS

Many of the above-mentioned species occur on the refuge already under the current management regime. With the continuation of current management practices, these species should continue to occur on Tallahatchie NWR. Federal and State listed species will be considered a priority and actions to benefit waterfowl or migratory birds will not be taken if those actions will be detrimental to the listed species. State Tier 1 and Tier 2 species will be considered as tertiary priorities. However, if conflicts do arise every effort will be made to accommodate these species, though not to the detriment of a higher priority resource of concern.

PADDLEFISH

SIGNIFICANCE

Paddlefish are a Tier 3 species of concern within the state (Mississippi Museum of Natural Science 2005) and populations are threatened by habitat degradation (siltation, pesticides, and loss of spawning habitat), introduced species (various carp species), and commercial harvest. Tier 3 species are of less immediate conservation concern, but are in need of planning and effective management due to unknown or decreasing population trends, specialized habitat needs or habitat vulnerability. These fish typically travel from large rivers into smaller tributaries to spawn and have fairly specific requirements for suitable spawning habitat. Paddlefish are found on the refuge in Tippo Bayou, primarily in the spring. In spite of the state ranking as a Tier 3 species, the state allows commercial paddlefish harvest in select waterbodies. Commercial harvest is not permitted in Tippo Bayou, but it is allowed in waterbodies further downstream, including Six Mile Lake and the Yazoo River.

IDENTIFICATION OF HABITAT REQUIREMENTS

Tippo Bayou supports paddlefish and is believed to be a historic spawning area for these fish. They spawn in spring water temperatures of 53^{o} F to 61^{o} F, during periods of high flow, in areas 6 to 40 feet deep, over a substrate of gravel, cobble, or woody debris (Becker 1983, Crance 1987, O'Keefe et al. 2007). Additionally, paddlefish feed on zooplankton, largely Cladocerans and Copepods (Chipps et a. 2009, Hoxmeier and Devries 1997, Moore and Cotner 1998). Paddlefish are intolerant of dissolved oxygen levels below six ppm and have the potential to be affected by the presence of introduced carp species. Asian carp, specifically bighead carp and to a lesser extent silver carp also feed on zooplankton and have the potential to outcompete paddlefish when food is limited (Schrank et al 2003).

POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Tippo Bayou is the dominant feature on Tallahatchie NWR. It runs northeast to southwest along the entire length of the refuge. The Tippo Bayou watershed comprises just over 10 percent of the 1.46 million-acre Yalobusha River watershed (Figure 5) (USGS 2008). The majority of the

Tippo Bayou watershed is within the Delta, and as a result, much of the runoff that flows into the system drains agricultural lands. Historically, most of this watershed was covered by bottomland hardwood forests. As the land was colonized, small scale clearing occurred. This changed rapidly beginning in the 1930's as agriculture became more mechanized and soybeans gained profitability as a crop. In Mississippi between 1930 and 1970, acres planted in soybeans increased from 12,000 acres to over two million, largely in the Delta (Saikku 2005). This increased land clearing, coupled with drainage projects to increase arable acres, has resulted in high silt loads in many drainages, including Tippo Bayou. Although many rivers and tributaries within the Delta have been channelized and dredged over time, the main channel of Tippo Bayou and several of its tributaries still largely follow their natural courses (USACE 1993b).

In addition to the increased silt load, increased agriculture within the watershed has added chemical pollutants to the system. In 2001, North Carolina State University sampled water, sediment, and fish on NWRs within the Lower Mississippi River Ecosystem and tested samples for various pesticides. On Tallahatchie NWR, they found that current levels of the banned pesticide, dichlorodiphenyltrichloroethane (DDT), and toxaphene in both benthic and predator fish was below U.S. Food and Drug Administration (FDA) Action Level, but levels of DDT and toxaphene in benthic fish was above the "predator protection level". DDT and toxaphene were also present in the sediment samples and were present in the water at concentrations above the U.S. Environmental Protection Agency (EPA) Chronic Water Quality Criteria. This study also tested for current-use pesticides. Acifluorfen, bentazon, metolachlor, metribuzin, and trifluralin were detected in water samples collected on the refuge. (Note: acifluorfen (Ultra-Blazer), bentazon (Basagran), and metribuzin – herbicides commonly used in soybean production; metolachlor (Dual) – herbicide used in soybean, corn, and milo production; trifluraline (Treflan) – pre-emergence herbicide used to control grasses and broadleaf weeds—all now require approval by the Regional Coordinator for use on refuges.)

In its present state, Tippo Bayou has been degraded by siltation and pesticides, as much of the land within its watershed has been cleared and used for agriculture in the last 40 to 50 years (Shea et al. 2001, USACE 1993b). Although it now experiences high turbidity, there is anecdotal evidence that historically the water in Tippo Bayou was much clearer and free of sediment.

Staff from Private John Allen National Fish Hatchery, along with refuge staff, are currently monitoring the movements of paddlefish into and out of Tippo Bayou. Although the presence of gravid female paddlefish in Tippo Bayou during the spring indicates the species historically used this area for spawning, it does not give any indication of whether the spawning is successful. Through working with partners to implement best management practices (BMPs) within the watershed, as well as employing BMPs on refuge lands, the water quality of Tippo Bayou should improve and result in increased success in paddlefish spawning and recruitment.

RECONCILING CONFLICTING HABITAT NEEDS

One of the priorities listed in the Improvement Act is to maintain the biological integrity, biological diversity, and environmental health of the System. The restoration of Tippo Bayou is a step towards this goal. Additionally, improved habitat and water quality in Tippo Bayou supports management for paddlefish and all other resources of concern. Because of this, management for paddlefish, particularly as it relates to improving the water quality of Tippo Bayou will be considered a top priority for the refuge.

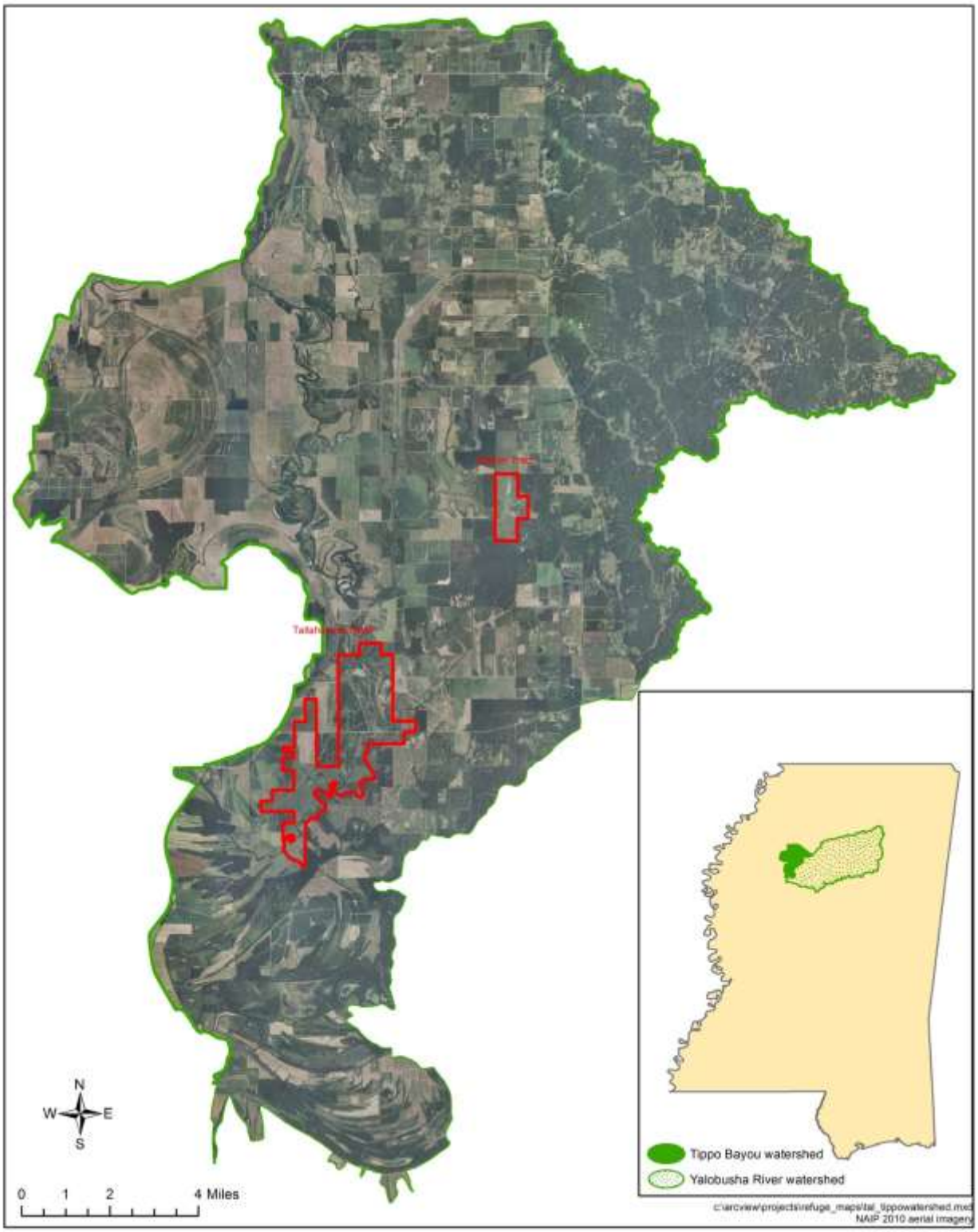

Figure 5: Aerial map showing the extent of the Tippo Bayou watershed and the location of Tallahatchie NWR within the watershed. Inset shows the location of the Tippo Bayou watershed with the Yalobusha River watershed in Mississippi.

CHAPTER IV. HABITAT GOALS AND OBJECTIVES

Habitat management goals and objectives were developed from the North Mississippi Refuges Complex CCP. A goal expresses a broad, qualitative statement that supports the establishing purposes and vision of the refuge. The step-down objectives are quantitative statements which provide more specific, measurable and time sensitive habitat direction for accomplishing the goals. The goals in the CCP were created to cover the three refuges and Farm Service Agency properties administered by the Complex and are based on wildlife populations rather than the habitat. Of the 8 goals in the CCP, four are related to habitat management. They are:

Goal 1 – Promote the conservation and management of migratory birds within northern Mississippi in a manner that supports treaties and national and international plans and initiatives.
Goal 2 – Implement a program of science-based stewardship of the fish and wildlife resources associated with the North Mississippi National Wildlife Refuges Complex.
Goal 3 – Protect and restore habitat for federal and state threatened and endangered species found in the Lower Mississippi River Ecosystem.
Goal 4 – Maintain and/or restore ecological systems within the Mississippi Alluvial Valley and Central Gulf Ecosystems, which mimic historical conditions.

Therefore, it was necessary to update and refine the goals to more closely reflect the habitat for Tallahatchie NWR while still retaining the intent of the goals in the CCP. This allowed for more specific objective(s) from the CCP to be expanded upon or combined to address the resources of concern identified the HMP **(Chapter 3).** Following each objective is a list of the associated primary resource(s) of concern and a supporting rationale**.** To meet goals and objectives, it is important to evaluate progress through research and inventory and monitoring and alter strategies as appropriate (adaptive management). Therefore, Adaptive Management Monitoring Elements are identified. Additional inventory and monitoring of wildlife species may occur based on a station-level inventory and monitoring plan, regional priorities, or research opportunities.

GOAL 1. BOTTOMLAND HARDWOOD FOREST HABITAT
Restore, enhance, and maintain healthy, bottomland hardwood forest habitat to support a natural diversity of plant and animal species and foster the ecological integrity of the Mississippi Alluvial Valley Ecosystem (CCP Goals 1, 3, and 4 combined, pages 60, 78, 80).

OBJECTIVE 1.1 REFORESTATION
By 2028, at least 35 percent of reforestation acreage should contain a diverse assemblage of both hard mast and soft mast producing hardwood species of at least two age classes and characterized by a minimum of 60 to 70 percent overstory canopy cover, 25 to 40 percent midstory cover, and 60 to 70 square feet per acre basal area (with over 25 percent in older age classes)(CCP Objective 4-2) to provide suitable habitat for the resources of concern.

Resources of Concern: Migrating and Wintering Waterfowl, Birds of Bottomland Hardwood Forests, State and Federally Listed Species and Species of Special Concern, Paddlefish

Rationale: Sixty stands containing nearly 2,000 acres have been planted in trees or allowed to naturally regenerate. These stands range from 2 to 17 years old. To speed development into a functioning bottomland hardwood forest, the LMVJV Forest Resource Conservation Working

Group (2007) recommends management towards the above-mentioned desired forest conditions, recognizing that no more than 35 to 50 percent of stands on the landscape are likely to meet those conditions at any given point in time. This translates into approximately 700 acres of the current reforestation acreage meeting these criteria during the life of this plan. The ultimate outcome of this restoration is to provide 80 acres of functioning bottomland hardwood forest to meet waterfowl objectives established by the LMVJV as well as contribute to the Malmaison BCA core acreage goal of 13,000 acres.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Overstory canopy cover • Midstory canopy cover • Basal area	• Forest cruise/inventory sampling (traditional)
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Songbird species composition • Successful use by breeding prothonotary warblers (use as a surrogate species for bottomland hardwood forest birds)	• Breeding bird survey (point counts) • Monitoring nesting success of prothonotary warblers

OBJECTIVE 1.2 CAVITY TREE
By 2028, evaluate at least 35 percent of all reforestation units for the potential of future development of a minimum of one tree greater than 26 inches diameter at breast height (dbh) per acre with a visible cavity sufficient to provide a nest site for wood ducks or roost for bats or provide an equivalent artificial structure (CCP Objective 1-2).

Resources of Concern: Breeding Wood Ducks, Birds of Bottomland Hardwood Forests, State and Federally Listed Species and Species of Special Concern

Rationale: The limited availability of natural cavities for wood ducks to nest has been well documented in the MAV (Lowney and Hill 1989, Lee 1991). Local populations of wood ducks and hooded mergansers can be increased dramatically by providing appropriate nesting habitat and/or artificial nest structures. Likewise, both Rafinesque's big-eared bats and southeastern myotis use cavities in large diameter trees for roosting and reproduction. The reforestation stands will still be too young (less than 60 years old) to have trees large enough to support large cavities, but can be evaluated to determine that such cavities may develop in the near future.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• DBH of trees • Cavities present/acre • Artificial nesting/roosting structures	• Forest cruise/inventory sampling • Mapping of cavity locations

Primary Wildlife Response Variables	Probable Assessment Methods
• Wood duck use of nestbox/cavities • Prothonotary warbler use of cavities • Bat use of cavities	• Nestbox checks • Cavity checks

OBJECTIVE 1.3 INVASIVE ANIMAL CONTROL – FERAL HOGS
Annually eradicate a minimum of 50 percent of the feral hog population found within refuge boundaries (CCP Objective 4-3) to maintain habitat quality for resources of concern.

Resources of Concern: Migrating and Wintering Waterfowl, Breeding Wood Ducks, Birds of Bottomland Hardwood Forests, State and Federally Listed Species and Species of Special Concern, Paddlefish

Rationale: Feral hogs destroy the integrity of bottomland hardwood forests by competing with native species for food, destroying understory vegetation, and changing the microhabitat conditions on the forest floor by reducing soil moisture and leaf litter. They also can hinder reforestation attempts by destroying developing seedlings.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Presence of wallows and rooting • Destruction of understory vegetation	• Visual surveys • Transects • Exclosures
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Feral hog use	• Hog surveys • Number of hogs removed through trapping and/or incidental hunting annually

GOAL 2. WETLAND HABITAT
Maintain a mosaic of wetland habitat types to provide foraging, roosting, nesting, migrating and over-wintering habitat for waterfowl (CCP Goal 1 page 60).

OBJECTIVE 2.1 MOIST-SOIL MANAGEMENT
On an annual basis in units 46, 48, 53, 54, 56, 101, and 103, provide 400 acres of herbaceous vegetation with a minimum of 75 percent cover of desirable moist soil plants (e.g., sprangletop, panicum, millet, toothcup, smartweed, Carex spp.), keeping non-desirables (e.g., coffeeweed and cocklebur) to less than 20 percent, and eliminating any invasive species (e.g., parrotfeather, alligatorweed) and flooded with 6 to 24 inches of water for a minimum of 60 days from October to March to support foraging habitat objectives for migrant and wintering waterfowl developed by the LMVJV (CCP Objectives 1-1, 4-1).

Resources of Concern: Migrating and Wintering Waterfowl; State and Federally Listed Species; and Species of Special Concern.

Rationale: Tallahatchie NWR was established to provide habitat for over-wintering waterfowl. For that reason, moist-soil management will be directed primarily towards managing for those plants preferred by waterfowl, contributing to the total DEDs provided by the refuge. Management activities will also provide habitat for several state species of special concern (e.g., wood stork, king rail, little blue heron, and white ibis).

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Dominant species present • Percent cover by species	• Annual herbaceous cover plots (m^2)
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Waterfowl use during winter • Rail use during migration	• Waterfowl counts/unit • Rail surveys (callback)

OBJECTIVE 2.2 FLOODED CROPLAND
On an annual basis in units 46, 47, 48, 49, 50, 51, 53, 54, 55, 56, 60, provide 212 acres of grain crops (millet, rice, corn, or milo) and flood to a depth of 18 inches or less, for a mininmum of 60 days from November 1 to March 15 to support habitat objectives for migrating and wintering waterfowl developed by the LMVJV (CCP Objective 1-1).

Resources of Concern: Migrating and Wintering Waterfowl.

Rationale: Grain crops provide a high energy food for migrating and wintering waterfowl. Providing this habitat will provide DEDs to help meet waterfowl foraging objectives provided by the LMVJV.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Acres of floodable grain crops	• GIS Mapping
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Waterfowl use	• Waterfowl surveys

OBJECTIVE 2.3 SHRUB SWAMP
On an annual basis in units 25, 26, 27, 28, 30, 31, 102 provide 200 acres of shrub swamp habitat characterized by 30 to 50 percent shrubs, 40 to 70 percent herbaceous emergent vegetation, 0 to 10 percent trees, no invasive aquatic species (e.g. parrotfeather, alligatorweed), and 25 percent open water and containing a minimum of 10 loafing sites (18 inches by 18

inches, 2 to 5 inches above water) per acre in close proximity to nest boxes or natural cavities to provide brood rearing habitat for wood ducks (McGilvrey 1968) (CCP Objectives 1-2, 1-4, 1-5).

Resources of Concern: Migrating and Wintering Waterfowl; Breeding Wood Ducks; Birds of Bottomland Hardwood Forests; State and Federally Listed Species; and Species of Special Concern.

Rationale: Providing shrub swamp habitat will provide brood habitat for breeding wood ducks and potential breeding habitat for several species of songbirds, white ibis, and little blue herons. Additionally, this habitat is critical for pair-bond formation and thermal cover for wintering waterfowl. Permanently flooded units will also provide habitat for other aquatic species and potential foraging areas for bats.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Percent herbaceous cover • Percent woody vegetation • Percent open water • Number of loafing sites • Presence of invasive vegetation	• Plots (m^2) • Visual survey (presence/absence)
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Wood duck brood use • Establishment of rookeries • Waterfowl use	• Brood counts • Rookery counts • Waterfowl surveys

OBJECTIVE 2.4 INVASIVE ANIMAL CONTROL– NUTRIA
Annually eradicate a minimum of 75 percent of the nutria population found within managed wetland units (CCP Objective 4-3) to provide quality habitat for resources of concern.

Resources of Concern: Migrating and Wintering Waterfowl, Breeding Wood Ducks, Birds of Bottomland Hardwood Forests, State and Federally Listed Species and Species of Special Concern, Paddlefish

Rationale: Nutria are very destructive in wetland systems. They impede management activities by clogging water control structures and burrowing into levees, causing levee failure. Additionally, they compete with native species for food resources and can change the vegetative composition in a wetland.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Presence of feeding platforms • Percent cover of different wetland plants	• Visual surveys • Exclosures

Primary Wildlife Response Variables	Probable Assessment Methods
• Nutria use	• Nutria surveys

GOAL 3. AQUATIC HABITAT
Restore, enhance, and maintain healthy aquatic systems to support a diverse and self-sustainable community of native plant and animal species and to foster the ecological integrity of the Lower Mississippi River Ecosystem (CCP Goals 3, 4, and 5 combined, pages 78, 80, and 85).

OBJECTIVE 3.1 PADDLEFISH HABITAT
By 2020 and annually after that, manage Tippo Bayou and tributaries within the refuge boundaries, to provide conditions favorable to support self-sustainable populations of paddlefish including dissolved oxygen concentrations of greater than six parts per million, the presence of four spawning areas per river mile characterized by a silt-free substrate of gravel, cobbles, or coarse woody debris, and a minimum average zooplankton density of 60 individuals per liter from May to September, dominated by Cladocerans and Copepods (Hoxmeier and Devries 1997; Schrank et al. 2003) (CCP Objective 2-3).

Resources of Concern: State and Federally Listed Species and Species of Special Concern; Paddlefish.

Rationale: Paddlefish are unable to tolerant low dissolved oxygen and need silt-free spawning areas. Their habitat needsmeet or exceed the tolerance range of the majority of the native fish species that should be present within Tippo Bayou.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Dissolved oxygen • Water temperature (annual variation) • Flow rates • Chlorophyll a levels (phytoplankton) • Number of potential spawning sites • Sedimentation rate	• Water chemistry tests • Visual survey (presence/absence) • Bathymetry
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Paddlefish use • Paddlefish spawning • Zooplankton density	• Gill netting • Telemetry • Spawning mats • Plankton net sweeps

OBJECTIVE 3.2. WATER QUALITY
By 2028, eliminate all point entry sites for chemicals and sediments entering Tippo Bayou and associated sloughs within refuge boundaries (CCP Objectives 2-2, 2-3, and 5-4).

Resources of Concern: State and Federally Listed Species and Species of Special Concern, Paddlefish.

Rationale: Tippo Bayou currently carries a heavy silt load largely as a result of runoff from agricultural lands. This runoff likely contains various agricultural chemicals as well, further impairing the water quality of Tippo Bayou, thus impacting the aquatic species able to use Tippo. A number of the fields and reforestation areas on the refuge currently have culverts that empty directly into Tippo Bayou and its associated sloughs, potentially contributing to the problems.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Water visibility • Water quality parameters • Water temperature	• Secchi disk • Standard water chemistry tests • Long-term temperature probes
Primary Wildlife Response Variables	**Probable Assessment Methods**
• Paddlefish use • Paddlefish spawning • Zooplankton density	• Gill netting • Telemetry • Spawning mats

OBJECTIVE 3.3. INVASIVE PLANT CONTROL
Annually maintain a minimum of 90 percent of Tippo Bayou and Long Branch and 100% of the area found in slough habitats free of alligatorweed and parrotfeather. (CCP Objective 4-3) to provide quality habitat for resources of concern.

Resources of Concern: Migrating and Wintering Waterfowl; Breeding Wood Ducks; State and Federally Listed Species and Species of Special Concern; and Paddlefish.

Rationale: Alligatorweed and parrotfeather are aggressive aquatic invaders. In shallow areas, they can quickly cover the surface of the water, shading out submerged aquatic vegetation and depleting dissolved oxygen in the water as they die back in fall and winter. In deeper water, they form floating mats that hinder access by wildlife and choke boat motors. Overall, the presence of these aquatic invaders reduces biodiversity.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
• Distribution and area of infestation	• GIS (acres, river miles infested) • Visual surveys
Primary Wildlife Response Variables	**Probable Assessment Methods**

• Paddlefish use • Paddlefish spawning • Native submerged aquatic vegetation	• Gill netting • Telemetry • Spawning mats • Visual surveys

CHAPTER V. HABITAT MANAGEMENT STRATEGIES

Habitat management strategies are specific treatments that can be implemented to achieve the goals and objectives in this plan. In many cases, strategies will be dynamic based in part on resource constraints, timing considerations, weather, or other unforeseen circumstances. Staff will incorporate new strategies as new scientific information is obtained through adaptive management or assumption-based reseach, or from inventories and monitoring conducted on the refuge.

BOTTOMLAND HARDWOOD FOREST HABITAT

Management strategies to meet the reforestation and cavity tree objectives are intimately tied together and in many cases will occur concurrently on the same units. For that reason, potential strategies and management prescriptions to achieve those objectives will be included together. The invasive animal management strategies and prescriptions will apply across all habitat types where feral hogs or nutria occur.

REFORESTATION AND CAVITY TREE MANAGEMENT
(OBJECTIVES 1.1 AND 1.2)

POTENTIAL MANAGEMENT STRATEGIES

The purpose of the reforestation and cavity tree management is to restore the areas replanted over the last 20 years, and the existing forested tracts, into a functioning hardwood forest, which takes time. The first step in the process of management of these forests will be evaluating the stand condition, followed by selection of those stands most in need of manipulation. If any of the following conditions are met, then treatment may be considered: overstory canopy cover greater than 80 percent; midstory cover less than 20 percent or greater than 50 percent; or tree stocking is less than 50 percent or greater than 90 percent. Any treatments would be done to reachand not exceed the specified desired forest conditions.

Due to differential survival in the reforestation areas, many of the traditional silvicultural techniques likely do not apply to these stands. The most typical problem encountered in reforestation stands is the development of dense, even-aged stands, with low species diversity and little to no herbaceous layer. In stands that are in this condition, possible strategies to counter this include thinning the stand and underplanting with additional species. Thinning can be accomplished either through mechanical or chemical methods. If mechanical methods are used, some degree of stump sprouting should occur, which would help in the formation of an uneven aged stand. Chemical methods would allow complete replacement of the treated tree which could presumably be replaced with a seedling of a different species, introducing diversity into the stand, as well as a new age class. If the stand is too dense, a heavy thinning and no underplanting would be recommended. Underplantings can be used to introduce additional species to the stand and can be accomplished either through the use of bare root seedlings or simply allowing natural succession to occur in openings that are created.

An important aspect of a functioning bottomland hardwood forest ecosystem is the hydrology. Although Tippo Bayou itself is largely unaltered, there are numerous ditches and drains throughout the property. Many of these ditches provide drainage to neighboring land owners and must be kept free of beaver debris and log jams. Those that only provide drainage to refuge lands could potentially be plugged and the water allowed to return to its original course. The key management challenge would be to get the water off the reforestation areas in a timely

manner to limit stress during the growing season. Those areas that do not drain well may need to be replanted with cypress and tupelo, as both those species are able to withstand inundation for long periods of time.

Currently, there are nine units totaling approximately 140 acres containing mature forest and 60 units totaling 1,989 acres that are regenerating forests. Additionally, there are 20 units totaling 435 acres that are classified as sloughs. Many of these units contain large trees. Trees in the sloughs and mature forests will likely be the first to develop cavities for wildlife use, and many cavities already exist. However, the units will need to be evaluated to determine the density of cavities present and suitability of existing cavities for use by wood ducks or bats. If insufficient natural cavities exist, the simplest recourse is to erect artificial structures, which are readily used by wood ducks.

SELECTED MANAGEMENT STRATEGIES
The following strategies will be used as applicable on all reforestation units, established forests, and sloughs (see Table 1 and Figure 2) to meet the Reforestation Objective (Chapter 4, Objective 1.1) and Cavity Tree Objective (Chapter 4, Objective 1.2) under the Bottomland Hardwood Forest Goal:

- Conduct standard cruises of each stand to assess condition. Oldest reforestation stands should be evaluated first, and stands should be visited every 10 years. (Table 7)
- Thin stands as needed to promote development toward suggested desired forest conditions. Initial thinings on reforestation stands may open units up to as low as 60% canopy coverage. Successive harvesting should consist of individual selection cuts, mimicking natural disturbance.
- If thinnings occur, leave individual trees that show early stages of cavity development.
- Replant hardwood species in areas where plantings failed; supplement stands by planting more seedlings in areas with low stocking rates.
- If cooperative farming becomes unavailable, consider reforesting a majority of the current agricultural field acres, particularly those units with higher elevation, not subject to flooding.
- Allow flooding on reforestation areas according to rainfall from November 1 to April 1.
- Clean critical drainage ditches throughout area of beaver debris and log jams to allow water to move freely through the area during dewatering periods.
- Allow plugging of drainage ditches where feasible, to restore natural water courses
- Evaluate each stand for the presence and suitability of existing cavities.
- Where natural cavities are lacking, erect additional wood duck boxes, in close proximity to suitable brood habitat.
- By February 15 each year, insure boxes are prepped with sawdust, are in good condition, have predator guards in place, and that any encroaching vegetation is trimmed.
- Evaluate boxes to clean as needed and collect data on use and hatching success.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 1 – 15, 17 – 24, 29, 32 – 34, 37 – 45, 52, 58, 59, 62 – 73, 75 – 86, 89 – 91, 93 – 95, 111, 112, 114 - 134
Units will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions for individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

Table 7: Approximate planting dates and acreages for reforestation areas on Tallahatchie NWR. Units in bold were not planted but have been fallow since the noted year.

Year Planted	Units	Total Acreage
1997	2,3	26
1998	5,8,9,12,14,17,18	175
1999	15,32,34,40,44,59	269
2000	1,4,6,7,20,21,23,24,29,37,38,39	787
2001	10,19,42,43,45,52,62,64,65,66,67,73	263
2006	**33,68,72,90,91,95,114,115,116,123**	124
2007	134	139
2008	58,**63**	74
2009	132	5
2012	**127**	27
2013	**126,128,129,130,131**	54

INVASIVE ANIMAL MANAGEMENT – HOGS AND NUTRIA
(OBJECTIVES 1.3 AND 2.4)

POTENTIAL MANAGEMENT STRATEGIES
Feral hogs are increasingly becoming a problem throughout Mississippi. They reproduce rapidly, feed on a wide variety of animal and plant material, and disturb large areas of soil while foraging. Additionally, their foraging activities provide avenues for the colonization of other invasive species (primarily plants). Feral hogs are already established on Tallahatchie NWR, though the population fluctuates depending on hunting pressure from surrounding properties. During the summer months, they are concentrated in the slough habitats, causing massive soil disturbance on the banks and in the shallows. Other times of year, they can be found in other habitats. Options for controlling feral hogs include shooting and trapping. Although both methods are time-intensive, trapping is likely the most efficient and effective. There is a period of about a month in late winter-early spring and during the late summer-early fall when natural food sources are scarce. Trapping during this time frame will be most efficient and effective (J. Cumbee, U.S. Department of Agriculture, Wildlife Services, pers. comm.).

Nutria are primarily a problem in managed wetland areas. They undermine the levee infrastructure through burrowing and build feeding platforms in units. Additionally, they compete directly with muskrats for food, and often exclude them. Nutria are present at Tallahatchie and are most frequently seen in units 25 through 28, 30, and 31, and occasionally in sloughs. Standard options for controlling nutria include trapping and shooting. At low population levels, opportunistic shooting can be effective at reducing or eliminating the population. They are most vulnerable to shooting in early spring when they bask on cool mornings. At higher population levels, trapping is necessary, as nutria become gun-shy. Trapping is effective throughout the year, using Conibear #220 traps placed in their trails.

SELECTED MANAGEMENT STRATEGIES
The following strategies will be used as applicable on all refuge units to meet the Invasive Animal Objective – Hogs (Chapter 4, Objective 1.3) under the Bottomland Hardwood Forest Goal and the Invasive Animal Objective – Nutria (Chapter 4, Objective 2.4) under the Wetland Goal:

- Continue to trap feral hogs using existing corral pens (units 127 and 130), targeting the timeframe when natural food resources are scarce.
- Construct additional corral pens in units 47, 50, 51, and other areas where heavy feral hog use occurs.
- Encourage shooting of feral hogs by hunters during established hunting seasons on open areas of the refuge.
- Opportunistically shoot nutria when encountered.
- When multiple nutria are seen in units, begin trapping in infested unit, concentrating efforts on trails and feeding/basking platforms.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR ALL REFUGE UNITS
Strategies will be used on an as needed basis. Because hogs tend to move through areas, all attempts will be made to respond quickly to the detection of hogs in a unit. Likewise, nutria will be shot/trapped as needed. General guidelines for invasive animal management strategies will be incorporated into the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

WETLAND HABITAT
The area under consideration for management as wetland habitat includes the Mississippi Department of Transportation mitigation ponds (units 25 to 28, 30, 31), the Walker impoundments (units 101 - 103), and the agricultural fields (units 46 to 51, 53 to 56, 60). Each of these units has traditionally been managed for one or several of these habitat types. As time progresses, these units may be diverted to different wetland habitats than previously managed for, dependent on the succession of individual units, changing staff availability, changing regional directives, and variation in environmental conditions on an annual basis. It is the responsibility of the manager to annually evaluate the units and determine which would best work to meet the objectives in a given year.

MOIST-SOIL MANAGEMENT
(OBJECTIVE 2.1)

Moist-soil management will be conducted primarily to provide food for wintering waterfowl of sufficient quality and quantity to meet the objective set forth by the LMVJV. Often, management for quality moist-soil habitat will result in habitat for migrating rails as well.

POTENTIAL MANAGEMENT STRATEGIES
Moist-soil management involves maintaining moist soil conditions during the growing season to promote the natural production of beneficial plants. Seeds produced by these plants often attract and concentrate waterfowl and other wetland wildlife species. The decomposing vegetation also provides substrate for invertebrates, which are critical for many wetland species. Although small grain crops (“hot-foods”) provide high energy for migrating waterfowl, these artificial foods do not provide the same nutrients found in these natural foods. By varying the timing of disturbance, drawdowns, and reflooding, it is possible to create a mosaic of habitats that provide foraging for wintering waterfowl.

Moist-soil management involves maintaining early-successional plant communities and controlling undesirable plants by disking, herbicides, water level manipulation, or periodically rotating agricultural crops. The Delta region of Mississippi already receives a huge influx of agrochemicals. Most moist-soil management can be successfully accomplished through

mechanical manipulations, monitoring, and quick reactions to undesirable conditions. When herbicide use is unavoidable, only the lowest treatment necessary of the appropriate chemical for the target species should be used.

SELECTED MANAGEMENT STRATEGIES

- Conduct early drawdowns (begin on or about March 1) to promote growth of moist-soil plants while limiting growth of coffeeweed and cocklebur.
- Additional drawdowns can be initiated after willows have seeded (usually after May 15). Later drawdowns may have issues with coffeeweed, but are more likely to promote sprangletop and toothcup.
- If cooperative farming becomes unavailable, consider managing low-lying portions of agricultural units for moist-soil vegetation.
- Disk units every two to three years to restrict willow colonization of units. Disking should be done June to August and be followed by a one to two week drying period to kill exposed willow roots. Following the drying period, the unit should be reflooded and, after a period of at least two weeks, can be drawndown again for shorebird use if desired. Note: waiting too long to reflood appears to allow for stump sprouting and may be counter-productive.
- In the year after disking, conduct an early drawdown. This seems to promote millet and smartweed germination. Early drawdowns tend to reduce germination by coffeeweed and cocklebur.
- Even if willow colonization is not an issue, disk at least every third year to promote annual vegetation and limit perennial vegetation.
- Use water to when possible to control undesirable vegetation. (Cocklebur is quickly killed by flooding. Coffeeweed must be overtopped to kill, so not as effective for that species.)
- Use mowing to control undesirable vegetation. In units with dense coffeeweed stands, mow coffeeweed when it begins to flower (before seed set). This will release any grasses underneath and can result in a very productive unit.
- In units with dense vegetation, strip mow or roll vegetation to create landing areas for ducks.
- Evaluate moist soil vegetation every year beginning in June for those units with early drawdown using standard protocol.
- Limit use of agrochemicals. When necessary to use, choose the appropriate chemical for the target species and apply at the lowest rate possible. Use techniques that minimize overspray and exposure to non-target organisms (i.e., Best Management Practices).
- Begin flooding a proportion of the units with dense vegetation in late August, to insure habitat availability for rails when migration begins (September) and for early-migrating waterfowl (i.e., blue-winged teal).
- Stagger fall pumping to ensure a continuous supply of food throughout the winter.
- Flood to a depth of no more than 18 inches; depths of 12 inches or less are preferred by dabblers.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 46, 48, 53, 54, 56, 101, 103
Units will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions for individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

FLOODED CROPLAND MANAGEMENT
(OBJECTIVE 2.2)

Flooded cropland will provide a high energy food source for wintering waterfowl and help meet the waterfowl foraging objectives set forth by the LMVJV.

POTENTIAL MANAGEMENT STRATEGIES
There are two primary methods used to provide "hot foods" or grain crops for waterfowl consumption on refuges. The most commonly used method is through the use of cooperative farming. The standard cooperative farming agreement requires the farmer using refuge lands leave 25 percent of the crop standing as the refuge share. This percent may vary, depending on the agreement, but traditionally has not dropped below 25 percent. The refuge staff works with the farmer to determine the crops that will be planted, the chemicals that can be used on the crops, and which portion will constitute the refuge share. Typically, the refuge share will consist of millet, rice, corn, or milo, and will be left in a floodable area.

The second means of providing grain crops is through "force-account" farming. This is farming conducted by the refuge staff. The benefit of this method is that less land is devoted to farming and 100 percent of the crop is left for waterfowl. This method is the most efficient use of the land and in general requires fewer chemicals, but requires more staff time and likely results in less food produced. Variants on this involve contract farming (paying a farmer to farm just the portion you want in crops) or contracting with a cropdusting service to fly rice seed onto drying impoundments. These can be viable options, depending on the availability of staff and/or funds.

SELECTED MANAGEMENT STRATEGIES
- Cooperatively farm approximately 608 acres per year in rice, corn, milo, or soybeans.
- Work with coop farmer to insure rice, milo, millet, or corn (preferred waterfowl "hot foods") is planted in floodable sections of units.
- If the cooperative farming program becomes unavailable (due to restrictions on the use of GMO's or agro-chemicals), contract with a local cropdusting service to seed approximately 215 acres of floodable land with rice or millet.
- Flood standing crops in fall to provide waterfowl access to grain.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 46 – 51, 53 – 56, 60
Units will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions for individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

SHRUB SWAMP MANAGEMENT
(OBJECTIVE 2.3)

Shrub swamps will be managed to provide habitat primarily for breeding wood ducks (brood and nesting habitat). This management will also benefit wintering waterfowl, potentially provide rookery areas for long-legged waders, provide permanent aquatic habitat for species of special concern, such as the alligator snapping turtle and northern starhead topminnow, and provide foraging areas for bats.

POTENTIAL MANAGEMENT STRATEGIES
The primary units for management as shrub swamps are the MDOT lands on the western side of the refuge. When these mitigation lands were transferred to USFWS, the management plan called for them to be managed as "areas of native vegetation" with water held year-round, with

the exception of natural evaporation. This should lead to the development of an emergent marsh, then finally a scrub swamp. There is likely to be some colonization by willows, during dry springs, but these can be controlled chemically or mechanically. In the past, these areas have primarily been managed for moist-soil vegetation.

Woody species to promote in shrub swamps include primarily buttonbush and swamp privet, although a limited amount of black willow and water elm is acceptable. Unit 102 at the Walker Tract is already moving in this direction with very little active management.

To meet criteria for wood duck brood habitat, loafing sites should be available. If necessary, logs or slash piles can be added to portions of the units. Those areas that are likely to support wood duck broods, will be more effective if they are shallowly flooded and do not support populations of any large predatory fish (e.g., largemouth bass, large catfish, etc.).

Because this represents a more permanent wetland type, it will also be more likely to be colonized by invasive species. The most likely aquatic plants to invade are parrotfeather and alligatorweed, both of which already occur at other locations on the refuge. These species can be controlled through chemical, mechanical, or biocontrol methods. Refer to the invasive plant management strategies below.

SELECTED MANAGEMENT STRATEGIES

- Strive to maintain water across the unit year round. If necessary, can dry in late August/September if need to remove predatory fish or promote development of buttonbush and swamp privet.
- Annually control any exotic/invasive species occurring in units, using all methods available.
- Add loafing structures (i.e., logs and slash piles) to areas best suited for wood duck broods.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 25 – 28, 30, 31, 102
Units will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions for individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

AQUATIC HABITAT
The area under consideration for management as aquatic habitat includes Tippo Bayou (unit 16), Long Branch (unit 96) and the numerous sloughs, ditches and ponds on the refuge (units11, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 89, 93, 112, 118, 119, 121, 124, 135) . It is the responsibility of the manager to annually evaluate habitat conditions on each unit to determine which units require management in a given year.

PADDLEFISH HABITAT MANAGEMENT
(OBJECTIVE 3.1)

POTENTIAL MANAGEMENT STRATEGIES
Management of Tippo Bayou will be conducted with the goal of meeting the habitat needs of paddlefish. Management will be geared towards decreasing the silt load in Tippo Bayou, increasing the dissolved oxygen content, increasing the availability of spawning areas, and ensuring an adequate food supply (i.e., zooplankton) for larval and juvenile fish.

Decreasing the silt load of Tippo Bayou can be accomplished by activities both on- and off-refuge. On refuge, it will be important to locate where and how silt is entering Tippo Bayou. Likewise, on private lands, target areas that contribute the most silt to the system, then work with landowner to alleviate the problem. Strategies for both refuge and private lands include: working with the Natural Resources Conservation Service through some of their buffer programs, locating erosion prone areas of farm fields adjacent to Tippo and controlling the erosion (sediment fencing, buffer strips, riprap), creating a forested stream corridor through reforestation efforts, and removal of point source inflow (culverts).

Increasing the dissolved oxygen (DO) in Tippo Bayou is a more complex issue. The first step would be to determine if there is a problem by monitoring DO levels. If they fall below six ppm, reducing the silt load of Tippo should help to increase the DO levels, as it will allow more submerged aquatic vegetation to survive. Additionally, as the Bayou becomes more shaded (through reforestation success), the resulting cooler water should have higher levels of DO. Too many nutrients in the water can cause eutrophication from the overabundance of phytoplankton in the water which consume DO when they decay. Controlling the influx of fertilizers into Tippo should help control the levels of nutrients.,

Spawning sites for paddlefish can be provided by creating structures over which the paddlefish can spawn. There is evidence that they will spawn over coarse woody debris and not just over gravel or cobble beds (O'Keefe et al. 2007). Logs could be strategically placed in areas where other spawning conditions are met in the spring. Likewise, wooden structures could be built and placed in locations to simulate natural debris, if this habitat is lacking. These areas would need to be kept free of silt as well.

Paddlefish feed primarily on zooplankton, particularly copepods and cladocerans (Chipps et al. 2009; and Zigler 2000; Moore and Cotner 1998; Schrank et al. 2003). There is some evidence to suggest that introduced Asian carp species, particularly bighead carp and silver carp, directly compete with paddlefish for food (Schrank et al. 2003). Additionally, when zooplankton is scarce, bighead carp can begin feeding on phytoplankton, while paddlefish cannot. Strategies to provide sufficient food resources for paddlefish largely involve controlling these introduced carp species. In 2007, a national plan for controlling these two species was finalized (Conover et al. 2007). Strategies include such things as increasing the commercial and recreational harvest of Asian carp species, physical removal of individual fish, introduction of sterile or tetraploid fish to inhibit reproduction, development of biological controls, use of piscicides, and application of Imazapyr and hydrological manipulations that favor native species over Asian carp. Not all of these strategies are likely to be feasible in an open system like Tippo Bayou.

SELECTED MANAGEMENT STRATEGIES

- Continue to work with the Private John Allen National Fish Hatchery to determine the extent of paddlefish use of Tippo Bayou.
- Eliminate direct runoff from cooperatively farmed fields on the refuge into Tippo Bayou through the use of filter strips and/or removal of culverts.
- Work with NRCS and landowners within the Tippo Bayou watersheds on private land projects to reduce the runoff from agricultural areas directly into Tippo through the use of filter strips and buffers.
- Continue reforestation efforts along Tippo Bayou to establish/improve a riparian buffer along the portion that passes through the refuge.

- Encourage the harvest of bighead and silver carp on and off the refuge by recreational anglers.
- Remove any bighead or silver carp encountered during other refuge activities (i.e., gill netting or electro-shocking for paddlefish).
- On portions of Tippo Bayou where spawning areas are lacking, consider providing coarse woody debris, in the form of old logs, constructed wooden structures, or other similar items.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNIT 16
Tippo Bayou will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

WATER QUALITY MANAGEMENT
(OBJECTIVE 3.2)

POTENTIAL MANAGEMENT STRATEGIES
Primary water quality concerns for Tippo Bayou and other water areas on the refuge focus on sediment and chemical runoff, primarily as a result of agricultural operations. Numerous culverts exist on the refuge, which are used to move water quickly off agricultural fields. These culverts also provide a direct source of chemicals and sediment into the aquatic systems on the refuge. Possible strategies for decreasing the impact of these culverts include removing the culvert and using filter strips in front of the culvert to allow sediment to settle out of the water. Both techniques could be used on the refuge but each unit would need to be independently evaluated to determine which is more appropriate.

Additionally, there are numerous best management practices (BMPs) that could be applied to improve water quality. These include: reducing pesticide usage; insuring the minimum amount of fertilizer is applied; observing buffers when applying pesticides or fertilizers; and using filter strips, buffers, and riprap to slow or stop erosion.

SELECTED MANAGEMENT STRATEGIES
- Eliminate direct runoff from cooperatively farmed fields on the refuge into Tippo Bayou and associated sloughs through the use of filter strips and/or removal of culverts.
- Work with landowners within the Tippo Bayou watersheds on private land projects to reduce the runoff from agricultural areas directly into Tippo and associated sloughs through the use of filter strips and buffers.
- Within refuge boundaries, identify fields or banks eroding into Tippo Bayou and other water bodies and slow or stop erosion through the use of riprap or filter strips.
- Reduce, where possible, the use of chemicals in areas adjacent to wetland areas. Observe a minimum of a 150-foot buffer (300-feet for aerial applications) when spraying areas adjacent to wetlands with a non-aquatic labelled pesticide.
- Determine if culverts and ditches draining reforestation areas are necessary and, if not, remove and allow water to return to a more natural course.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 11, 16, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 89, 93, 96, 112, 118, 119, 121, 124, 135
Units will be evaluated in the fall of the previous year to determine which of the above-mentioned strategies will be applied the following spring. Management prescriptions for

individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

INVASIVE PLANT MANAGEMENT
(OBJECTIVE 3.3)

POTENTIAL MANAGEMENT STRATEGIES
The primary invasive aquatic plants occurring on Tallahatchie NWR include alligatorweed and parrotfeather. These two floating aquatic plants tend to form monocultures, provide very few benefits to wildlife, and out-compete the native vegetation. They can be controlled by mechanical removal (using care not to break the plants) or through the use of chemicals. Additionally, there are several biological control agents for alligatorweed including: the alligatorweed flea beetle; a thrip; and a stem borer. The alligatorweed-flea beetle can be obtained through the U.S. Army Corps of Engineers in Florida. There are currently no biological control agents available for parrotfeather.

Mechanical control, though an option, is generally not successful. Both of these plants grow rapidly and will spread by fragmentation of the rhizomes. Some success is possible when using chemical means. The recommended chemicals for control of these species include: 2,4-D; fluridone; imazapyr; triclopyr; and carfentrazone ethyl. Additionally, alligatorweed can be treated with glyphosate and parrotfeather can be treated with endothall, penoxsulam, and diquat (MSUES 2008). Any application of chemicals should always follow label directions. All herbicides will be approved through the Pesticide Use Proposal process as required and updated and will follow Integrated Pest Management Policy (569 FW 1). An up-to-date list of approved herbicides is kept on file at the refuge complex office.

SELECTED MANAGEMENT STRATEGIES
- Hand-pull single plants in newly invaded area. Pulled plants should be secured in bags and removed from the site for proper disposal..
- Use biological control for large expanses of alligatorweed.
- Apply the above-listed chemical at appropriate rate to shoreline infestations. Focus on new colonies first to prevent further infestation, then target existing populations.

MANAGEMENT STRATEGY PRESCRIPTIONS FOR UNITS 11, 16, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 89, 93, 96, 112, 118, 119, 121, 124, 135
Units will be evaluated in the fall of the previous year and periodically checked to determine extent of invasive plant colonies. Management prescriptions for individual units will be detailed in the Annual Habitat Work Plan each year, which should be prepared no later than March 1 each year.

MANAGEMENT UNIT PRESCRIPTIONS

Table 8: A summary of habitat objectives and management strategies by unit.

Unit	Size (acres)	Current Habitat Classification	Habitat Objective(s)	Management Strategies
1	65	Reforestation	*OBJECTIVE 1.1: REFORESTATION* By 2028, at least 35 percent of reforestation acreage should contain a diverse assemblage of both hard mast and soft mast producing hardwood species of at least two age classes and characterized by a minimum of 60 to 70 percent overstory canopy cover, 25 to 40 percent midstory cover, and 60 to 70 square feet per acre basal area (with over 25 percent in older age classes)(CCP Objective 4-2)	• Conduct standard cruises of each stand to assess condition. Oldest reforestation stands should be evaluated first, and stands should be visited every 10 years. • Thin stands as needed to promote development toward suggested desired forest conditions. Initial thinings on reforestation stands may open units up to as low as 60% canopy coverage. Successive harvesting should consist of individual selection cuts, mimicking natural disturbance. • If thinnings occur, leave individual trees that show early stages of cavity development. • Replant hardwood species in areas where plantings failed; supplement stands by planting more seedlings in areas with low stocking rates. • If cooperative farming becomes unavailable, consider reforesting a majority of the current agricultural field acres, particularly those units with higher elevation, not subject to flooding. • Allow flooding on reforestation areas according to rainfall from November 1 to April 1. • Clean critical drainage ditches throughout area of beaver debris and log jams to allow water to move freely through the area during dewatering periods. • Allow plugging of drainage ditches where feasible, to restore natural water courses
2	12	Reforestation		
3	14	Reforestation		
4	19	Reforestation		
5	6	Reforestation		
6	15	Reforestation		
7	14	Reforestation		
8	21	Reforestation		
9	26	Reforestation		
10	68	Reforestation		
12	13	Reforestation		
13	42	Reforestation		
14	24	Reforestation		
15	9	Reforestation		
17	76	Reforestation		
18	4	Reforestation		
19	21	Reforestation		
20	26	Reforestation		
21	59	Reforestation		
23	141	Reforestation		
24	12	Reforestation		
29	67	Reforestation		
32	126	Reforestation		
33	18	Reforestation		
34	8	Reforestation		
37	16	Reforestation		
38	242	Reforestation		
39	111	Reforestation		
40	42	Reforestation		
42	15	Reforestation		
43	19	Reforestation		
44	57	Reforestation	*OBJECTIVE 1.2: CAVITY TREE*	• Evaluate each stand for the presence and suitability of existing
45	13	Reforestation		

52	28	Reforestation	By 2028, evaluate at least 35 percent of all reforestation units for the potential of future development of a minimum of one tree greater than 26 inches diameter at breast height (dbh) per 10 acres with a visible cavity sufficient to provide a nest site for wood ducks or roost for bats or provide an equivalent artificial structure (CCP Objective 1-2). *OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* Annually eradicate a minimum of 50% of the feral hog population found within refuge boundaries (CCP Objective 4-3).	cavities. • Where natural cavities are lacking, erect additional wood duck boxes, in close proximity to suitable brood habitat. • By February 15 each year, insure boxes are prepped with sawdust, are in good condition, have predator guards in place, and that any encroaching vegetation is trimmed. • Evaluate boxes to clean as needed and collect data on use and hatching success. • Continue to trap using existing corral pens (units 127 and 130), targeting the timeframe when natural food resources are scarce. • Construct additional corral pens in units 47, 50, 51, and other areas where heavy feral hog use occurs. • Encourage shooting of hogs by hunters during established hunting seasons on open areas of the refuge.
58	28	Reforestation		
59	26	Reforestation		
62	13	Reforestation		
63	46	Reforestation		
64	12	Reforestation		
65	28	Reforestation		
66	24	Reforestation		
67	15	Reforestation		
68	21	Reforestation		
72	17	Reforestation		
73	17	Reforestation		
90	18	Reforestation		
91	12	Reforestation		
95	6	Reforestation		
114	9	Reforestation		
115	4	Reforestation		
116	17	Reforestation		
123	2	Reforestation		
126	17	Reforestation		
127	27	Reforestation		
128	13	Reforestation		
129	4	Reforestation		
130	7	Reforestation		
131	13	Reforestation		
132	5	Reforestation		
134	139	Reforestation		
41	29	Forest	*OBJECTIVE 1.2: CAVITY TREE* (see above) *OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above)	See above. See above.
70	23	Forest		
94	60	Forest		
111	3	Forest		
117	6	Forest		
120	3	Forest		
122	8	Forest		
125	3	Forest		
133	3	Forest		

11	8	Slough	*OBJECTIVE 1.2: CAVITY TREE* (see above) *OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above) *OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* Annually eradicate a minimum of 75 percent of the nutria population found within managed wetland units (CCP Objective 4-3). *OBJECTIVE 3.2: WATER QUALITY* By 2028, eliminate or mitigate all point entry sites for chemicals and sediments entering Tippo Bayou and associated sloughs within refuge boundaries (CCP Objectives 2-2, 2-3, 5-4).	See above.
75	16	Slough		See above.
76	53	Slough		
77	52	Slough		• Opportunistically shoot nutria when encountered. • When multiple nutria are seen in units, begin trapping in infested unit, concentrating efforts on trails and feeding/basking platforms.
78	26	Slough		
79	4	Slough		
80	62	Slough		• Eliminate direct runoff from cooperatively farmed fields on the refuge into Tippo Bayou and associated sloughs through the use of filter strips and/or removal of culverts. • Work with landowners within the Tippo Bayou watersheds on private land projects to reduce the runoff from agricultural areas directly into Tippo and associated sloughs through the use of filter strips and buffers. • Within refuge boundaries, identify fields or banks eroding into Tippo Bayou and other water bodies and slow or stop erosion through the use of riprap or filter strips. • Reduce, where possible, the use of chemicals in areas adjacent to wetland areas. Observe a minimum of a 150-foot buffer (300-feet for aerial applications) when spraying areas adjacent to wetlands with a non-aquatic
81	12	Slough		
82	47	Slough		
84	9	Slough		
85	14	Slough		
86	6	Slough		
89	47	Slough		
93	7	Slough		

112	17	Slough	*OBJECTIVE 3.3: INVASIVE PLANT* Annually maintain a minimum of 90 percent of Tippo Bayou and Long Branch and 100% of the area found in slough habitats free of alligatorweed and parrotfeather. (CCP Objective 4-3).	labelled pesticide. • Determine if culverts and ditches draining reforestation areas are necessary and, if not, remove and allow water to return to a more natural course. • Hand-pull single plants in newly invaded area. Pulled plants should be secured in bags and removed from the site for proper disposal.. • Use biological control for large expanses of alligatorweed. • Apply the above-listed chemical at appropriate rate to shoreline infestations. Focus on new colonies first to prevent further infestation, then target existing populations.
118	6	Slough		
119	16	Slough		
121	9	Slough		
124	4	Slough		
135	18	Slough		
46	61	Agricultural field	*OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above) *OBJECTIVE 2.1: MOIST-SOIL MANAGEMENT* On an annual basis in units 46, 48, 53, 54, 56, 101, and 103 provide 400 acres of herbaceous vegetation with a minimum of 75 percent cover of desirable moist soil plants (e.g., sprangletop, panicum, millet, toothcup, smartweed, Carex spp.), keeping non-desirables (e.g.,	See above. • Conduct early drawdowns (begin on or about March 1) to promote growth of moist-soil plants while limiting growth of coffeeweed and cocklebur. • Additional drawdowns can be initiated after willows have seeded (usually after May 15). Later drawdowns may have issues with coffeeweed, but are more likely to promote sprangletop and toothcup. • If cooperative farming becomes unavailable, consider managing low-lying portions of agricultural units for moist-soil vegetation.

48	190	Agricultural field	coffeeweed and cocklebur) to less than 20 percent, and eliminating any invasive species (e.g., parrotfeather, alligatorweed) and flooded with 6 to 24 inches of water for a minimum of 60 days from October to March to support foraging habitat objectives for migrant and wintering waterfowl developed by the LMVJV (CCP Objectives 1-1, 4-1).	• Disk units every two to three years to restrict willow colonization of units. Disking should be done June to August and be followed by a one to two week drying period to kill exposed willow roots. Following the drying period, the unit should be reflooded and, after a period of at least two weeks, can be drawndown again for shorebird use if desired. Note: waiting too long to reflood appears to allow for stump sprouting and may be counter-productive. • In the year after disking, conduct an early drawdown. This seems to promote millet and smartweed germination. Early drawdowns tend to reduce germination by coffeeweed and cocklebur. • Even if willow colonization is not an issue, disk at least every third year to promote annual vegetation and limit perennial vegetation. • Use water to when possible to control undesirable vegetation. (Cocklebur is quickly killed by flooding. Coffeeweed must be overtopped to kill, so not as effective for that species.) • Use mowing to control undesirable vegetation. In units with dense coffeeweed stands, mow coffeeweed when it begins to flower (before seed set). This will release any grasses underneath and can result in a very productive unit. • In units with dense vegetation, strip mow or roll vegetation to create landing areas for ducks. • Evaluate moist soil vegetation every year beginning in June for
53	26	Agricultural field		

54	54	Agricultural field		those units with early drawdown using standard protocol. • Limit use of agrochemicals. When necessary to use, choose the appropriate chemical for the target species and apply at the lowest rate possible. Use techniques that minimize overspray and exposure to non-target organisms (i.e., Best Management Practices). • Begin flooding a proportion of the units with dense vegetation in late August, to insure habitat availability for rails when migration begins (September) and for early-migrating waterfowl (i.e., blue-winged teal). • Stagger fall pumping to ensure a continuous supply of food throughout the winter. • Flood to a depth of no more than 18 inches; depths of 12 inches or less are preferred by dabblers.
56	38	Agricultural field	*OBJECTIVE 2.2: FLOODED CROPLAND* On an annual basis in units 46, 47, 48, 49, 50, 51, 53, 54, 55, 56, 60 provide 212 acres of grain crops (millet, rice, corn, or milo) and flood to a depth of 18 inches or less, for a mininmum of 60 days from November 1 to March 15 to support habitat objectives for migrant and wintering waterfowl developed by the LMVJV (CCP Objective 1-1). *OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* (see above)	• Cooperatively farm approximately 608 acres per year in rice, corn, milo, or soybeans. • Work with coop farmer to insure rice, milo, millet, or corn (preferred waterfowl “hot foods”) is planted in floodable sections of units. • If the cooperative farming program becomes unavailable (due to restrictions on the use of GMO’s or agro-chemicals), contract with a local cropdusting service to seed approximately 215 acres of floodable land with rice or millet. • Flood standing crops in fall to provide waterfowl access to grain. See above.

101	278	Moist-soil	*OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above) *OBJECTIVE 2.1: MOIST-SOIL MANAGEMENT* (see above) *OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* (see above)	See above. See above. See above.
103	144	Moist-soil		
47	30	Agricultural field	*OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above) *OBJECTIVE 2.2: FLOODED CROPLAND* (see above)	See above. See above.
49	28	Agricultural field		
50	35	Agricultural field		
51	65	Agricultural field		
55	52	Agricultural field		
60	29	Agricultural field		
36	34	Fallow field	*OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above)	See above.
104	34	Fallow field		
74	2	R.O.W.		
98	1	R.O.W.		
99	6	R.O.W.		
25	44	Moist-soil	*OBJECTIVE 1.3: INVASIVE ANIMAL CONTROL – FERAL HOGS* (see above) *OBJECTIVE 2.3: SHRUB SWAMP MANAGEMENT* On an annual basis in units 25, 26, 27, 28, 30, 31, 102 provide 200 acres of shrub swamp habitat characterized by 30 to 50 percent shrubs,	See above. • Strive to maintain water across the unit year round. If necessary, can dry in late August/September if need to remove predatory fish or promote development of buttonbush and swamp privet. • Annually control any exotic/invasive species occurring in units, using all
26	47	Moist-soil		
27	42	Moist-soil		

28	48	Moist-soil	40 to 70 percent herbaceous emergent vegetation, 0 to 10 percent trees, no invasive aquatic species (e.g. parrotfeather, alligatorweed), and 25 percent open water and containing a minimum of 10 loafing sites (18 inches by 18 inches, 2 to 5 inches above water) per acre in close proximity to nest boxes or natural cavities to provide brood rearing habitat for wood ducks (McGilvrey 1968) (CCP Objectives 1-2, 1-4, 1-5). *OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* (see above)	methods available. • Add loafing structures (i.e., logs and slash piles) to areas best suited for wood duck broods. See above.
30	16	Moist-soil		
31	18	Moist-soil		
102	103	Moist-soil		
16	209	Tippo Bayou	*OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* (see above) *OBJECTIVE 3.1: PADDLEFISH HABITAT* By 2020 and annually after that, manage Tippo Bayou and tributaries within the refuge boundaries, to provide conditions favorable to support self-sustainable populations of paddlefish including dissolved oxygen concentrations of greater than six parts per million, the presence of four spawning areas per river mile characterized by a silt-free substrate of gravel, cobbles, or coarse woody debris, and a minimum average	See above. • Continue to work with the Private John Allen National Fish Hatchery to determine the extent of paddlefish use of Tippo Bayou. • Eliminate direct runoff from cooperatively farmed fields on the refuge into Tippo Bayou through the use of filter strips and/or removal of culverts. • Work with NRCS and landowners within the Tippo Bayou watersheds on private land projects to reduce the runoff from agricultural areas directly into Tippo through the use of filter strips and buffers. • Continue reforestation efforts along Tippo Bayou to establish/improve a riparian buffer along the portion that passes through the refuge. • Encourage the harvest of bighead and silver carp on and off the

			zooplankton density of 60 individuals per liter from May to September, dominated by Cladocerans and Copepods (Hoxmeier and Devries 1997; Schrank et al. 2003) (CCP Objective 2-3). *OBJECTIVE 3.2: WATER QUALITY* (see above) *OBJECTIVE 3.3: INVASIVE PLANT CONTROL* (see above)	refuge by recreational anglers. • Remove any bighead or silver carp encountered during other refuge activities (i.e., gill netting or electro-shocking for paddlefish). • On portions of Tippo Bayou where spawning areas are lacking, consider providing coarse woody debris, in the form of old logs, constructed wooden structures, or other similar items. See above. See above.
88	7	Pond/lake	*OBJECTIVE 2.4: INVASIVE ANIMAL CONTROL – NUTRIA* (see above) *OBJECTIVE 3.2: WATER QUALITY* (see above) *OBJECTIVE 3.3: INVASIVE PLANT CONTROL* (see above)	See above. See above. See above.
92	2	Pond/lake		
96	71	Long Branch (Lake)		
97	20	Ditch		
110	2	Pond/lake		
113	4	Pond/lake		

CHAPTER VI. LITERATURE CITATIONS

Bateman, D., R. M. Kaminski, and P. A. Magee. 2005. Wetland invertebrate communities and management of hardwood bottomlands in the Mississippi Alluvial Valley. Pages 173-190 *in* L. H. Fredrickson, S. L. King, and R. M. Kaminski, eds. Ecology and management of bottomland hardwood systems: the state of our understanding. University of Missouri-Columbia. Gaylord Memorial Laboratory Special Publication No. 10. Puxico, Missouri.

Beadle, D. and J. Rising. 2002. Sparrows of the United States and Canada. Academic Press, San Diego, California. 328 pp.

Becker, G. C. 1983. Fishes of Wisconsin. The University of Wisconsin Press. Madison, Wisconsin. 1052 pp.

Bellrose, F. 1990. The history of wood duck management. Pages 14-20 *in* Fredrickson, L. H., G. V. Burger, S. P. Havera, D. A. Graber, R. E. Kirby, and T. S. Taylor eds. Proceedings of the 1988 North American Wood Duck Symposium, St. Louis, Missouri.

Bellrose, F. C. and D. J. Holm. 1994. Ecology and management of the wood duck. The Wildlife Management Institute. Stackpole Books, Pennsylvania.

Brittingham, M. C. and S. A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Carter, T. C. and G. A. Feldhamer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219:259-268.

Chipps, S. R., H .D. Symens, and J. Bollig. 2009. Influence of Cladoceran composition and abundance on survival of age-0 paddlefish. American Fisheries Society Symposium 66:411-422.

Conover, G., R. Simmonds, and M. Whalen, editors. 2007. Management and control plan for bighead, black, grass, and silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force. Washington, D.C. 223 pp.

Cooper, R. J., L. A. Wood, J. J. Gannon, and R. R. Wilson. 2009. Effects of timber harvest and other factors on a floodplain forest indicator species, the prothonotary warbler. Wetlands 29(2):574-585.

Crance, J. H. 1987. Habitat suitability index curves for paddlefish, developed by the Delphi techniques. North American Journal of Fisheries Management 7:123-130.

Darrah, A. J. and D. G. Krementz. 2009. Distribution and habitat use of king rails in the Illinois and Upper Mississippi River Valleys. Journal of Wildlife Management 73(8):1380-1386.

Depkin, F. C., M. C. Coulter, and A. L. Bryan, Jr. 1992. Food of nestling wood storks in east-central Georgia. Colonial Waterbirds 15(2):219-225.

Ernst, C. H. and J. E. Lovich. 2009. Turtles of the United States and Canada – 2nd Edition. The Johns Hopkins University Press. Baltimore, Maryland. 839 pp.

Faulkner, S. P. 2010. Forecasting the effects of land-use and climate change on wildlife communities and habitats in the lower Mississippi Valley. U.S. Geological Survey Fact Sheet 2010–3112, 6 pp.

Foster, R.W. and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy, 80(2):659-672.

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

Harvey, M. J., J. S. Altenbach, and T. L. Best. 2011. Bats of the United States and Canada. The Johns Hopkins University Press. Baltimore, Maryland. 213 pp.

Hawkins, T. S., D. A. Skojac, Jr., B. R. Lockhart, T. D. Leininger, M. S. Devall, and N. M. Schiff. 2009. Bottomland forests in the Lower Mississippi Alluvial Valley associated with the endangered *Lindera melissifolia*. Castanea 74(2):105-113.

Haynes, R. J. 2004. The development of bottomland hardwood forest restoration in the lower Mississippi Alluvial Valley. Ecological Restoration 22:170 – 182.

Heitmeyer, M. E. 1988. Body composition of female mallards in winter in relation to annual cycle events. Condor 90:669-680.

Heltzel, J. M. and P. L. Leberg. 2006. Effects of selective logging on breeding bird Communities in bottomland hardwood forests in Louisiana. Journal of Wildlife Management 70(5):1416-1424.

Hoxmeier, R. H. J. and D. R. Devries. 1997. Habitat use, diet, and population structure of adult and juvenile paddlefish in the lower Alabama River. Transactions of the American Fisheries Society 126(2):288-301.

Hunter, W. C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. U.S. Fish & Wildlife Service, Southeast Region, Atlanta, Georgia. 131 pp.

Jennings, C. A. and S. J. Zigler. 2000. Ecology and biology of paddlefish in North America: historical perspectives, management approaches, and research priorities. Reviews in Fish Biology and Fisheries 10:167-181.

Kaminski, R. M., J. B. Davis, H.W. Essig, P. D. Gerard, and K. J. Reinecke. 2003. True metabolizable energy for wood ducks from acorns compared to other waterfowl foods. Journal of Wildlife Management 67:542-550.

Karl, T. R., J. M. Melillo, and T. C. Peterson (eds.). 2009. Global climate Change Impacts in the United States. Cambridge University Press. New York, New York. pp. 111 – 116.

Kushlan, J. A. 1979. Feeding ecology and prey selection in the white ibis. The Condor 81(4):376-389.

Lee, D. M. 1991. Density of natural cavities suitable for nesting wood ducks in bald cypress and tupelo gum stands. M.S. Thesis, Mississippi State University, Mississippi State, Mississippi. 44 pp.

Lower Mississippi Valley Joint Venture Forest Resource Conservation Working Group. 2007. Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt. Vicksburg, Mississippi. 95 pp.

Lowney, M. S., and E. P. Hill. 1989. Wood duck nest sites in bottomland hardwood forests of Mississippi. Journal of Wildlife Management 53: 378-382.

McGilvrey, F. B. 1968. A guide to wood duck production habitat requirements. Bureau of Sport Fisheries and Wildlife. Patuxent Wildlife Research Station. Research Publication 60. Laurel, Maryland. 32 pp.

Mississippi Museum of Natural Science. 2005. Mississippi's Comprehensive Wildlife Conservation Strategy. Mississippi Department of Wildlife, Fisheries and Parks, Mississippi Museum of Natural Science. Jackson, Mississippi. 418 pp.

Mississippi State University Extension Service. 2008. Weed Control Guidelines for Mississippi. Publication 1532. Mississippi State, Mississippi. 196 pp.

Moore, C. K. and J. B. Cotner. 1998. Zooplankton community structure of Lake Livingston, Texas, as related to paddlefish food resources. Journal of Freshwater Ecology 13(1):115-128.

Norris, J. L., M. J. Chamberlain, D. J. Twedt. 2008. Effects of wildlife forestry on abundance of breeding birds in bottomland hardwood forests of Louisiana. Journal of Wildlife Management 73(8):1368-1379.

Nuttle, T., L.W. Burger. 2005. Birds of bottomland hardwood reforestation sites: Patterns of occurrence and response to vegetation structure. Pages 353-372 *in* Ecology and Management of Bottomland Hardwood Systems: The State of Our Understanding: a Symposium, March 11-13, 1999, The Peabody Hotel, Memphis, TN. University of Missouri-Columbia.

O'Keefe, D. M, J. C. O'Keefe, and D. C. Jackson. 2007. Factors influencing paddlefish spawning in the Tombigbee watershed. Southeastern Naturalist 6(2):321-332.

Ouchley, K., R. B. Hamilton, W. C. Barrow, and K. Ouchley. 2000. Historic and Present-Day Forest Conditions: Implications for Bottomland Hardwood Forest Restoration. Ecological Restoration Vol. 18, No. 1, pp. 21-25.

Pashley, D. N. and W. C. Barrow. 1993. Effects of land use practices on Neotropical migratory birds in bottomland hardwood forests. Pages 315-320 *in* D. M. Finch and P. W. Stangel,

editors. Status and management of Neotropical migratory birds. U.S. Forest Service General Technical Report RM-229, Washington, D.C.

Reinecke, K. J. and R. M. Kaminski. 2007. USGS Memorandum to Rich Johnson and Tom Edwards. Subject: Final revision of Table 5 (Duck energy-days; DEDs).

Reinecke, K. J., R. M. Kaminski, D. J. Moorhead, J. D. Hodges, and J. R. Nassar. 1989. Mississippi Alluvial Valley. pp.203-247 L. M Smith, L. M., R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock, Texas.

Robinson , W. D. and S. K. Robinson. 1999. Effects of selective logging in forest bird populations in a fragmented landscape. Conservation Biology 13:58-66.

Rosenzweig, C., G. Casassa, D. J. Karoly, A. Imeson, C. Liu, A. Menzel, S. Rawlins, T. L. Root, B. Seguin, and P. Tryjanowski. 2007. Assessment of observed changes and responses in natural and managed systems. Climate change 2007—impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Parry, O.G. Canzianai, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson, eds. Cambridge University Press, Cambridge, United Kingdom. pp. 79 – 131.

Ross, S. T. 2001. Inland Fishes of Mississippi. Mississippi Department of Wildlife, Fisheries, and Parks. Jackson, Mississippi. 644 pp.

Saikku, M. 2005. This Delta, This Land: An Environmental History of the Yazoo-Mississippi Floodplain. University of Georgia Press.Athens, Georgia. 373 pp.

Schrank, S. J., C. S. Guy, and J. F. Fairchild. 2003. Competitive interactions between age-0 bighead carp and paddlefish. Transactions of the American Fisheries Society 132(6):1222-1228.

Shea, D., C. S. Hofelt, D. R. Luellen, A. Huysman, P. R. Lazaro, R. Zarzecki, J. R. Kelly. 2001. Chemical Contamination at National Wildlife Refuges in the Lower Mississippi River Ecosystem. Report by N.C. State University to the U.S. Fish and Wildlife Service. Atlanta, Georgia. 40 pp.

Smith, J. P. 1997. Nesting season food habits of 4 species of herons and egrets at Lake Okeechobee, Florida. Colonial Waterbirds 20(2):198-220.

Stevenson, C. L. 2008. Availability and seasonal use of diurnal roosts by Rafinesque's big-eared bat and southeastern myotis in bottomland hardwoods of Mississippi. M.S. Thesis, Mississippi State University, Mississippi State, Mississippi. 109 pp.

Southeastern Aquatic Resources Partnership. 2008. Southeast Aquatic Habitat Plan. 55 pp.

Strader, R. W., and P. H. Stinson. 2005. Moist Soil Guidelines for the U.S. Fish and Wildlife Service, Southeast Region. Division of Migratory Birds, U.S. Fish and Wildlife Service. Jackson, Mississippi. 17 pp.

Strickland, B. K., R. M. Kaminski, and A. Tullos. 2010. Waterfowl Management Handbook for the Lower Mississippi River Valley. Mississippi State University Extension. Publication 1864. Mississippi State Extension, Mississippi State, Mississippi.

Tennant, A. 2003. Snakes of North America: Eastern and Central Regions (Revised Edition). Lone Star Books, Lanham, Maryland. 635 pp.

Thatcher, B. S. 2007. Evaluation of forest management to improve breeding habitat for songbirds in oak hickory forests at Tennessee National Wildlife Refuge. Doctoral Dissertation, University of Tennessee, Knoxville, Tennessee, 256 pp.

Tiner, R. W., Jr. 1984. Wetlands of the United States: current status and recent trends. United States Fish and Wildlife Service, National Wetland Inventory. Washington, D.C.

Turcotte, W. H. and D. L. Watts. 1999. Birds of Mississippi. Mississippi Department of Wildlife, Fisheries, and Parks. Jackson, Mississippi. 470 pp.

Twedt, D.J. and S.G. Somershoe. 2008. Bird response to prescribed silvicultural treatments in bottomland hardwood forests. Journal of Wildlife Management 73(7):1140-1150.

Twedt, D., D. Pashely, C. Hunter, A. Mueller, C. Brown, and B. Ford. 1999. Mississippi Alluvial Valley Bird Conservation Plan Physiographic Area #5. Partners in Flight Version 1. Bureau of Land Management. Washington, D.C. 74 pp.

U.S. Army Corps of Engineers. 1993a. Upper Yazoo Projects Reformulation Study, Reformulation Report, Volume II, Appendices 5-9. Vicksburg, Mississippi.

U.S. Army Corps of Engineers. 1993b. Upper Yazoo Projects Reformulation Study, Reformulation Report, Volume IV, Appendicies 16-21. Vicksburg, Mississippi.

U.S. Army Corps of Engineers. 1992. Ascalmore Creek – Tippo Bayou Item No. 3, Control Structure: Foundation Report. Flood Control, Mississippi River and Tributaries, Yazoo River Basin – Tallahatchie River, Tallahatchie County, Mississippi. Vicksburg, Mississippi.

U.S. Department of Agriculture. 1970. Soil Survey of Tallahatchie County, Mississippi. U.S. Government Printing Office. Washington, D.C. 180 pp.

U.S. Department of Agriculture. 1967. Soil Survey of Grenada County, Mississippi. U.S. Government Printing Office. Washington, D.C. 152 pp.

U.S. Fish and Wildlife Service. 2011a. Identifying Refuge Resources of Concern and Management Priorities, A Handbook: https://fishnet.fws.doi.net/regions/4/nwrs/HMP/Shared%20Documents/1-HMP%20Guidance%20and%20Support%20Documents/6%20-%20Identifying%20Refuge%20Resources%20of%20Concern%20Handbook%20-%202011.pdf.

U.S. Fish and Wildlife Service. 2011b. North Mississippi Refuges Complex Biological Program 'Pulse-Check' Review: Coldwater, Dahomey, and Tallahatchie National Wildlife Refuges. U.S. Fish and Wildlife Service. Jackson, Mississippi. 7 pp.

U.S. Fish and Wildlife Service. 2005. North Mississippi National Wildlife Refuges Complex Comprehensive Conservation Plan. Atlanta, Georgia. 239 pp.

U.S. Fish and Wildlife Service. 2003. North Mississippi Refuges Complex Biological Review. Grenada, Mississippi. 64 pp.

U.S. Fish and Wildlife Service. 1991. Tallahatchie National Wildlife Refuge Environmental Assessment and Land Protection Plan. Atlanta, Georgia. 44 pp.

U.S. Fish and Wildlife Service. 1991 – 2007. North Mississippi Refuges Complex Annual Narratives. Grenada, Mississippi.

U.S. Fish and Wildlife Service. 1986. North American Waterfowl Management Plan. U.S. Department of Interior. Washington, D.C. 19 pp.

U.S. Geological Survey. 2008. MSWBD_Polyline & WBD_MS_polygon. Vector Digital Data. http://www.ncgc.nrcs.usda.gov/products/datasets/watershed

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 Tallahatchie 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 North Mississppi Refuges Complex 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 provide high quality habitat for wildlife, particularly migratory birds (focus on waterfowl). Management would focus on waterfowl through a continuation of cooperative farming, force-account farming, and moist-soil management to meet established wintering waterfowl foraging habitat goals of the Lower Mississippi River Valley Joint Venture.

The CCP has defined goals (i.e., 1, 2 and 4) and their corresponding objectives and strategies to achieve the stated action. The actions further detailed in the HMP have been identified, addressed, and authorized by the North Mississippi Refuges Complex CCP and accompanying Environmental Assessment (U.S. Fish and Wildlife Service 2005). These include:

- Reforestation and Cavity Tree Management: Manage the reforestation areas on the refuge for the collective benefit of resources of concern. For the duration of the HMP reforestation areas will be manipulated as needed to move them towards “Desired Forest Conditions” as defined by the Lower Mississippi Valley Joint Venture Forest Resource Conservation Working Group (CCP Objectives 1-1, 1-2, 4-2).

- Moist-soil Management: Manipulate water levels and vegetative cover in moist soil units to provide wintering waterfowl habitat (CCP Objectives 1-1, 4-1).

- Flooded Cropland Management: Use a cooperative farm program to grow high-energy cereal grains to provided needed foods for migrating and wintering waterfowl (CCP Objective 1-1).

- Shrub Swamp Management: Maintain and promote conditions on selected units to provide brood habitat for wood ducks (CCP Objective 1-2).

- Paddlefish Habitat Management: Manage Tippo Bayou and tributaries within the refuge boundaries to provide conditions favorable to support self-sustainable populations of paddlefish (CCP Objective 2-3)

- Water Quality Management: Improve water quality within Tippo Bayou and associated sloughs (CCP Objectives 2-2, 2-3, 5-4)

- Invasive Plant Management: Control/eradicate invasive aquatic plant species to accomplish management objectives outlined for resources of concern throughout the HMP (CCP Objectives 4-3).

- Invasive Animal Management: Control/eradicate wild hogs and nutria to accomplish management objectives outlined for resources of concern throughout the HMP (CCP Objective 4-3).

CATEGORICAL EXCLUSION(S).

Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10) is applicable to implementation to the proposed action. It 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.

The HMP is a step-down management plan consistent with the above-referenced Categorical Exclusion. It. provides guidance for implementating the general goals, objectives, and strategies established in the CCP, particularly those components specific to habitat management.

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

- Habitat management goals and objectives are restated so as to provide improved clarity in the context of the HMP.

- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.

- Specific habitat management guidance, strategies, and implementation schedules to meet the CCP goals and objectives are included (e.g., the location, timing, frequency, and intensity of applications).

- All details are consistent with the CCP and serve to provide the level of detail necessary to guide the refuge supporting the resources of concern and goals and objectives.

PERMITS/APPROVALS.

Endangered Species Act, Intra-Service Section 7 Consultation was conducted and signed August 21, 2015 as part of the HMP preparation process. The determination was a concurrence that the HMP may affect, but is not likely to adversely affect, pondberry and the northern long-eared bat.

PUBLIC INVOLVEMENT/INTERAGENCY COORDINATION.

The proposed HMP is a step-down of the approved CCP for North Mississippi Refuges Complex, which included Tallahatchie NWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed (USFWS 2005) which proposed and addressed management alternatives and environmental consequences.

Public involvement included notification in the local Grenada and Cleveland, Mississippi newspapers that the Draft CCP and EA were available for public review and comment. Two public meetings were held but unattended. Written comments were received from four sources: a private citizen, a state agency, a federal agency, and a Mississippi State University professor. Refer to CCP (Chapter 3 and Appendix H) for specific comments and Service response.

SUPPORTING DOCUMENTS.

Supporting documents for this determination include relevant office-file materials, the references cited above and the following key references:

U.S. Fish and Wildlife Service. 2005. North Mississippi National Wildlife Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Fish and Wildlife Service, Southeast Region. Atlanta, Georgia. 270 pp.

U.S. Fish and Wildlife Service. 2005. North Mississippi National Wildlife Refuges Complex Comprehensive Conservation Plan. U.S. Fish and Wildlife Service, Southeast Region. Atlanta, Georgia. 269 pp.

Refuge Manager — Date: 8/21/15

Project Leader — Date: 8/21/15

Acting — Regional Refuge NEPA Coordinator — Date: 10/7/2015

Regional Chief, Southeast Region — Date: 10/6/15

For

APPENDIX B – COMMON AND SCIENTIFIC NAMES OF SPECIES REFERENCED IN THIS DOCUMENT

Common Name	**Scientific Name**
Lamprey, chestnut	*Ichthyomyzon castaneus*
Sucker, blue	*Cycleptus elongatus*
topminnow, northern starhead	*Fundulus dispar*
Paddlefish	*Polyodon spathula*
Sunfish spp.	*Lepomis spp.*
Bass, Largemouth	*Micropterus salmoides*
Catfish, channel	*Ictalurus punctatus*
Carp, bighead	*Hypophthalmichthys nobilis*
Carp, silver	*Hypophthalmichthys molitrix*
Turtle, alligator snapping	*Macrochelys temminckii*
Kingsnake, prairie	*Lampropeltis calligaster calligaster*
Milksnake, red	*Lampropeltis triangulum syspila*
Bittern, American	*Botaurus lentiginosus*
Bittern, least	*Ixobrychus exilis*
Blackbird, rusty	*Euphagus carolinus*
Bunting, painted	*Passerina ciris*
Coot , American	*Fulica americana*
Cowbird, brown-headed	*Molothrus ater*
Cuckoo, yellow-billed	*Coccyzus americanus*
Dove, common ground	*Columbina passerina*
Duck, wood	*Aix sponsa*
Eagle, bald	*Haliaeetus leucocephalus*
Flycatcher, Acadian	*Empidonax virescens*
Grebe, pied-billed	*Podilymbus podiceps*
Heron, little blue	*Egretta caerulea*
Ibis, white	*Eudocimus albus*
Kite, swallow-tailed	*Elanoides forficatus*
Oriole, orchard	*Icterus spurius*
Owl, short-eared	*Asio flammeus*
Rail, king	*Rallus elegans*
Rail, sora	*Porzana carolina*
Sparrow, grasshopper	*Ammodramus savannarum*
Sparrow, LeConte's	*Ammodramus leconteii*
Stork, wood	*Mycteria americana*
Thrush, wood	*Hylocichla mustelina*
Vireo, Bell's	*Vireo bellii*
Vireo, white-eyed	*Vireo griseus*
Warbler, cerulean	*Dendroica cerulea*
Warbler, Kentucky	*Oporornis formosus*
Warbler, northern parula	*Parula americana*
Warbler, prothonotary	*Protonotaria citrea*
Warbler, Swainson's	*Limnothlypis swainsonii*

Warbler, worm-eating	*Helmitheros vermivora*
Woodpecker, red-headed	*Melanerpes erythrocephalus*
Bat, hoary	*Lasiurus cinereus*
Bat, Indiana	*Myotis sodalis*
Bat, northern long-eared	*Myotis septentrionalis*
Bat, Rafinesque's big-eared	*Corynorhinus rafinesquii*
Bat, southeastern myotis	*Myotis austroriparius*
Bear, American black	*Ursus americanus americanus*
Bear, Louisiana black	*Ursus americanus luteolus*
Hog, feral	*Sus scrofa*
Nutria	*Myocastor coypus*
Raccoon	*Procyon lotor*
Alligatorweed	*Alternanthera philoxeroides*
Ash, green	*Fraxinus pennsylvanica*
Buttonbush	*Cephalanthus occidentalis*
Cocklebur	*Xanthium strumarium*
Coffeeweed	*Sesbania herbacea*
Cottonwood, eastern	*Populus deltoides*
Cypress, bald	*Taxodium distichum*
Grass, sprangletop	*Leptochloa fusca*
Grass, panic	*Panicum spp.*
Grass, millet	*Echinochloa spp.*
Lotus, American	*Nelumbo lutea*
Mayhaw	*Crataegus aestivales*
Oaks	*Quercus spp.*
Oak, cherrybark	*Quercus pagoda*
Oak, Nuttall	*Quercus nuttallii*
Oak, overcup	*Quercus lyrata*
Oak, pin	*Quercus palustris*
Oak, willow	*Quercus phellos*
Oak, water	*Quercus nigra*
Parrotfeather	*Myriophyllum aquaticum*
Pecan, sweet	*Carya illinoensis*
Persimmon	*Diospyros virginiana*
Plum, Chickasaw	*Prunus angustifolia*
Pondberry	*Lindera melissafolia*
Redbud, eastern	*Cercis canadensis*
Sedges	*Carex spp.*
Smartweed	*Polygonum spp.*
Sugarberry	*Celtis laevigata*
Sweetgum	*Liquidamber styraciflua*
Sycamore, American	*Platanus occidentalis*
Toothcup	*Ammannia auriculata*
Tupelo, water	*Nyssa aquatica*
Willow, black	*Salix nigra*

APPENDIX C – LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

AHWP – Annual Habitat Work Plan

BCA – Bird Conservation Area

CCP - Comprehensive Conservation Plan

Complex – North Mississippi Refuges Complex

FSA – Farm Service Agency

HMP – Habitat Management Plan

Improvement Act – National Wildlife Refuge Improvement Act of 1997

LCC – Landscape Conservation Cooperatives

LMVJV – Lower Mississippi Valley Joint Venture

MAV – Mississippi Alluvial Valley

NAWMP – North American Waterfowl Management Plan

NWR – National Wildlife Refuge

PIF – Partners in Flight

Refuge Administration Act – National Wildlife Refuge System Administration Act of 1966

Refuge System – National Wildlife Refuge System

SARP – Southeast Aquatic Resources Partnership

Service - U.S. Fish and Wildlife Service

System – National Wildlife Refuge System

APPENDIX D – INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

Originating Person: Becky Rosamond
Telephone Number: 662-226-8286 x114
E-Mail: becky_rosamond@fws.gov
Date: 08/20/2015

PROJECT NAME: Tallahatchie National Wildlife Refuge Habitat Management Plan

I. Service Program:
___ **Ecological Services**
___ **Federal Aid**
___ **Clean Vessel Act**
___ **Coastal Wetlands**
___ **Endangered Species Section 6**
___ **Partners for Fish and Wildlife**
___ **Sport Fish Restoration**
___ **Wildlife Restoration**
___ **Fisheries**
_X_ **Refuges/Wildlife**

II. State/Agency: USFWS

III. Station Name: North Mississippi Refuges Complex

IV. Description of Proposed Action
The U.S. Fish and Wildlife Service, North Mississippi Refuges Complex, has developed a Habitat Management Plan for Tallahatchie National Wildlife Refuge (NWR) to guide the management of the refuge for the next 15 years.

The plan identifies resources of concern (ROCs) for Tallahatchie NWR and details habitat goals and objectives related to these ROCs. Resources of concern for Tallahatchie NWR include: migrating and wintering waterfowl, breeding wood ducks, birds of bottomland hardwood forests, Federal and State listed species and Species of Special Concern, and paddlefish. For each ROC, the plan addresses the habitat needs and management options, then identifies the strategies that will be used to manage habitat for the ROC. Additionally, the plan addresses potential conflicts between management for other ROCs. Where conflicts occur between Federal and State listed species and other ROCs, the listed species will be given priority.

V. Pertinent Species and Habitat:

A. Include species/habitat occurrence map:

B. Complete the following table:

SPECIES/CRITICAL HABITAT	STATUS[1]
Pondberry (*Lindera melissafolia*)	E
Northern long-eared bat (*Myotis septentrionalis*)	T

[1]STATUS: E=endangered, T=threatened, PE=proposed endangered, PT=proposed threatened, CH=critical habitat, PCH=proposed critical habitat, C=candidate species, S/A=Similar Appearance

VI. Location (attach map):

A. Ecoregion Number and Name: Region4/Gulf Coast Ozark LCC

B. County and State: Grenada and Tallahatchie Counties, Mississippi

C. Section, township, and range (or latitude and longitude: N 33.7671277, W 90.1482916

D. Distance (miles) and direction to nearest town: Approximately 3 miles east of Philipp, MS

E. Species/habitat occurrence: There are no local records for either pondberry or northern long-eared bats on Tallahatchie NWR.

VII. Determination of Effects:

A. Explanation of effects of the action on species and critical habitats in item V. B:

SPECIES/ CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
Pondberry (*Lindera melissifolia*)	Neutral. There is no expected impact to this species.
Northern long-eared bat (*Myotis septentrionalis*)	Neutral. There is no expected impact to this species.

B. Explanation of actions to be implemented to reduce adverse effects:

SPECIES/ CRITICAL HABITAT	ACTIONS TO MITIGATE/MINIMIZE IMPACTS
Pondberry (*Lindera melissifolia*)	No forest cutting, herbicide spraying, or hydrological manipulation will occur where this species is present.
Northern long-eared bat (*Myotis septentrionalis*)	No habitat manipulation will occur within ¼ mile of any occupied roost for this species.

VIII. Effect Determination and Response Requested:

SPECIES/CRITICAL HABITAT	DETERMINATION[1]			REQUESTED
	NE	NA	AA	
Pondberry (*Lindera melissifolia*)		X		Concurrence
Northern long-eared bat (*Myotis septentrionalis*)		X		Concurrence

'DETERMINATION/ RESPONSE REQUESTED:
NE = no effect. This determination is appropriate when the proposed action will not directly, indirectly, or cumulatively impact, either positively or negatively, any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested is optional but a "Concurrence" is recommended for a complete Administrative Record.

NA = not likely to adversely affect. This determination is appropriate when the proposed action is not likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat or there may be beneficial effects to these resources. Response Requested is a" Concurrence".

MA = likely to adversely affect. This determination is appropriate when the proposed action is likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested for listed species is "Formal Consultation". Response requested for proposed and candidate species is "Conference".

Thomas J. Carpenter — 8/20/2015
Signature (originating station) — **Date**

Deputy Project Leader
Title

IX. Reviewing Ecological Services Office Evaluation:

A. Concurrence ✓ **Nonconcurrence** _____

B. Formal consultation required _____

C. Conference required _____

D. Informal conference required _____

E. Remarks (attach additional pages as needed):

Kathy M. Finneyfrock — 08/21/2015
Signature — **Date**

Fish and Wildlife Biologist — MS ES FO Jackson, MS
Title — **Office**