Cypress Creek National Wildlife Refuge
Habitat Management Plan
March 2014

Cover Photo: Prothonotary Warbler on a snag at Cypress Creek NWR. Photo: Mike Jeffords

The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife and plants. Since the designation of the first wildlife refuge in 1903, the System has grown to encompass more than 150 million acres, 550 national wildlife refuges and other units of the Refuge System, plus 37 wetland management districts.

Habitat Management Plan
For
Cypress Creek National Wildlife Refuge

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Executive Summary

This habitat management plan (HMP) for Cypress Creek National Wildlife Refuge provides a long term vision and specific guidance on managing Refuge habitat for the next 15 years. This HMP is an extension of the CCNWR Comprehensive Management Plan (1997). Both plans are required by the National Wildlife Refuge Improvement Act of 1997, and will help meet the original purposes of CCNWR and contribute to the mission of the National Wildlife Refuge System. This HMP consists of four chapters. Chapter one covers the laws, policies, and conservation plans that effect the management of CCNWR. Chapter two provides historical, physical, and biological descriptions of CCNWR. Chapter three gives a brief description of the habitats, animals and plants that have been identified as Resources of Concern for CCNWR. Chapter four outlines the goals and objectives for managing those priority natural communities identified as Resources of Concern, and outlines the strategies and prescriptions that will be used to accomplish those goals and objectives.

Inventory and monitoring protocols will be developed within a separate inventory and monitoring plan. Habitat management strategies and prescriptions outlined here are intended to inform and provide a framework for development of monitoring protocols and priorities.

Chapter I. Introduction

Scope and Rationale

Enactment of the National Wildlife Refuge System Improvement Act in 1977 requires that National Wildlife Refuge System growth and management be planned to contribute to the conservation of ecosystems and that the biological integrity, diversity and environmental health of the System be maintained for the benefit of present and future generations. Addressing the natural resource conservation challenges of the 21st century and fulfilling the Refuge System mission and vision laid out in the Improvement Act will require detailed planning and partnerships. The Comprehensive Conservation Plan (CCP) and Habitat Management Plan (HMP) for each Refuge are essential to the Refuge System's ability to meet these challenges.

Cypress Creek National Wildlife Refuge (CCNWR) completed a Comprehensive Management Plan (CMP) in 1997, which serves as an umbrella plan to guide Refuge staff in the implementation of various preservation, restoration and wildlife-dependent public use activities.

This HMP provides a long-term vision and specific guidance on managing habitat for the resources of conservation concern on CCNWR. The contributions of CCNWR to ecosystem and landscape scale resource and biodiversity conservation are incorporated in this plan. The HMP sets the direction for the next 15 years and will ensure continuity and consistency of the habitat management of CCNWR. A plan review will be conducted every 5 years and adaptive management will be used to assess and modify management activities as research and monitoring may require.

Legal Mandates

Statutory Authority

The National Wildlife Refuge Improvement Act of 1997 established for the first time a singular conservation mission for the National Wildlife Refuge System: *"*To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans*"*.

The legislation requires that the mission of the System and purposes of the individual refuges are carried out. Refuges must first address their establishing purposes, while at the same time contributing to the broader System and ecosystem needs.

Refuge Purposes

Purposes of a refuge are those specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or a refuge sub-unit.

The relationship of the System mission and the purpose(s) of each refuge are defined in Section 3 of the FWS Director Order No. 132 which states:

> "We view the System mission, goals, and unit purpose(s) as symbiotic; however, we give priority to achieving a unit's purpose(s) when conflicts with the System mission or a specific goal exist." Section 14 of this order indicates "When we acquire an addition to a unit under an authority different from the authority used to establish the original unit, the addition also takes on the purpose(s) of the original unit, but the original unit does not take on the purpose(s) of the addition".

Cypress Creek National Wildlife Refuge was established in 1990 for the following purposes:

> …the conservation of wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions…16 U.S.C., Sec. 3901 (b) (Emergency Wetlands Resources Act of 1986)

Cypress Creek National Wildlife Refuge's purpose and importance to migratory birds, particularly waterfowl, were further described in the Service's Environmental Assessment for the proposed establishment of CCNWR (1990) and Approval Memorandum for refuge establishment:

> 1) to protect, restore and manage wetlands and bottomland forest habitats in support of the North American Waterfowl Management Plan; 2) to provide resting, nesting, feeding and wintering habitat for waterfowl and other migratory birds; 3) to protect endangered and threatened species and their habitats; 4) to provide for biodiversity; 5) to protect a National Natural Landmark, 6) and to increase public opportunities for compatible recreation and environmental education.

Links to Other Plans

Comparison of species and habitats identified in all of the plans listed below helped to identify resources of concern, goals and objectives of this Habitat Management Plan in addition to consideration of CCNWR purposes and mandates noted above.

Refuge Plans

Biological Concept Plan-Cypress Creek National Wildlife Refuge completed a Biological Concept Plan in July 1992, which laid out a general plan to guide restoration and enhancement

activities as land was acquired. This plan addressed issues such as control of siltation, restoring old drainage patterns, the need for waterfowl sanctuary areas, and the need for and location of public facilities.

Comprehensive Conservation Plan (CMP)-Cypress Creek National Wildlife Refuge completed a CMP in December 1996, which provided long-term direction for management, biology, and wildlife-oriented public use. The CMP also highlighted CCNWR's vision to be a "35,000 acre contiguous tract of land by connecting remnants of cypress-tupelo swamp, oak barrens, buttonbush groves, and vast stands of bottomland forests" The CMP has guided management decisions and actions on CCNWR for the last 13 years.

Fire Management Plan (FMP)-A FMP is mandated by the U.S. Fish and Wildlife Service (Service) policy for any Refuges that have "vegetation capable of sustaining fire". The CCNWR FMP addresses wild and prescribed fire events with guidelines on the level of protection needed to ensure safety, protect facilities and resources, and restore and perpetuate natural processes.

State and Regional Plans

Bird Conservation Region (BCR) 24- The Central Hardwoods Joint Venture Concept Plan-CCNWR is included in BCR 24 (The Central Hardwoods). Members of the Central Hardwoods Joint Venture formed a partnership beginning in 2000 with the primary purpose of elevating emphasis on all-bird conservation in the Central Hardwoods Bird Conservation Region (BCR 24). The Central Hardwoods Joint Venture Concept Plan was created in 2003 with the intention to impart the Joint Venture's long term vision.

Partners in Flight (PIF) –Bird Conservation Plan for The Interior Low Plateaus-Formed in 1990, PIF is concerned primarily with landbirds and has developed Bird Conservation Plans for numerous Physiographic areas. These plans include priority species lists, associated habitats, and management strategies. Cypress Creek belongs to the Interior Low Plateau Physiographic area.

Upper Mississippi Valley/Great Lakes Joint Venture Individual Plans-Cypress Creek is part of The Upper Mississippi Valley/Great Lakes Joint Venture (UMVGL). The UMVGL Region provides a wide variety of waterbird nesting, roosting and foraging habitats: marshes, ponds, creeks, streams, sloughs, lake shorelines, islands (especially in the Great Lakes), shoals, river floodplains (especially along the Mississippi, Illinois, Missouri, and Ohio Rivers), and reservoirs. A total of 46 species regularly occur on CCNWR during some portion of the year, including loons, grebes, pelicans, cormorants, herons, night-herons, egrets, bitterns, rails, moorhens, coots, cranes, gulls and terns, and 19 of these species are of high conservation, stewardship or management concern. In a continental context, the Region is extremely important for many of these waterbird species. We utilized the four UMRGLR Joint Venture individual plans listed below in the development of habitat management goals and objectives for CCNWR.

-Shorebirds Upper Mississippi River/Great Lakes Region
-Waterbirds Upper Mississippi River/Great Lakes Region
-Waterfowl Upper Mississippi River/Great Lakes Region

United States Fish and Wildlife Service Region 3 Fish and Wildlife Resource Conservation Priorities-The Fish and Wildlife Resource Conservation Priorities list identifies all the species considered to be in the greatest need of attention under the Fish and Wildlife Service's full span of authorities. The management strategies identified in the document contribute to the conservation, protection, and recovery of migratory birds, threatened and endangered species, and interjurisdictional fish, as well as the habitat that they depend on, and therefore fulfilling the Service's mission.

Endangered Species Recovery Plans-Cypress Creek follows recovery plan guidelines for the management of federally threatened and endangered species.

> *Indiana Bats (Myotis sodalis)* forage on flying insects typically along the shorelines of rivers and lakes, in the canopy of trees in floodplains, and in upland forests. In summer, habitat consists of wooded or semi-wooded areas, mainly along streams. Females bear their offspring in hollow trees or under loose bark of living or dead trees. Trees standing in sunny openings are attractive because of warmer air spaces and crevices under the bark. Maternity sites have been reported in riparian areas, floodplain forests, and upland habitats. Limestone caves with pools are preferred for hibernacula during winter.
>
> The Refuge is used by at least three, large maternity colonies of the Indiana bat. The forested wetlands also provide high quality foraging habitat for the bats. Additionally, the area is located within 5-miles of the large Indiana bat winter hibernacula at Magazine Mine. Forested areas, in particular forested wetlands provide foraging and roosting habitat for both male and female Indiana bats during the critical fall swarming period (personal communication USFWS).
>
> *Gray Bat (Myotis grisecens)* occurs in several Illinois and Missouri counties where it inhabits caves both during summer and winter. This species forages over rivers and reservoirs adjacent to bottomland forested tracts.
> There are no caves on the Refuge at the present time, though this may change with subsequent acquisitions.
>
> *Interior Least Tern (Sterna antillarum*) historic breeding range includes the Mississippi River system (USFWS 1990). Surveys of the Mississippi River have found the majority of breeding colonies occur south of Cairo, IL. However, breeding birds have been found in Scott and Mississippi counties. The characteristics required for suitable breeding grounds include "bare alluvial islands or sandbars", food, and appropriate water regime. Least terns arrive at breeding grounds in late April and the breeding season is complete by early September (DOI 1990).
>
> *Pallid Sturgeon (Scaphirhynchus albus)* are found in the Mississippi River downstream of its confluence with the Missouri River. Pallid Sturgeon forage for fish along the bottom of large rivers. Pallid Sturgeon are most frequently caught over a sand bottom, which is the predominant bottom substrate within the species' range on the Mississippi

River. Recent tag returns have shown that the species may be using a range of habitats in off-channel areas and tributaries of the Mississippi River.

Orange footed pimpleback pearlymussel (Plethobasis cooperianus) prefers clean, fast-flowing water in silt-free rubble, gravel or sand of medium to large rivers. It buries itself in sand or gravel in water as deep as 29 feet. Only the edge of its shell and its feeding siphons are exposed.

Sheepnose (Plethobasus cyphyus) mussels live in larger rivers and streams where they are usually found in shallow areas with moderate to swift currents that flow over coarse sand and gravel. However, they have also been found in areas of mud, cobble and boulders, and in large rivers they may be found in deep runs.

Rabbitsfoot (Quadrula cylindrica) is a riverine mussel requiring clear streams with gravel substrate and moderate, stable currents

Illinois Comprehensive Wildlife Conservation Plan & Strategy-The Illinois Comprehensive Wildlife Conservation Plan was completed in 2005. The Plan identifies habitat areas that demonstrate the greatest conservation need and potential, and establishes specific conservation goals for the enhancement and protection of these sites. Natural Division Assessments are provided in the plan and includes priority resources, conservation philosophy, wildlife habitat objectives and key actions for each natural division. The priorities, philosophy, objectives and actions for the Coastal Plain section of the plan are very closely aligned and complimentary with CCNWR's overall resource goals and objectives. We utilized this document in the development of habitat management goals and objectives for CCNWR.

Cache River Watershed Strategic Resource Plan-This planning initiative, completed in 1999, was a cooperative effort of the Cache River Ecosystem Partnership, (NRCS,IDNR, USFWS, TNC, and The Friends of the Cache River Watershed), which is concerned with all natural resources in the Cache River Watershed. The mission of the plan is to promote restoration and maintenance of soil, water, forest, wildlife, and wetland resources in a manner that supports socioeconomic and ecological sustainability.

Cache River Macrosite Plan-The Nature Conservancy developed a site conservation plan in 2003 based on the vision of preserving the area's biological diversity and to restoring a naturally functioning landscape. This plan supports the maintenance of natural communities that are stable enough to maintain themselves, large enough to allow for functioning ecological processes, and contiguous enough to provide for the interaction of species. Restoring sites such as these is to be achieved by restoring a more natural hydrologic regime, maintaining connections between wetland and non-wetland habitats, protecting existing high quality natural areas, and restoring critically located sites and species.

Through cooperative conservation, the Cache River Wetlands Joint Venture has acquired and protected approximately 35,000 acres. The focus of CCNWR and Joint Venture partners includes restoring the Cache River structure and function to a level of productivity that will

sustain social, agricultural and ecological resources (Cache River Watershed Resource Planning Committee, 1995). This work primarily involves the following:

- restoration of bottomland hardwood forest, and wetland habitat for migratory waterfowl and shorebirds,
- reduction of sediment loads and runoff from agricultural lands, and the
- restoration of hydrologic processes which will assure a self-sustaining riparian ecosystem.

Copperbelly Watersnake Conservation Agreements- In 1994, the U.S. Fish and Wildlife Service began discussions with State mining regulatory agencies and the Office of Surface Mining Reclamation and Enforcement in Indiana, Illinois, and Kentucky and with coal industry representatives to address the issue of incidental take of the snake from coal mining if the snake was listed. These discussions prompted the coal industry, with Service support, to develop a draft conservation agreement for the copperbelly in southern Indiana. When the listing moratorium ended in April 1996, discussions accelerated in Kentucky, leading to a similar conservation agreement. The agreements greatly reduce the existing threats to the southern copperbelly water snake population, especially those threats posed by mining operations, precluding the need to list the southern population of the snake under the Endangered Species Act.
Although they are separate documents, the two conservation agreements developed for the copperbelly water snake share the same objectives: eliminate or reduce threats to the copperbelly and provide for long-term conservation of the species, with a minimum of disruption to economic activities, primarily coal mining. The conservation agreements direct public agencies, including state resource agencies and mining regulatory agencies, to treat the copperbelly as a listed species when considering actions which could affect the snake and its habitat, such as granting permits or acquiring land. Mining companies that are signatories to the agreements will follow specific guidelines for mining and reclamation in copperbelly habitat.

Continental Plans

North American Bird Conservation Initiative (NABCI) -The NABCI brings together, in a continental effort, shorebird, waterbird, and waterfowl plans to protect and restore all native bird populations and their habitats in North America. All bird conservation partnerships reduce duplication of effort, and identification of unique landscape and habitat elements targeted for protection, management, and restoration. It utilizes Bird Conservation Regions (BCRs) to guide landscape scale, science-based approaches to conserving birds and their habitats.

North American Waterfowl Management Plan-The goal of this plan, which was signed in 1986, is to restore waterfowl populations to historic levels. The NAWMP outlines a broad framework for waterfowl management strategies and conservation efforts in the United States, Canada, and Mexico. This plan is designed to reach its objectives through joint ventures of private, state, and federal participation.

Chapter II. Background

Refuge Location

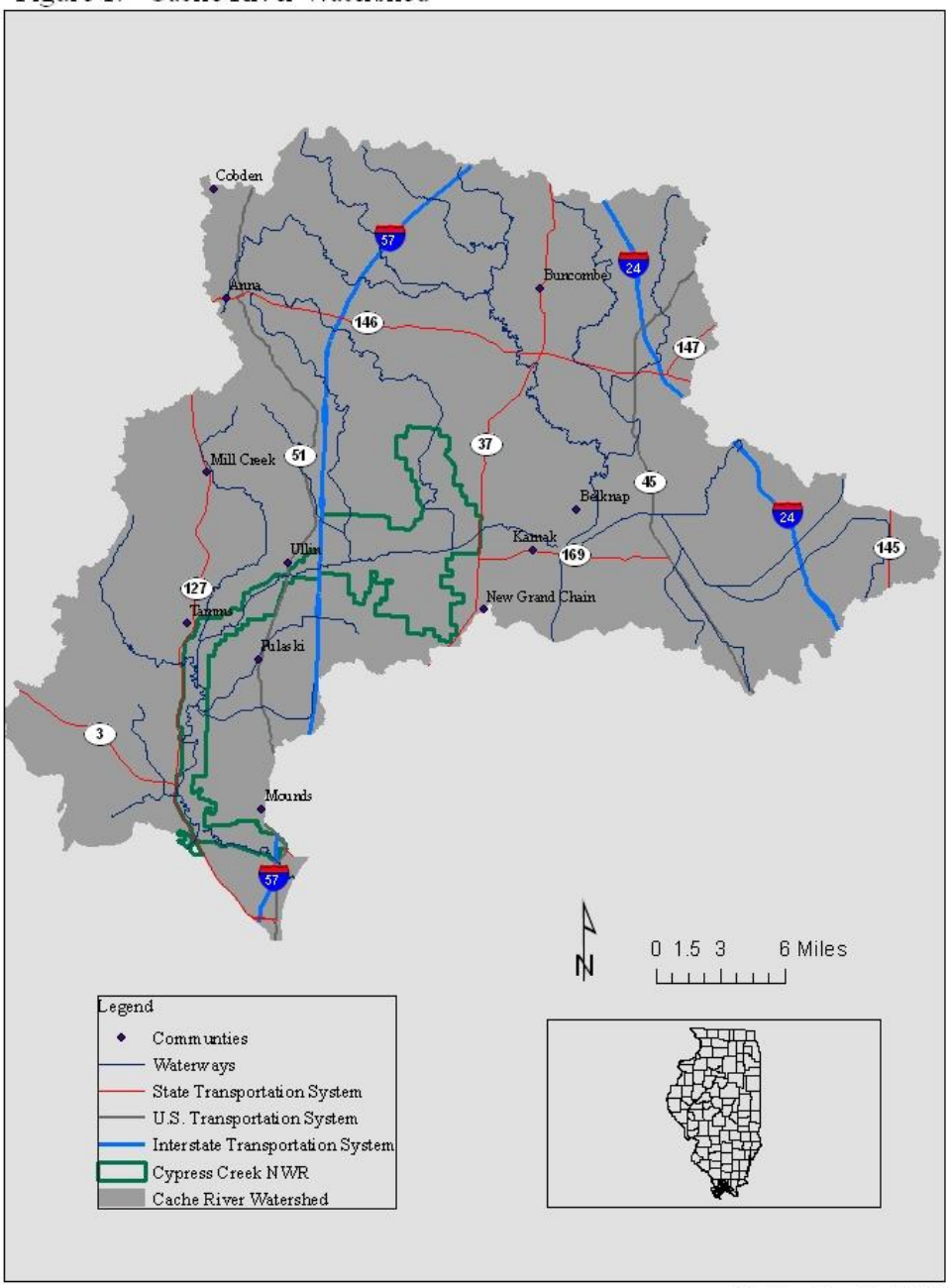
Cypress Creek National Wildlife Refuge (CCNWR) is located in southern Illinois just north of the confluence of the Ohio and Mississippi Rivers. Approximately 16,000 acres of the 35,320 acres delineated within the CCNWR acquisition boundary have been purchased. Cypress Creek National Wildlife Refuge is also part of a larger 60,000 acre boundary delineated by the Cache River Wetlands Joint Venture Project. To date, approximately 35,000 acres have been protected and are managed by the United States Fish and Wildlife Service, Illinois Department of Natural Resources (Cache River State Natural Area and Horseshoe Lake Fish and Wildlife Area), and The Nature Conservancy (Grassy Slough Preserve).

The Cache River Basin

Cypress Creek National Wildlife Refuge is within the Cache River Watershed (CRW) basin which drains a watershed of approximately 500,000 acres -- nearly the entire southern tip of Illinois (Figure 2). The major tributaries on the lower Cache within CCNWR are Big Creek, Cypress Creek, Mill Creek and Limekiln Slough. The area is situated at the intersection of four major physiographic regions of the United States, creating a unique area with a rich natural history. Within the Cache River basin, floodplain forests contain a greater diversity of bottomland tree species than any other watershed in Illinois including bald cypress trees that are over 1,000 years old. In addition, there are few places in North America that support the diversity and density of migratory waterfowl, wading birds, and Neotropical migratory songbirds as the Cache River and Cypress Creek Wetlands (IDNR, 1997). Researchers have cataloged 128 breeding songbird species, 49 species of mammals, 32 amphibian species, 43 reptile species, 84 freshwater fish species 47 native mussels, and 34 crustacean species within the watershed. (See The Refuge's Establishment Assessment for comprehensive species list (USFWS 1990). Although the basin only makes up 1.5 percent of Illinois' total land area, the CRW harbors 11.5 percent of the remaining high-quality floodplain forest habitat and 91 percent of the state's high quality swamp and wetland communities (IDNR, 1997). As a result of this diversity of habitat and wildlife the Cache River Wetlands and CCNWR has been designated one of 27 Ramsar Wetland of International Importance located in the United States (Ramsar 2010).

CCNWR falls within Alexander, Johnson, Pulaski, and Union Counties, generally between Illinois Route 37 to the east and Illinois Route 127 to the west (Figure 4). CCNWR is located in a section of the Cache River Basin known as the Lower Cache. Prior to settlement, the Cache River originated near Anna, Illinois and flowed in a southeastward direction for about 55 miles toward Belknap, Illinois. This section of river later became known as the "Upper Cache River" after construction of the Post Creek Cutoff. Downstream from this point the river is known as the "Lower Cache River" (Figure 3). The CCNWR purchase boundary encompasses the Lower Cache River at Highway 37 to its original mouth at the Ohio River near Mound City Illinois. However, the course and length (approximately 110 miles) of the Cache River today has been changed by human-induced alterations summarized in the following sections (Hutchison, 1995).

Figure 1. Cache River Watershed



Map Date: November 16, 2010

Physical and Geographic Setting

The physical environment of the Cache River watershed includes 4 physiographic regions (soils, topography, and climate) and explains much about the biological diversity of the region (Figure 2*)*. The CRW lies within one of only six areas in the U.S. where four or more physiographic regions overlap. This phenomenon is a result of a number of physical factors (elevation and convergence of 2 major rivers, diversity of soil and bedrock, geologic uplifts, faulting, glacial history and ancient Paleozoic periods of flooding) that created a diversity of natural communities seldom matched elsewhere in Illinois (IDNR, 1997). The three major physiographic provinces within CCNWR include the Interior Low Plateau to the north, the Upper East Gulf Coastal Plain to the south, and the Mississippi River Alluvial Plain to the southwest. Cypress Creek National Wildlife Refuge is found primarily within the Gulf Coastal plain and formerly included extensive stands of bottomland hardwood (BLH) forest and bald cypress-tupelo swamps.
The Cache River and its associated tributaries and floodplain within CCNWR and the surrounding wetlands have been named as a "wetland of International Importance because of their crucial role in sustaining waterfowl and shorebirds that use the Mississippi flyway. In addition to the 36,000 acre acquisition boundary, the Illinois Department of Natural Resources owns and manages approximately 20,000 acres adjoining the Refuge.

Geographical Definitions

As described by Gough, (2005), sections of the Cache River are defined below. These definitions will be used throughout the plan.

Upper Cache: The Cache River and its watershed that drains into the much flatter Cache Valley. The Post Creek Cut-off sends run-off from the Upper Cache south to the Ohio River, by-passing the Lower Cache.

Lower Cache: The Cache River and its watershed that drains from the mouth of Big Creek to its mouth at the Mississippi Diversion.

Old Cache River Channel: The section of river cut-off from the main channel of the Cache by the Mississippi Diversion. It includes approximately 6 miles of river channel from the diversion east to the Ohio River gates.

Refuge Management Units

Cypress Creek National Wildlife Refuge is divided into eight management units (Figure 5) that differ in soils, hydrology, topography, land use and vegetative cover. These individual units are described briefly below beginning at the northern end; acreages include land within the CCNWR purchase boundary some of which is currently within private ownership.

Cypress Creek Unit: This unit forms the northernmost boundary of CCNWR and includes some of the higher elevations (500 feet msl) on CCNWR. The area is drained by Cypress Creek which flows into the Cache River south of the Perks Road. The unit contains approximately 6,000 acres

of land with over 3500 acres in agriculture (includes private land); in addition to 1,100 acres of low, poorly drained bottomland. To date CCNWR owns 3,400 acres of which 1,611 acres have been restored to forest and wetlands.

Limekiln Slough Unit: This unit includes approximately 6,600 acres with only 22% in Refuge ownership (1,500 acres). The area includes 4,500 acres of agriculture and is bounded on the east, south, and west by low hills. The area is drained by Limekiln Slough which empties into the Cache River. The central portion of the unit historically was a large floodplain forest dominated by oaks and hickories until it was cleared in the 1970's. To date CCNWR owns 1,500 acres of which 850 acres have been restored to forest and wetlands.

Cache River Unit: This unit includes 5,276 acres. The primary feature within this unit is Buttonland Swamp – a National Natural Landmark owned by the Illinois Department of Natural Resources; however CCNWR acquisition boundary forms a buffer around this section of river which widens with a gradual fall of .2-.3 feet per mile. Currently, CCNWR owns 1,136 acres of which 750 acres have been restored to restore the riparian corridor to forest and wetlands. Historically, this section of the river featured wide expanse of open water with depths of more than 10 feet. Within the last century land clearing and channelizations to increase drainage has resulted in excessive silt and sediment deposition eliminating this deep water. In 2002, approximately 1 mile of river within this unit was dredged to remove sediment and initiate deepwater habitat restoration. Today, this section of river contains old growth stands of bald cypress and tupelo and areas dominated by buttonbush.

Butter Ridge Unit: This area contains 5,936 acres of which 60% are in agricultural production. Currently CCNWR owns 2,281 which include the 1,000 acre Frank Bellrose Waterfowl Reserve; there are 270 acres of moist soil wetlands within the Reserve. This area is intensively managed for waterfowl and shorebirds and provides a sanctuary to migrating ducks. Both Big Creek and Little Creek enter the Cache through the Butter Ridge Unit. Big Creek has a relatively steep hydrologic gradient and drains a basin covering 52 square miles; the channelized lower reach of this tributary bisects the Bellrose Reserve and enters the Cache River. During flood events Big Creek's stream volume and velocity threatens Bellrose moist soil units by backing silt-laden water into the moist soil units and or breaching the levees; Big Creek stream flow can also exceeds the Cache River's ability to maintain a west and south flow thus reversing the flow of the Cache River and increasing sedimentation into Buttonland Swamp (within the Middle Cache Valley).

Indian Camp Creek: This unit which is low, flat and primarily river floodplain includes approximately 3,000 acres with 1,208 acres in agriculture (primarily private land). Extensive channelization between the towns of Ullin and Tamm's cut-off many of the historic oxbows and river meanders from the main river channel. To date CCNWR owns approximately 1,000 acres which includes floodplain forest and wetlands.

Sandy Creek and Lake Creek Units: These units include 7,432 acres and form a relatively narrow corridor along the Cache River from the town of Tamms to the Mississippi Diversion. Cypress Creek National Wildlife Refuge owns approximately 5,700 acres with 300 acres in agriculture. The remaining acreage has been restored to floodplain forest and wetlands.

Extensive channelization between the towns of Sandusky and Ullin, has cut-off many of the historic oxbows and river meanders from the main river channel.

Old Cache Channel Unit: This unit includes 2,537 acres with approximately 1,038 acres in Refuge ownership. Approximately 90% of the unit is low, poorly drained bottomland (~320 feet msl) and is characterized by hydric soils. The Old Cache River Channel forms the south boundary of this unit. In 1950 a ditch was cut on the west end of the channel diverting water from Cache River directly into the Mississippi thus abandoning approximately 6 miles of river channel that empties into the Ohio River. Prior to Refuge ownership, the United States Army Corps of Engineers (USACE) has maintained a floodgate into the Ohio River (on the east end of the old channel). The USACE with the cooperation of the Cairo Drainage District, are currently responsible for manipulating water levels in the channel to maintain drainage and flood control. When the gates are open and the Ohio River is down, water levels can drop to 2' or less; however, existing drainage district staff assist with maintaining a minimal water level in the channel.

The following tables summarize total acreage within each management unit in the purchase boundary (Table 1) and the acreage in Refuge ownership (Table 2).

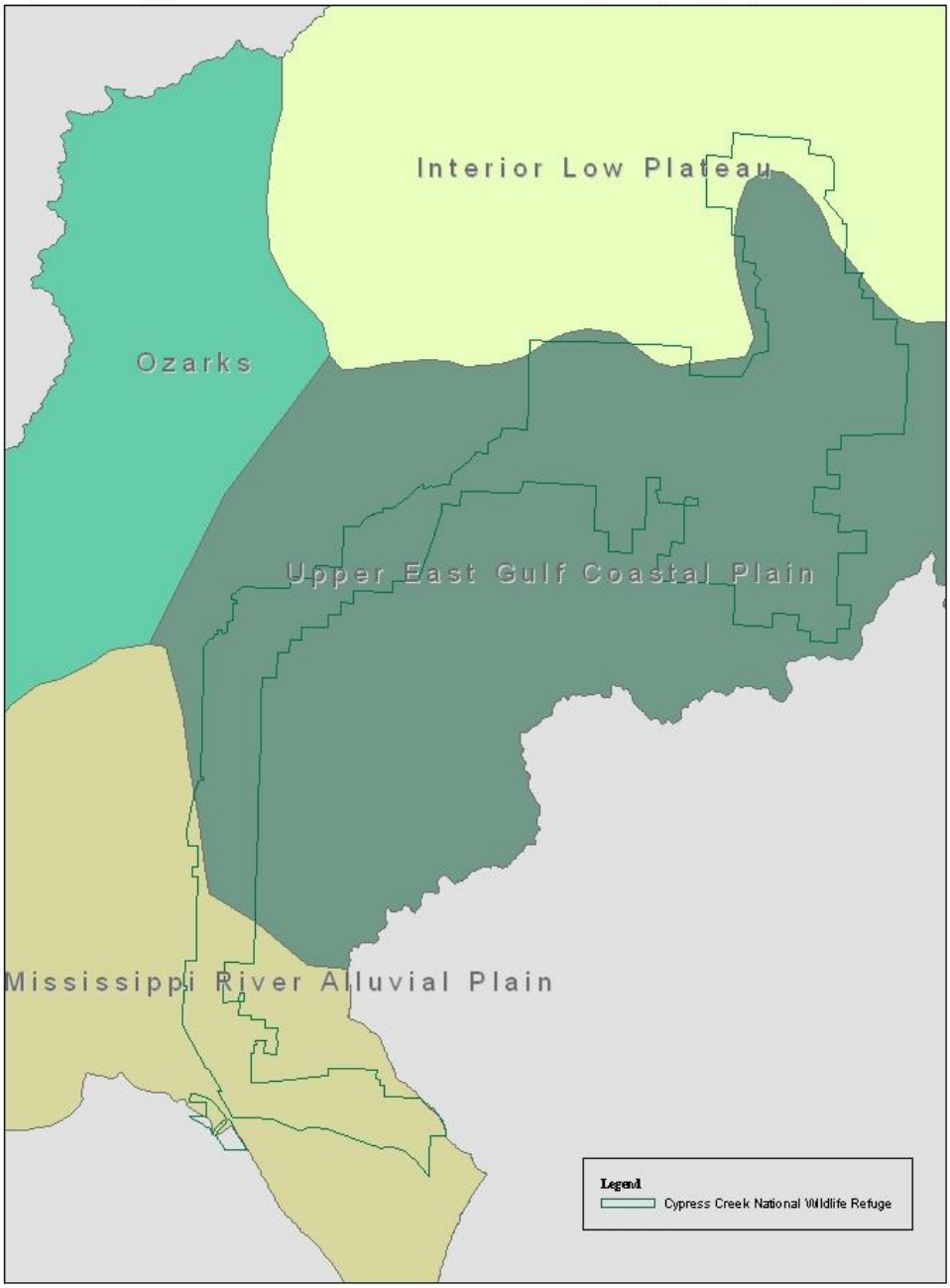
Table 1. Land Cover Acres within Cypress Creek NWR Management Units (Acquisition Boundary)

Management Unit	Urban	Forested	Wetlands	Water	Grass	Ag	Restored	TOTAL
Cypress Creek	7	1092	314	32	793	2246	1791	6280
Limekiln	10	385	79	15	798	4505	902	6694
Cache River	15	339	828	188	170	2409	1327	5276
Butter Ridge	44	734	230	101	941	3410	474	5936
Indian Camp Creek	7	904	398	101	339	1208	35	2992
Sandy Creek	5	1250	339	32	343	1045	1151	4180
Lake Creek	2	1619	203	89	457	618	264	3252
Old Channel	49	272	84	133	106	1868	25	2537
TOTAL	124	6595	2475	691	3947	17309	5869	35,320

Table 2. Land Cover Acres within Cypress Creek NWR Management Units (Refuge Ownership)

Management Unit	Urban	Forested	Wetlands	Water	Grass	Ag	Restored	TOTAL
Cypress Creek	2	783	208	12	353	450	1611	3419
Limekiln	0	111	42	10	163	351	852	1529
Cache River	2	148	99	72	37	27	751	1136
Butter Ridge	17	484	190	54	314	751	469	2279
Indian Creek	2	393	210	42	151	126	35	959
Sandy Creek	2	983	289	32	222	277	0	2952
Lake Creek	0	1324	185	72	378	531	264	2754
Old Channel	2	203	74	101	37	596	25	1038
TOTAL	27	4429	1297	395	1655	3109	4007	16,066

Figure 2. Cypress Creek National Wildlife Refuge Physiographic Regions



Map Date: November 14, 2010

Climate

The climate of the Cache River Watershed (CRW) is characterized by warm summers and relatively mild winters (IDNR 1997). Mean maximum/minimum temperatures in July at Anna, Illinois are 89/67° Fahrenheit (F) while similar mean maximum/minimum temperatures in January are 41/23° F (Table 3). Mean annual precipitation is about 48 inches and is highest from March through May and lowest in October and January (Table 4). Precipitation occurs on average about 110 days per year. Humidity is muggy from late spring through early autumn, with daytime humidity 60-80%. Thunderstorms and associated heavy showers are major sources of summer precipitation, with gusty wind, hail, and occasional tornados possible. Snow cover seldom lasts for more than a few days and constitutes only 12% of total average winter precipitation.

Table 3. Temperature Summary for Anna, lllinois. (Averages are from 1961-1990 and extremes are from 1901-1996. Temperatures are in ºF).

Month	Avg high	Avg low	Record high (year)	Record low (year)	# of days with high ≥90°F	# of days with low ≤32°F	# of days with low ≤0°F
January	40.8	22.5	76 (1909)	-20 (1918)	0.0	23.0	1.1
February	45.9	26.3	78 (1917)	-13 (1905)	0.0	19.0	0.4
March	57.2	36.3	91 (1910)	0 (1960)	0.0	12.0	0.0
April	68.4	46.4	92 (1915)	21 (1996)	0.1	2.1	0.0
May	77.5	54.9	98 (1911)	31 (1903)	1.2	0.0	0.0
June	85.9	63.3	105 (1936)	42 (1903)	9.0	0.0	0.0
July	89.1	67.2	112 (1901)	46 (1947)	17.0	0.0	0.0
August	87.5	65.3	110 (1930)	45 (1918)	13.0	0.0	0.0
September	80.7	58.6	107 (1925)	32 (1995)	5.5	0.0	0.0
October	70.4	46.8	95 (1910)	20 (1981)	0.3	1.5	0.0
November	57.2	37.8	83 (1902)	-5 (1991)	0.0	11.0	0.0
December	44.7	27.4	76 (1982)	-14 (1989)	0.0	20.0	0.5

Long-term trends in precipitation at Anna indicate relatively regular 15-20 year patterns of greater annual precipitation in the 1920s, 1940s, late 1950s to early 1960s, the 1980s, and 2000s that alternated with lower precipitation amounts in the 1930s, early 1950s, 1970s, and 1990s. The recurring regular patterns of alternating peak and low precipitation suggests at least some long-term regular dynamic pattern of local water inputs to the Cache River ecosystem. Long-term historic records for the Mississippi and Ohio Rivers indicate an approximate 11-15 year cycle of increasing discharge followed by declining flow and drought (Knox 1984, 1999, Franklin et al. 2003).

Table 4. Precipitation Summary for Anna, Illinois. (Averages are from 1961-1990 and extremes are from 1901-1996. Precipitation is in inches.)

Month	Avg. preclp.	Record high (year)	Record low (year)	Largest one-day amount (year)	Snow-fall	# of days w/ preclp.
January	3.03	16.55 (1950)	0.35 (1943)	4.22 (1950)	5.5	8
February	3.40	8.59 (1989)	0.28 (1947)	4.04 (1945)	4.8	7
March	5.17	13.69 (1945)	0.10 (1910)	5.40 (1964)	2.4	10
April	4.61	12.07 (1911)	0.73 (1915)	3.63 (1948)	0.2	9
May	5.26	13.80 (1957)	0.30 (1925)	4.75 (1973)	0	9
June	3.76	18.21 (1928)	0.25 (1933)	4.86 (1983)	0	8
July	3.86	13.57 (1958)	0.18 (1974)	6.15 (1909)	0	7
August	3.88	12.77 (1985)	0.34 (1936)	4.45 (1959)	0	6
September	3.29	11.65 (1965)	0.00 (1928)	4.45 (1993)	0	6
October	3.07	11.43 (1910)	0.00 (1908)	5.10 (1910)	0	6
November	4.16	9.28 (1934)	0.26 (1910)	5.05 (1934)	0.5	8
December	4.34	13.01 (1982)	0.18 (1925)	5.15 (1918)	2.7	9

Average annual surface water runoff from local streams in the CRW is about 1/3 of annual precipitation (IDNR 1997). About 70-80% of gauged floods in the Cache River floodplain occur from March to June when local rainfall is heaviest (Gough 2005)

Topography

The elevations in the CRW range from 890 feet mean sea level (msl) at the northernmost portion of the watershed to a low of 280 feet msl at the Mississippi River. The northern portion of CCNWR (portions of Johnson, Union, and Pulaski Counties) includes bluffs and hills that reach 510 feet msl overlooking the Cache River floodplain. The topography can be rugged with steep ravines and some exposed rock. CCNWR is bounded on the west (Union and Alexander counties) by the Ozark uplift characterized by loose gravel and cobble and drains quickly into the river valleys. The majority of CCNWR is encompassed by the Coastal plain (Alexander and Pulaski counties); while mostly flat, some relief, small knolls and low gently rising ridges are not uncommon throughout the broad alluvial floodplain.

History

Geographic History

The interaction between landforms, hydrology, and biota are unique in the CRW. As stated by Gough (2005), the valley was formed and influenced by repeated ice advances 1.8 million to 10,000 years ago. These episodes caused repeated scouring to bedrock and filling with glaciofluvial sediments. Approximately 90% of Illinois was glaciated at least once; however the

southern limit of glacial drift did not reach extreme southern Illinois. The CRW marks the geographical point where the last invasion of the sea into the Midwest reached its northernmost limit and lies just south of the southernmost extent of the continental glaciers; although low-lying areas and the river valleys were impacted by drift carried by glacial rivers. The Cache River as it appears today did not exist until the end of the Great Ice Age (13,000 to 10,000 years ago); the general pattern of drainage across the Midwestern states was set millions of years ago when the region became a lowland between the Appalachians and Rocky Mountains. For eons rivers from north, east, and west have met in this southernmost Illinois region and flowed south to the sea (Hutchison, 1995).

About 100,000 years before the present, the low lying areas of the Cache were flooded by meltwaters of the Illinoisan glaciation. During the Wisconsian, the last glaciation, massive torrents of meltwater flowed south and west. This giant river that later became the Ohio River, cut across southern Illinois leaving behind sediment up to 180 feet thick. As the glacier retreated northward, the meltwater slowly dropped and the nearly flat glacial mud left by the ancient Ohio blocked its own tributaries to form a series of swamps wetlands and small lakes called the "scatters" (Hutchison, 1984). The Cache River reestablished its channel through these low-lying, flat areas that were once the prehistoric river valley of the Ohio.

Vegetation and Animal Community History

Paleoclimate Vegetation

During the late Wisconsian full-glacial interval (ca. 18,000 BP), the Upper Mississippi Alluvial Valley (MAV) including the CRW was covered mostly by boreal forest communities (Delcourt and Delcourt 1981, Delcourt et al. 1999). Apparently, a spruce-jack pine-willow forest type was present on braided stream terrace geomorphic surfaces of the region that was created by glacial melt water flowing down the Mississippi and Ohio River corridors. Post-glacial warming of the region about 14,000 BP caused the jack pine-dominated community in the Upper Mississippi River Valley to recede northward, however some evidence suggests that considerable spruce and willow communities were retained at least in areas east of Crowley's Ridge in Missouri (Delcourt et al. 1999). By 12,000 BP, warming temperatures allowed expansion of oak-hickory forests onto CRW abandoned stream terraces. Subsequently, by 10,000 BP vegetation in the region had shifted to temperate to warm temperate types and a sweetgum-elm forest type perhaps similar to contemporary floodplain forest communities apparently occupied areas along the Mississippi River channels; some giant cane likely was present on natural levee locations. Willow and early succession tree species including cottonwood, sycamore and maple similar to the contemporary Riverfront Forest (see below) occupied newly scoured and regularly inundated areas along the active river channels (Delcourt et al. 1999). Baldcypress and water tupelo along with water tolerant shrubs occupied edges of abandoned channels and other deeper depressions including relict Valley Train channels. An oak-hickory forest similar to the contemporary high elevation BLH communities appears to have expanded onto higher elevation braided stream terraces at this time.

Beginning about 8,000 BP, continental climate warmed and dried significantly from the period through about 4,000 BP (Saucier 1994, Delcourt et al. 1999). Drought-tolerant tree species expanded and most of the oak-hickory forest that had previously dominated higher elevations

probably shifted to a savanna community with interspersed prairie occurring on higher and drier elevations and soils (King 1981). Wetter areas along the Mississippi and Ohio Rivers probably contained a diverse BLH community likely dominated by sweetgum, elm, ash, and willow with giant cane present on natural levees and some floodplain ridges (Delcourt et al. 1999). Baldcypress and tupelo also apparently remained in floodplain depressions and abandoned channel locations.

Starting about 4,000 BP, climate in the Upper MAV moderated to a milder and wetter condition (Delcourt et al. 1999). The sweetgum-elm forest apparently re-expanded onto lower floodplain terraces and Riverfront Forest communities widened along active river channels. A diverse Terrace Hardwood Forest community likely expanded on higher elevation terraces and prairie and savanna areas likely decreased in extent at this time. The continuous channel migrations of the Mississippi and Ohio Rivers in the CRW region undoubtedly shifted the positions of Holocene floodplain vegetation communities regularly as water flow pathways, sediment, and scouring actions reworked and redistributed soils and water regimes. By about 1,000 BP certain portions of higher elevations in the CRV may have been covered by perennial grass and old field vegetation (Delcourt et al. 1999). These areas may have been sites disturbed or farmed by Native people and represented succession of abandoned fields (Kullen and Walitschek 1996).

Presettlement Vegetation

The heterogeneity of geomorphic surfaces, soils, and topography in the CRW in the late 1700s and early 1800s created diverse and highly interspersed vegetation communities distributed across elevation and hydrological gradients. Major natural community/habitat types that were present on CCNWR during the Presettlement period included: 1) the main channel of the Cache River and major tributaries, 2) Bottomland Lakes often referred to as oxbows or abandoned channel depressions, 3) Riverfront Forest, 4) Cypress/Tupelo “Swamp” forest, 5) Shallow, high elevation, BLH Floodplain Forest, 6) low elevation BLH, 7) Terrace Hardwood Forest, 8) Mixed Hardwood “Slope” Forest, and 9) Mesic Upland Forest (Telford 1926, Miller and Fuller 1921, Voight and Mohlenbrock 1964, Leitner and Jackson 1981, Robertson et al. 1984, TNC 1995, Brugam and Patterson 1996, IDNR 1997, Hutchinson 2000). Lists and scientific names of fauna and flora for these habitats are provided in TNC (1995), IDNR (1997), and Battaglia (2007).

The main channels of the Cache River and its major tributaries contained open water with some aquatic vegetation and bald cypress trees in flatter, low gradient reaches. A wide variety of fish historically were present in the Cache River and tributary rivers and these habitats also were used by many amphibians, a few aquatic mammals, and some water and shorebirds (IDNR 1997, Shasteen et al. 1999).

Bottomland Lakes were present in the CRW during the Holocene period and occupied abandoned Mississippi, Ohio, and Cache River channels (U.S. Government Land Office (GLO) 1804-1840, Hutchinson 1984). These old lakes included The Scatters, Grassy Slough, Long Reach, Round Pond, Cypress Pond, Fish Lake, Long Lake, and Horseshoe Lake (Hutchinson 2000). The location, age, and size of bottomland lakes determined depth, slopes, and consequently composition and distribution of vegetation communities. Bottomland lakes in the CRW historically were surrounded by Bottomland Forest and usually contained embedded or narrow bands of Baldcypress, water tupelo, and/or S/S vegetation along their edges (e.g., Robertson et al. 1978).

Bottomland Lakes supported a diversity of animal species. Historically, fish moved into these

lakes for foraging and spawning (Jackson 2005) when they became connected with the Mississippi or Ohio Rivers during flood events. Many fish subsequently moved back into the main channel when flood water receded (e.g., Sparks 1995). Bottomland Lakes also supported a diversity of amphibian and reptile species. (e.g., Tucker 2003). Aquatic mammals regularly used Bottomland Lakes and more terrestrial mammals traveled in and out of these areas for seasonal foraging, breeding, and escape cover during dry periods. Bird diversity in these lakes was high, and high densities of waterfowl, rail, shorebirds, and wading birds used these habitats for foraging, nesting, and resting sites (Heitmeyer et al. 2005).

Forest covered most of CCNWR and other nearby Mississippi and Ohio River floodplain areas during the late 1700s (Hutchins 1784, Collott 1826, GLO 1804-40, Nuttall 1821, Leitner and Jackson 1981). The distribution of tree and woody shrub species was arrayed along geomorphic/topographic and hydrological gradients similar to those described below in the current conditions section. Generally, a continuum of riverfront forest, bottomland hardwood and terrace hardwood communities was present from the edges of the Cache River channel up to mixed hardwood mesic forests in uplands that bound the Cache River.

Bison and elk formerly were present in the region but apparently were extirpated by 1860 (Beckwith 1887 cited in Hendershott 2004). Other common upland species in these habitats were bobwhite quail, grassland songbirds, racerunner lizards and fence lizards, white-tailed deer and rabbits.

Human History

The area's natural resources have always been important to people living in the Cache River valley. Vast tracts of naturally flooded bottomland within the Cache River basin have provided habitat for migratory birds and other wildlife, which in turn have attracted humans for the past 12,000 years or more. Cypress Creek National Wildlife Refuge and the Cache River area was used as a trading crossroads by Native Americans, and has several sites of archeological interest within its boundaries, including the Cypress Citadel site just south of Cypress, Illinois. French Voyageurs gave the river its modern name, calling it "cache" which means secret or hidden place. Euro-American hunters, trappers, and soldiers passed through the Cache River basin in the 18th century, followed by settlers in the 19th century. The intense human use of the area is recorded in archeological sites that can be found throughout CCNWR. A comprehensive cultural resource overview was completed for CCNWR (Kullen et. al, 1996). This report provides a summary of known cultural resources within CCNWR and a five mile radius around it. The report addresses the importance of the various documented sites in terms of scientific, religious, and symbolic values and provides a framework for predicting the frequency and location of undiscovered sites within CCNWR (Kullen et.al., 1996).

Today the Cache River area is primarily rural and most of the land that is not forested is used for agriculture. Over the last 200 years, the basin has been altered by widespread hydrologic alterations and land clearing. The Post Creek cut-off, completed in 1916, was especially damaging to the wetlands because it diverted the upper segment of the Cache River directly into the Ohio River and isolated approximately 40 miles of the middle and lower Cache channel. In the 1960s and 1970s, thousands of acres of floodplain forest were cleared, drained, and converted to agriculture. By the 1980s, natural and agricultural lands began to flood more often.

Silt from cleared land and unstable stream channels choked natural drainage paths and sedimentation rates in the Lower Cache were as high as 24 inches per year (Schwegman, 1991).

As a result, local, citizen-based conservation efforts were initiated in the late1970's and received a significant boost with the formation of the Cache River Wetlands Joint Venture in 1990. The partners recognized the need to influence land use changes throughout the 500,000-acre watershed. By working with other groups, including the Soil and Water Conservation Districts, Friends of the Cache River Watershed, universities, landowners and private citizens, the Joint Venture Partnership is uniquely positioned to address the scale and complexity of the efforts needed to protect and restore the Cache – a task no one organization could achieve alone.

Alterations to Land Cover and Natural Hydrology

Land Cover Changes

Over the last 200 years there have been significant changes to the Cache Valley and its natural processes. Prior to human disturbance, the structure and function of natural communities within the Cache River Watershed were in a state of dynamic equilibrium as described by Hutchison (1995):

> "The natural hydrologic regime of the Cache was primarily determined by the geomorphology of the region. The high bedrock hills in the northern part of the watershed were rugged and dissected the stony, high gradient streams. The Cache Valley was broad and flat with sluggish mud-bottomed stream channels and extensive swamps. In the Lower Cache bottoms, tributary streams coming down from the hills followed swales between the low parallel ridges, often flowing back and forth for long distances before finally reaching the main channel. Floodwaters generally spread out over broad areas, and fluctuations in flow were more subtle than today. Periodically, floodwaters flushed the swamps and other wetlands, thus keeping them from filling with upland sediment. The extensive swamps served as reservoirs to temporarily store large amounts of storm water and allow it to move slowly downstream moving through the wide valley on their way to join the Ohio River near Mound City. Thus the stream banks remained well-protected and relatively stable in most places. Channel scour was rare and the waters in all of the streams and swamps were nearly always clear. The abundant springs along the base of the bedrock hills helped to keep the wetlands permanently wet with cold clear water. And occasionally, the Ohio River would flood the entire Cache Valley thereby changing forest structure in some areas, providing aquatic organisms' access to areas that were previously isolated from them, and creating localized areas of scour and deposition."
>
> In the uplands, the fine-textured silt loams were susceptible to erosion, but they were generally well protected by deep leaf litter and various types of vegetation (trees, shrubs, forbs, and grasses). The forest canopy was locally impacted by natural disturbances such as windfalls, floods, diseases, and periodic wildfires. The natural processes allowed for changes due to natural disturbances, because most were localized, did not occur often, and were generally not catastrophic."

The most significant changes, described below, in the watershed that affected the Cache ecosystem are hydrologic alterations undertaken to control flooding and drainage for agriculture (IDNR, 1997). Cumulatively, these changes have disrupted natural flooding regimes, increased sedimentation in the bottomlands, increased channel downcutting and decreased bank stability.

Alterations

Post Creek Cut-off

In 1915, the Cache River Drainage Commission completed the construction of the Post Creek Cut-off which diverted water from the Upper Cache River via Post Creek, a tributary, to a point on the Ohio River upstream from the old mouth of the Cache; this seven-mile ditch drained wetlands for agriculture and controlled flooding and essentially split the watershed into 2 halves: the Upper and Lower Cache River (Figure 3). The Upper Cache River channel has a steep gradient and drains about 235,520 acres. The slope through much of the Upper Cache River is 1 to 1.5 feet per mile and increases to 2.5 to 3 feet per mile as the influence of the Post Creek Cutoff becomes more prevalent. (Initial Evaluation Report, Alexander and Pulaski Counties, Illinois, 1984). In the Upper Cache River, the primary problem is erosion and channel entrenchment. Upstream migration of the stream channel and lateral gullying has drained many off-channel wetlands and threatens to drain Heron Pond and Little Black Slough, some of the most significant wetland and natural areas in the State (Demissie et al., 1990).

The Middle and Lower Cache River as it exists today has a watershed of approximately 229,120 acres and is about 50 miles long from the Post Creek Cutoff to the mouth of the Lower Cache River Diversion near Cache, Illinois, that empties into the Mississippi River. A series of stream modifications during the past 40 years has reduced the length of the Cache River by approximately 35 miles. (USACE, 1984).

The entire reach of the Middle and Lower Cache River was once the ancient channel of the Ohio River. Given this influence, the Lower Cache River floodplain is nearly 4 miles wide and very flat; and on average only falls 1 foot per mile. Buttonland Swamp, a National Natural Landmark (within the Middle Cache) has a gradient of only .2 to .3 feet per mile. Flow reversals in this segment of the river are common due to the slight gradient and influences of Big Creek flows and the Post Creek Cut-off.

Middle Cache River Flow Reversal

Natural drainage and flow patterns of the Cache River have been dramatically changed by numerous alterations. A combination of the Post Creek Cut-off, drainage and channelization activities cause the Cache River to flow backwards (to the east) during major storm events. This occurs when Big Creek, a major tributary, enters the Cache (south of the Bellrose Waterfowl Reserve) with high flow velocities. Over the last century, conversion of forested land to cropland and pasture, together with the channelization of the middle and lower reaches of Big Creek has resulted in a dramatic increase of sediment and the delivery of water to the Cache River. This increased volume exceeds the Cache River's ability to maintain a west and south

flow resulting in flow reversal to the east. Since the Post Creek Cut-off was constructed, and increased flow volumes from Big Creek, flow reversals (along with increased sediment delivery) occur more frequently and are more extensive as water follows the path of least resistance to the lowest point at the Post Creek Cut-off.

Levee Construction

Authorized by the Federal Flood Control Act of 1938, the Army Corp of Engineers (USACE) completed several large flood control projects in the area. The Reevseville levee (which separates the Bay Creek and Cache River watersheds) was built to prevent Ohio River floodwater from reaching the Middle Cache Valley. The Cache River Levee (Karnak Levee) was constructed to provide protection for the Middle and Lower Cache River Valley from floodwaters from the Upper Cache River and from backwaters of the Ohio entering through the Post Creek Cut-off. The economic justification for both levees was based on the flood protection they would provide to the towns of Karnak and Ullin. At the same time they provided incentives for the conversion of more wetlands to agriculture. (IDNR, 1997).

In 2003, the Karnak levee received significant damage when two 48" drain culverts washed out leaving a large breach. Without the protection of the levee, Cache River flow reversals have increased, draining wetlands west of the structure and creating the potential for flooding of Karnak from the Upper Cache River. The Illinois Department of Natural Resources is developing proposals to repair the breach that would allow partial reconnection of the Upper Cache with the Middle Valley Cache.

Cache River Diversion

The Lower Cache River diversion was constructed in 1950 and diverts water directly into the Mississippi River. The 1 mile diversion ditch is approximately 60' wide with poured concrete side walls and delivers water from the Lower Cache River directly into the Mississippi River. The seven mile segment (Old Cache Channel) of the Cache River situated between the diversion ditch near Cache, Illinois and the traditional outlet into the Ohio River was severed from the rest of the Cache River watershed when the diversion ditch was constructed. Currently water within the old channel is controlled by the Ohio River flood gates maintained by the USACE. The gates allow for the manipulation of water in the channel for drainage and flood control. In an effort to maintain and support a fishery within the channel, the Cairo Drainage District and USACE have worked cooperatively with CCNWR to maintain a minimum level of water throughout the year.

Stream Channelization and Drainage

Following the levee projects, there was extensive channelization and land clearing of the bottomlands primarily for agriculture. By the 1960's numerous drainage districts had formed in the valley with the focus of clearing and farming much of the Cache River valley bottomlands. (Hutchison, 1999).

The drainage when combined with soil erosion from the uplands, drainage ditches and channelized streams has drastically altered the Middle Cache Valley. Reductions in flow

combined with increased sediment loads encouraged sediment deposition resulting in as much as 4 feet in some places (Allgire and Cahill 2001) and greatly reduced deep water habitat. Channelization of Big Creek and Cypress Creek significantly increased water velocity and sediment delivery into the Lower Cache River valley as well (Demissie et al. 1990).

Big Creek, a major tributary of the Cache is the largest contributor of sediment to the River (Demissie et. al 1990). In addition, it threatens the integrity of CCNWR's Bellrose Waterfowl Reserve which is intensively managed to produce food for waterfowl. The Reserve occupies a small but significant part of the floodplain where Big Creek enters the Cache River. During flood events sediment laden water will back up into the Reserve or break levees resulting in excessive sedimentation and decrease water quality within the units.

Sedimentation

Erosion and sedimentation are a major problem in the Cache River basin due to their negative impacts both on agricultural drainage and on preservation of natural areas. Three sediment monitoring stations are located within the Lower Cache River watershed. The stations are on Big Creek, Cypress Creek, and the Lower Cache River. The stations on Big Creek and Cypress Creek provide information on the amount of sediment being transported into the Middle Cache by tributary streams. The station on the Lower Cache River near Ullin, Illinois, provides information on the amount of sediment leaving the Middle Cache.

Sediment deposition from the lower Cache River near Ullin, Illinois, is lower than the sediment yield from Big Creek alone. The reason for this difference is that the wetlands in Buttonland Swamp trap a significant amount of the sediment delivered from the tributary streams, Big Creek and Cypress Creek. Data collected over a three year period in 1985 to 1988 showed that the Big Creek watershed contributed 58,000 tons/year (70%) of the sediment yield into the Middle and Lower Cache River with Cypress Creek contributing an estimated 10,630 tons (13%) (Demissie et. al. 2001). A primary concern for management of the Middle and Lower Cache River is the amount of sediment deposited in Buttonland Swamp due to reverse flow of the Cache River. This high rate of sedimentation will continue to degrade the aquatic habitat in the lower Cache River and associated wetlands.

Further downstream of Big Creek, as more tributaries enter the Lower Cache River, it widens to 100' (at the mouth of the diversion) and10-15 feet deep; the fall rate increases slightly to 1 foot per mile. The gradual slope of the Cache River is conducive to backwater flooding from the Mississippi River. Floodwater discharge from upland streams creates backwater conditions throughout the valley and further upstream into tributary stream channels. In addition the accumulation of sediment in stream channels reduces the stream flow and increases flooding potential. Continuous accumulation of sediment has changed the hydrology within the wetlands and could result in a change in the types of plants and animals found in that area. (USDA,1987).

Ongoing Restoration Strategies

To date, almost 35,000 acres have been acquired and protected through restoration work in the Cache River basin on both public and private land. This work includes three components: forest

and wetland habitat restoration, reduction of sedimentation and stream bank/bed erosion, and hydrologic restoration.

Forest and Wetland Habitat Restoration

Almost 30,000 acres within the Cache River Watershed, most of which were marginal farmland, have been reforested or restored to wetlands; fourteen thousand of those acres have included private land restoration, and approximately 5,000 acres have included land on CCNWR. Reforestation on CCNWR has included 4300 acres of bottomland and 700 acres of upland, and includes up to 30 species (Refuge Data). The enrollment of private cropland in programs such as the Conservation Reserve Program (CRP) and the Wetlands Reserve Program (WRP) is also an important tool for the preservation of the Cache River wetlands. Reforestation, wetland restoration, and conservation tillage address many of the conservation issues affecting the Cache River Watershed by increasing the function of the floodplain, increasing habitat available to wildlife, and reducing the amount of sediment entering the river from adjacent lands.

Reducing Sedimentation

Restoring forests and wetlands is an important part of fixing the Cache River's hydrology and reducing runoff. A sediment control project popular with private landowners in the Upper Cache involves the construction of in-stream weirs and strategically located flood retention ponds on private land within the Big Creek and Cypress Creek basins, both major contributors of sediment to the Cache River. To date fifty-four, five-acre flood retention ponds have been completed and will contribute to lowering peak flood flows and reducing the amount of sediment being deposited into the Lower Cache. Thirty-eight of sixty planned rock weirs in the Upper Cache, Big Creek and other tributaries will greatly reduce in-stream soil erosion by dissipating the energy of the water preventing further channel incision and lateral gullying that threatens to drain many isolated wetlands, like Heron Pond, in the Upper Cache. In addition, the Conservation Reserve Program's conservation tillage plan has also helped landowners make tremendous progress in reducing sedimentation. From 1987 to 1995 alone, participants in the CRP reduced sedimentation on more than 175,000 acres in the Cache River Watershed by more than 1 million tons annually (Cache River Watershed Resource Planning Committee, 1995).

Restoring Hydrology of the Cache River

The third component of the restoration of the Cache River ecosystem will be the partial reconnection of the Upper, Middle, and Lower segments of the river. The hydrologic alterations in the Cache River have impacted the river's structure and function and ultimately threaten the long-term sustainability of the area's biological diversity. Currently the JVP has developed of a set of reconnection measures that are in the planning stages and will take the efforts and support of public and private entities to accomplish.

Historically, sections of the Middle and Lower Cache River featured wide expanse of open water with depths of more than 10 feet within scour pools (in-channel and off-channel), oxbow lakes, and sloughs. Today much of the Middle and Lower Cache River rarely exceeds four feet due to

habitat loss, channelization and drainage. In an effort to restore deepwater habitat and maintain a minimum water level in the Middle Cache the following measures were completed:

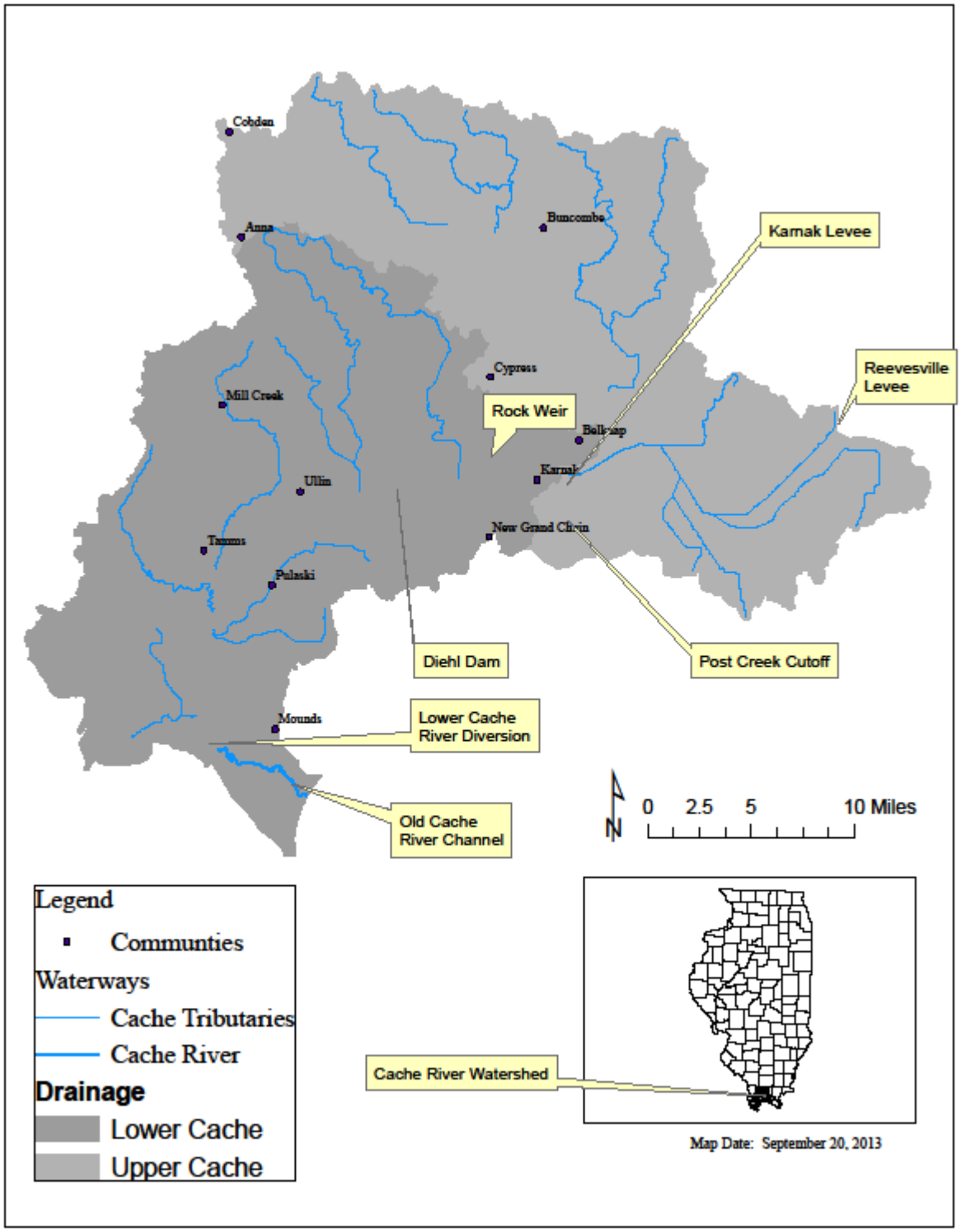
1. Two rock weir structures were installed in the Middle Cache River to maintain seasonal low water levels and slow sediment deposition from Big Creek flow reversals. The Diehl dam was constructed in 1982 west of Long Reach Road; it is located on private property and with the landowner, is maintained by the Illinois Department of Natural Resources under a formal agreement. The Hwy 37 structure was constructed in 1995.

2. In an effort to restore deepwater habitat, the JVP secured funding to dredge a one mile section of river channel from Long Reach Road upstream to the east (within Buttonland Swamp). The project involved removing excess silt that had accumulated in a section of the Cache River, locally known as Long Reach and Short Reach. The primary goal of this project was to remove excess silt within 60 feet wide by 6 feet deep area. There are expectations to continue dredging upstream as permits and funding are acquired.

Table 5. Summary of Alterations, Resource Impacts and Restoration Strategy

Alteration	Result	Strategy
Land Cover Conversion of forest to agriculture	Increased discharge/flow volume and velocity -decrease flood storage capacity -accumulation of sediment in stream channels reduces the stream flow and increases flooding potential	Water Retention Basins, Habitat Restoration (WRP, CRP), Remove Highly Erodible Lands
Post Creek Cut-off , Levee Construction, Cache River Diversion	-Lateral gullies, sedimentation, flow reversal -Excessive sedimentation in the lower basin and excessive erosion (entrenchment and lateral gullies) in the upper basin -Cut-off/abandoned many of the historic oxbows and river meanders from the main river channel.	Restoration Measures (Reconnection Structure, East and West Swamp Structures)
Middle Cache River Flow Reversal	-Excessive sedimentation in the Middle Cache	-Restoration Measures (Reconnection Structure, East and West Swamp Structures -Restore floodplain structure and function
Stream Channelization (Cache River, Big Creek, Cypress Creek)	-Lateral gullies, -Increase sedimentation and channel degradation -Loss of deepwater habitat	-Install Newberry Weirs and -Water Retention Structures -Dredging
Loss of Floodplain	-Increased discharge/flow volume and velocity -Sedimentation -Decrease flood storage capacity	-Land Acquisition, -Restore floodplain structure and function -Dredging

Figure 3. Cache River Watershed Hydrology



Current Condition and Management Strategies

Plant Communities

Vegetation of CCNWR may be broadly divided into wetlands (comprised mainly of bottomland and mixed hardwood forests) and upland forest.

Wetlands

Most of the area is subject to seasonal flooding and is wet during at least a portion of each year. The distribution of tree and woody shrub species are arrayed along geomorphic/topographic and hydrological gradients. Generally, a continuum of bald cypress/ tupelo swamp, riverfront forest, bottomland hardwoods and terrace hardwood communities are present from the edge of the Cache River channel up to mixed hardwood mesic forests in uplands that bound the Cache River's floodplain. Different community types are delineated within the refuge based on dominant species, elevation, and inundation.

The main channels of the Cache River and its major tributaries contain open water with some aquatic vegetation and bald cypress trees in flatter, low gradient reaches. Some river chutes and old side channels are disconnected from main channel flows and have semipermanent water regimes that support woody Shrub/scrub (S/S) and herbaceous "moist-soil" plant assemblages that germinate on periodically exposed mud flats. During high river flows chutes and side channels historically were connected with the main channel. The extent and duration of river connectivity is the primary ecological process that controls nutrient inputs and exports, primary and secondary productivity, and animal use of chutes and side channels

Emergent and Scrub/Shrub (S/S) communities represent the transition area from more herbaceous and emergent vegetation in the aquatic part of the swamp to higher floodplain surfaces that support trees. S/S habitats typically are flooded a few inches to 2-3 feet deep for extended periods of each year except in extremely dry periods. S/S habitats in the CCNWR are dominated by buttonbush, swamp privet, and willow (TNC 1995). A natural levee usually is present along the edges of larger bottomland lakes and these areas support diverse composition less water tolerant BLH forest species (e.g., Robertson et al. 1978).

Riverfront Forest communities are dominated by early successional tree species and range from water tolerant species such as black willow and silver maple along the river channel and in low elevations and swales to intermediate water tolerant species such as green ash, cottonwood, sycamore, box elder, pecan, and sugarberry on ridges. Pin oak occasionally is present in higher elevations in Riverfront Forest areas, but this species has high mortality during extended flood events and oak patches are probably small and scattered. Shrub and herbaceous vegetation cover in Riverfront Forests is sparse near the Cache River but dense tangles of vines, shrubs, and herbaceous vegetation are present on higher elevations away from the river where alluvial silts were deposited. Typical shrub and vine species are poison ivy and Virginia creeper. Giant cane occasionally is present on these higher elevations, but repeated river flooding and scouring limit its occurrence and persistence (e.g., Gagnon 2007). The dynamic scouring and deposition in chute and bar areas also limits the tenure of many woody species except on the highest elevation

ridges where species such as cottonwood and sycamore often become large mature stands (e.g., Hosner and Minckler 1963).

Riverfront Forests are used by many animal species, especially as seasonal travel corridors and foraging sites. Many bird species nest in Riverfront Forests, usually in higher elevation areas where larger, older, trees occurred (Papon 2002). Arthropod numbers are high in Riverfront Forests during spring and summer and these habitats also contain large quantities of soft mast that is consumed by many bird and mammal species (e.g., Knutson et al. 1996). Few hard mast trees occur in Riverfront Forests, but occasional "clumps" of pecan or oak provide locally abundant nuts. The very highest elevations in chute and bar areas provide at least some temporal refuge to many ground-dwelling species during flood events (Heitmeyer et al. 2005).

Bottomland hardwood and bald cypress/tupelo forest communities historically covered extensive areas of the CCNWR (e.g., Leitner and Jackson 1981). These forest types occur in several soil types and contain diverse mixtures of species (Conner and Sharitz 2005, Heitmeyer et al. 2006). Tree species composition in BLH communities in the CRV can be separated along elevation and flooding gradients. Bald cypress/Tupelo, also called "swamp forest" communities occur in floodplain sites, and some sluggish low gradient Cache River channel areas, that range from being flooded for extended periods each year, and occasionally year round, to being flooded for 4-6 months in winter and spring. The lowest elevations in the CCNWR contain bald cypress, water locust, pecan, water elm and water tupelo (e.g., Robertson et al. 1984). Soils in forested swamp settings are Karnak, Piopolis, Petrolia, and Birds types. Edges of bald cypress/Tupelo forests near more permanent waters include bands of S/S vegetation. At slightly higher elevations in the CRV, Low BLH (sometimes called "Deep Floodplain") communities are present and contain slightly less water tolerant trees such as overcup oak, green ash, red maple, and pecan with scattered tupelo and bald cypress present in low elevation pockets. Woody shrubs in Low BLH sites include buttonbush and swamp privet. Many understory vines typically are present in Low BLH communities and include greenbrier, and poison ivy. Ground herbaceous cover usually is sparse in Low BLH because of extended flooding, but sedges, swamp beggar ticks, water and water pepper smartweed, butterweed, and rice cutgrass often are abundant during dry periods. Soils in Cypress/Tupelo and Low BLH communities in the CRV are Birds, Petrolia, Dupo, Bonnie, and Cape clays.

Shallow Floodplain (SBLH) (similar to the Wet-Mesic Bottomland Forest category in some botanical literature, e.g., TNC 1995, Nelson 2005) in the CRW occurs mainly in floodplain areas that typically flood for up to 2-4 months annually during the dormant season and into early spring (Heitmeyer et al. 2006, Heitmeyer 2008). Soil saturation in these forests often becomes extended for 3-4 months in wet years, but surface flooding may not occur in extremely dry years. Soils in shallow floodplain forests in the CRV are dominated by silty-clay loams including Dupo, Wakeland, Haymond, Hurst, Banlic, Belknap, Ginat, Sharon, Okaw, and Ware types. Tree species composition in SBLH is diverse and includes pin oak, swamp chestnut oak, bur oak, green ash, slippery elm, pecan, sugarberry, American elm, box elder, sweetgum, and some widely scattered swamp white oak in areas that flood regularly for short durations during the dormant season. Small depressions in BLH zones, such as vernal pools, include overcup oak, green ash, maple, and pecan. Giant cane is occasionally present in some floodplain forest locations, mostly on higher ridges (Platt and Brantley 1999, Brantley and Platt 2001, Gagnon 2007). Common privet, honeysuckle, grape, trumpet creeper, greenbrier, and poison ivy are common understory plants in SBLH. Early explorers often commented on the relatively "impenetrable" nature of these floodplain forests (e.g., Collot 1826). The shallow floodplain

BLH along tributaries of the CRW resembles in many ways the Floodplain Forests, with low oak composition, that historically covered large expanses of the Middle Mississippi River Corridor floodplain on point bar surfaces and along tributary streams (Hus 1908, Telford 1926, Gregg 1975, Robertson et al. 1978, Klimas 1987, Brugam and Patterson 1996, Heitmeyer 2008). Typical floodplain BLH in northern parts of the MAV typically develop on mixed silt loam soils where older point bar "ridge-and-swale" topography occurred. Most of these older point bar surfaces were within the 1-2 year flood frequency zone. Some botanical literature also calls this forest type the "sugarberry-elm-sweetgum" zone (e.g., Lewis 1974, Gregg 1975).

Animal diversity is high throughout low and shallow BLH community types because of the deep alluvial soils, seasonal flooding regimes, diverse plant communities, high structural complexity, and rich detrital food bases (Heitmeyer et al. 2005). Most foods within BLH become available in seasonal "pulses" that provide many different types of nutrients used by many trophic levels and within many niches. Consequently, this community supported large numbers of animal species and individuals. The primary ecological process that sustain BLH communities and their productivity is seasonal, mostly dormant-season, flooding. Regular disturbance events also help sustain this ecosystem through periodic extended flooding or drought, wind storms, and rarely fire in at least the higher elevations.

Terrace Hardwood Forest historically occurred in the CRW on the edges of floodplain surfaces where overbank and backwater flooding is rare (> 20-year recurrence elevations) and soils grade into sandier Entisols including Lamont, Sciotoville, Wheeling, and Racoon types (Fig. 8). These communities are often called "Flats" (Klimas et al. 2009), "Flatland Hardwood" (Marks and Harcombe 1981), or "Bottomland Flatwoods" (Nelson 2005) because they occur on old high elevation terraces that often are subject to ponding of rainwater or short duration local stream flooding. During extremely high Mississippi and Ohio River floods, these high terraces are inundated, usually for short periods in spring. Dominant canopy trees in Terrace Hardwood Forests are pin oak, cherrybark oak, post oak, willow oak, hickory, winged elm, and persimmon (Nelson 2005). Trumpet creeper and climbing dogbane are common shrubs and sedges, goldenrod, stiff bedstraw, spider lily, and wood sorrel are common herbaceous species.

Upland Forests

Slope Forest occurrs in the Cypress Creek NWR region on lower slopes of the Shawnee and Coastal Plain Hills and some alluvial fan areas. Slope Forests contain unique mixes of trees representing both upland and floodplain communities that occur adjacent to alluvial fans (TNC 1995, Battaglia 2007). Some authors refer to this habitat as the "shatter zone" between upland and river valley floor plant associations (Gregg 1975). More typically, this community is referred to as mesic lower slope mixed hardwood (Robertson et al. 1984). The diverse tree species present in Slope Forests includes hickory, sugarberry, swamp white and swamp chestnut oak, white oak, bur oak, southern red oak, black walnut, hawthorn, persimmon, honey locust, Kentucky coffeetree, and slippery elm. Many other woody species are present in the understory and as occasional canopy trees. Herbaceous cover often is extensive in Slope Forest (Chmurny 1973, Gregg 1975), especially on the lowest elevations of alluvial fans and includes columbine, spikenard, wild ginger, spring beauty, pepperroot, cleavers, sensitive fern, sweet jarvil, pokeberry, map apple, great Solomon's seal, and false Solomon's seal (Zawacki and Hausfater 1969).

Slope Forests are not flooded except during extreme floods. Even during extreme floods, only

the low elevation bottom parts of the hill slopes historically would have been inundated. Most water flows off alluvial fan slopes in a wide overland sheetflow manner and only minor drainages originate from these areas. Many alluvial fans have seep spring areas where upland groundwater exits (Phillips 1996). Soils in slope areas of the CRW region usually are deeper loess types such as Alford, Menfro, Winfield, and Hosner.
Upper slopes of the Shawnee Hills contain a mesic hardwood forest overstory similar to those found in the Ozarks (Fralish 1976, Mohlenbrock 1989, Fralish et al. 1991). White, red, and black oaks are common dominant species in this community. Other forest species similar to mesic types found in the Slope Forest assemblages also are present. Soils in upland forest areas include Alford, Stoy, Zanesville, Wellston, and Berks.

Ongoing Management Strategies

Land Acquisition Program/Priorities

Cypress Creek National Wildlife Refuge was established in 1990 with a land acquisition boundary of 35,320 acres. Refuge land acquisition is ongoing on a willing seller basis. Current refuge acreage totals approximately 16,000 (Figure 4). Land acquisition funding has been through the Land and Water Conservation Fund (LWCF). Refuges using LWCF funding are prioritized based on their potential contribution to the overall refuge system in terms of ecosystem conservation, bird conservation, endangered and threatened species and fisheries and aquatic resources.

All land acquisition is on a willing seller basis, which often results in several tracts to consider for acquisition with a limited amount of funding. Land acquisition is prioritized relative to refuge goals related to the North American Waterfowl Management Plan; protection of valuable wetlands and bottomland hardwoods; and providing contiguous ownership necessary for hydrology restoration activities. Priority is usually given to tracts adjoining the Cache River and major tributaries, tracts with significant wetlands or wetland restoration potential, and tracts that have the potential to increase forest block size.

Description of the CCNWR Farming Program

The CCNWR Cooperative farm program includes approximately 1200 acres and eight cooperative farmers.

The use of farming as a land management tool supports the biological purposes and management strategies of CCNWR as presented in the Refuge establishment Environmental Assessment and will adhere to all regional and national policies and guidance, such as; Region 3 Pesticide Use Policy (USFWS 2014), Region 3 Farm Program Guidance and the U.S. Fish and Wildlife Service (FWS, Service)'s Midwest Region Environmental Assessment (EA) for row crop farming and the use of genetically-modified, glyphosate-tolerant (GMGT) corn and soybeans on refuge/district land (FWS, 2011).

Similarly, the Service's ecological integrity policy specifies that

> "Farming, haying, logging, livestock grazing, and other extractive activities are permissible habitat management practices only when prescribed in plans to meet wildlife or habitat management objectives, and only when more natural methods such as fire or grazing by native herbivores, cannot meet refuge goals and objectives.
>
> We do not allow refuge uses or management practices that result in the maintenance of non-native plant communities unless we determine there is no feasible alternative for accomplishing refuge purpose(s). For example, where we do not require farming to accomplish refuge purpose(s), we cease farming and strive to restore natural habitats.
>
> We use native seed sources in ecological restoration. We do not use genetically modified organisms in refuge management unless we determine their use is essential to accomplishing refuge purposes(s) and the Director approves the use (USFWS, 2003).

Habitat restoration is a core objective of most refuges in achieving their purpose and in some circumstances, the use of GMGT crops could be essential. However, habitat management, supplemental food, and wildlife viewing objectives can more readily be accomplished without the use of GMGT seeds, and thus, their use is not likely essential.

Farming on CCNWR is accomplished through the issuance of a Special Use Permit (SUP) to private individuals (cooperative farmers). The SUP provides direction to the cooperative farmer on: types of crops to be planted, crop shares or cash payments for farming privileges, use of pesticides, use of best management practices, and other special conditions to ensure the farming program is conducted in an appropriate manner and within state, regional, and national Service guidance. The SUP is completed, issued, and signed by the Refuge project leader. These annual agreements are typically written to work with the same cooperator farming a specific unit for multiple years.

Approximately 50% of the land acquired by the Refuge includes a history of agricultural production (Figure 10) The Cooperative Farm Program includes 1200 acres and 8 cooperative farmers. Farmed tracts vary in size from 25 to 500 acres and are located on terrain described as flat to gently rolling. Crops planted on Refuge property include corn, soybeans, millet, alfalfa, and wheat.

Cooperative farmers use conventional farming practices including the use of tractors, plows, disks, planters, spray equipment, and combines. Typically, planting begins as early as March and is usually completed by early July depending on weather, soil conditions and type of crop planted. Cooperating farmers are required to follow Service policy and Special Conditions for Cooperative Farming.

Each farmer provides all equipment, supplies, and labor to plant, maintain, and harvest the crop. Harvest techniques are the same for both no-till and traditional farming practices. Harvest begins in the late summer (August) through mid-Fall (November). Self-propelled harvesting implements such as a combine are used in this process. At times, winter wheat is planted as a

cover crop in the late summer or early fall. Planting and harvest activities are restricted to minimize disturbance to wildlife. Also Cooperative harvest provisions are included in the SUP and include a percent share provision where the cooperator harvests part of the crop and leaves part of the crop for the benefit of migratory and resident wildlife.

Use of Genetically Modified- Glysophate TolerantCrops (GMGT)

As of 2011 the use of genetically-modified crops (Bt or glyphosate-tolerant corn) is not permitted on CCNWR property. For the past several years, the Service has been reducing the number of acres farmed on National Wildlife Refuge System land as well as the number of acres planted to GMGT crops within the region. This trend is also occurring on CCNWR.

Use of Insecticide-treated Seed

Cypress Creek NWR does not allow the use of insecticide-treated (i.e. neonicotinoids) seed. The use of treated crop seeds, particularly those treated with chemicals referred to as neonicotinoids, have been a growing environmental concern due to potential effects on pollinator species. Neonicotinoids are a class of insecticides chemically similar to nicotine. They are marketed and distributed in various forms including sprays, powders, and seed treatments. Trade names containing neonicotinoids may include (but are not limited to) Acceleron®, Acetamiprid®, Actara®, Adage®, Adjust®, Admire®, Advantage®, Alpine®, Arena®, Assail®, Belay®, Calypso®, Celero®, Centric®, Clutch®, Confidor®, Cruiser®, Dinotefuran®, Encore®, Flagship®, Gaucho®, Helix®, Inside®, Intruder®, Ledgend®, Merit®, Meridian®, Nipsit®, Platinum®, Poncho® , Pravado®, Premise®, Regent®, Safari®, Scorpion®, Titan®, Touchstone ®, Tristar®, and Venom®. Active ingredients include: acetamiprid, clothianidin, dinotefuran, imidacloprid, nithiazine, sulfoxaflor, thiacloprid, and thiamethoxam.

Purposes of Farming

Farming is used on CCNWR for two purposes. First, to accomplish habitat restoration objectives and second, for wildlife habitat. Farming is implemented primarily to prepare a substrate for the establishment of native hardwood trees. Farming may be used for one to two years to reduce noxious weeds, or non-native plant species. Newly acquired properties for CCNWR are often agricultural land. Furthermore, many of the tracts acquired by CCNWR have been farmed for a long period of time. SUPs may be used to extend the farming program to keep the land free of weeds until funds are available for habitat restoration; however, CCNWR has a goal to only continue farming newly acquired tracts for two years or less. Farming is also used as a tool to help manage 237 acres of wildlife habitat surrounding the Bellrose Waterfowl Reserve. Farming surrounding this area supplements the natural food resources available to migrating waterfowl as part of CCNWR's waterfowl management program. Cultivated grains are often used in waterfowl management because agricultural seeds tend to have greater energy than many natural seeds and agricultural crops have higher yield per unit area than natural wetland plants. Some waterfowl biologists recommend providing unharvested grain fields and natural wetlands for migrating and wintering waterfowl because seed resources are low in harvested agricultural fields (Dugger et al. 2007, Gruenhagen and Fredrickson 1990, Fredrickson 1982). The Bellrose Waterfowl Reserve was established to support populations of waterfowl or migratory birds. Providing food for large populations of waterfowl is often accomplished by managing a complex of natural wetlands, moist soil impoundments, and cultivated grains.

Site-Specific Effects Analysis for the Farming Program on Cypress Creek NWR

No site-specific effects on the environment, other than what have already been disclosed in other NEPA documents completed by other federal agencies, are expected from the farming program on CCNWR because of the following:

1. *The U.S. Environmental Protection Agency (EPA) regulates the use of pesticide chemicals, including herbicides, in the environment.*

The EPA regulates the use of pesticide chemicals, including herbicides, in the environment. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA has the authority to regulate the testing, sale, distribution, use, storage, and disposal of pesticides. Before a pesticide may be sold, distributed, or used in the United States, it must be registered under FIFRA.

For example, the EPA first issued a registration standard for glyphosate in June of 1986. Because of advances in scientific knowledge, pesticides that were first registered years ago are required by law to be reregistered to make sure that they meet today's more stringent standards. In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. Glyphosate was reregistered in 1993 as it was found to "not pose unreasonable risks or adverse effects to humans or the environment." Furthermore, "EPA determined that the effects of glyphosate on birds, mammals, fish and invertebrates are minimal," (EPA, 1993). In 1997, permanent tolerances for residues of glyphosate were established in or on raw agricultural commodities including field corn varieties genetically-modified to be tolerant of glyphosate (EPA, 1997).

The herbicide 2,4-D has been used since the 1940s as a pre-plant or post-emergent herbicide to control broadleaf weeds on a broad range of crop and non-crop sites, including cornfields. The EPA first issued a registration standard for 2,4-D in 1988, and the herbicide was reregistered in 2005. In summary, the EPA stated, "Some ecological risks are of concern on some sites for some species," (EPA, 2005). They provide mitigation measures "expected to lessen, but not eliminate, the risk of 2,4-D to wildlife and plants," (EPA, 2005). Currently, 2,4-D is approved for pre-plant and post-emergent application on corn and pre-plant application on soybeans.

Dicamba is widely used in agricultural, industrial, and residential settings for the post emergent control of certain broadleaf weeds and woody plants. It was first registered by the EPA in 1967 and was reregistered in 2006 with amendments in 2008 (EPA, 2009). During the reregistration, the EPA determines whether the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA. As a result of the reregistration review, the EPA "determined that all products containing the active ingredient dicamba are eligible for reregistration provided that the risk mitigation measures indicated in the document are adopted," (EPA, 2009).

APHIS is currently considering the deregulation of new genetically engineered corn, soybean, and cotton plants resistant to the herbicides known as 2,4-D and dicamba. However, the use of GMO crops in CCNWR is not permitted.

Since another federal agency, the EPA regulates the use of pesticides, and that agency has completed NEPA documentation including effects analyses of this activity, the Service relies on the findings from that agency when determining the effects of the same activity on refuge system land. The EPA has both the regulatory authority and the necessary technical expertise to assess effects of pesticide use on the environment while the Service has no regulatory jurisdiction over that activity. Therefore, no other site-specific effects other than what have already been disclosed by the EPA are expected from pesticide use by the Service.

The Service uses available scientific information to create an annual list of chemical herbicides containing certain active ingredients that are pre-approved for use on Refuge lands under the condition that station Best Management Practices and all label conditions are used.

If chemical treatment is considered, a Pesticide Use Proposal (PUP) must be prepared and approved by an appropriate level supervisor prior to the chemical application.

2. The farming program on CCNWR will follow the Service's Midwest Region Environmental Assessment (EA) for row crop farming and the use of genetically-modified glyphosate tolerant (GMGT) corn and soybeans on refuge/district land.

In 2011, the Service's Midwest Region completed an EA for row crop farming and the use of GMGT corn and soybeans on refuge/district land (FWS, 2011c). Under the selected alternative, beginning in calendar year 2012, the use of GMGT corn and soybeans on Refuge System land in the Midwest Region would continue only for the purpose of habitat restoration. According to the EA, the use of GMGT corn and soybeans would be limited to five years on any individual tract being prepared for habitat restoration. Refuge and district managers are required to demonstrate that their proposed use of GMGT crops is essential for habitat restoration. The Service has established an approval process for the use of GMGT corn and soybeans that includes completion of a Standard Eligibility Questionnaire for Genetically Modified Crops on National Wildlife Refuge System Lands. When managers propose to use GMGT corn and soybeans, they are required to complete this questionnaire as part of the approval process. After completion of the eligibility questionnaire, and a site specific analysis of the farming program at CCNWR, it was determined that the use of GMGT corn and soybeans was not necessary, and would not be allowed. Farming with non GMGT corn and soybeans will continue to be used as a management tool for achieving refuge management objectives. Multiple objectives include but are not limited to the following:

- Habitat restoration
- Habitat management
- Supplemental food for wildlife
- Attracting wildlife for viewing and photography

3. The farming program on CCNWR will adhere to all national, Department of Interior, Service, and Region 3 policies regarding pest management and treatments.

Pest management activities on Service land and facilities must conform to all EPA regulations, chemical labels, Material Safety Sheets, and Service and Department of the Interior policies and directives including:

517 DM 1 (http://www.nature.nps.gov/biology/ipm/Documents/DOI517DM1.pdf),
569 FW 1 (http://www.fws.gov/policy/569fw1.html),and
242 FW 7 (http://www.fws.gov/policy/242fw7.html).

These policies state that pests will be managed using an integrated sustainable approach when the pest is detrimental to site management goals and objectives and the planned pest management actions will not interfere with achieving site management goals and objectives.

Service employees use their best professional judgment and available scientific information to select the lowest risk, most effective integrated pest management method, or combination of methods that is feasible for each pest management project.

If chemical treatment is considered, a Pesticide Use Proposal (PUP) must be prepared and approved by an appropriate level supervisor prior to the chemical application.

PUPS are extensive, detailed documents that require specific information about the planned treatment (pest target, threshold for treatment, active ingredient, application rate, application method) as well as a descriptions of the treatment site(s) (soil type, slope, organic content, nearest water, depth to ground water).

The PUPs are valid for only one year and provide a timely, site-specific evaluation of the current conditions. Reports regarding the efficacy of the treatments are required in February of each year so Service staff can evaluate past management actions, and refine and improve subsequent control measures.

Site specific Section 7 consultations have been completed with the Ecological Services branch of the Service for pesticide use in CCNWR regarding threatened and endangered species.

4. Best Management Practices (BMPs) are currently being used for the farming program on CCNWR, and a more thorough list of BMPs will be developed for the farming program to follow in the future.

Special Conditions/Best Management Practices

The Cooperative Farming Program involves practices that provide benefits to both agricultural production and wildlife habitat. These practices result in reduced energy consumption, reduced soil erosion. Best Management Practices are implemented to control erosion and sedimentation; maintain hydrologic flow (open drainage), and enhance wildlife habitat on acreage within the cooperative farming program. Examples of these BMPs include: maintenance of native grass buffers and field borders between 30'-50'; minimizing forest fragmentation such as wide mowed roadsides or maintenance of large openings and the use crop rotation to avoid potential adverse effects such as pest resistance.

Note: These stipulations may change over time to reflect new information.

- Use of chemicals must be approved through a Pesticide Use Proposal.
- Manure applications are prohibited.
- Fall tillage is prohibited. Use of glyphosate tolerant corn and soybean seed will not be permitted for use on CCNWR.
- No insecticides may be used.

The following Best Management Practices will be followed to lessen any potential effects from pesticide application within CCNWR:

- Allow pesticide application buffers around sensitive areas,
- Follow pesticide labels, spray only when winds are 12 mph or less (but not inversions),
- Control drift through use of low pressure and nozzles that create larger droplets,
- Monitor current and predicted winds,
- Monitor predicted rainfall,
- Be cautious around shallow groundwater, and
- Maintain a buffer around water and wetlands.

5. Much of the land in the farming program within CCNWR has been farmed for over a century, more recently with the use of GMGT crops and pesticides.

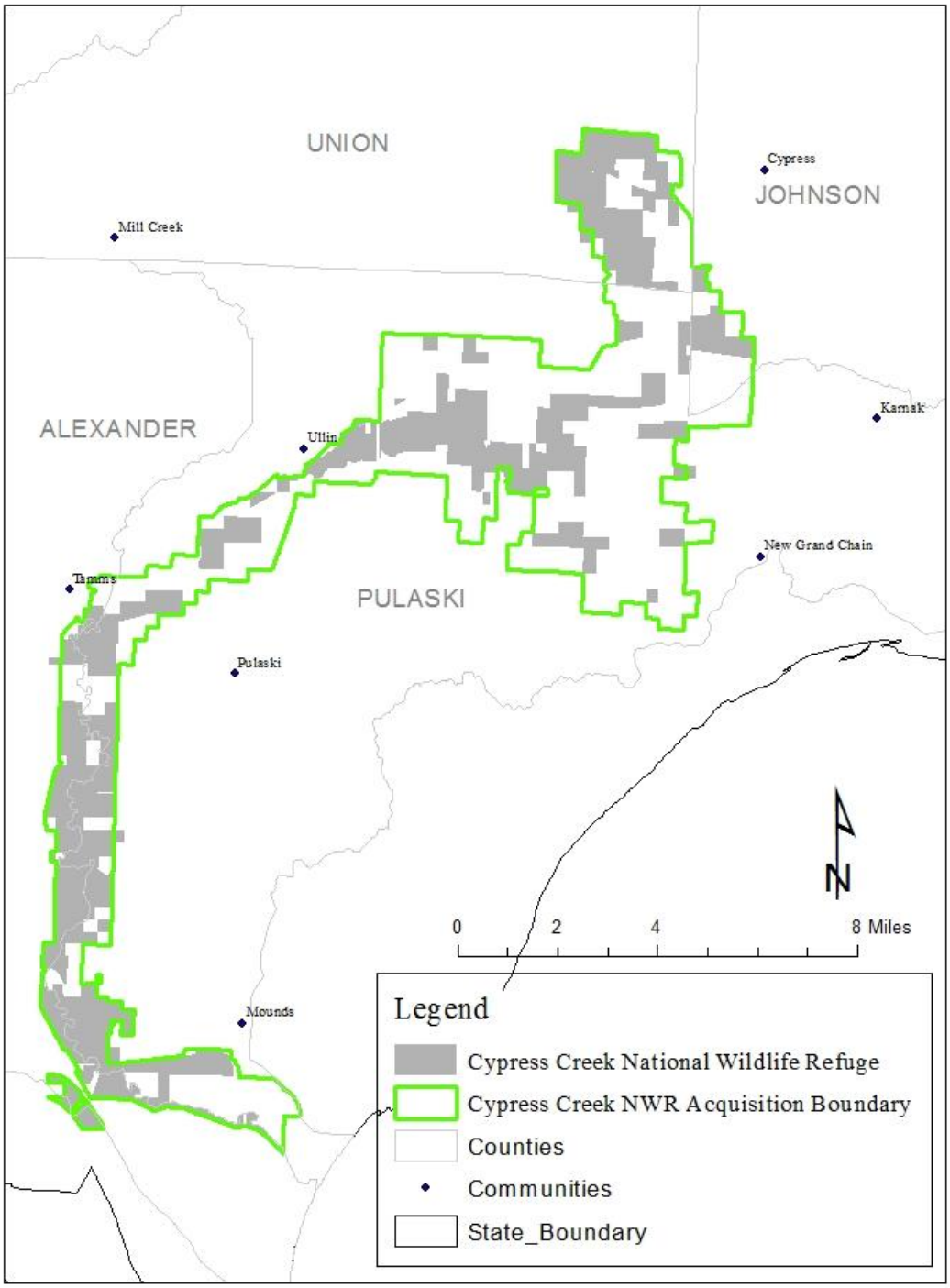
Approximately 50% of the land acquired by CCNWR includes a history of agricultural production . Since Refuge establishment, many of these fields have been removed from production and restored to forest or wetlands (Figure 10). The 1200 acres currently farmed on the Refuge is a minimal part of the agricultural land within the watershed. Agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. The small remnants of wetlands in the basin only make up about 4% of the watershed (20,000 acres).

Scientific advances in biotechnology (crop genetics, broadcast treatment of weeds, etc.) as well as general technology (larger and more aggressive tillage equipment, more accurate planting and harvesting equipment, etc.) continue to change and influence farming today as it did in the past. Farming on CCNWR occurs on approximately 5 percent of the total Refuge acres and will occur on only previously disturbed areas, such as previously farmed or currently farmed land. The farming program is used as a tool to prepare the seedbed for restoration of natural cover. All of the above analyses have been used to determine the potential effects on the environment that would result from the farming program on CCNWR.

In summary, no significant effects are expected from the proposed farming activities, based on the following list of factors that have been used to do a site-specific analysis of the farm program at CCNWR: 1) the effects analysis completed in the Environmental Assessment for this HMP,2) use of a restricted list of EPA approved herbicides,3) we do not allow the use of insecticides,4) we do not allow the use of genetically modified organisms, 5) we follow all EPA, DOI, and FWS pest management policies, 6) we implement many Best Management Practices, 7) we have been, and continue to, convert CCNWR agricultural land to forest and wetland (Figure 10).

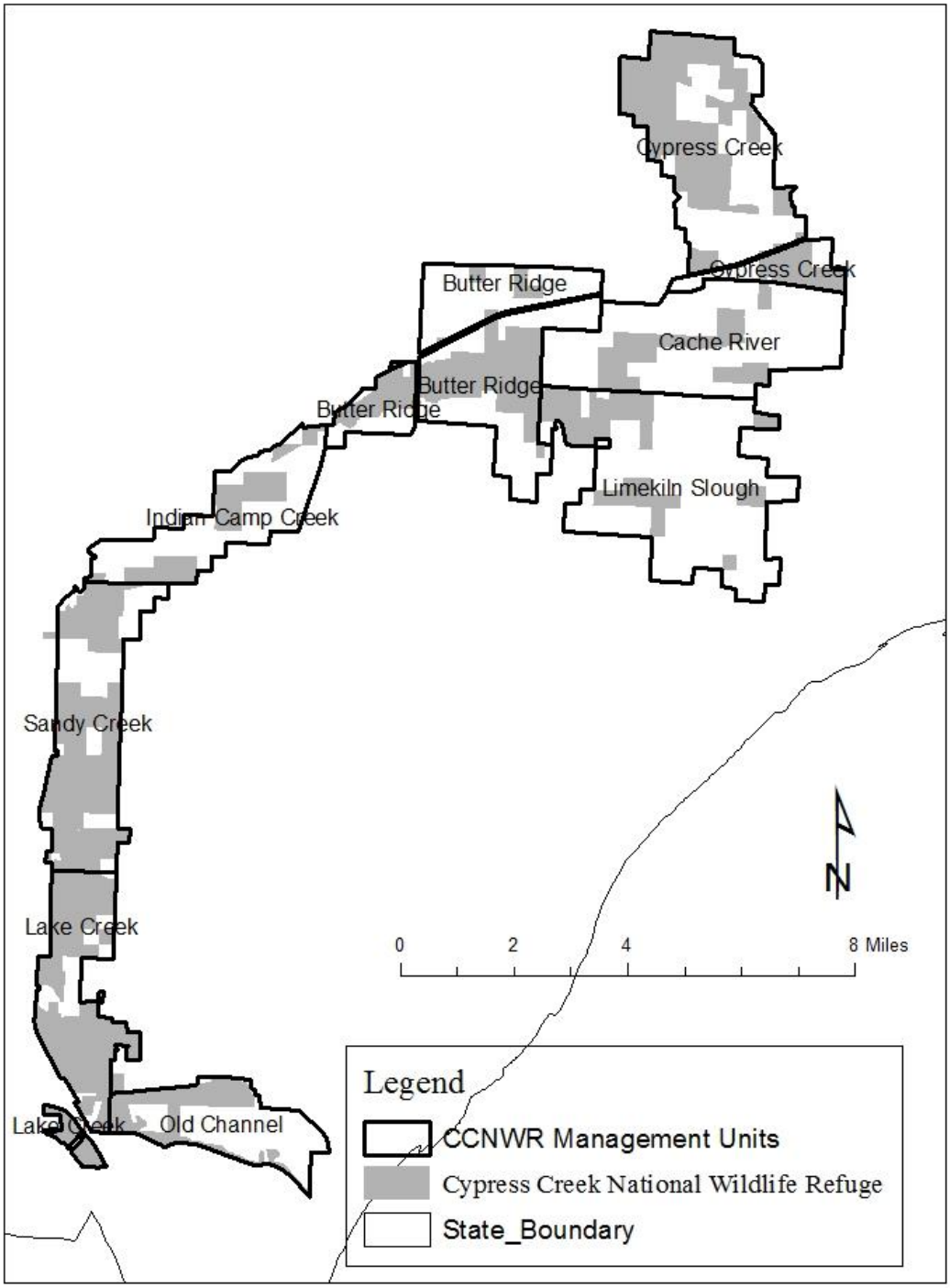
In general, the Refuge System is reducing the amount of farming on national wildlife refuges, and this has been demonstrated to be the path at CCNWR. Due to the many policies listed above, farming within CCNWR is not expected to have the potentially significant adverse effects to the environment as surrounding farming practices on private land.

Figure 4. Cypress Creek National Wildlife Refuge Ownership and Acquisition Boundary



Map Date: September, 20, 2013

Figure 5. Cypress Creek National Wildlife Refuge Management Units



Map Date: September, 20, 2013

Wetland Management

Moist Soil - Thirteen moist soil units totaling 700 acres are managed on CCNWR with the primary purpose of producing food for migrating waterfowl. Periodic disturbance and water level manipulation are utilized within the impoundments in order to encourage the germination of valuable moist soil plants such as annual smartweeds, wild millets, and beggar-ticks. Incremental flooding of moist soil units begins in September or October. The units are progressively flooded as waterfowl arrive in order to concentrate feeding areas, and avoid premature deterioration of moist soil seeds. All units remain flooded through the winter and provide invertebrates for early spring migrating waterfowl. Drawdown begins in mid to late March and can occur, depending on the unit anytime between March and the following fall depending on the vegetation community that is desired and the guild of waterbirds that are being targeted. Drawdowns serve as a valuable tool to attract a diversity of foraging birds. An annual water management plan is developed and implemented each year which provides a staggered schedule in order to maximize the diversity of water levels and therefore availability of habitat for the greatest diversity of species.

Invasive Species Control

There are a number of invasive species throughout CCNWR. Table 4 shows those species causing the highest level of concern and considered high priority for control measures. The key to controlling invasive species is early detection and treatment which is not always feasible due to staff and funding limitations. Due to limited resources, invasives work at CCNWR has been concentrated on limiting the spread of large infestations, eliminating small infestations (especially those of priority species) where it is possible, and then working on larger infestations when possible. A baseline inventory of invasive species was conducted in order to document and identify the presence of invasive species and the extent of infestation. Current control measures include the use of chemicals and mechanical control.

Table 6. Priority Invasive Species at Cypress Creek National Wildlife Refuge

NAME	SPECIES
Amur Honeysuckle	*(Lonicera maackii)*
Autumn Olive	*(Elaeagnus umbellatae)*
Chinese Yam	(*Dioscorea oppositifolia)*
Garlic Mustard	*(Alliaria petiolata)*
Japanese Chafflower	*(Achyranthes japonica)*
Japanese Hops	(*Humulus japonicus*)
Japanese Honeysuckle	*(Lonicera japonica)*
Japanese Stilt Grass	*(Microstegium vimineum)*
Kudzu	*(Pueraria Montana var. lobata)*
Multiflora Rose	*(Rosa multiflora)*
Oriental Bittersweet	*(Celastrus orbiculatus)*
Phragmites	*(Phragmites australis)*
Princess Tree	*(Paulownia tomentosa)*
Reed Canary Grass	*(Phalaris arundinacea)*
Sericia lespedeza	*(Lespedeza cuneata)*
Tree Of Heaven	(*Ailanthus altissima)*

Prescribed Burning:

Cypress Creek National Wildlife Refuge has a limited prescribed fire program due to the emphasis on reforestation and wetland restoration. When fire is utilized, it serves the purpose of manipulating vegetation for a desired Refuge goal.

Prescribed fire played an important role in the life history of giant cane. A fire management plan to enhance existing cane growth as well as transplanted cane is necessary in order to maintain a robust giant cane habitat over time. Given the establishing purposes of CCNWR, a habitat component such as cane, which serves as a sediment filter and a structurally important habitat for

rare and endangered species, should be a management priority. Disturbance caused by fire results in multiple benefits including stimulating sprouting of new culms, returning nutrients to the soil, and reducing competition from other plants. In addition, there is evidence that burning may bolster resistance to subsequent environmental shocks (Gagnon 2006).

Current Resource Inventory

Despite changes that have occurred over the years, CCNWR provides valuable habitat for migratory birds as well as numerous species of resident mammals, birds, reptiles, amphibians, and fish. Because of significant natural values and the potential for wetlands restoration, CCNWR was identified as a high priority for acquisition under the New Madrid Wetlands Project – a component of the Lower Mississippi Valley Joint Venture of the NAWMP. In 1994 the area, along with the Cache River SNA, was designated a "Wetland of International Importance" by the Ramsar Convention (2010) and an “Important Bird Area” by Audubon. The area also features a number of ecologically sensitive flora and fauna species and includes eight federally listed and 102 state listed threatened and endangered species. Broad habitat types within CCNWR include: wetlands, bottomland forests, and upland forests.

Vegetation

The Lower Cache River watershed, comprised of four overlapping physiographic regions; the Upper East Gulf Coastal Plains, Ozarks, Mississippi River Alluvial Plain, and the Interior Low Plateau, contains unique plant and animal species influenced and molded by the habitat and environmental conditions within the specific region. When these regions overlap, species from each region can be found together. These conditions create a habitat area of unusual species abundance and diversity.

Forest covered most of the Cache River Watershed and other nearby Mississippi and Ohio River floodplain areas historically. Major natural communities/habitat types that were present in the Cypress Creek NWR region included: 1) the main channel of the Cache River and its major tributaries 2) bottomland lakes, 3) riverfront forest, 4) bald cypress/water tupelo swamp forest, 5) floodplain bottomland hardwood forest, 6) terrace hardwood forest 7) mixed hardwood slope forest and 9) mesic upland forest (Leitner and Jackson 1981). A map of the potential distribution of these communities on CCNWR and a description of these community types are provided in the Cypress Creek Hydrogeomorphic Evaluation Report (Heitmeyer and Mangan 2012). The cypress, tupelo, and other swamp trees make up the oldest living stand of trees east of the Mississippi River. Core samples from some of the largest of the cypress trees (the largest individual with a circumference of 31 feet 2 inches and over 95 feet tall) indicate ages of well over 1,000 years. Two of the largest individual swamp trees of their species in the United States, a water locust (circumference 3 feet 3 inches, height 30 feet), live here. In addition, twelve state champion trees have been recorded in this stand. Surveys have documented the presence of hundreds of trees with trunks larger than four feet in diameter (White, 1980).

Several species found in CCNWR are at the northern extent of their range and usually are characteristic of species found at more southern latitudes, notably bald cypress and water tupelo. Many endangered or threatened plant species also occur within the Cache River Watershed. An

additional 80 State threatened or endangered plant species have been reported from the four counties that encompass the CCNWR (Appendix B). Forty-three of these have been observed in the Cache watershed to date. Surveys in the study area have been revealed 138 species of woody plants (trees, shrubs, and vines), 251 species of non-woody plants, and 11 species of ferns (United States Department of Interior, 1990)

Soils

The soils on the uplands of the Cache Watershed are mainly derived from loess. They have a fragipan, are relatively thin on slopes, and are subject to severe erosion when disturbed. Hosmer, Stoy, Zanesville, Lax, and Alford are typical soils of the hills both north and south of the Basin. Along the upper reaches of the Cache River, Cypress Creek, and Big Creek, the primary bottomland soils are wakeland and Haymond. Downstream along the upper Cache, the swamp soils are mapped as Sharon and Belknap. The terrace soils along the lower Cache in the Basin are Weinbach, Giant, and Sciotoville. The swamp and poorly drained soils along the lower cache are Karnak, Dupo, Belknap, Bonnie, Cape, and Darwin. The natural area soils are mapped as the Karnak-Darwin association. These are light colored and moderately dark colored, fine-textured, poorly drained, slightly acid and medium acid soil. The bottomland soils formed in sediments left from the Ohio River floodplain and in recent alluvium derived from the loess washed down into the Basin. Most of the silty soils, both on the uplands and in the bottomlands, are extremely soluble in water and settle out very slowly. A map of the soils and a complete description can be found in Heitmeyer and Mangan (2012).

Wildlife

The Cache River and its associated wetlands are well known for their diversity and outstanding wildlife values. Waterfowl, shorebirds, wading birds, raptors, songbirds, reptiles, amphibians, furbearers and other mammals utilize the area.

Birds - Nearly 250 species of resident and migratory bird species use CCNWR throughout the year. Migrational counts number in the tens of thousands and include ducks, geese, shorebirds, wading birds, and countless other avian species.

Wide arrays of other avian species use CCNWR due to the diversity of habitats within CCNWR and surrounding watershed. Many species of birds are on the Illinois' Endangered, threatened, or species of concern lists.

Neotropical bird studies indicate that CCNWR and the surrounding watershed contain one of the most diverse assemblages of such species remaining in the Midwest.

The Bald Eagle, a recently de-listed species from the federal threatened and endangered list, is a fairly common migrant and winter resident, along the Ohio, Mississippi and area Rivers, and 3 pairs of birds are currently nesting on CCNWR. State listed endangered species which often utilize CCNWR include Northern Harrier, Little Blue Heron, and Barn Owls.

Mammals - CCNWR contains 47 known species of mammals. Resident species include white-tailed deer, squirrel, swamp rabbits, bobcat, and otter.

CCNWR contains large areas with excellent foraging and nursery habitat for the Indiana Bat, a federally listed endangered species.

Reptiles and amphibians - Cypress Creek NWR and the surrounding wetland contain 54 known species of reptiles and amphibians. Of the 20 species of frogs and toads in the state, 18 have been recorded in the watershed.

The state threatened Eastern Ribbon snake and Canebrake rattlesnake, a subspecies of the Timber Rattlesnake both utilize CCNWR and surrounding wetlands.

Cropland/Agriculture

As for most of the state, agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. The small remnants of vast wetlands in the basin only make up about 4% of the watershed (20,000 acres).

The Cache lies farther south than do other "southern" cities as Louisville, Lexington, and Richmond resulting in a relatively long average frost-free growing season of 230 days.
Corn and soybeans are the principle crops of the Cache River basin farms along with sorghum, wheat, and hay, and some livestock. Because the dominant soils in the basin are not very fertile and in some years considerably wet compared to the prairie soils of central Illinois, overall yields of staple row crops are typically below the state average.

Chapter III. Resources of Concern

Identification of Refuge Resources of Concern

As stated in Chapter 1, this Habitat Management Plan (HMP) will set forth strategies for achieving goals and objectives and guide refuge staff in management decisions over the next fifteen years. In order to develop these strategies, it is essential to understand Cypress Creek National Wildlife Refuge authorizing legislation, purpose and related resources of concern. This HMP also documents the process used by refuge staff to identify and prioritize trust resources and other elements of biodiversity for conservation action.

Cypress Creek National Wildlife Refuge was established in 1990 under the Emergency Wetlands Resources Act (16 U.S.C. 3901b, 100 stat.3583, PL 99-645), with the following primary purposes:

> …"the conservation of wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions" (16 U.S.C., Sec. 3901 (b) (Emergency Wetlands Resources Act of 1986)

Cypress Creek National Wildlife Refuge purpose and importance to migratory birds, particularly waterfowl, were further described in the Service's Environmental Assessment (1990) and Approval Memorandum for Refuge establishment:

> "To protect, restore and manage wetlands and bottomland forest habitats in support of the North American Waterfowl Management Plan; 2) to provide resting, nesting, feeding and wintering habitat for waterfowl and other migratory birds; 3) to protect endangered and threatened species and their habitats; 4) to provide for biodiversity; 5) to protect a National Natural Landmark, 6) and to increase public opportunities for compatible recreation and environmental education"

In addition, the National Wildlife Refuge System Improvement Act of 1997 also requires that System growth and management be planned to contribute to the conservation of ecosystems and that the biological integrity, diversity and environmental health of the System be maintained for the benefit of present and future generations. The Service defines these terms as:

Biological Diversity	The variety of life and its processes, including the variety of living organisms, the genetic differences between them, and the communities and ecosystems in which they occur.
Biological Integrity	Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.

Environmental Health Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment

In addition to providing habitat for trust species, refuges also support other elements of biodiversity including invertebrates, rare plants, unique natural communities, and ecological processes (USFWS, 2003).

Resources of Concern

Resources of concern were identified through consideration of CCNWR purposes and mandates noted above, and comparison of lists of species and habitats identified in all of the plans listed below (Appendix 2). In addition, while compiling the list of resources of concern, an emphasis was placed on those species that are 1) Federal or State threatened or endangered 2) rare, declining or unique to CCNWR and surrounding landscape 3) species which require rare or declining habitat or finally 4) species that are appropriate and native to the area but do not fall into a special category of concern but which we are capable (through management actions) of fulfilling the habitat needs of those species. In order to be able to focus refuge management objectives, a list of species that are considered "priority" resources of concern were chosen. Priority species of concern are those species whose habitat requirements may not necessarily be met by simply protecting the natural community within which they exist, or species which are especially imperiled and may require special consideration. Additionally, natural communities were also chosen as resources of concern when they were specifically identified in the CCNWR purpose, support species or species groups identified in those purposes. Additional factors considered when choosing these communities was the role they play in ecological processes that shape CCNWR habitat, ecosystem drivers that shape surrounding landscapes within the Cache watershed, or finally, their maintenance or restoration of biological integrity, diversity, and environmental health. Using these concepts as a guidance tool, a condensed list of species (Table 7) and natural communities (Table 8) which are resources of concern was developed for CCNWR. Plans used to help identification of resources of concern included:

- Partners in Flight Physiographic Area 14 –Bird Conservation Plan for the Interior Low Plateaus
- Bird Conservation Region 24- CHJV Concept Plan
- UMVGLJV Bird Conservation Plans (shorebird, waterbird, waterfowl, landbird)
- USFWS Region 3 Fish and Wildlife Resource Conservation Priorities
- The North American Waterfowl Management Plan
- Federal Threatened and Endangered Species lists and recovery plans
- Illinois Threatened and Endangered Species list
- Illinois State Comprehensive Wildlife Conservation Plan
- Illinois State Natural Heritage Database
- Cypress Creek Comprehensive Conservation Plan
- The Nature Conservancy Cache River Macrosite Plan

Table 7. Cypress Creek National Wildlife Refuge Priority Resources of Concern "Species and Species groups"

	Life Cycle/Season	Occurrence in Cache River Watershed	Monitored or Managed For on Refuge	Federal or State Status[1]	USFWS Region 3 Priority Species[2]	Illinois Species of Concern[3]
Birds						
Waterfowl	Migration	Common	Yes			Yes
Shorebirds	Migration/Breeding	Common	Yes			Yes
Forest Birds	Migration/Breeding	Common	Yes			Yes
Amphibians						
Northern Crawfish Frog	Year Round	Uncommon	Yes		No	Yes
Bird-Voiced Treefrog	Year Round	Uncommon	Yes	ST	No	Yes
Reptiles						
Copper-Belly Watersnake	Year Round	Uncommon	No		Yes	Yes
Timber Rattlesnake (Canebrake Rattlesnake)	Year Round	Uncommon	No	ST	Yes	Yes
Fish						
Cypress Minnow	Year Round	Rare	No	SE	No	Yes
Mammals						
Indiana Bat	Breeding	Rare	Yes	SE, FE	Yes	Yes
Plants						
Cypress Knee Sedge	Year Round	Rare	No	SE	No	Yes

1. FE = Federally Endangered, SE = State Endangered, ST = State Threatened
2. (United States Fish and Wildlife Service, 2002)
3. (Illinois Natural Heritage Database, 2010)

Birds

Waterfowl - The resources available to waterfowl on CCNWR have a historical basis because the Mississippi Flyway corridor associated with the river systems in southern Illinois has been a major site where natural disturbances provided abundant food resources in herbaceous and forested wetlands. (L. Fredrickson, personal communication). Eight waterfowl species that are commonly observed on CCNWR that are USFWS Region 3 Conservation Priority species (USFWS 2002) include Wood Duck, Black Duck, Mallard, Blue-Wing Teal, Northern Pintail, Canvasback, Lesser Scaup, and Canada Goose. Thousands of ducks and geese migrate through and winter in the area (September-March). Increasing land acquisition by public agencies and enrollment of private land in federal programs has resulted in increases in wintering populations of waterfowl within the Cache River Watershed. To date, the Natural Resource Conservation Service has enrolled 10,000 acres of private lands within the Cache River Watershed into the Wetland Reserve Program. CCNWR provides habitat for approximately 26 species of waterfowl throughout the migration and wintering portion of their annual cycle (Refuge data). The temporal and spatial distribution of these habitats must correspond with the migration chronologies of migratory species as well as meet the year-round needs of resident species. The forested wetlands of CCNWR also provide valuable breeding habitat for cavity-nesting ducks such as Wood Ducks and Hooded Mergansers.

Forest Song Birds - Cypress Creek National Wildlife Refuge is mostly forested. CCNWR and the surrounding watershed provide important breeding and migration habitat for approximately 150 forest song bird species. These birds benefit from extensive stands of hardwood forests and a major focus of CCNWR management has been the acquisition and restoration of additional floodplain woods. The diversity of the CCNWR forest song bird community results from its mix of swamp, floodplain, and upland forests. Forest breeding bird surveys and research on nest success conducted on CCNWR and the surrounding Cache River watershed since 1994 give invaluable insight into forest bird habitat suitability), and results of these studies have suggested that CCNWR and the surrounding forests of the Cache River Watershed may make significant contributions to regional populations of forest song birds (Hoover 1995, 2006, Robinson et al. 1995).

Shorebirds - This area is an important migration stopover for shorebirds due to its strategic location between major shorebird flyways along the Ohio and Mississippi Rivers. The interior linear wetland systems of CCNWR and the surrounding Cache River wetlands have the potential to serve as a valuable link between southern non-breeding areas and northern breeding grounds of migrant populations of many Midwestern shorebird species (Hands, 1991, Skagen et al. 1999). Cypress Creek national Wildlife Refuge has conducted spring shorebird surveys since 1996.CCNWR provides habitat for approximately 16 species of shorebirds (Appendix C) throughout the fall (July-October) and spring (March-June) migration periods. Six of the shorebird species that use CCNWR are USFWS Region 3 Conservation Priority Species (USFWS 2002, 2003).

Amphibians and Reptiles

Approximately 75% of the amphibians and reptiles found in the state of Illinois are known to occur within the Cache River Watershed.

Copperbelly watersnake- Populations of this watersnake in southern Illinois are fragmented and isolated, however, CCNWR and the surrounding Cache River Watershed may provide some of the better habitat complexes due to the extent of intact floodplain forest and swamp habitat. The copperbelly watersnake has undergone a long term decline throughout much of its range, primarily due to habitat destruction (Http://www.herpcenter.ipfw.edu.html). It congregates in shrubby wetlands and swamps during the breeding season and then moves over land to other wetlands as seasonal ponds dry up. Copperbelly watersnakes typically forage on small amphibians and fish, but appear to favor adult and larval frogs.

Canebrake rattlesnake- This rattlesnake, a subspecies of the timber rattlesnake inhabits forested swamp along rocky outcrops and bluffs, and canebrakes. Canebrake Rattlesnakes over-winter in the base of hollow trees or in stumps. This species is active April through October in our area. This species is threatened in Illinois. Timber rattlesnakes have been observed in Union County within the Cache River Watershed on both IDNR and Shawnee National Forest lands. The major threat to this species is the clearing of forest.

The Northern crawfish frog- This species lives underground most of year in mammal burrows, storm drains, and abandoned crayfish burrows. This species has been observed recently in Johnson, Union, and Alexander counties. Currently, frog call surveys are done on CCNWR every spring. Crawfish frogs have been observed at six of the sites surveyed on CCNWR. This species is uncommon and declining in some areas where breeding habitats have been drained. Moist soil units and areas such as emergent marsh with semi-permanent and permanent water on CCNWR provide important habitat for these and other amphibians. They are most commonly found in habitat with hardpan clay soils in low, wet areas.

Bird-voiced tree frog- This state threatened species inhabits trees and shrubs within bald cypress-tupelo swamps and nearby floodplain forests. In Illinois, this species is known to be in six counties, including the four counties which encompass CCNWR, where it can be locally common in areas with good habitat. This species has been documented on four sites on

CCNWR. Recent observations have been reported in all four counties within the CCNWR boundary (INHS database). This species is listed as threatened in Illinois.

Fish

Cypress Minnow - This state endangered fish was historically located throughout much of the watershed. This species was once thought to be extirpated in Illinois but was rediscovered in the Cache watershed in 1984. Continued sampling confirmed the species was still present in the Cache River after the 1993 flood (Burr et al. 1996). The cypress minnow is listed as endangered in Illinois.

Mammals

Indiana Bat - Indiana bats are a federally listed endangered species that is experiencing widespread declines. Despite these declines, the species appears to have stable wintering populations within southern Illinois and populations may be increasing within the Cache River Watershed. Potential habitat for this species occurs in caves, mines, small stream corridors with well-developed riparian woods, and upland and bottomland forests. Mist-netting and acoustical surveys are currently being conducted on CCNWR in order to locate Indiana bat roosting habitat.

Plants

Cypress Knee Sedge - The cypress-knee sedge is an aquatic sedge that is usually associated with Bald Cypress trees, logs or knees (Voigt and Mohlenbrock, 1964). It occurs in permanently flooded bald cypress-tupelo swamp habitat on CCNWR. This sedge may often be found on floating or partially submerged rotting logs or stumps as well, and in a full range of lighting conditions from full sun to dense canopy

Natural Communities

An emphasis was placed on natural communities or habitats that are considered 1) rare, declining or unique to CCNWR and surrounding landscape 2) contain high to medium concentrations of priority species or species groups with similar habitat needs or 3) have the capability (through management actions) to meet the habitat needs of those species. Table 8 highlights priority natural communities and associated Resources of Concern at CCNWR.

Table 8. Cypress Creek National Wildlife Refuge Priority Resources of Concern " Natural Communities"

Priority Natural Communities	**Associated Resources of Concern**
Bottomland Forest	Indiana Bat, Forest Birds (*Yellow-Billed Cuckoo, red-headed woodpecker, Wood thrush, Cerulean Warbler, Prothonotary Warbler , Yellow throated warbler, Kentucky warbler and Louisiana Waterthrush),*Waterfowl (*Mallards, WoodDucks, Mergansers*) Copperbelly watersnake)
Cypress-Tupelo Swamp	Waterfowl, Forest Birds (*Yellow-throated warbler, Red-headed woodpecker, Prothonotary warbler*), Bird-voiced tree frog Cypress Knee Sedge
Non-forested, ephemeral wetlands	Waterfowl, Shorebirds, Little Blue Heron, Crawfish Frog, Copperbelly water snake
Canebrakes	Forest Birds (*Swainson's Warbler*), Canebrake Rattlesnake). Creole pearly Eye, Lepidopteran cane obligates (*cobweb little skipper, yellow little skipper, cane little skipper*)

Identification of Habitat Requirements

The goal at CCNWR is to provide the optimum quality and quantity of habitat possible in order to fulfill the habitat needs of our priority species and species groups. This involves taking into account the vegetative characteristics, timing of availability, distribution, and the associated ecological processes necessary to support these species.

Birds

Waterbirds - Many of the species of wintering and migrating water birds using CCNWR have similar habitat needs. With a well-planned management strategy, we have the capabilities to maximize the wildlife for which we are providing suitable habitat. For example, the majority of priority species require shallow water depths ranging from 0 to 10 inches in order to forage, therefore, keeping the water levels in flooded impoundments below 10 inches will maximize the

number of species that benefit. Both the herbaceous and forested wetlands within the Cache River Watershed produce an abundance and diversity of invertebrates, crustaceans, amphibians, fish, and plant material which are essential for the survival of the diverse waterbird species using CCNWR. As mentioned above, the temporal and spatial distribution of these habitats must correspond with the migration chronologies of winter migratory species such as well as meet the year-round needs of summer breeding species such as Wood Ducks. Table 9 summarizes the chronology of waterbird use at Cypress Creek National Wildlife.

Table 9. Chronology of waterbird use at Cypress Creek National Wildlife Refuge

Season	**Bird Species**	Date
Early Fall	Blue-winged teal, Northern pintail, Rails, Bitterns, Shorebirds	August 1-November 9
Mid Fall	American wigeon, Gadwall, Green-winged teal, Snipe, White Fronted Geese	November 10-November 24
Late Fall	Mallards, Canada Geese	November 24-January 5
Early Spring	Mallards, Northern pintail, Canada Geese	March 1-March 31
Mid Spring	Teal, Northern Shoveler, Shorebirds, Rails, Herons	April 1-May 25
Late Spring	Herons, Shorebirds	May 25-July 8

Waterfowl - Waterfowl, particularly dabbling ducks, tend to concentrate in shallow water wetlands where natural "moist soil" plants such as wild millet, panic grass and beggarticks are abundant. (Fredrickson 1982). Row crops have traditionally been an integral part of waterfowl management in this area, and are particularly important in providing high energy foods for concentrations of larger waterfowl such as geese and mallards during fall migration and winter (Ringelman, 1990). Early fall migrants such as Blue-winged Teal and Northern Pintail begin to arrive in southern Illinois as early as mid-September. These shallow water foragers require the smaller seeds from moist soil plants such as panic and crab grasses, and use water depths 5-8 inches. Mallard, Gadwall, and American Widgeon arrive in mid fall (October) and also utilize shallow water less than 10 inches deep for optimum foraging. Northern Shovelers can use a variety of water depths, because they are able to strain invertebrates from the surface of deeper water. Mallard and Pintail feed extensively from the bottom; however, Mallards generally dabble from the surface in shallower water, while Pintails are more likely to tip-up in deeper water. Blue winged Teal frequent areas with submerged vegetation (Fredrickson 1982).

Diving ducks such as Lesser Scaup and Ring - necked Ducks use both shallow and deep water areas on CCNWR for feeding and loafing. In the spring, both dabbling and diving ducks rely heavily on protein rich invertebrates as a major food source as they prepare for egg laying or molting.

Bottomland hardwood forests are also critical to migratory and wintering waterfowl on CCNWR and the surrounding watershed. These forests should provide food resources in the form of mast produced primarily by red oak, white oak, and tupelo. Invertebrates can be extremely abundant

in these habitats, and they provide an invaluable food source to waterfowl. Forested wetlands also provide thermal, loafing, and escape cover for waterfowl. Bottomland hardwood acreage in the Cache River Watershed should be maintained or increased to sustain current waterfowl populations. Bottomland hardwood areas must seasonally flood to provide adequate habitat for waterfowl. Specifically, waterfowl utilize these areas during migration and winter, and flood events during these periods are critical.

Shorebirds - Migratory shorebirds require substantial energy to replace depleted fat reserves that fuel their long distance migrations (Helmers 1993). Macroinvertebrates are a key energy resource for shorebirds. Many shorebirds feed predominately on fly larvae during migration.

Shorebirds are a morphologically diverse group that exploits shallowly flooded wetlands. Preferred foraging depths range from 1-3 inches. For the most part, shorebirds require mudflats or shallow water of 2 inches or less, and prefer vegetation height to be less than half their body height (Helmers 1993). Common Snipe and Pectoral Sandpipers will forage on sites with short, moderately dense vegetation; however most shorebirds prefer sites with less than 25% vegetative cover. Shorebirds respond very well to shallow water zones interspersed with mudflats.

Shorebirds migrating through southern Illinois respond well to early spring drawdowns conducted within moist soil units. Most areas within moist soil impoundments provide ideal foraging habitat because they are free of vegetation after spring drawdown.

Wading Birds - Herons prefer open water with an abundance of submerged and floating vegetation but only sparse emergent vegetation. Little Blue Herons and other waders frequent the herbaceous marsh areas and moist soil units on CCNWR in the spring and summer as water levels are decreasing, and food resources are concentrated. Incorporating some late season drawdowns into CCNWR water management plan could increase habitat available to Little Blue Herons and other waders. Wading species also respond well to newly re-vegetated and re-flooded impoundments in the late summer and fall. Little Blue Herons, as with many wading birds, typically forage in shallow water between 2-6 inches (Rodgers et al. 1995).

Forest Birds - Forest songbirds have been negatively affected by forest fragmentation, resulting in reduced populations and lower reproductive success (Hoover 1995, 2006). In addition, forest bird species richness has been positively correlated with forest patch size. Key spatial features that are required by forest interior birds are larger forest patches (> 70 ha) or, in other words, patches with larger amounts of core or interior habitat, and patches surrounded by habitats that allow dispersal (for example, grassland rather than agriculture). Forest tracts within the Cache river watershed tend to be long and linear and of limited size. As a result, species that have moderate or low forest tract size requirements such as Acadian Flycatcher, Wood Thrush, and Prothonotary Warbler may be more apt to show high nesting productivity. Some of the key structural features required by forest interior birds are high levels of structural diversity, tall canopies, closed canopies, and a mix of dense and open understory.

Amphibians and Reptiles

Copperbelly watersnake- This snake is associated with shrubby wetlands and swamps, emergent wetlands and floodplain forests (Hyslop 2001, Herbert 2003). They tend to shy away from moving water such as rivers. This species congregates in shrub swamps during the breeding season and then moves over land to other wetlands as seasonal ponds dry up. This species requires a matrix of wooded or vegetated corridors that provide protection from predators as they migrate among wetlands between seasons. Copperbellies typically forage in shallow water, in the order of 5-10 cm. While they may bask on logs and shrubs in deeper water, they do not utilize deeper water, except as a potential travel lane. Given their mobility on uplands, copperbellies can be found far away from water, but also at farm ponds and other wetlands that are situated well away from the floodplain. Excursions into uplands usually last from one to several days, but have been recorded as long as two weeks. When not in wetlands the snakes are often found in very thick vegetation, under mats of detritus, or in burrows (Http://www.herpcenter.ipfw.edu.html). They will also exploit springs adjacent to floodplains if suitable emergent or shrubby habitat is available. Individuals using uplands favor forest gaps and forest/field margins. They usually avoid farm fields, but may use old fields adjacent to forest and wetlands. Copperbellies typically hibernate in crayfish burrows in areas that may be prone to spring flooding (Kingsbury and Coppola, 2000).
These areas are generally above the water table in the fall, but come spring they may be inundated by several feet of water. Copperbellies will not leave their overwintering sites during the winter if they are flooded, and can survive underwater for extended periods (weeks) if the water is cold. A high water table protects the ground from freezing. This is what protects the copperbellies in the winter as they hibernate. Drawing water down in wetlands during the winter may thus have a devastating impact on copperbellies as well as other amphibians and reptiles overwintering there.

Timber rattlesnake- Timber rattlesnakes inhabit heavy forest along rocky outcrops and bluffs and are active April through October in our area. They are often observed sunning on rock ledges near winter dens. They forage during summer in upland forests and disturbed habitats where rodents are abundant The Timber rattlesnake diet consists mainly of small mammals, such as mice, squirrels, and chipmunks. Mating usually occurs in July and August with 6-10 young born late summer or early autumn of the following year. . Most rattlesnakes found in southern Illinois hibernate within rocky forested hillsides or crevices in bluffs. The species is threatened in Illinois. Canebrake rattlesnakes have been observed in Alexander, Johnson and Union County. Threats to this species include clearing of forest.

Northern crawfish frog - The Northern crawfish frog lives underground most of year in mammal burrows, storm drains, and abandoned crayfish burrows. Crawfish burrows comprise the most frequently used upland retreat of crawfish frogs (Heemeyer et al. 2012). This species has been observed recently in Johnson, Union, and Alexander counties. Their diet consists of mostly of invertebrates, followed by crayfish, and small amphibians and reptiles. Adults will breed in pools of water in various habitats such as herbaceous wetlands or bottomland hardwood forests during March and April, sometimes in large numbers. Female lays 3,000-7,000 eggs, and the tadpoles

transform in midsummer. This species is uncommon and declining in some areas where breeding habitats have been drained. They are most commonly found in habitat such as prairies, woodlands, and brushy fields in hardpan clay soils in low, wet areas.

Bird-voiced tree frog-Bird-voiced tree frogs inhabit trees and shrubs within bald cypress-tupelo swamps and nearby floodplain forests. This species also has been observed perched in vegetation in upland areas of regenerating forest up to 440 meters from breeding wetlands. (Palis 2010). Adult diet includes small arboreal insects and spiders. This species breeds mid-May to August. Eggs are laid in shallow water in submerged packets that hatch in a few days into colorful tadpoles which then develop into adults within about a month. Threats include clearing and draining of bald cypress-tupelo swamps. This species is only known to be in extreme southern counties, where it is locally common in some good habitats. Recent observations have been reported in Alexander, Pulaski, Johnson and Union Counties in recent years (INHS database). This species is threatened in Illinois.

Fish

Cypress Minnow- The cypress minnow is a bottomland species that inhabits sluggish back waters of streams, oxbows and cypress swamps over soft substrates such as sand, silt, detritus and mud. Protection from wetland destruction, pollution, and excessive siltation are the primary needs of this species.

Mammals

Indiana Bat- The Indiana bat migrates seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula used include caves and abandoned mines that fulfill their need for cold temperatures during hibernation. In late March or early April, female bats emerge from hibernacula and migrate to summer roosts, where they form nursery colonies under the loose, exfoliating bark of trees, or in tree cavities and crevices. During the summer months, this species forages along the corridors of small streams, within the canopy of floodplain and upland forests, over clearings with early successional vegetation, along the borders of croplands, and over small pools and ponds, but prefer to forage over forested areas. In summer they forage exclusively on flying insects.

Plant Species

Cypress Knee Sedge-The cypress-knee sedge is an aquatic sedge that is usually associated with bald cypress trees, logs or knees. It occurs in permanently flooded bald cypress-tupelo swamp habitat on CCNWR. This sedge may often be found on floating or partially submerged rotting logs or stumps as well, and in a full range of lighting conditions from full sun to dense canopy. Associated species on CCNWR may include: baldcypress, swamp black gum, red maple, possum haw, and buttonbush.

Table 10. Timing of Habitat Needs for Resources of Concern at Cypress Creek National Wildlife Refuge

Focal Species	J	F	M	A	M	J	J	A	S	O	N	D
Birds												
Waterfowl												
Shorebirds												
Forest Birds												
Amphibians												
Northern Crawfish Frog												
Bird-Voiced Treefrog												
Reptiles												
Copper-Belly Watersnake												
Timber Rattlesnake												
Fish												
Cypress Minnow												
Mammals												
Indiana Bat												
Plants												
Cypress Knee Sedge												

Priority Natural Communities

Bottomland Forest/Cypress Tupelo Swamp

Although some of the finest remaining examples of forested wetlands and swamps in the state of Illinois occur within the Cache watershed, just 700 acres are considered high quality (IDNR, 1997). This leaves great cause for concern over both the extent and functionality of these forested wetlands. The hydrologic alterations mentioned in chapter 2 have dramatically altered the natural interaction of the Cache River with the surrounding floodplain, which is critical to maintaining the structure and function of these communities (TNC 2002). In many cases there is a reduction or total elimination of a natural flood pulse. Seasonal inundation followed by long periods of drying is important processes for these natural communities and the species that rely on them. For example, research by Dr. Jeff Hoover with the Illinois Natural History Survey has shown that restoring a more natural flooding and drying regime has the potential to decrease rates of nest predation on forest birds (Hoover, 2006).

Nonforested, Ephemeral Wetlands

These ephemeral wetlands provide important feeding areas for migrating waterbirds as well as a host of other species of plants and animals. In addition, they provide critical habitat for a number of amphibians and reptiles. Connectivity is a key component for these wetlands; connectivity between upland and wetland habitats as well as providing a diversity of hydroperiods. Most amphibian and reptile life cycles require connectivity of wetlands (for breeding and feeding) and uplands (for hibernation). Consequently, restoration and management of a complex of non-forested ephemeral wetlands throughout CCNWR should also benefit scores of shorebirds, wading birds, waterfowl, reptile and amphibian species, and a number of other organisms (fish, invertebrates, etc.).

Canebrakes

Dense stands of giant cane (*Arundinaria gigantea*) were historically found in bottomland sites in the southeastern United States, and information from the General Land Office surveys indicates that canebrakes were common within the Cache River Watershed as well. This floodplain community which is largely missing from the landscape now once provided habitat for a number of rare or extirpated species such as the Swainson's Warbler, Bachman's Warbler, and the Swamp Rabbit. Although the large stands of cane have disappeared, the small patches (most are less than one acre) that remain provide habitat for several cane-obligate butterflies (Brantley and Platt 2001). Canebrakes are now considered to be a critically endangered ecosystem (Brantley and Platt 2001). Additionally, giant cane growing in riparian buffers enhances water quality and stabilizes stream banks, reducing nitrates and sediments in ground water and overland flow because of its dense mat of culms and rhizomes.

Conflicting Needs

Habitat management activities inherently create short term conflicts between species and species groups that arise as vegetative, soil, or hydrological manipulations are completed. For example, timber harvest or timber stand improvement activities temporarily change the vertical structure and canopy closure in the forest, which can negatively impact forest interior bird species. Additionally, vegetation management in the open lands can adversely affect existing plant communities in the short term. Disking, mowing, flooding, and prescribed fire essentially decimate the existing plant community and vertical structure upon which some species depend for food, cover, and breeding habitat. Conversely, these same actions benefit other species as desirable vegetation replaces the undesirable plant species or is rejuvenated from the initial treatment, thereby creating desirable habitat conditions. However, these impacts are typically short term in duration and have long term positive benefits for priority species. Today, active wildlife management practices have become essential as natural ecological processes and habitats have been limited and even eliminated in some cases. In a normal annual hydrological cycle, CCNWR has the capacity to meet the habitat needs for the priority wildlife resources of concern. Each year, a complex of different wetland types is provided, either by natural means or through management decisions and manipulations. The manipulation of impounded wetlands influences plant diversity, seed production, and aquatic invertebrate communities. Forested tracts

will be managed through sound silvicultural practices to ensure that the forest provides desirable tree species and structural composition which meet the needs of priority species. Consequently, initial conflicts among species groups are remedied through time and kept to a minimum through unit evaluation, prioritization, and planning. Refuge actions will be prioritized by establishing purposes and when appropriate, to support objectives established under conservation partnership plans. Management actions will be based on sound science and the best technology to ensure quality management for target natural resources and provide a model for land management. Management efforts will focus on meeting habitat objectives to fulfill the needs of target natural resources, and any conflicts will be resolved by priority decisions based on establishing purposes. For example, the Refuge will provide an inviolate sanctuary for wintering waterfowl and other migratory birds. Additionally, refuge management actions will benefit migratory birds, but will emphasize wintering waterfowl management. Likewise, there are objectives to protect, manage, and enhance the ever diminishing bottomland hardwood forest ecosystem, to protect endangered species, and to protect, manage, and enhance habitat for other species of wildlife and plants, and to provide compatible public use opportunities.

Chapter IV. Management Objectives, Strategies and Prescriptions

The following goals and objectives were developed as a result of discussions held during a habitat management workshop held at CCNWR in May 2006. Natural resource experts familiar with CCNWR and the habitat management planning process were invited to this workshop to assist in identifying management goals and objectives and the strategies necessary to obtain them. The following goals and objectives are based on those workshop discussions, goal and objectives set forth in the CCNWR CMP, and further literature review. The strategies and prescriptions developed to meet CCNWR objectives are presented as well.

Bottomland Forest

Goal

Maintain healthy, functioning bottomland forest communities (this includes riverfront forest, shallow and low bottomland hardwood forest) associated with the Cache River and its tributaries. Forest management will concentrate on providing a range of habitats, on developing complex vertical structure, and maintaining integrity of interior forest.

Rationale

The objectives for forest habitat management on CCNWR must focus on managing a diverse forest with complex vertical structure and species diversity to meet the needs of a broad range of forest birds and animals enhancing and restoring habitat for endangered species, and conserving examples of rare and declining natural systems.

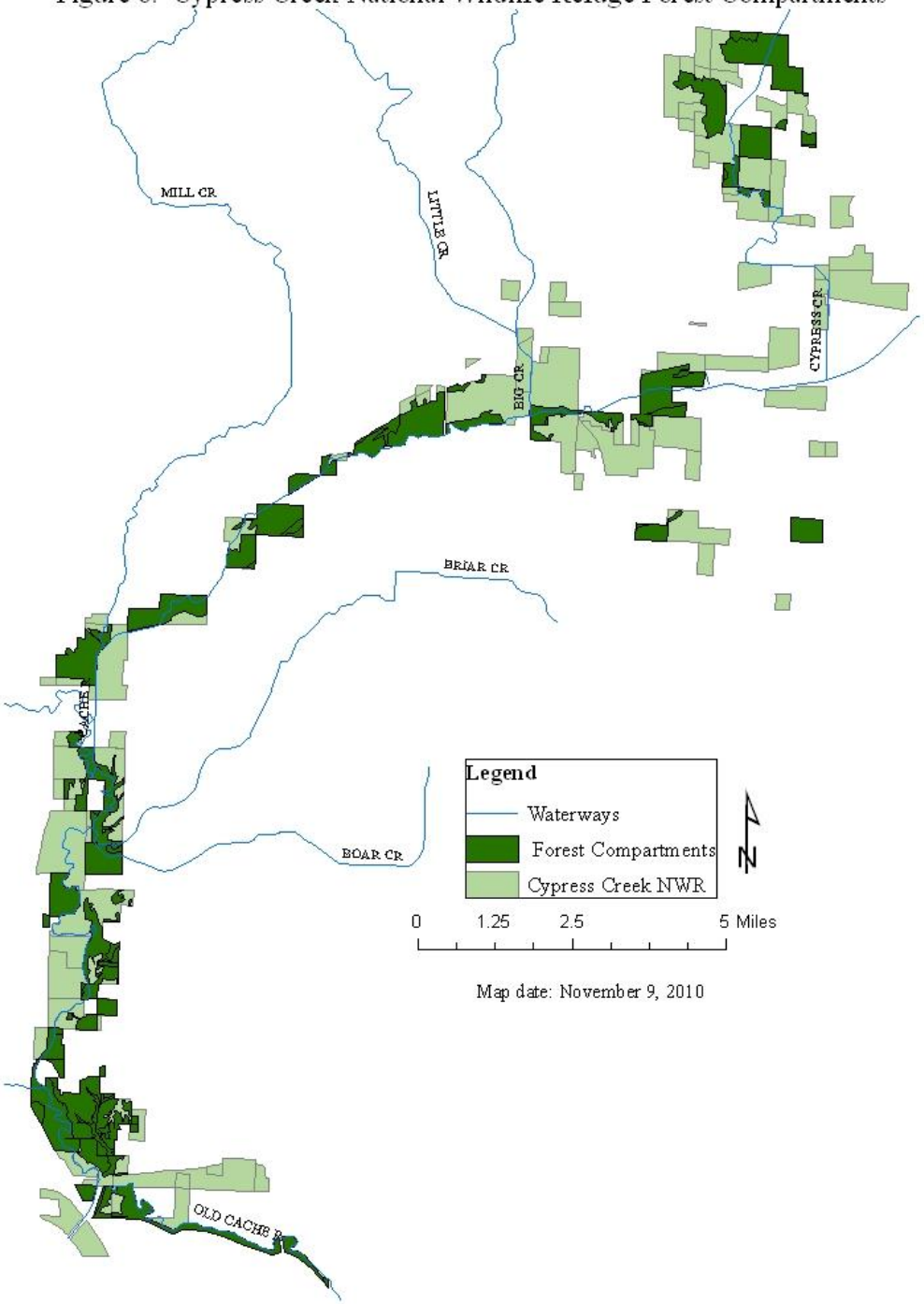
Effective restoration and management of all bottomland hardwood forests on CCNWR will provide important habitat for migrating waterbirds, as well as amphibians, reptiles, fish and other wildlife. The existing bottomland hardwood forests on CCNWR provide important habitat for several high priority species of migrating waterfowl and nesting forest birds, in addition to serving as potential roosting areas for the federally endangered Indiana Bat and the state endangered Rafinesque's big-eared bat. It is important to maintain a system of bottomland forests that will continue to provide habitat for species of various life stages such as hibernation, reproduction, and migration.

Objective 1

Within 4 years of plan approval, characterize the maternity habitat of Indiana bats throughout the entire Refuge. While the general roosting ecology of Indiana bats has been described, few studies have looked at actual roost availability and made recommendations on snag densities to assist land managers in managing for this species. Location of maternity colony sites will enhance knowledge of what the Indiana bat summer populations are within CCNWR and also to understand what type of habitat is being used by this species for roosting and maternity areas. A two-mile radius around all roost trees will be managed for bat roosting/maternity colony habitat. Approximately 50 to 75 percent of live trees with a diameter greater than 11 inches diameter at breast height (DBH) will be maintained in known roosting habitats. These habitats should

include mostly species with exfoliating bark, such as American elm, slippery elm, eastern cottonwood, bitternut hickory, shellbark hickory, shagbark hickory and red oak species. All riparian corridors will be protected and/or enhanced.

Figure 6. Cypress Creek National Wildlife Refuge Forest Compartments



Rationale

Many species of bats, including the federally endangered Indiana Bat and the state endangered Rafinesque's big-eared bat and southeastern myotis use bottomland forests for both summer foraging and roosting habitat. A limiting factor for these bat species as well as several other species of wildlife will be roost trees. Indiana Bats are almost always found under the exfoliating bark of dead or dying trees (Carter 2006). Snags with cavities and trees with exfoliating bark are valuable as roosting and maternity sites for bats as well as many other wildlife species" (Saugey, 1997). Snag and cavity tree retention, and regeneration of exfoliating barked trees for future roost trees are an important part of this forest management objective. In addition, one of the twenty-three existing Primary 1 Indiana bat hibernacula is located less than 2 miles from CCNWR boundary. Priority 1 hibernacula typically have (1) a current and/or historically observed winter population ≥ 10,000 Indiana bats and (2) currently have suitable and stable microclimates (USFWS 2007). Primary 1 hibernacula are considered essential to the recovery and long term conservation of Indiana bats. This type of management will also create habitat opportunities for a variety of other wildlife species such as overwintering insectivorous birds (ex: red-headed woodpecker), and nesting birds (ex: brown creepers, wood ducks, hooded mergansers). Mist- net surveys combined with radio-telemetry will determine presence/absence of various bat species as well as the location of Indiana Bat roosting and maternity colony sites. Location of maternity colony sites will enhance knowledge of what type of habitat is being used by this species for roosting and maternity areas on CCNWR. Indiana bats often forage along streams and wetlands, where they drink water or catch flying insects. The removal of a stream, wetland, and/or associated edges/banks may harm bats by removing their foraging area, causing them to expend energy locating a new foraging area, and potentially engaging in intraspecific (bat to bat) competition.

Strategies

1) Conduct acoustical survey monitoring to determine areas with high bat activity and possible roost and maternity trees from May through September.

2) Mist-netting will be conducted within the areas with the highest activity in an effort to locate both roosting and maternity habitats.

3) Retention of any exfoliating-barked trees, dead or alive, canopy gaps, or any trees with a dbh greater than 11 inches.

4) Perform any forest management activities outside the summer roosting period between April 1 and November 15.

5) Maintain the integrity of all riparian corridors, by retaining a "no-cut" buffer zone immediately adjacent to all waterways. Maintain long, continuous corridors of that are 50 meters or greater where feasible.

Prescription

All standing, dead trees will be retained unless removal is necessary for human safety or to accomplish management objectives. All potentialroost trees within five miles of known roosts or hibernacula will be retained, as well as a diversity of age, size and species classes of potential roost trees within these areas. When the removal of dead trees or trees with exfoliating bark is required for safety or to accomplish forest management objectives it will be done between November 15 and April 1. Any areas where tree removal is done outside this time period will be evaluated for bat-use prior to removal. Potential roost-trees cannot be removed during this period unless they are evaluated and/or surveyed to confirm non-use by roosting bats.

An average overstory closure between 30 and 80 percent will be maintained in stands with live trees greater than 11 inches DBH, where possible, except for shrub swamps.

Girdling trees (i.e., cutting of the bark and a portion of the underlying cambium layer to create a ring-like groove encircling the base of the trunk) may be used to create short-term Indiana bat roosting habitat. The need for girdling will be determined on a site-specific basis. Girdling may not be necessary if there is an adequate number (i.e., at least 6 natural snags or girdled trees per acre) of dead trees (≥11" dbh) or other potential roost trees, that can provide suitable habitat for Indiana bats. If sufficient trees/snags are not available, at least six trees per acre will be girdled with a two mile radius of known maternity colonies. (*Range-wide Indiana Bat Protection and Enhancement Plan Guidelines* USFWS 2009) contains a preferred list of tree species suitable for girdling. If there are not enough species from the tree list of the appropriate size, then other species will be substituted. A forester or another person with expertise in tree identification must select and mark the trees for girdling.

A minimum 50-meter buffer along each side of the Cache River, and all creeks, ditches and wetlands will be maintained (100 meters is preferred where possible) Natural riparian vegetation will be restored or maintained on the banks of the Cache River, and all creeks, ditches, and wetlands. When restoring streams and associated riparian zones, the tree planting mix will include tree species from the Tree Species List found in the *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines* (USFWS 2009).

Objective 2

Within 15 years of plan approval, inventory 100 percent of existing mature (approximately 30 years and older) bottomland forest stands (Figure 6) to determine whether or not they satisfy the desired forest conditions in Table 11. (Lower Mississippi Joint Venture 2006) and implement active management on 70-95% percent of any mature forest that does not meet the desired stand structure conditions recommended within these guidelines. A total of 400 acres will be inventoried annually until a complete forest habitat inventory is completed (15-20 years). Active management will be implemented annually on 100-300 acres of bottomland forest stands not meeting the desired stand conditions.

Rationale

As stated above, the objective for forest habitat management on CCNWR is to develop, manage and perpetuate the diversity of native wildlife populations. In particular, this includes providing habitat and protection for those species of plants and animals that are endangered or threatened, waterfowl and other migratory birds. The desired forest conditions found in Table 11 were created by the Lower Mississippi Joint Venture (2006) with population sustainability in mind. Although specific habitat requirements vary among species, many forest wildlife species share broad, overlapping habitat requirements, on which these recommended forest conditions have been based. The successful implementation of these recommendations will require coordination with a detailed, monitoring program.

Table 11. Desired Forest Conditions as determined by the Lower Mississippi Joint Venture

Forest Variables[1]	Desired Stand Structure	Conditions That may Warrant Management
Primary Management Factors		
Overstory Canopy Cover	60-70%	➢ 80%
Midstory Cover	25-40%	<20% or > 50%
Basal Area	13.7-16 m²/ha with ≥ 25% in older age classes[2]	> 20.6 m²/ha or ≥ 60% in older age classes
Tree Stocking	60-70 %	< 50% or > 90 %
Secondary Management Factors		
Dominant Trees[3]	➢ 5/ha	< 2.5/ha
Understory Cover	25-40%	< 20%
Regeneration[4]	30-40% of area	<20% of area
Coarse Woody Debris (>25 cm diameter)	≥ 14 m³/ha	< 7 m³/ha
Small Cavities (hole < 25 cm diameter)	➢ 10 visible holes/ha or > 10 "snag" stems/ha ≥ 10 cm dbh or ≥ 5 stems/ha > 51 cm dbh	< 5 visible holes/ha or < 5 snags/ha ≥10 cm dbh or < 2.5 stems/ha ≥ 51 cm dbh
Den Trees/Large Cavities[5]	One visible hole/4 ha or ≥ 5 stems/ha ≥ 66 cm dbh (≥ 1.8 m² BA/ha ≥ 66 cm dbh)	No visible holes/ 4 ha or < 2.5 stems/ha ≥ 66 cm dbh (< 0.9 m² BA/ha≥ 66 cm dbh)
Standing Dead and/or Stressed Trees[5]	➢ 15 stems/ha ≥ 25 cm dbh or ≥ 5 stems/ha ≥ 51 cm dbh (> 0.9 m² BA/ha > 25 cm dbh)	< 10 stems ≥ 25 cm dbh/ha or < 2.5 stems/ha ≥ 51 cm dbh (< 0.5 m² BA/ha≥ 25 cm dbh)

[1]Promotion of species and structural diversity within stands is the underlying principle of management. Management actions should promote vines and cane within site limitations.
[2]We view "older age class" as those stems approaching biological maturity. We do not advocate coring for defining age but instead using species/site/size relationships as practical surrogates to discern age.
[3]Dominants (a.k.a. emergents) should have stronger consideration on more diverse sites, such as ridges and first bottoms.
[4] Advanced regeneration of shade-intolerant trees in sufficient numbers (ca. 1,000/ha) to ensure their succession to forest canopy. Areas lacking overstory canopy (i.e. group cuts) should be restricted to < 20% of stand area.
[5] Utilizing BA parameters allows the forest manager to maintain this variable in size classes most suitable for the stand, versus pinpointing specific size classes as noted.

Strategies

1) Inventory and analyze each of the eight refuge management units on a systematic basis, and then make decisions to implement the best management action for individual stands within these management units. Evaluate one management unit per year. The Habitat Inventory completed in 2006 (Battaglia 2007) will be used to prioritize unit assessment.

2) Perform timber stand improvement methods such as chemical injection (USFWS), thinning, commercial sale, fire etc. in stands that do not meet the desired forest conditions.

Prescription

Once a description of the forest habitat is complete, the forest management objective is to maintain seventy to ninety percent of the forest area within CCNWR under active management via sustainable silvicultural practices to attain the desired stand conditions listed in table 9 with thirty to fifty percent of the forest area meeting those desired stand conditions at any given time.

Stands that contain dominant canopy trees with a diversity of species, age classes and health, but with an estimated canopy closure greater than 80 percent will be candidates for thinning back to an estimated 60 percent canopy closure. The desired canopy closure will be achieved by removal of undesirable trees, especially those that are suppressing regeneration of desirable species.

In mature stands (those with an average dbh of 11 inches or greater) lacking the qualities (age classes, species composition, health etc.) to achieve the desired forest conditions, regeneration will be a consideration. Shelterwood establishment cuts, small clearcuts (≤ 5 acres), group selection (in areas 1/4 to 1 acre), or clearcuts (in areas > 5 acres) will be used to restore these types of stands depending on the existing level of regeneration within each individual stand.

Forest stands with a heavy (greater than 50%) shade tolerant midstory will receive both midstory and overstory treatments. This will prevent less desirable midstory trees such as Ash, Maple, and Elm from taking over the stand. Selected midstory and overstory trees will be removed to maintain the presence of a desirable species mix in the mid and understory levels, preventing the loss of shade intolerant species. Trees of commercial quality should be sold and cut, and the remaining trees will be removed by noncommercial means. This will be accomplished by cutting, girdling, herbicide treatment, or, controlled burning.

Habitat improvements may be accomplished through either chemical (USFWS, 2014) or mechanical means or controlled burns. In cases where commercial operations are not feasible, other available means will be used. This may involve refuge staff, contractors, youth conservation corps, approved volunteers, or educational institutions under cooperative agreements.

Objective 3

Within 6 years of plan approval, restore 500 acres (80 acres annually) of bottomland hardwood forest for greater migratory waterfowl habitat by increasing species diversity, age class and occurrence of mast producing trees such as red oaks (in particular red oaks with smaller acorns such as Pin, Cherrybark, Willow, Water, and Nuttall) to 40-60% and maintaining in flooded condition between November and February as winter habitat for priority waterfowl species such as Mallards, American Black Ducks, Wood Ducks, and Hooded Mergansers.

Rationale

This area has traditionally been important to waterfowl due to its location on the Mississippi Flyway and waterfowl, according to Refuge purpose, are one of the featured species groups of CCNWR. Eight species commonly observed on CCNWR between November and February are USFWS Region 3 Conservation Priority species (USFWS 2002). In addition to using bottomland forests as a major food source, waterfowl use the forest for shelter, protection from predators, and freedom from human disturbance (Baldassarre & Bolen, 1994). These forested areas will enhance an existing complex of habitats on CCNWR which enables ducks to feed on acorns and invertebrates in flooded forests, or on seeds of moist-soil plants in seasonally flooded openings, to roost and court in more open marshes and sloughs, and to escape predation and social harassment in shrub swamps.

Strategies

1) Use hydrogeomorphic assessments to determine the restoration sites that have the appropriate hydrological regime for establishment of hard mast species beneficial to waterfowl.

2) Plant 40-60 percent hard mast species in all new bottomland reforestation plantings

3) Encourage mast-producing oaks wherever possible in both new reforestation plantings and existing stands.

Prescription

Hard mast species will comprise 40-60 percent of all new bottomland reforestation plantings, with possible higher percentages in areas not expected to have significant natural regeneration. Planting rate will be at a density of 435 seedlings per acre. Species will comply with the appropriate species as detailed in (Heitmeyer and Mangan 2012) according to the site hydrology, soils and geology. Plots will be established in order to monitor seedling survival in all new reforested plantings. The acceptable survival rate three years post planting will be a minimum of 300 trees per acre.

Wherever possible, mast-producing oaks will be encouraged, following similar management strategies as indicated in Objective 3.

Objective 4

Within 7 years of plan approval, restore 1000 acres of bottomland forest (150 acres annually) in order to increase forest connectivity and acreage of interior forest. (interior forest is any forest greater than 500 meters from cropland, pasture, grassland, urban, and suburban areas) Protect and maintain large areas of contiguous bottomland forest with linkages between upland and bottomland habitat in order to sustain and promote viable populations of forest interior birds and other wildlife species such as the copperbelly water snake.

Rationale

Forest song birds have been negatively affected by forest fragmentation, resulting in reduced populations and lower reproductive success. In addition, forest bird species richness has been positively correlated with forest patch size (Hoover et. al. 1995). In small patches, forest birds are subjected to: (1) more competition with other species (2) increased parasitism from brown-headed cowbirds (Robinson and Wilcove 1994, Hoover et. al. 1995), (3) increased likelihood of predation (Andrén and Angelstam 1988; Marzluff and Restani, 1999), (4) greater disturbance from human activities (Knight and Gutzwiller, 1995), and (5) increased isolation and inhibition of dispersal (Doak et al. 1992).

Species such as the state-threatened copperbelly water snake congregate in shallowly flooded bottomland forest during the breeding season (March-June) and then require a matrix of wooded or vegetated corridors in order to migrate to other wetlands as seasonal wetlands become dry. Providing wetland and forest complexes at appropriate spatial scales is important for the conservation of these species (Petranka et al., 2006).

Strategies

1) Utilize biologically based, spatially explicit decision support tools (Reforestation Priority Model, Figure 7) to determine high priority areas for restoration.

2) Restore approximately150 acres of forest each year.

3) Avoid the introduction of habitat conditions suitable to cowbird propagation, such as mowed areas.

Prescription

Figure 7 shows the high priority areas for reforestation, and Table 12 outlines the timeline for reforestation of these areas over the next 7 years. Prioritization of these areas was determined with a GIS decision support model (Figure 7) which was developed by Refuge biological and

GIS staff in 2007using the habitat requirements of forest bird species which are considered high priority within the Cache River Watershed. This model emulates the model developed by Twedt et al. (2004) for the Lower Mississippi Alluvial Valley. This model enhances forest bird conservation on CCNWR, and helps prioritize forest restoration to reduce fragmentation and increase the area of interior forest. This tool enables Refuge staff to rely more on ecologically-based strategies rather than opportunity-based when choosing priority sites for land acquisition and restoration. Approximately 100 acres will be restored to bottomland hardwood habitat each year, following the timeline presented below.

Figure 7. Reforestation Prioritization of Fields on CCNWR

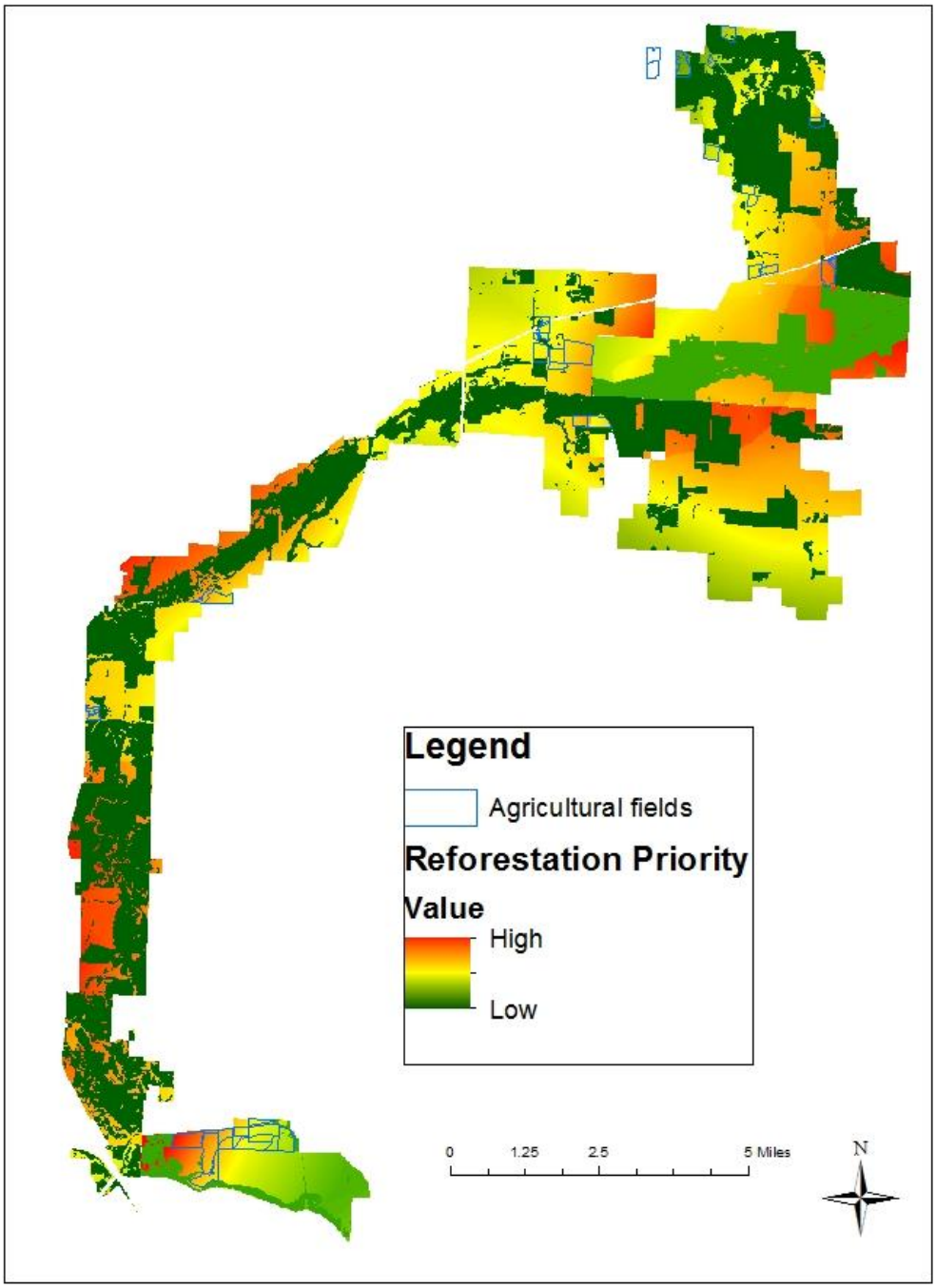


Table 12. Timeline for restoration of agricultural fields on Cypress Creek National Wildlife Refuge

Restoration Plan for Agricultural Fields- CCNWR (2014-2020)				
Year Planted	Tract Name	Tract Number	Acres per tract	Total Acreage per Year (all tracts)
2014	Wood Duck Slough Hickory Bottoms Delta Lands (Boot)	55 36 274	57 36 57	150
2015	Delta Lands Robertson	274 49	99 97	196
2016	Earnhart 40 Cross Chambliss	13A 10B 170A	42 67 61	170
2017	Churchill Delta Lands Honey	135 255 205	35 98 28	161
2018	Delta Lands	255	169	169
2019	Delta Lands	274	143	143
2020	Hileman	91a	70	70

Wide, mowed roadsides and fire roads will be avoided where possible to decrease the introduction of habitat conditions suitable to cowbird propagation and increase connectivity.

Point count surveys will be conducted to monitor forest bird populations, particularly in habitats altered by forest management activities.

Bald cypress-Tupelo Swamp

Goal

Manage healthy and sustainable bald cypress-tupelo swamp habitats within a matrix of other bottomland and upland habitats.

Rationale

More than half of the wetlands in the United States have been converted to other land use types (Dahl, 2000). In southern Illinois, for example, more than fifty percent of the original bald cypress/tupelo swamps have been lost during the last century (Fish and Wildlife Service 1990), and the regeneration of these swamps has become an important issue. Since CCNWR was

established under the authority of the Emergency Wetlands Act, the protection of these natural communities is a high priority.

Proper restoration and management of all CCNWR bald cypress-tupelo swamps will provide important habitat for migrating waterbirds, amphibians, reptiles, fish and other wildlife. The existing bald cypress-tupelo swamps on CCNWR provide important habitat for several high priority species such as nesting Wood Ducks, Hooded Mergansers, and Yellow-Throated Warblers. In addition to serving as potential roosting areas for the federally endangered Indiana Bat and the state endangered Rafinesque's big-eared bat, which frequently uses hollow bald cypress or tupelo trees that are characteristic of older bald cypress- tupelo forests (Gooding and Langford, 2004). Historically, much of the Cache River basin was seasonally flooded bald cypress forest that was species rich. (Hutchison, 1995, Middleton, 2003). It is important to maintain such a system of wetlands that will continue to provide habitat for species of various life stages such as hibernation, reproduction, and migration.

There is a need to examine the hydrology of existing sites, and to determine whether there is a need and/or potential to restore a more natural hydrology within existing swamps. Many of the swamps in the lower Cache have a seasonal flood pulse with high water levels in the winter, followed by a natural dry period during the late summer in most years (Middleton, 2003). Bald cypress regeneration is dependent on this type of pulse to create occasional mudflats that are required for seedling germination.

Objective 1

Within 5 years of plan approval, restore 100 acres of baldcypress-tupelo habitat within an appropriate location on CCNWR. Restoration will involve re-establishing a permanent vegetative cover of appropriate species and re-establishing and maintaining the natural water levels.

Rationale
See above

Strategies

1) Identify potential restoration sites detected by the HGM study (Heitmeyer and Mangan 2012).

2) Evaluate and prioritize potential restoration sites by cost, degree of current disturbance, location

3) Restore bald-cypress-tupelo habitat within abandoned channels of the Cache River that have appropriate hydrology for maintaining these species by planting seedlings or spreading seed.

4) Implement the structural modifications necessary in order to restore the appropriate hydrologic regime suitable for maintaining bald-cypress tupelo- habitat in areas that historically had this type of habitat but have been modified.

5) Monitor and treat existing bald cypress-tupelo swamps to support native plant diversity.

Prescription

Bald cypress-tupelo habitat is suited to, and can probably be restored and/or enhanced most easily within the abandoned channels that exist on CCNWR. In some locations, simply planting seedlings or spreading seed will be sufficient to restore this type of habitat, however, in others; there may be a need to restore a semi-permanent water regime. In some areas, such as the Poole wetland, cypress-tupelo habitat is slowly converting to open water habitat because water is present year round, never allowing for germination of baldcypress and tupelo seedlings. Structural modifications may be needed in some of these areas in order to restore a hydrologic regime where surface water is present an average of three to nine months out of the year and has the capability to dry out periodically during late summer. Existing and potential restoration sites for bald-cypress wetlands have been identified with the completion of a hydrogeomorphic (HGM) evaluation of the entire refuge (Heitmeyer and Mangan 2012) An evaluation of the geology, soils, topography, climate and hydrology of current sites was conducted using refuge field data, GLO Notes, National Wetland Inventory Maps (NWI) and a combination of other information.. Soil maps were examined in order to determine where wetland soils exist. Vegetation transects will be completed within existing bald cypress wetlands to determine diversity and cover of native and invasive or non-native plant species. Note: Since the historic presence of these wetlands was a function of disturbances such as ice, wind or fire, location of possible restoration sites will be highly dependent on locating those areas where the appropriate hydrology can be restored in order to establish and maintain this type of habitat.

Herbaceous Wetlands

Goal

Manage non-forested, herbaceous wetlands within a matrix of other bottomland and upland habitats. These wetlands will be managed as a complex rather than isolated habitats and require connectivity among a diversity of wetland types with variable hydroperiods.

Rationale

Proper restoration and management of a complex of herbaceous wetlands will provide important feeding areas for migrating birds and a host of other wildlife and plant species as well as being critical habitat for a number of amphibians and reptiles.

Objective 1

Manage 270 acres of moist soil impoundments at Bellrose Waterfowl Reserve for desirable annual moist soil vegetation. The objective will be to achieve a minimum of 60% (192 acres) cover of “good” or “desirable” plants and produce a minimum of 400 pounds of readily available moist soil seeds per acre from September through April. This moist soil objective of 400 pounds per acre is at least partially derived from the Lower Mississippi Joint Venture. In calculating the

acreage needed to meet waterfowl foraging habitat objectives in the Lower Mississippi Valley, that Joint Venture established wintering waterfowl foraging habitat capabilities by habitat type. These habitat capabilities were derived from the daily energy requirements of mallards and represent the number of ducks that could obtain daily food requirements (duck use days) from each acre of major foraging habitats. In calculating the duck use days value for moist soil habitat, (1,386 duck use days/acre) it was assumed an average of about 400 pounds per acre of native seeds were available to waterfowl. he three impoundments will be managed as a complex in order to provide a diversity of water depths at various times in order to provide the maximum benefits to migratory waterfowl. Management capabilities within these impoundments allow for manipulation of water during both fall flooding and spring drawdown. Due to the exposure of these units to major flood events, it must be acknowledged that in some years, certain events preventing the meeting of the objectives are likely to occur.

Rationale

Although the Cache River Watershed was densely forested prior to settlement, there were open areas lacking trees (Hutchison, 1995). Herbaceous wetlands occurred within openings in the floodplain forests of the Cache River Watershed in temporary or ephemeral basins, or in areas that underwent scouring during flood flows. Disturbance from beavers, lightning and wind could sometimes create openings as well. In some cases, larger wetland basins with seasonal hydrology likely produced vast amounts of food when early drawdowns stimulate annual plant production (Fredrickson 1982, 1996). Many desirable species of wetland plants satisfy nutritional requirements and provide suitable habitats for waterfowl and many other species of wildlife throughout the year. As stated in Chapter 2, CCNWR's purpose, and primary establishment goal is providing resting, nesting, feeding and wintering habitat for waterfowl and other migratory birds is the establishing purpose.

Strategies

1) Obtain elevation surveys conducive to developing at least six inch contours for assisting with developing a hydrological understanding of each unit.

2) Maintain a hydrologic regime with appropriate depth, duration and timing for optimizing use by waterfowl, while at the same time providing habitat for shorebirds, marsh birds, and wading birds when possible.

3) Manage water levels to enhance germination of desirable wetland plants using knowledge of:

a) Topographic and hydrologic conditions within each impoundment.

b) Germination requirements of desirable plants such as wild millets, smartweeds, pigweeds, flat sedge, and cutgrass species (Table 13).

c) Germination requirements of undesirable species such as cocklebur, water primrose, water pepper, and willow (Table 13).

4) Integrate a rotation of disturbance (ex: disking, mowing, crops, burning) within and among moist soil impoundments to provide periodic soil disturbance and control woody vegetation.

Prescription

The moist soil impoundments at Bellrose Waterfowl Reserve (Figure 8) will be managed as a complex to provide diverse water levels for a variety of species. Water level manipulations will be timed to coincide with the arrival times and populations of migrant species. The following is an example of an annual flood regime and will be modified on an annual scale in order to meet annual habitat objectives:

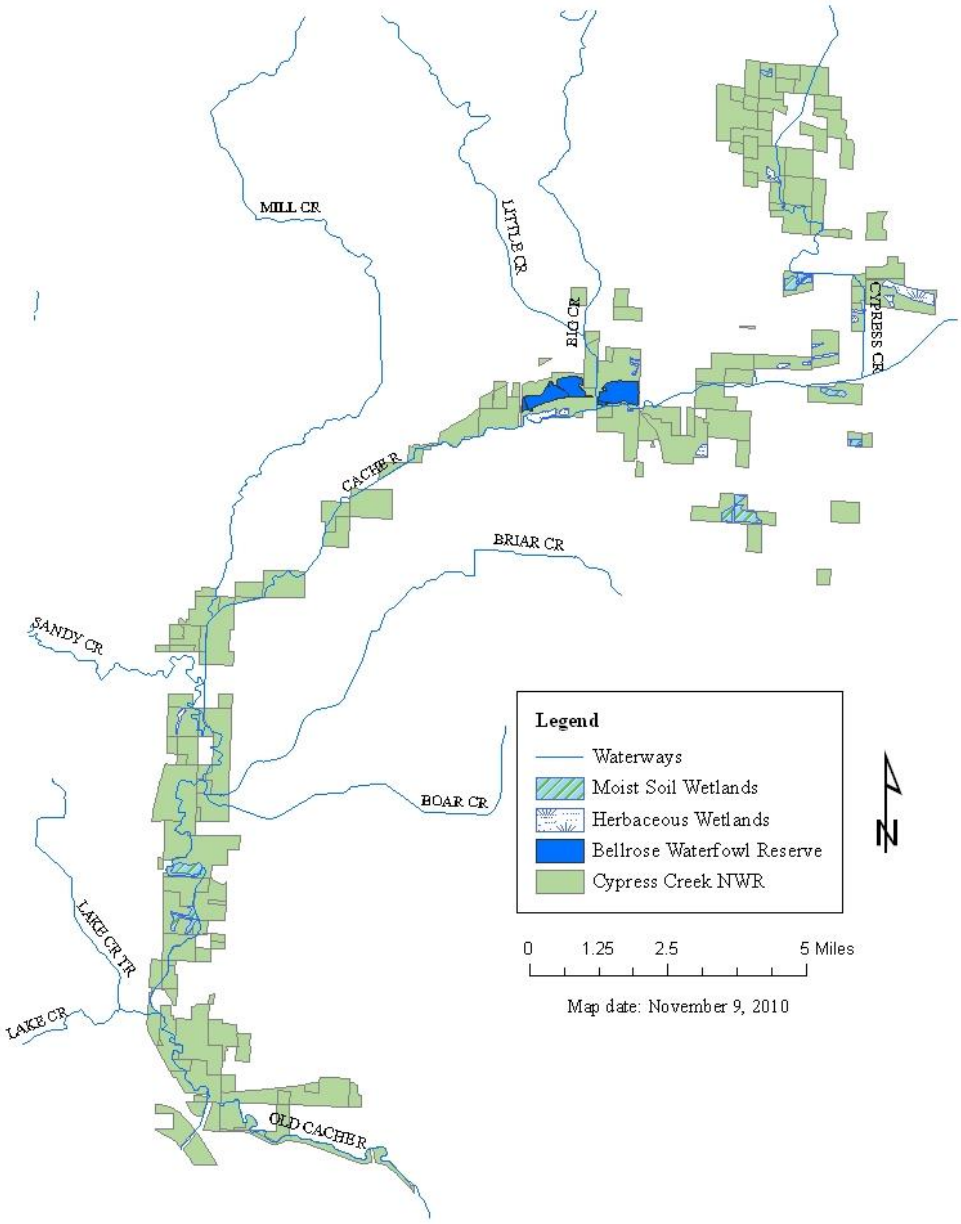
Fall flooding: Early fall flooding will begin with shallow inundation of impoundments to accommodate increasing waterfowl populations Ten percent of the entire area (30 acres) will be gradually flooded in early fall (beginning in mid to late September) for migrant Blue-winged teal, Northern Pintail and Wood Ducks, with a gradually increasing flooding regime to accommodate increasing waterfowl populations, with a goal of 85% (230 acres) of the surface area flooded to an average depth of 30 centimeters or less by mid-December This flooding strategy will maximize moist soil seed availability for foraging, migrating and wintering dabbling ducks (eg, teal, pintail, mallards). (See Table 14 for a sample annual schedule of water management).

Table 13. Response of common moist-soil plants to drawdown date.

Species		Drawdown Date		
Common name	Scientific name	Early	Midseason	Late
Swamp timothy	*Heleochloa schoenoides*	+	+++	+
Rice cutgrass	*Leersia oryzoides*	+++	+	
Sprangletop	*Leptochloa sp*		+	+++
Crabgrass	*Digitaria sp.*		+++	+++
Panic grass	*Panicum sp.*		+++	++
Wild millet	*Echinochloa crusgalli var. frumentacea*	+++	+	+
Wild millet	*Echinochloa walteri*	+	+++	++
Wild millet	*Echinochloa muricata*	+	+++	+
Red-rooted sedge	*Cyperus erythrorhizos*		++	
Chufa	*Cyperus esculentus*	+++	+	
Spikerush	*Eleocharis spp.*	+++	+	+
Pennsylvania smartweed	*Polygonum pensylvanicum*	+++		
Curltop ladysthumb	*Polygonum lapathifolium*	+++		
Dock	*Rumex spp.*		+++	+
Sweetclover	*Melilotus sp.*	+++		
Sesbania	*Sesbania exalta*	+	++	
Cocklebur	*Xanthium strumarium*	++	+++	++
Beggarticks	*Bidens spp.*	+	+++	+++
Aster	*Aster spp.*	+++	++	+
Purple loosestrife	*Lythrum salicaria*	++	++	+
Toothcup	*Ammania coccinea*	+	++	++
Morning glory	*Ipomoea spp.*	++	++	

+ = fair response; ++ = moderate response; +++ = excellent response (adapted from Frederickson, 1982)

Figure 8. Cypress Creek National Wildlife Refuge Herbaceous Wetlands



Spring drawdown: Gradual, staggered drawdowns of all units will be initiated in order to maximize foraging habitat for migratory waterfowl, shorebirds, wading birds and rails when possible. Thirty percent of the area will be drawn down beginning in mid to late February for early migrants such as Mallards and Northern Pintail, Forty percent of the area will be drawn down from mid-March to mid-April for mid spring migrants such as teal, Northern Shovelers, as well as incidental shorebirds, rails, and herons, and thirty percent will be drawn down from mid-April until mid-May in order to encourage a greater diversity of moist soil plant species as well as to provide incidental habitat for late spring wading and shorebird species.

Water levels will be managed to enhance germination of desirable wetland plants using the bathymetry data collected for each unit used in combination with germination requirements of desirable plants such as wild millets, smartweeds, flat sedges, and cutgrass species as well as germination requirements of the undesirable species such as cocklebur, water primrose, water pepper and willow.

As needed, based on plant community composition, a rotation of disturbance (ex: disking, crops, burning) will be incorporated within and among the three moist soil impoundments to provide periodic soil disturbance and control woody vegetation. When crops are planted they will be "dirty" ie: rows will be spaced 30" apart and will only be sprayed once, as a post-emergent application in order to encourage growth of annual native moist soil plants in the understory.

Table 14. Sample Target Water elevations for Bellrose Waterfowl Reserve (feet above MSL)

Date	Unit 1	Unit 2	Unit 3	Acres Flooded
Oct 1	331.0	329.0	Dry	29.37
Nov 1	332.0	329.5	328.0	155.2
Dec 1	332.0	330.0	328.4	254.5
Jan 1	332.0	330.5	328.5	293.5
Feb 1	332.0	330.5	328.5	293.5
Mar 1	331.5	329.5	328.5	216.3
Apr 1	331.0	329.5	328.4	133.4
May 1	330.0	329.0	328.2	38.72

Objective 2

Manage 300 acres of moist soil impoundments outside the BellroseWaterfowl Reserve as a complex in order to provide a diversity of water depths at various times in order to provide the maximum benefits to migratory birds and other wildlife. Management capabilities within these moist soil impoundments allow for enhanced manipulations of water levels during drawdown. The objective will be to achieve a minimum of 60% (180 acres) cover of "good" or "desirable" plants and produce a minimum of 400 pounds of readily available moist soil seeds per acre from September through April. Gradual, staggered drawdowns will begin in mid-February, and continue through July in order to maximize foraging habitat for migratory waterfowl, shorebirds, wading birds and rails when possible.

Rationale

See Objective 1 above.

Strategies

1) Maintain a hydrologic regime with appropriate depth, duration and timing for optimizing use by waterfowl, while at the same time providing habitat for shorebirds, marsh birds, and wading birds.

> Spring drawdown: Thirty percent of the area (approximately 75 acres) will be drawn down in mid to late February for early migrants such as Mallards and Northern Pintail. The location of these seventy-five acres will change from year to year, rotating among the various units. Forty percent of the area (approximately 100 acres) will be drawn down in mid-March and April for Mid Spring migrants such as teal, northern shovelers, shorebirds, rails, and herons, and thirty percent (approximately 75 acres) will be drawn down from mid-April to mid-May in order to encourage a greater diversity of moist soil plant species as well as to provide incidental habitat for late spring wader and shorebird species.

2) Integrate 3-4 year rotation of disturbance (ex: disking, crops, burning) within and among moist soil impoundments to provide periodic soil disturbance and control woody vegetation. Units will be scheduled for disturbance/renovation when the objective of achieving a minimum of 60% (180 acres) cover of "good" or "desirable" plants and production of a minimum of 400 pounds of readily available moist soil seeds per acre is no longer being achieved.

3) Manage water levels to enhance germination of desirable wetland plants and prevent germination of undesirable plants (Table 13)

Prescription

The remaining 300 acres of moist soil impoundments (Figure 8) will be managed similarly to the Bellrose impoundments. Water levels will be managed to enhance germination of desirable wetland plants using knowledge of topographic and hydrologic conditions within each impoundment as well as germination requirements of desirable plants such as wild millets, smartweeds, pigweed, flat sedges, and cutgrass species as well as the undesirable species such as cocklebur, water primrose, water pepper and willow. The following is an example of an annual flood regime and will be modified on an annual scale in order to meet habitat objectives. Because of the lack of pumping capabilities within these units, two to three boards will be placed in each structures in mid to late September and continually added (one board added every two weeks) as the winter progresses in order to mimic the gradual flooding occurring at Bellrose. For spring drawdown, 30% percent of the area (approximately 75 acres) will be drawn down in mid to late February for early migrants such as Mallards and Northern Pintail, 40% percent of the area (approximately 100 acres) will be drawn down in mid-March and April for mid spring migrants such as teal, northern shovelers, shorebirds, rails, and herons, and 30% percent

(approximately 75 acres) will be drawn down from mid-April to mid-May in order to encourage a greater diversity of moist soil plant species as well as to provide incidental habitat for late spring wader and shorebird species Drawdowns will be rotated among all the units from year to year. Those units in the most need of disturbance/renovations will drawn down the earliest.

Canebrakes

Goal

Inventory, protect, enhance and restore a matrix of giant cane habitat within the bottomland forest habitat inside CCNWR boundary.

Objective 1

Within 15 years of plan approval, plant 15 acres of giant cane in existing forest openings and as a buffer along forest/cropland or riparian boundaries in order to improve soil/water/wildlife benefits. Patches will be no less than one acre in size and have a minimum stem density 30,000 stems/ha.

Rationale

Giant Canebrake communities were once a dominant landscape feature which represented critical habitat for a number of rare or extirpated species such as the black bear, and the Bachman's Warbler. Canebrakes disappeared rapidly following European settlement due to a combination of overgrazing, altered burning regimes, agricultural land clearing, and changes in floodplain hydrology (Brantley and Platt 2001) and are nearly nonexistent today. Canebrakes represent critical habitat for several forest birds including Bachman's Warbler,, Hooded Warbler, and the rare, state endangered Swainson's Warbler, as well as other wildlife species such as swamp rabbits and canebrake rattlesnakes. In addition, at least six lepidopteron species have recently been identified as bamboo obligates (Gagnon 2006). Four of which, the Creole pearly Eye, cobweb little skipper, the yellow little skipper, and the cane little skipper are listed as Species in Greatest Need of Conservation for Illinois (Illinois Department of Natural Resources 2005). Giant cane has also been identified as an excellent riparian buffer because it serves as a good filter. Cane growing in riparian buffers enhances water quality by reducing sedimentation and removing nitrates, as well as stabilizing stream banks (Zaczek et al. 2004). Canebrakes are now considered one of the most imperiled types of plant communities in the country, and the inventory and management of remaining canebrakes deserve high priority (Brantley and Platt 2001, Noss et al.1995). Because canebrakes are a historical component of healthy, bottomland forested wetlands, and they also serve to improve the water quality of those wetlands, the restoration of canebrakes is considered a high priority pursuant to the establishment purposes of CCNWR.

Consistently, there is great interest in restoring canebrake ecosystems. However, canebrake restoration efforts face difficulties such as inefficient establishment and management techniques. Previous efforts in cane restoration have been burdened with poor survival of planting stock

coupled with slow rates of spread. In addition, seedlings require 2-3 years of growth in order to provide rhizomes of significant size that can actively spread throughout an area. These factors combined create difficulty for large scale restoration efforts. The method of propagation by digging and transplanting culms is labor intensive, cumbersome and costly (Platt and Brantley 1993). Currently, there is no large scale, commercially feasible giant cane nurseries in the United States, so all vegetative material used for propagation must be obtained from existing cane patches. Naturally regenerated cane may take two years to form a rhizome. Cane flowering is a rare and unpredictable occurrence, and when it does flower, the seed is often low in viability or sterile. This is a very slow process which makes it hard to rely on natural regeneration when increasing the size of a canebrake.

Planting cane will expedite the enhancements being done to existing patches, which will in turn accelerate the beneficial effects to the wetlands and bottomland forests of CCNWR. Planting cane in a forest opening, where it can receive partial sunlight will result in much faster production of stem density (culms/m²) than cane planted within the shaded forest. Canebrake habitat along forest and field edges will soften the edge effects by providing cover and foraging habitat opportunities for many species, as well as serve as an effective filter of agricultural sediment. The filtering effects of cane were shown by Schoonover et al. (2006). Giant cane buffers outperformed forest buffers in reducing incoming sediment mass. Continued research is a necessary component since, as mentioned before, restoration efforts up to this point have been limited due to the lack of available planting stock and difficulties in propagation of cane (Zaczek et al. 2004), In addition, descriptions of minimum habitat standards for species such as the Swainson's warbler are still lacking. Patch size (area) and culm density appear to be important defining parameters; however, historical and current literature provides few actual measurements. In a study done on 5 study sites in Arkansas, Louisiana, Mississippi, and Florida, researchers concluded that stem densities from 30,000 to 50,000 stems/ha provide the cover necessary for high-quality Swainson's Warbler habitat (Graves 1996). In southern Illinois, the average stem density in Swainson's nesting habitat was 26,390 stems/ha, and no birds were detected in areas with 5,000 stems/ha.(Eddleman et al. 1980). Also, it is a high priority to continue research efforts currently underway to determine the best procedures for transplanting cane. Giant cane restoration methods are still being tested, and continuation of these methods will be based on survival success of planted cane patches.

<u>Strategies</u>

1) Acquire infrared aerial images over CCNWR acquisition boundary.

2)Identify and map the perimeters of all significant existing giant cane patches (greater than 10 m in width and/or length) in order to determine location and size.

3) Collect abiotic information on each site such as soil moisture and ph, canopy cover (sunlight),

4) Install buffers along all existing agricultural fields with significant (greater than 10m in length or width) giant cane growth around the perimeter or remove these areas entirely from agricultural production, in order to allow the natural spread of giant cane rhizomes.

5) Gather giant cane rhizomes from existing stands in late winter and early spring in order to use as planting stock.

6) Transplant cane rhizomes focusing on existing forest openings greater than 1 acre and 50 foot wide buffers along forest/cropland boundaries, with fertile, well drained soils, ranging from sandy highly acidic, with moderate disturbance

7) Transplant cane rhizomes in 1 or 2 acres patches along mature forest edge before implementing reforestation on adjoining land.

Prescription

Giant Cane buffers measuring 50 feet wide will be installed along any existing agricultural fields that have cane growing adjacent within the first year of plan implementation.

A minimum of one acre of giant cane will be planted each year. Planting will take place in March or April while the cane is still dormant. Rhizomes will be collected from existing stands either during the preceding fall or in the spring before planting occurs. Rhizomes collected in the fall will be stored in a cooler at 40 degrees Fahrenheit. Approximately 3500 bare rhizomes will be collected each year and re-planted using a tree planter. Rhizomes will be planted on a five foot by five foot spacing.

Objective 2

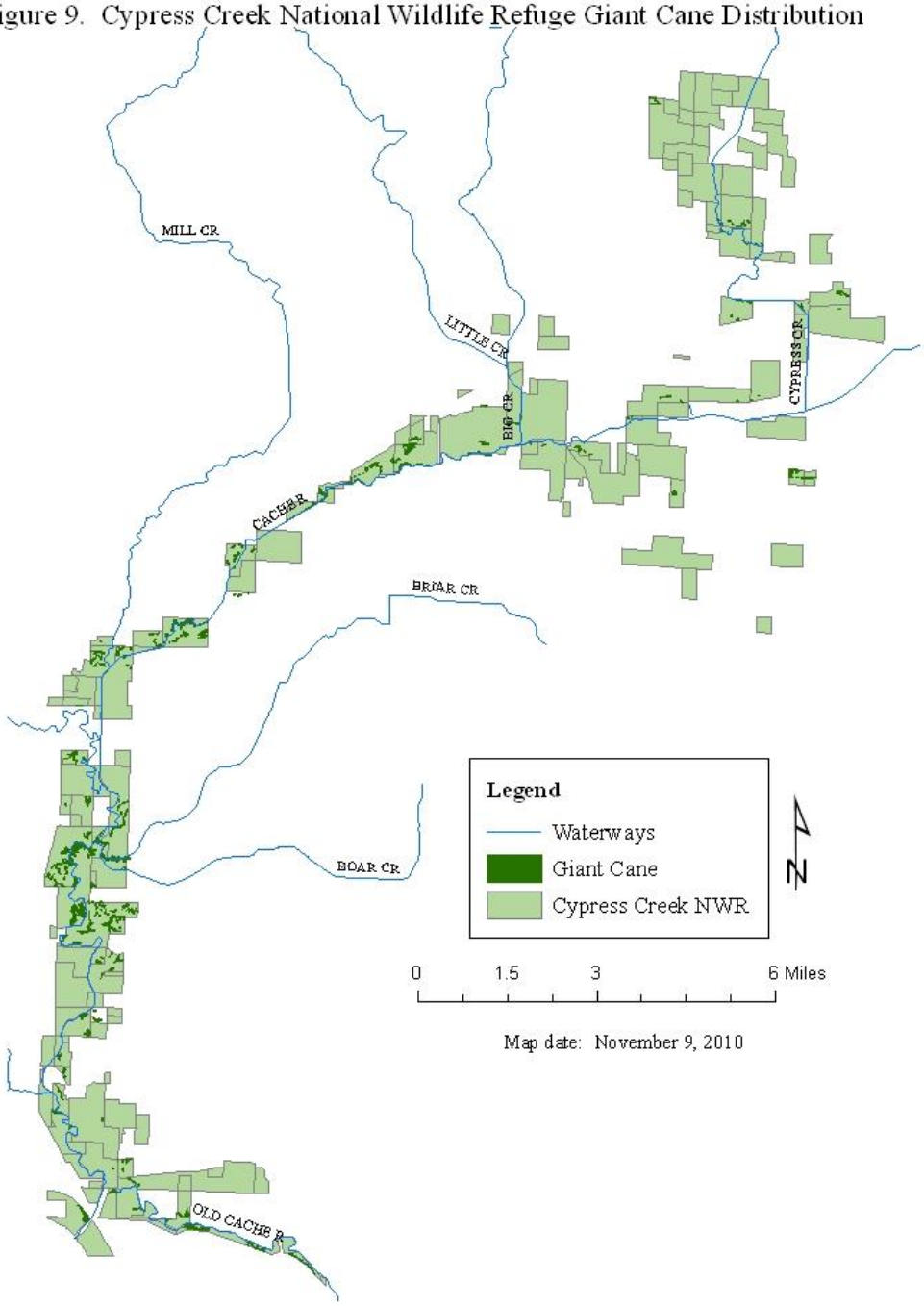
Within five years of plan approval, develop a management strategy, based on adaptive management that provides periodic disturbances, such as those that would have historically been generated by windstorms and fire. Implementing a management plan involving overstory thinning, periodic prescribed fire, fertilization, mowing and supplemental plantings in at least 10% of existing cane within CCNWR boundary annually will encourage more robust canebrake habitat.

Rationale

A management plan to enhance existing cane growth as well as transplanted cane is necessary in order to maintain a robust giant cane habitat over time. Given the establishing purposes of CCNWR, a habitat component such as cane, which serves as a sediment filter and a structurally important habitat for rare and endangered species, should be a management priority. Disturbance caused by fire results in multiple benefits including stimulating sprouting of new culms, returning nutrients to the soil, and reducing competition from other plants. In addition, there is evidence that burning may bolster resistance to subsequent environmental shocks (Gagnon 2006). Mowing cane may result in re-sprouting of culms as well, and could be used as an alternative where burning is not feasible. Native American use of fire, for agricultural use, warfare, hunting etc, resulted in burning of canebrakes an average of once every 7-10 years, a practice that has been shown to be beneficial in maintaining and expanding canebrakes by eliminating competing woody vegetation (Brantley and Platt 2001,Gagnon 2006).

Regimes. Giant cane is generally found in fertile soils, ranging from sandy to highly acidic (Cirtain et al 2004). However, much remains unknown about this species' environmental constraints. Recent work in transplanting giant cane suggests that it may be restricted to seepages, stream terraces, and natural levees. Although it requires moist, it seems unable to withstand long inundation. A study of the effect of soil moisture regimes and nitrogen on rivercane growth, found that N fertilization increases shoot growth in well-drained soils, but had no effect in flooded or drought soils. Well-drained soils also resulted in giant cane with greater biomass and number of leaves. It has been suggested that silica in the soil may be a limiting factor to giant cane growth (Cirtain et al. 2004). Other studies suggest that giant cane may be able to tolerate nitrogen concentrations up to and possibly exceeding ten times normal application (Gagnon 2007). Results from both field and laboratory experiments indicate that giant cane growth increases with increased light (Gagnon 2007).

Figure 9. Cypress Creek National Wildlife Refuge Giant Cane Distribution



Strategies

1) Perform late fall or early winter prescribed burns or mowing.

2) Fertilize cane patches that appear stressed.

3) Monitor survival of existing canebrakes.

Prescriptions

An on-going management strategy will be implemented in which the stem density, height, and size of existing canebrakes are assessed every 3-4 years in order to document any spread, reduction or movement of existing cane patches. Late fall and early winter prescribed burns will be conducted in well established, dense canebrakes on seven to ten year intervals in order to stimulate re-sprouting of new culms, return nutrients to the soil, and reduce competition from other plants. When Cane patches appear stressed, they may be fertilized in order to postpone flowering and subsequent diebacks

Agricultural Fields

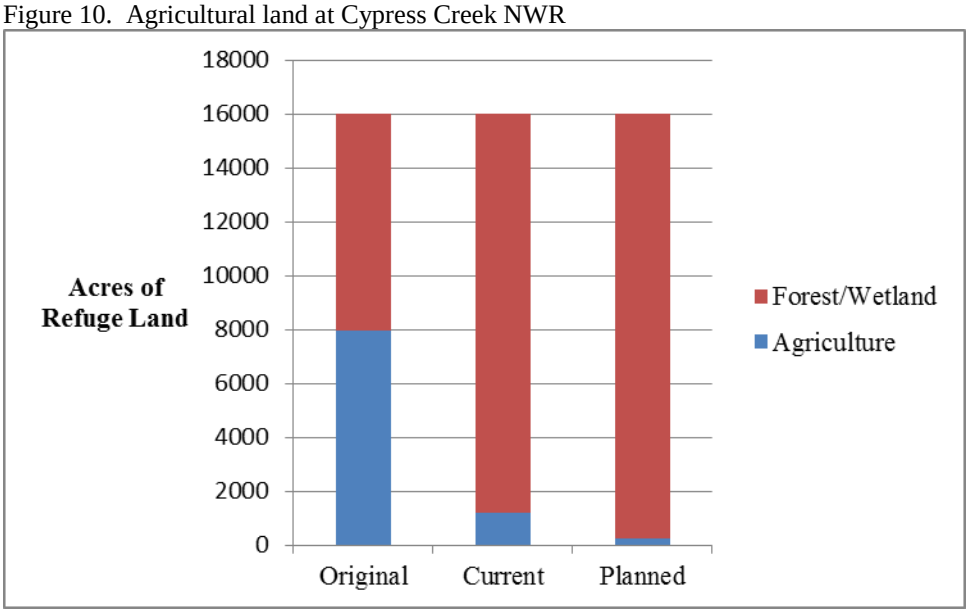
Goal

Maintain a cropland management program that supports both CCNWR purposes to restore and manage wetlands and bottomland forest habitats and provide migratory and wintering habitat for waterfowl and other migratory birds. Over 50% of CCNWR lands purchased have a long-history of agricultural use. Agriculture in combination with best management practices will be used in order to prevent the invasion of undesirable vegetation, noxious weeds, and to prepare the land for restoration.

Rationale

At Refuge establishment (1990), agriculture lands within CCNWR acquisition boundary totaled 22,026 acres. Currently, CCNWR includes approximately 16,000 acres. Of those 16,000 acres currently in ownership, approximately 50% were originally in agriculture (mostly corn, beans, and milo). Approximately 80% of the purchased agriculture land included highly erodible lands or floodplain fields which were taken out of production and restored to forest, wetland, or moist soil wetlands (Figure 10). Currently, approximately 1200 acres of CCNWR is in row crop (this acreage will change as tracts are restored annually and also as farm land is acquired). The majority of these acres (955) are being farmed to control invasive noxious weeds and prepare the land for future habitat restoration. Approximately 237 crop acres will be managed in conjunction with moist soil impoundments, at the Bellrose Waterfowl Reserve to enhance habitat and food resources for migratory birds. Current crop land and agricultural land acquired in the future will be evaluated and prioritized for reforestation (with the exception of the acreage at the Bellrose Reserve).

Figure 10. Agricultural land at Cypress Creek NWR



Objective 1

Within 6 years of plan approval, convert approximately 955 acres of cropland to forest in order to increase forest connectivity/interior.

Rationale

Converting CCNWR cropland to forest and wetland will result in positive effects to the water and soil. Reduction of cropland and increased restoration of forests and wetlands coupled with the blocking of drainage ditches associated with these fields will help reduce erosion and sedimentation as well as fertilizer and herbicide use in the Cache River Watershed.
This objective will also have positive effects on vegetation because it will a) restore more acres of native forest in order to increase forest connectivity and acreage of interior forest. (interior forest is any forest greater than 500 meters from cropland, pasture, grassland, urban, and suburban areas) b) protect and maintain large corridors of contiguous forest with linkages between upland and bottomland habitat in order to sustain and promote viable populations of forest interior birds and other wildlife species such as the copperbelly water snake (Twedt et al. 2004). c) Provide wetland and forest complexes at desired spatial scales, and d) further forest habitat management objectives on the Refuge by managing for a healthy and diverse forest with complex vertical structure and species diversity, and conserving examples of rare and declining natural systems.

Restoring native vegetation will also result in greater protection of priority species and important habitats leading to increased conservation and ability to maintain healthy, functioning bottomland forest communities associated with the Cache River and its tributaries. This objective is more compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

Strategies

1) Use biologically based, spatially explicit decision support tools (reforestation priority model) to determine high priority areas for restoration.

2) Retire a minimum of 100 acres of crop land annually and restore to forest and or wetland habitat.

3) Concentrate on providing a range of habitats, on developing complex vertical structure, and maintaining integrity of interior forest.

Prescription

Using the reforestation priority model, cropland areas have been prioritized for restoration (Table 12). From the priority list, a minimum of 100 acres will be targeted each year. A year prior to restoration, the cooperative farmer and Farm Services Agency will be notified that a particular field or fields will be removed from the cooperative farming program. This will allow enough time for the cooperative farmer to prepare for the coming year and an acreage reduction. The following spring native seedlings will be planted on the selected site. Seedlings will be acquired from a local source and planted at a rate of 435 seedlings/acre.

Objective 2

Use farming as a tool to help manage 237 acres of wildlife habitat surrounding the Bellrose Waterfowl Reserve.

Rationale

Farming surrounding this area will supplement the natural food resources available to migrating waterfowl as part of CCNWR's waterfowl management program. Cultivated grains are often used in waterfowl management because agricultural seeds tend to have greater energy than many natural seeds and agricultural crops have higher yield per unit area than natural wetland plants. Some waterfowl biologists recommend providing unharvested grain fields and natural wetlands for migrating and wintering waterfowl because seed resources are low in harvested agricultural fields (Dugger et al. 2007, Gruenhagen and Fredrickson 1990, Fredrickson 1982). The Bellrose Waterfowl Reserve was established to support populations of waterfowl or migratory birds. Providing food for large populations of waterfowl is often accomplished by managing a complex of natural wetlands, moist soil impoundments, and cultivated grains.

Objective 3

Identify and employ best management practices that control erosion and sedimentation and enhance wildlife habitat on acreage within the cooperative farming program (currently approximately 1200 acres).

Rationale

Conservation and environmental farming involves practices that provide benefits to both agricultural production and wildlife habitat. These best management practices result in reduced energy consumption, reduced soil erosion, and reduced use of chemical with a result of improved soil fertility and biological diversity. These best management practices are incorporated into cooperative farming agreements and SUP's for each individual farmer on CCNWR. The special use permit also includes a share provision where the cooperator harvests a percentage of the crop and leaves a percentage of the crop for the benefit of migratory and resident wildlife.

Strategies

1) Develop native grass buffers and field borders between 30'-50' that provide habitat requirements for priority species and aids in minimizing runoff and erosion.

2) Avoid the introduction of habitat conditions suitable to cowbird propagation, i.e. forest fragmentation such as wide mowed roadsides, maintenance of large openings, etc.

3) Require cooperative farmers to use chemicals from the USFWS Pesticide Granted Field Station Approval List for CY 2014 list (USFWS 2014) and keep accurate records of chemical application.

4) Maintain diversity within cropland area to provide wildlife habitat; grasses, shrubs, forbs along road and field borders, buffers along ditches will contribute to wildlife food and cover requirements.

5) Use crop rotation to avoid or minimize potential adverse effects such as pest resistance (corn and soybeans).

6) Prohibit the use of genetically modified crop seeds.

7) Prohibit the use of insecticide-treated seed.

Prescription

Until restoration can take place, limited agriculture will be used to control invasive species and prepare the land for restoration to native habitat. The cooperative farming program on CCNWR includes 1200 acres and employs best management practices to control erosion and minimize impacts to wildlife. Practices include incorporating 30' to 50' grass buffers around each field. Buffers will consist of a native grass/forb mix and be planted in either the spring or fall. Approximately 200 acres of grass buffers will be maintained through spot herbicide treatment, mowing or intermittent burning to control invasive species.

There will be no use of genetically-modified crops in CCNWR The use of non-GMO crop will be allowed only for the purpose of habitat restoration, and CCNWR has a goal of accomplishing habitat restoration projects on all but 200 acres of the currently farmed individual tracts within six years, weather permitting.

Timeline for Accomplishment

The above goals and objectives were developed to guide the habitat management of CCNWR for the next 15 years. As noted above, these goals and objectives were the result of discussions held with resource experts familiar with CCNWR and the habitat management planning process. The following goals and objectives are based on those discussions, as well as the goals and objectives set forth in the CCNWR CMP.

Below, in Table 15 is the annual timeline of accomplishment for the strategies and prescriptions that were created in order to accomplish those habitat goals and objectives.

Table 15. Annual Schedule of Objective Completion at Cypress Creek NWR

HMP Objectives	Year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Characterize Summer Bat Habitat	X	X	X	X											
Manage 1,600 acres for bat roost/maternity colony					X	X	X	X	X	X	X	X	X	X	X
Forest Monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Achieve Active management on 70-95% Bottomland Forest															X
Manage 500 acres Bottomland Forest for ducks	X	X	X	X	X	X	X								X
Reforest a minimum of 100 acres Bottomland Forest/Year	X	X	X	X	X	X	X								
Restore 100 acres Baldcypress-Tupelo Swamp	X	X	X	X	X										
Manage 270 acres MSU @ Bellrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Manage 300 MSU	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Plant 1 Acre of Cane Habitat/Year	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Develop Cane Management Plan	X	X	X	X	X										

Appendices

Appendix A: Cypress Creek National Wildlife Refuge Species mentioned in HMP

Cypress Creek National Wildlife Refuge -Species Mentioned in the HMP

Common Name of Species	Scientific Name of Species
Acadian Flycathcher	*Empidonax virescens*
American Bittern	*Botaurus lentiginosus*
American Black Duck	*Anas rubripes*
American Elm	*Ulmus americana*
American Sycamore	*Platanus occidentalis*
American Widgeon	*Anas Americana*
American Woodcock	*Scolopax minor*
Amur Honeysuckle	*Lonicera maackii*
Autumn Olive	*Elaeagnus umbellate*
Bachman's Warbler	*Vermivora bachmanii*
Bald Cypress	*Taxodium distichum*
Bald Eagle	*Haliaeetus leucocephalus*
Barn Owl	*Tyto alba*
Beaver	*Castor canadensis*
Beggarticks	*Bidens spp.*
Bird Voiced Treefrog	*Hyla avivoca*
Bitternut Hickory	*Carya cordiformis*
Black Bear	*Ursus americanus*
Black Rail	*Laterallus jamaicensis*
Blue Winged Teal	*Anas discors*
Bobcat	*Lynx rufus*
Brown Creeper	*Certhia americana*
Bulrush	*Scirpus polyphyllus*
Buttonbush	*Cephalanthus occidentalis*
Canada Geese	*Branta canadensis*
Cane Little Skipper	*Amblyscirtes reversa*
Canebrake Rattlesnake	*Crotalus horridus*
Cattail	*Typha latifolia*
Cerulean Warbler	*Dendroica cerulea*
Chinese Yam	*Dioscorea oppositifolia*
Cobweb Little Skipper	*Amblyscirtes aesculapius*
Cocklebur	*Xanthium spp.*
Common Moorhen	*Gallinula chloropus*
Common Snipe	*Capella gallinago*
Copperbelly Water Snake	*Nerodia erythrogaster*
Creole Pearly Eye	*Enodia creola*
Cutgrass	*Leersia spp.*
Cypress Knee Sedge	*Carex decomposita*
Cypress Minnow	*Hybognathus hayi*
Dickcissel	*Spiza americana*
Eastern Cottonwood	*Populus deltoides*
Eastern Ribbon Snake	*Thamnophis sauritus*
Fescue	*Festuca spp.*
Flat Sedges	*Cyperus spp.*
Fox Sedge	*Carex vulpinoidea*
Gadwall	*Anas Strepera*

Appendix B State Threatened and Endangered Species by County

Illinois Threatened and Endangered Species by County

Alexander County

Scientific Name Common Name State Protection # of occurrences Last Observed

Carex intumescens Swollen Sedge LT 1 1993	*Carex oxylepis* Sharp-scaled Sedge LT 3 2007-05-23	*Carya aquatica* Water Hickory LT 1 1993-07-03	*Carya pallida* Pale Hickory LE 1 1980-05-10	*Cladrastis lutea* Yellowwood LE 1 2007-11-10
Clematis crispa Blue Jasmine LE 2 2000-05-17	*Corynorhinus rafinesquii* Rafinesque's Big-eared Bat LE 2 2010-06	*Crotalus horridus* Timber Rattlesnake LT 5 2010-09-24	*Egretta caerulea* Little Blue Heron LE 2 2006-07-30	*Eryngium prostratum* Eryngo LE 2 1997-08-06
Glyceria arkansana Manna Grass LE 1 2007-05-24	*Heteranthera reniformis* Mud Plantain LE 1 2004-10-29	*Hybognathus hayi* Cypress Minnow LE 1 1993-06-29	*Hyla avivoca* Bird-voiced Treefrog LT 1 2003-05-08	*Ictinia mississippiensis* Mississippi Kite LT 1 2004-08-12
Justicia ovata Water Willow LE 1 1991-08-20	*Lanius ludovicianus* Loggerhead Shrike LE 2 1988	*Lepomis miniatus* Redspotted Sunfish LE 1 2001	*Lepomis symmetricus* Bantam Sunfish LT 4 1996-05-15	*Limnothlypis swainsonii* Swainson's Warbler LE 2 1993-06-24
Melothria pendula Squirting Cucumber LT 2 2007-07-01	*Moxostoma carinatum* River Redhorse LT 1 2006	*Myotis austroriparius* Southeastern Myotis LE 4 2011-02-14	*Myotis grisescens* Gray Bat LE 1 1991-07-01	*Myotis sodalis* Indiana Bat LE 6 2011-02-14
Notropis boops Bigeye Shiner LE 8	*Ochrotomys nuttalli* Golden Mouse LT 5 2008-10	*Orconectes lancifer* Shrimp Crayfish LE 2 1999-10-01	*Oryzomys palustris* Rice Rat LT 6 2008-06-19	*Penstemon tubaeflorus* Tube Beard Tongue LE 2 2004-05-21
Planera aquatica Water Elm LT 1 1991-08-21	*Pseudacris illinoensis* Illinois Chorus Frog LT 1 2011-03-03	*Pseudemys concinna* River Cooter LE 1 1985-04-13	*Quercus montana* Rock Chestnut Oak LT 1 2007-05-23	*Quercus phellos* Willow Oak LT 1 2006-07-01
Quercus texana Nuttall's Oak LE 2 2006-07-01	*Schoenoplectus hallii* Hall's Bulrush LT 1 1993	*Sternula antillarum* Least Tern LE 3 2009-08-05	*Styrax americana* Storax LT 2 2010-09-15	*Styrax grandifolia* Bigleaf Snowbell Bush LE 1 2007-11-10
Urtica chamaedryoides Nettle LT 2 2007-05-24				

Johnson County

Scientific Name Common Name State Protection # of occurrences Last Observed

Carex bromoides Sedge LT 1 1996	*Carex decomposita* Cypress-knee Sedge LE 2 2008-10-15	*Carex gigantea* Large Sedge LE 1 1994-07-05	*Carex intumescens* Swollen Sedge LT 5 2011-09-26	*Carex oxylepis* Sharp-scaled Sedge LT 4 1994-05-02
Carex willdenowii Willdenow's Sedge LT 3 2009-05-20	*Carya aquatica* Water Hickory LT 2 2008-10-14	*Cimicifuga rubifolia* Black Cohosh LT 1 1999-09-18	*Circus cyaneus* Northern Harrier LE 1 2002-06-17	*Clematis crispa* Blue Jasmine LE 1 2009-05-21
Clematis viorna Leatherflower LE 1 1969-06-11	*Corynorhinus rafinesquii* Rafinesque's Big-eared Bat LE 4 2010-07-21	*Crangonyx packardi* Packard's Cave Amphipod LE 3 1997-04-19	*Crotalus horridus* Timber Rattlesnake LT 1 2000-07-13	*Dennstaedtia punctilobula* Hay-scented Fern LE 1 2004-06-07

Desmognathus conanti Spotted Dusky Salamander LE 2 2011-09-15	*Dichanthelium joorii* Panic Grass LE 2 2008	*Dodecatheon frenchii* French's Shootingstar LT 7 2010-06-03	*Dryopteris celsa* Log Fern LE 1 2005-05-08	*Euonymus americanus* American Strawberry Bush LE 3 2011-06-16
Hybognathus hayi Cypress Minnow LE 1 1996-11-01	*Hydrolea uniflora* One-flowered Hydrolea LE 2 2010-08-19	*Hyla avivoca* Bird-voiced Treefrog LT 7 2010-07-28	*Ictinia mississippiensis* Mississippi Kite LT 3 2010-07-03	*Lampetra aepyptera* Least Brook Lamprey LT 1 2005-11
Lanius ludovicianus Loggerhead Shrike LE 1 1990-06	*Limnothlypis swainsonii* Swainson's Warbler LE 1 1977	*Lysimachia radicans* Creeping Loosestrife LE 4 2011-09-26	*Matelea obliqua* Climbing Milkweed LT 2 2008-06-23	*Myotis austroriparius* Southeastern Myotis LE 6 2010-07-21
Myotis grisescens Gray Bat LE 2 1991-07-15	*Myotis sodalis* Indiana Bat LE 2 2010-07-22	*Nyctanassa violacea* Yellow-crowned Night-Heron LE 4 2010-06-28	*Ochrotomys nuttalli* Golden Mouse LT 5 2008-10	*Orconectes indianensis* Indiana Crayfish LE 2 2007-06-27
Oryzomys palustris Rice Rat LT 4 2009-03-15	*Planera aquatica* Water Elm LT 3 2010-09-30	*Plantago cordata* Heart-leaved Plantain LE 1 2004-06-03	*Platanthera flava var. flava* Tubercled Orchid LE 2 1997-07-27	*Quercus phellos* Willow Oak LT 1 1987-06
Rhynchospora glomerata Clustered Beaked Rush LE 1 1999-08-31	Page 51 of 12 10/4/2012	*Salvia azurea ssp. pitcheri* Blue Sage LT 1 2011-06-10	*Scleria pauciflora* Carolina Whipgrass LE 1 2008-06-23	*Spiranthes vernalis* Spring Ladies' Tresses LE 2 2011-07-19
Stenanthium gramineum Grass-leaved Lily LE 2 2002-06-29	*Styrax americana* Storax LT 5 2011-09-26	*Talinum parviflorum* Small Flower-of-an-hour LT 5 2010-07-27	*Thamnophis sauritus* Eastern Ribbon Snake LT 2 2012-03-30	*Thryomanes bewickii* Bewick's Wren LE 2 1981-05-09
Trichomanes boschianum Filmy Fern LE 3 2002-09-26	*Tyto alba* Barn Owl LE 4 2012-06-14			

Johnson Total # of Species 51

Pulaski County

Scientific Name Common Name State Protection # of occurrences Last Observed

Carex decomposita Cypress-knee Sedge LE 1 2007-05-25	*Carex gigantea* Large Sedge LE 1 2002-08-14	*Carex intumescens* Swollen Sedge LT 1 1997-09-04	*Carya aquatica* Water Hickory LT 1 2007-06-15	*Clematis crispa* Blue Jasmine LE 1 1997-09-04
Corynorhinus rafinesquii Rafinesque's Big-eared Bat LE 2 2010-09-03	*Cyclonaias tuberculata* Purple Wartyback LT 2 1995-10	*Cyperus lancastriensis* Galingale LT 1 2005-10-04	*Desmognathus conanti* Spotted Dusky Salamander LE 14 2010-09-01	*Ellipsaria lineolata* Butterfly LT 2 2002-08-15
Elliptio crassidens Elephant-ear LT 1 2002-08-15	*Euonymus americanus* American Strawberry Bush LE 1 2005-10-16	*Fusconaia ebena* Ebonyshell LT 5 2008-08-27	*Halesia carolina* Silverbell Tree LE 1 2010-06-28	*Hybognathus hayi* Cypress Minnow LE 1 1996-11-01
Hyla avivoca Bird-voiced Treefrog LT 2 2010-06-15	*Ictinia mississippiensis* Mississippi Kite LT 2 2010-07-27	*Ixobrychus exilis* Least Bittern LT 1 2002	*Justicia ovata* Water Willow LE 1 2002-08-09	*Lanius ludovicianus* Loggerhead Shrike LE 1 1988
Lepomis miniatus Redspotted Sunfish LE 1 1979-10-27	*Lepomis symmetricus* Bantam Sunfish LT 1 1995-08-26	*Ligumia recta* Black Sandshell LT 3 2008-08-27	*Limnothlypis swainsonii* Swainson's Warbler LE 2 1993-06-24	*Lysimachia radicans* Creeping Loosestrife LE 2 2005-10-16
Melanthera nivea White Melanthera LE 1 2004	*Melothria pendula* Squirting Cucumber LT 2 2007-05-24	*Myotis austroriparius* Southeastern Myotis LE 1 2010-07-21	*Myotis grisescens* Gray Bat LE 1 1991-07-15	*Myotis sodalis* Indiana Bat LE 1 2010-07-22
Necturus maculosus Mudpuppy LT 1 2001-04-01	*Notropis anogenus* Pugnose Shiner LE 1 1940	*Noturus stigmosus* Northern Madtom LE 1 2009-07	*Nyctanassa violacea* Yellow-crowned Night-Heron LE 2 2010-06-24	*Oryzomys palustris* Rice Rat LT 4 2009-03-15

Planera aquatica Water Elm LT 2 2010-06-15	*Plethobasus cooperianus* Orange-foot Pimpleback LE 1 1984-08-22	*Pleurobema cordatum* Ohio Pigtoe LE 2 1995-10	*Quadrula cylindrica* Rabbitsfoot LE 1 2005-08-04	*Quercus phellos* Willow Oak LT 2 2005-10-16
Quercus texana Nuttall's Oak LE 2 2005-10-16	*Stenanthium gramineum* Grass-leaved Lily LE 1 2010-06-30	*Sternula antillarum* Least Tern LE 1 2002-08-11	*Styrax americana Storax LT 3 2010-06-16*	*Thamnophis sauritus Eastern Ribbon Snake LT 2 2010-09-07*
Tilia heterophylla White Basswood LE 1 2001-07-17	*Tyto alba* Barn Owl LE 5 2012-06-13			

Pulaski Total # of Species 47

Union County
Scientific Name Common Name State Protection # of occurrences Last Observed

Agalinis skinneriana Pale False Foxglove LT 1 2005-10	*Ammocrypta clarum* Western Sand Darter LE 1 1997	*Asplenium bradleyi* Bradley's Spleenwort LE 2 2005-06-18	*Asplenium resiliens* Black Spleenwort LE 3 2005-06-18	*Carex decomposita* Cypress-knee Sedge LE 1 2002-07-27
Carex gigantea Large Sedge LE 1 2005-06-18	*Carex nigromarginata* Black-edged Sedge LE 1 2011-06-28	*Carex oxylepis* Sharp-scaled Sedge LT 1 1986	*Carex physorhyncha* Bellows Beak Sedge LE 1 1973-03-30	*Carex willdenowii* Willdenow's Sedge LT 1 1988-05-26
Carya aquatica Water Hickory LT 1 1957-06-27	*Carya pallida* Pale Hickory LE 1 1987-02	*Crangonyx packardi* Packard's Cave Amphipod LE 1 1965-06	*Crotalus horridus* Timber Rattlesnake LT 7 2012-07-30	*Dendroica cerulea* Cerulean Warbler LT 2 2007-06-12
Dichanthelium joorii Panic Grass LE 1 1988	*Dodecatheon frenchii* French's Shootingstar LT 2 2010-08-20	*Fundulus dispar* Starhead Topminnow LT 3 1999-10-02	*Gallinula chloropus* Common Moorhen LE 1 1993-07-30	*Gastrophryne carolinensis* Eastern Narrowmouth Toad LT 1 1969-06-03
Glyceria arkansana Manna Grass LE 2 2007-05-22	*Heteranthera reniformis* Mud Plantain LE 2 2001-10-26	*Hydrolea uniflora* One-flowered Hydrolea LE 1 1977-09-14	*Hyla avivoca* Bird-voiced Treefrog LT 3 2008-07-02	*Ictinia mississippiensis* Mississippi Kite LT 2 2004-08-12
Ixobrychus exilis Least Bittern LT 1 1993-07-30	*Lanius ludovicianus* Loggerhead Shrike LE 1 1989-05-06	*Lepomis miniatus* Redspotted Sunfish LE 1 2004-06-01	*Lepomis symmetricus* Bantam Sunfish LT 6 2009-07-08	*Macrochelys temminckii* Alligator Snapping Turtle LE 1 1984-11-15
Matelea decipiens Climbing Milkweed LE 1 1991-06-04	*Melothria pendula* Squirting Cucumber LT 3 2001-10-26	*Myotis sodalis* Indiana Bat LE 8 2011-02-14	*Necturus maculosus* Mudpuppy LT 1 2010-03-14	*Neotoma floridana* Eastern Wood Rat LE 1 2011
Nerodia cyclopion Mississippi Green Watersnake LT 1 2010-10-14	*Notropis boops* Bigeye Shiner LE 6 2009-06-10	*Notropis texanus* Weed Shiner LE 1 2007	*Ochrotomys nuttalli* Golden Mouse LT 4 2008-10	*Oryzomys palustris* Rice Rat LT 5 2009-07-14
Pinus echinata Shortleaf Pine LE 1 2003-06-06	*Prostoia completa* Central Forestfly LE 2 2002-03-23	*Quercus montana* Rock Chestnut Oak LT 1 2003-06-06	*Quercus phellos* Willow Oak LT 1 2007-05-22	*Scaphirhynchus albus* Pallid Sturgeon LE 1 1972-03-20
Styrax americana Storax LT 1 2010-07-28	*Talinum parviflorum* Small Flower-of-an-hour LT 1 1973-07-11	*Tantilla gracilis* Flathead Snake LT 1 1971-05-04	*Torreyochloa pallida* Grass LE 1 2005-06-18	*Trillium viride* Green Trillium LE 1 2008-05-15
Tyto alba Barn Owl LE 7 2012-06-13	*Urtica chamaedryoides* Nettle LT 3 2001-10-26	*Villosa lienosa* Little Spectaclecase LT 2 2009-07-09		

Union Total # of Species 5

Appendix C Cypress Creek National Wildlife Refuge Resources of Concern

		Amphibians				
Species	**State T & E**	**Il Priority**	**USFWS**	**Rare Habitat**	**Rare Species**	**Global Rank**
Spotted Dusky Salamander	Endangered	x		x	x	
Illinois Chorus Frog	Threatened	x		x	x	
Northern Crawfish Frog		x		x	x	
Hellbender	Endangered	x	x	x	x	G3

Mammals						
Species	Federal T & E	State T & E	Global Rank	Illinois Priority	USFWS	Comments
Gray Bat	Endangered	Endangered	G3	x	x	
Indiana Bat	Endangered	Endangered	G2	x	x	
Southeastern Myotis		Endangered	G3	x		
Northern Myotis		Endangered		x		
Rafinesque's Big-Eared Bat		Endangered		x		
River Otter				x		Declining
Golden Mouse		Threatened		x		
Rice Rat		Threatened		x		
Eastern Woodrat		Endangered		x		
Swamp Rabbit						

Mussels

Species	USFWS	Illinois Priority	State T & E	Federal T & E	Global Rank
Pink Mucket Pearlymussel	x	X	Endangered	Endangered	G2
Fat pocketbook pearymussel	x	X	Endangered	Endangered	G1

Plants				
Species	Federal T & E	State T & E	Il Priority	USFWS
Price's Potato Bean	Threatened		x	x
Cypress Knee Sedge		Endangered	x	
Swollen Sedge		Threatened	x	
Giant Sedge		Endangered		
Giant Cane			x	
Butternut			x	
Nuttall's oak		Endangered		
Willow Oak		Threatened	x	
Riverbank Lichen			x	
Heart-Leaved Plantain		Endangered	x	
Ovate Catchfly		Endangered	x	
Powdery Thalia			x	
Water Elm		Threatened	x	
Snowbell Bush		Threatened		
Strawberry Bush		Endangered	x	
Water Hickory		Threatened	x	

Reptiles							
Species	Federal T & E	State T & E	Il Priority	USFWS	Rare habitat	Rare Species	Global Rank
Green Water Snake		Threatened	x		x	x	
Timber Rattlesnake		Threatened	x	x	x	x	
Alligator Snapping Turtle		Endangered			x	x	G3
Copperbelly Watersnake					x	x	
Eastern Ribbon Snake					x	x	
Broad-Banded Watersnake					x	x	

Birds of Prey									
Species	Life Cycle	Federal T & E	State T & E	BCR 24	JV Landbird	USFWS	Significant % Pop	Rare habitat	Rare Species
Bald Eagle	Breeding/Wintering	T	Threatened	x		x	x		
Barn Owl	Breeding/Wintering		Endangered	x		x		x	x
Long-Eared Owl	Wintering			x		x			
Mississippi Kite	Breeding/Wintering		Endangered	x				x	x
Northern Harrier	Breeding/Wintering		Endangered	x		x		x	x
Red-Shouldered hawk	Breeding/Wintering		RR	x		x			
Short-Eared Owl	Wintering		Endangered	x	x	x		x	x

Marsh Birds

Species	Life Cycle	Federal T & E	IL T & E	BCR 24	JV Waterbird	USFWS	Rare habitat	Rare Species
American Bittern	Breeding/Migration		Endangered		x (Moderate)	x		
Black Rail	Breeding/Migration		Endangered	x (High)	x (Moderate)	x	x	x
Black Tern	Breeding/Migration		Endangered	x (moderate)	x (Moderate)	x	x	x
Black-crowned Night Heron	Breeding/Migration		Endangered	x (moderate)	x (Moderate)	x		
Common Moorhen	Breeding/Migration		Threatened			x	x	x
King Rail	Breeding/Migration		Endangered	x (High)	x (Highly Imperiled)	x	x	x
Least Bittern	Breeding/Migration		Threatened	x (High)	x (Moderate)	x	x	x
Yellow Rail	Breeding/Migration				x (High)		x	x
Purple Gallinule								

					Shorebirds				
Species	**Life Cycle**	**IL T & E**	**USFWS**	**BCR 24**	**JV Plan**	**JV Landbird**	**Significant % Pop**	**Rare Habitat**	**Rare Species**
American Golden Plover	Migration				3		x	x	x
American Woodcock	Migration/Brreeding		x	x	4	x		x	x
Buff-Breaasted Sandpiper	Migration		x		4		x	x	x
Common Snipe	Migration				3			x	x
Dunlin	Migration				3				
Greater Yellowlegs	Migration		x		4			x	x
Killdeer	Migration/Breeding				3				
Least Sandpiper	Migration				3				
Semipalmated Sandpiper	Migration				3				
Short-billed Dowitcher	Migration		x		4			x	x
Solitary Sandpiper	Migration				3				
Spotted Sandpiper	Migration/Breeding								
Stilt Sandpiper	Migration		x		3			x	x
Upland Sandpiper	Migration/Breeding	E	x		4	x	x		

Wading and Water Birds								
Species	Life Cycle	Federal T & E	IL T & E	BCR 24	JV Waterbird	USFWS	Rare habitat	Rare Species
Common Tern	Breeding/Migration		Endangered	x (High)	x (Moderate)		x	x
Forster's Tern	Breeding/Migration		Endangered	x (moderate)	x (Moderate)	x	x	x
Least Tern (Interior)	Breeding/Migration	E	Endangered	x (High)	x (Highly Imperiled)	x		
Little Blue Heron	Breeding/Migration		Endangered	x (High)	x (Moderate)		x	x
Snowy Egret	Breeding/Migration		Endangered	x (High)	x (Moderate)		x	x
Yellow-crowned Night Heron	Breeding/Migration		Endangered	x (moderate)	x (High)		x	x

				Waterfowl				
Species	**Life Cycle**	**IL T & E**	**USFWS**	**BCR 24**	**NAWMP**	**Significant % pop**	**Rare habitat**	**Rare Species**
American Green-winged Teal	Migration				x (low)			
American Widgeon	Migration				x (low)			
Black Duck	Migration		x	x	x (high)	x	x	x
Blue-winged Teal	Migration		x					
Bufflehead	Migration				x (low)			
Canvasback	Migration		x		x (low)	x	x	x
Common Goldeneye	Migration				x (low)			
Gadwall	Migration				x (high)			
Greater Scaup	Migration				x (low)			
Hooded Merganser	Migration/Breed				high, non-breeding; low			x
Lesser Scaup	Migration	E	x	x	x (low)	x	x	x
Mallard	Migration		x		x (high)			
Northern Pintail	Migration		x		x (low)			
Northern Shoveler	Migration				x (low)			
Ring-necked Duck	Migration				x (high)			
Ruddy Duck	Migration				x (low)			
Wood Duck	Migration/Breed		x		high, breeding; low, non-breeding			

Appendix D Cypress Creek National Wildlife Refuge Environmental Assessment to the Habitat Management Plan

U.S. Fish & Wildlife Service

Environmental Assessment of the Habitat Management Plan For

Cypress Creek National Wildlife Refuge Ullin, Illinois

Abstract: This Environmental Assessment addresses the implementation of the Habitat Management Plan for Cypress Creek National Wildlife Refuge (Refuge). Once approved for implementation, the Habitat Management Plan will guide management of Refuge habitat for the next 15 years. The Refuge is located in southern Illinois in Alexander, Johnson, Pulaski and Union counties. Goals and objectives in the Habitat Management Plan follow guidance set forth in the Refuge Comprehensive Management Plan (USFWS, 1991), however, some changes are being proposed in the way agricultural lands are being managed on the Refuge. This environmental assessment evaluates 4 possible alternatives for habitat management of existing agricultural lands as well as any agricultural lands that may be acquired in the future:
Alternative A: Maintain farming on approximately ten percent of Refuge land (currently 1600 acres) (No Action). Alternative B: Eliminate farming on Refuge land, with active restoration.
Alternative C: Alternative C: Eliminate farming on Refuge land, with passive restoration.
Alternative D: Eliminate farming on all but 200 acres (currently approximately 1% of Refuge land) on the Bellrose Waterfowl Reserve (Preferred alternative).

Alternative (D) is the preferred alternative based on the Refuge's need to ensure that it is managing consistent with Service Policy which precludes the maintenance of non-native plant communities unless it is essential to meeting Refuge Purposes (U. S. Fish and Wildlife Service 2001). Farming is a management tool that helps the Refuge reach long-term habitat goals of restoring land to native forests and providing food for migrating and wintering migratory waterfowl. Service policy calls for maintaining or restoring refuge habitats to historic conditions if doing so does not conflict with refuge purposes

At Refuge establishment, agricultural lands within the Refuge acquisition boundary totaled 22,026 acres. To date, the Refuge includes approximately 16,000 acres, of which, 7934 acres (approximately 50%) were originally in agriculture (corn, beans, milo). Many of these tracts (approximately 6,364 acres) included highly erodible lands or floodplain fields which were taken out of production and restored to forest, wetland, or moist soil wetlands. Currently, approximately 1000 acres of the Refuge is in row crop for the above mentioned reasons. This is consistent with the Refuge EA (1990), which states "approximately 10% of the most suitable and productive upland areas within Refuge ownership, could remain in agriculture to support Refuge habitat management goals". Until restoration can take place, agriculture through the cooperative farming has been used as an important tool to enhance and maintain wildlife habitat.

For further information about the environmental assessment, please contact:

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Responsible Agency and Official:
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U.S. Fish & Wildlife Service
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Ft. Snelling, MN 55111 iii

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CHAPTER 1. PURPOSE AND NEED FOR ACTION

1.1 Introduction

This environmental assessment reviews and evaluates the alternatives and environmental effects of implementing a Habitat Management Plan on Cypress Creek National Wildlife Refuge (Refuge). The Habitat Management Plan proposes changes to how farming practices are currently used on the Refuge as a habitat management tool to support establishing purposes of Cypress Creek National Wildlife Refuge as well as the Refuge System's mission.

Refuge System lands are managed consistent with a number of federal statutes, regulations, policies, and other guidance. The National Wildlife Refuge System Administration Act of 1966, as amended, (NWRS Administration Act, 16 U.S.C. 668dd-668ee) is the core statute guiding management of the National Wildlife Refuge System. The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) made important amendments to the NWRS Administration Act, and created comprehensive legislation spelling out how the Refuge System would be managed and how it could be used by the public. All of the alternatives evaluated in this EA are consistent with the Improvement Act:

- Wildlife conservation comes first on national wildlife refuges.
- The Service will adhere to biological integrity, diversity and environmental health of the Refuge System.
- Compatibility determinations will guide uses of Refuge System lands.
- Six wildlife-dependent recreational uses are priority public uses of the Refuge System: hunting, fishing, wildlife observation and photography, environmental education and interpretation.
- A comprehensive conservation plan will be prepared for every refuge and wetland management district.

Comprehensive conservation planning and the associated step down plans such as the Cypress Creek National Wildlife Refuge Habitat Management Plan has required field stations to assess their current farming program and establish objectives for the future.

This assessment will be used by the U.S. Fish and Wildlife Service (Service) to encourage public involvement in the Refuge planning process and to determine whether the implementation of a Habitat Management Plan would have significant environmental consequences. This environmental assessment is part of the Service's decision-making process in accordance with the National Environmental Policy Act.

1.2 Proposed Action

The Service proposes to implement a Habitat Management Plan that would change the way the existing agricultural lands on the Refuge are managed.

1.3 Purpose

The purpose of this Environmental Assessment is to review and evaluate current and alternative actions that use farming as a habitat management tool to support establishing purposes of Cypress Creek National Wildlife Refuge as well as the Refuge System's mission, and to then select an alternative. Each alternative is evaluated based on the environmental consequences, including physical, biological and socioeconomic impacts, in accordance with the National Environmental Policy Act. Alternatives are also evaluated based on how effectively they support the purposes for which Refuge System lands were established and the mission of the Refuge
.

1.4 Need

At Refuge establishment, farmed, or agricultural (land on which row crops such as corn, beans, wheat, or milo are grown) land within the Refuge acquisition boundary totaled 22,026 acres. To date, the Refuge includes approximately 16,000 acres. Of the 16,000 acres currently in ownership, 7934 acres (approximately 50%) were originally agricultural. Approximately 80% of the purchased agricultural land included highly erodible lands or floodplain fields which were taken out of agricultural production and restored to forest, wetland, or moist soil wetlands. Currently, 919 acres of the Refuge is farmed (this acreage will change as agricultural land is acquired).

The impetus for this change is that the Refuge needs to ensure that it is managing consistent with Service Policy which precludes the maintenance of non-native plant communities unless it is essential to meeting Refuge Purposes (U. S. Fish and Wildlife Service 2001). Farming is a management tool that helps the Refuge reach long-term habitat goals of restoring land to native forests and providing food for migrating and wintering migratory waterfowl. Service policy calls for maintaining or restoring refuge habitats to historic conditions if doing so does not conflict with refuge purposes

1.5 Decisions That Need To Be Made

This Environmental Assessment is prepared to evaluate the environmental consequences of restoring these agricultural tracts to forest, wetland, or moist soil wetlands. Three alternatives are presented in this document:

Alternative A; Maintain farming on approximately ten percent of Refuge land. (No Action).

Alternative B: Eliminate farming on Refuge land, with active restoration.

Alternative C: Eliminate farming on Refuge land with passive restoration.

Alternative D: Maintain farming on approximately 200 acres of land on the Bellrose Waterfowl Reserve, with active restoration of the remainder of existing Refuge farm land. (Preferred Alternative)

The U.S. Fish and Wildlife Service's (Service) Regional Director, is the official responsible for determining the action to be taken in the proposal by choosing an alternative. This individual will also determine whether this Environmental Assessment (EA) is adequate to support a Finding of No Significant Impact (FONSI) decision, or whether the preparation of an Environmental Impact Statement (EIS) is needed.

1.6 Background

Farming assists in achieving the habitat management goals and objectives of the Refuge in three ways. First, in managed moist soil habitat, the use of agriculture provides an effective means of controlling undesirable woody or perennial noxious weeds that invade these areas; this type of renovation within the moist soil units is usually implemented on a 3-4 year rotation. Second, while farming provides a means to renovate moist soil impoundments, at the same time agricultural crops provide high energy foods for waterfowl as well as upland species such as deer, turkey, and quail. And third, areas slated for reforestation are maintained by annually planting crops in order to prevent the invasion of exotic or undesirable species (fescue, multiflora rose, sericia lespedeza, autumn olive, Japanese honey suckle, etc.) until restoration with native hardwoods is possible.

The majority of the existing agricultural land on the Refuge exists to control invasive noxious weeds and prepare land for future habitat restoration. An additional 213 acres, at the Bellrose Waterfowl Reserve, is used to enhance moist soil production and provides food resources for migratory and wintering waterfowl. This is consistent with the Refuge EA (1990), which states "approximately 10% of the most suitable and productive upland areas (within Refuge ownership) could remain in agriculture to support Refuge habitat management goals".

Approximately 50% of the land acquired by CCNWR includes a history of agricultural production; many of these acres include highly erodible lands. Since Refuge establishment, many of these Highly Erodible Lands that were farmed have been removed from production and restored to forest or wetlands. Currently, the CCNWR Cooperative farm program includes approximately 900 acres and 8 cooperative farmers.

CHAPTER 2: PROPOSED ACTION AND ALTERNATIVES

2.1 Alternatives not Considered for Analysis

No alternative was eliminated from analysis

2.2 Alternatives Carried Forward for Analysis

2.2.1 Alternative A (No Action) Maintain farming on approximately ten percent of Refuge land. Under Alternative A, Farming would continue to be used for multiple objectives, including

but not limited to the following: habitat management, supplemental food for wildlife, attracting wildlife for viewing and photography. Currently, the farming program on the Refuge involves a third party, or "cooperator," who farms under the terms and conditions of a cooperative farming agreement. The terms and conditions typically include a provision for leaving some percentage of the crops in the field as food for wildlife, primarily migrating birds. The farming activities have been found to be compatible through a compatibility determination. Refuge staff work with farming cooperators to use best management farming practices to improve soils, reduce pest issues, lessen impacts to wildlife, and to prevent sediment, chemical and nutrient runoff. These practices include crop rotation, cover crops, no-till planting, and use of herbicides with low environmental impact. Crop type is determined by the Refuge manager and is based on wildlife needs, soil types, integrated pest management, and economic viability. The most commonly planted crops are corn, soybeans, and winter wheat. Farming would continue to be allowed using either conventional farming techniques or no-till (conservation) farming. Mechanical equipment such as tractors, plows, disks, harrows, and seeders would typically be used on a parcel several days each year. Farming activities could include: soil preparation, planting, nutrient management, pest management, and harvesting. Conditions outlined in the Service's Special Use Permit would be followed.

2.2.2 Alternative B: Eliminate farming on Refuge land with active restoration. All land that is currently being farmed would be actively restored to either forest or wetland. Approximately 100 acres will be restored each year, following the timeline presented below. Until restoration can take place, agriculture through the cooperative farming program will be used as an important tool to enhance and maintain wildlife habitat

Table 1. Tentative timeline for restoration of agricultural fields on Cypress Creek National Wildlife Refuge

Year	Tract Number	Acres	Total Acres per year
2012	113, 13,	84, 7	91
2013	91A, 93, 29	52, 23, 40	115
2014	36, 49, 55	38, 57, 52	147
2015	274	157	157
2016	13A, 10b, 170a	40, 67, 61	168
2017	135, 809, 255	36, 11, 98	145
2018	255, 274	169	149
2019	274	143	155
2020	3182	70	70

Restoration of cropland to bottomland forest will increase forest connectivity and acreage of interior forest. Eliminating all farmland will further protect and maintain larger corridors of contiguous bottomland forest with linkages between upland and bottomland habitat.

2.2.3 Alternative C Eliminate all farming on Refuge land with passive restoration. All farming practices would be discontinued immediately and natural succession would be allowed to take place.

2.2.4 Alternative D: (Preferred Action) Under this alternative, all land with the exception of 200 acres within the Bellrose Waterfowl Reserve would be restored to either forest or wetland. As in Alternative B, restoration of cropland to forest will increase forest connectivity and acreage of interior forest. Restoring forest and wetlands will further protect and maintain large corridors of contiguous bottomland forest with linkages between upland and bottomland habitat.

Farming would continue on approximately 200 acres of land within the Bellrose Waterfowl Reserve under Alternative C. Farming would continue to be used for habitat management and to provide supplemental food for wildlife. Refuge staff would work with farming cooperators to use best management farming practices to improve soils, reduce pest issues, lessen impacts to wildlife, and to prevent sediment, chemical and nutrient runoff. These practices include crop rotation, cover crops, no-till planting, and use of herbicides with low environmental impact. Crop type would be determined cooperatively by the Refuge staff and is based on wildlife needs. The most commonly planted crops would be corn, milo, and winter wheat. Farming would continue

to be allowed using either conventional farming techniques or no-till (conservation) farming. Mechanical equipment such as tractors, plows, disks, harrows, and seeders would typically be used on a parcel several days each year. Farming activities could include: soil preparation, planting, nutrient management, pest management, and harvesting. Conditions outlined in the Service's cooperative agreement would be followed.

CHAPTER 3. AFFECTED ENVIRONMENT

The affected environment, including vegetation, fish, and wildlife resources, and cultural resources is described in detail in Chapters 2 and 3 of the Habitat Management Plan.

3.1 Physical Characteristics

Cypress Creek National Wildlife Refuge was established on June 26, 1990 under the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901 b, 100Stat.3583, PL 99-645). The Refuge is located in southern Illinois approximately 7 miles north of the confluence of the Ohio and Mississippi Rivers. It is situated along forty miles of the Cache River and its tributaries in Alexander, Johnson, Pulaski and Union counties. The Refuge is also part of a larger boundary delineated by the Cache River Wetlands Joint Venture Project; this includes 60,000 acres shared by the Refuge, Illinois Department of Natural Resources (at Cache River State Natural Area and Horseshoe Lake Fish & Wildlife Area), and The Nature Conservancy.

3.2 Biological Environment & Habitat/Vegetation

Despite changes that have occurred over the years, the Refuge provides valuable habitat for migratory birds as well as numerous species of resident mammals, birds, reptiles, amphibians, and fish. Because of significant natural values and the potential for wetlands restoration, the Refuge was identified as a high priority for acquisition under the New Madrid Wetlands Project – a component of the Lower Mississippi Valley Joint Venture of the NAWMP. In 1994 the area, along with the Cache River State Natural Area was designated a "Wetland of International Importance" by the Ramsar Convention (1994) and an "Important Bird Area" by Audubon. The area also features a number of ecologically sensitive species and includes eight federally listed and 102 state listed threatened and endangered species. Broad habitat types within CCNWR include: wetlands, bottomland forests, and upland forests.

The Refuge is located in the Lower Cache River watershed, and is comprised of four overlapping physiographic regions; the Upper East Gulf Coastal Plains, Ozarks, Mississippi River Alluvial Plain, and the Interior Low Plateau, contains unique plant and animal species influenced and molded by the habitat and environmental conditions within the specific region. When these regions overlap, species from each region can be found together. These conditions create an area of unusual species abundance and diversity.

The Cache River area is composed primarily of wetlands, bottomland forest, upland forest, and agricultural lands. Five general categories of wetlands occur on CCNWR area: 1) swamp; 2) shrub swamp; 3) open water; 4) wet floodplain forest; and 5) successional fields (wet farmland). The swamp and shrub swamp areas are dominated by cypress and tupelo trees with varying amounts of buttonbush scrub thicket. Water in these areas stands at a depth of approximately two feet when full. The bottomland hardwood forest (wet floodplain forest) represents the transition

zone between permanent water areas and uplands. Soils range from areas that are saturated throughout most of the growing season to sites where soil saturation may last a week or month out of the growing season. In this area, the cypress and tupelo become increasingly less frequent while sweet gum, swamp cottonwood, oak, elm, ash, sugarberry, hickory, and maple become more common.

3.2.2 Listed, Proposed, and Candidate Species

Cypress Creek follows recovery plan guidelines for the management of the following federally threatened and endangered species.

Indiana Bat (*Myotis sodalis*) forage on flying insects typically along the shorelines of rivers and lakes, in the canopy of trees in floodplains, and in upland forests. In summer, habitat consists of wooded or semi-wooded areas, mainly along streams. Females bear their offspring in hollow trees or under loose bark of living or dead trees. Trees standing in sunny openings are attractive because of warmer air spaces and crevices under the bark. Maternity sites have been reported in riparian areas, floodplain forests, and upland habitats. Limestone caves with pools are preferred for hibernacula during winter.

The Refuge is used by two, large maternity colonies of the Indiana bat. The forested wetlands also provide high quality foraging habitat for the bats. Additionally, the area is located within 5-miles of the large Indiana bat winter hibernacula at Magazine Mine. Forested areas, in particular forested wetlands provide foraging and roosting habitat for both male and female Indiana bats during the critical fall swarming period (personal communication USFWS).

Gray Bat (*Myotis grisecens*) occurs in several Illinois and Missouri counties where it inhabits caves both during summer and winter. This species forages over rivers and reservoirs adjacent to bottomland forested tracts.

There are no caves on the Refuge at the present time, though this may change with subsequent acquisitions.

Interior Least Tern (*Sterna antillarum*) historic breeding range includes the Mississippi River system (USFWS 1990). Surveys of the Mississippi River have found the majority of breeding colonies occur south of Cairo, IL. However, breeding birds have been found in Scott and Mississippi counties. The characteristics required for suitable breeding grounds include “bare alluvial islands or sandbars”, food, and appropriate water regime. Least terns arrive at breeding grounds in late April and the breeding season is complete by early September (USFWS 1990).

Pallid Sturgeon (*Scaphirhynchus albus)* are found in the Mississippi River downstream of its confluence with the Missouri River. Pallid Sturgeon forage for fish along the bottom of large rivers. Pallid Sturgeon are most frequently caught over a sand bottom, which is the predominant bottom substrate within the species' range on the Mississippi River. Recent tag returns have shown that the species may be using a range of habitats in off-channel areas and tributaries of the Mississippi River.

Orange footed pimpleback pearlymussel (*Plethobasis cooperianus*) prefers clean, fast-flowing water in silt-free rubble, gravel or sand of medium to large rivers. It buries itself in sand or gravel in water as deep as 29 feet. Only the edge of its shell and its feeding siphons are exposed.

Sheepnose (*Plethobasus cyphyus*) mussels live in larger rivers and streams where they are usually found in shallow areas with moderate to swift currents that flow over coarse sand and gravel. However, they have also been found in areas of mud, cobble and boulders, and in large rivers they may be found in deep runs.

Rabbitsfoot (*Quadrula cylindrica*) is a riverine mussel requiring clear streams with gravel substrate and moderate, stable currents

3.2.3 Other Wildlife Species

The Refuge and associated Cache River wetlands are known for diversity and outstanding wildlife values. Waterfowl, shorebirds, wading birds, raptors, songbirds, reptiles, amphibians, furbearers and other mammals use the area (Illinois Department of Natural Resources, 2005).

Birds - Nearly 250 species of resident and migratory bird species use CCNWR throughout the year. Migrational counts number in the thousands and include ducks, geese, shorebirds, wading birds, and countless other avian species. Wide arrays of other avian species use the Refuge due to the diversity of habitats. The Bald Eagle is a fairly common migrant and winter resident along the Ohio, Mississippi and Cache Rivers, and 3 pairs of birds are currently nesting on the Refuge. State listed endangered species which often use the Refuge include Northern Harrier, Little Blue Heron, and Barn Owls.

Mammals –Cypress Creek Refuge includes 47 species of mammals. A few of the resident species include white-tailed deer, squirrel, raccoon, swamp rabbits, bobcat, and river otter.

Reptiles and amphibians – The Refuge and the surrounding wetland includes 54 species of reptiles and amphibians. Of the 20 species of frogs and toads in the state, 18 have been recorded in the watershed.

3.3 Land Use

Agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. The small remnants of vast wetlands in the basin only make up about 4% of the watershed (20,000 acres).

3.4 Cultural Resources

There are no known cultural resources on any of the agricultural tracts on the Refuge (Kullen, 1996).

3.5 Local Socio-economic Conditions

The 919 acres currently farmed on the Refuge is a minimal part of the agricultural land within the watershed. Agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. The small remnants of wetlands in the basin only make up about 4% of the watershed (20,000 acres).

The Refuge and associated Cache River Watershed in southern Illinois is a major attraction for hunters and outdoor enthusiasts. Recreational opportunities throughout the Refuge provide benefits to the local economy through the sale of food, gas, supplies or lodging. According to research on economic effects, recreation on the Refuge resulted in significant expenditures for both travel-related goods and services and activity related equipment purchases (Caudill, 2003).

Chapter 4. ENVIRONMENTAL CONSEQUENCES

Chapter 4 discusses and analyzes the environmental impacts expected to occur from the implementation of Alternatives A, B and C as described in Chapter 2. Direct, indirect, and cumulative impacts are described where applicable for each alternative. Alternative A (no action) is the continuation of maintaining 10% of Refuge lands in agricultural crops and serves as the baseline against which Alternatives B, and C are compared.

Table 2. Comparison of Impacts by Issue				
Issues	**Alternative A** Maintain farming on approximately ten percent of Refuge land. (No Action).	**Alternative B** Eliminate farming on Refuge land. Active Restoration	**Alternative C** Eliminate farming on Refuge land. Passive Restoration	**Alternative D** Maintain farming on approximately 200 acres on the Bellrose Waterfowl Reserve. (Preferred Alternative)
Physical Environment	Limited negative effects due to soil disturbance, herbicide and fertilizer use. Not consistent with USFWS Policy.	Positive effects due to reduction of sedimentation and erosion. Consistent with USFWS Policy.	Positive effects due to reduction of sedimentation and erosion. Consistent with USFWS Policy.	Positive effects due to reduction of sedimentation and erosion and supplemental food for wildlife. Consistent with USFWS Policy.
Biological Resources	Negative effects to native vegetation and wildlife. Not entirely consistent with USFWS Policy.	Positive effect to native vegetation and wildlife. Consistent with USFWS Policy.	Positive effect to native vegetation and wildlife. Consistent with USFWS Policy.	Positive effect to native vegetation and wildlife. Consistent with USFWS Policy.
Social and Economic	Positive effect on agricultural community but negative effect on recreational community	Negative effect on agricultural community, Positive effect on recreational community	Negative effect on agricultural community, Positive effect on recreational community	Negative effect on agricultural community. Positive effect on recreational community

4.1 Direct and Indirect Impacts to the Physical Environment

4.1.1Alternative A (no action): Under this alternative, farming would be maintained on approximately 10% of the Refuge. This would result in limited negative effects due to soil disturbance and continued use of herbicide and fertilizers. The existing drainage ditches, associated with these farmed areas, increase sediment loads and run-off into tributary streams such as Cypress Creek and Big Creek as well the Cache River. Adherence to the conditions outlined in the Service's cooperative farming agreement, which outline the best management practices designed to protect soil and water, and to manage pest and nutrients will keep many of these disturbances to a minimum. Erosion and sedimentation from agricultural lands cause the

majority of the water quality problems in the Cache River, especially during periods of moderate to high flows (IDNR 1997). This alternative is not as compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997, as either of the other two alternatives.

4.1.2.Alternative B: Converting Refuge cropland to forest and wetland would result in positive effects to the water and soil. Reduction of cropland and increased restoration of forests and wetlands coupled with the blocking of drainage ditches associated with these fields will help reduce erosion and sedimentation as well as fertilizer and herbicide use in the Cache River Watershed. This alternative is more compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

4.1.3. Alternative C: Converting Refuge cropland to forest and wetland would result in positive effects to the water and soil. Reduction of cropland and increased restoration of forests and wetlands will help reduce erosion and sedimentation as well as fertilizer and herbicide use in the Cache River Watershed. This alternative is more compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

4.1.4. Alternative D: (preferred alternative): Similar positive effects to Alternative B would occur with this alternative. Some level of herbicide, and fertilizer use would still occur on approximately 200 acres left for farming; however, the most highly erodible lands will be removed from the farming program. The increased restoration of forests and wetlands coupled with the blocking of drainage ditches associated with the restored fields and reductions in fertilizer, herbicide, and pesticide use in the Cache River Watershed will help reduce local sediment loads into the Cache River, and its associated tributaries. This will in turn result in these particular sites being wetter and more productive. This alternative is more compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

4.2. Direct and Indirect Impacts to the Biological Resources

4.2.1.Vegetation Impacts

Alternative A: Under this alternative, farming would be maintained on approximately 10% of the Refuge. Farming has a great impact on biodiversity and impacts ecosystems by replacing natural habitats with vegetation that is nearly monotypic. These practices result in a negative effect to the native vegetation not only within the farmed areas but in the forested areas and wetlands adjacent to these areas. The extensive ditching practices related to farming has resulted in these sites being “drier” now than historically, which is less compatible with USFWS Policy

such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

4.2.2. Alternative B:

This alternative would have positive effects on vegetation because it would a) restore more acres of native forest in order to increase forest connectivity and acreage of interior forest. (interior forest is any forest greater than 500 meters from cropland, pasture, grassland, urban, and suburban areas) b) protect and maintain large corridors of contiguous forest with linkages between upland and bottomland habitat in order to sustain and promote viable populations of forest interior birds and other wildlife species such as the copperbelly water snake. c) Provide wetland and forest complexes at desired spatial scales, and d) further forest habitat management objectives on the Refuge by managing for a healthy and diverse forest with complex vertical structure and species diversity, and conserving examples of rare and declining natural systems.

This alternative would result in greater protection of priority species and important habitats leading to increased conservation and ability to maintain healthy, functioning bottomland forest communities associated with the Cache River and its tributaries. This alternative is more compatible with USFWS Policy such as the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) which spells out how the Refuges should be managed and how they could be used by the public.

4.2.3 Alternative C Effects from the implementation of Alternative C would be the similar to the positive effects for alternative B. (see 4.2.2 above). In a fragmented landscape such as the Refuge, however, lack of a seed source or large distances to seed sources can reduce the rate of forest recovery and result in a landscape dominated by low diversity and early successional vegetation (Hodges 1997, McClanahan and Wolfe 1993).

4.2.4. Alternative D (Preferred Alternative): Effects from the implementation of Alternative D would be the similar to the positive effects for alternative B. (see 4.2.2 above)

4.3.Wildlife Impacts

4.3.1.Alternative A: While some species in the Midwest have readily adapted to the large scale conversion of native habitats to cultivated farmland, most wildlife species have been negatively impacted by farming. Farming has a great impact on biodiversity and impacts ecosystems by replacing natural habitats with vegetation that is nearly monotypic, decreasing primary production, and using pesticides and fertilizers on a scale that influences ecosystem functioning, and directly affect plants and animals (Firbank et al. 2008, Tilman et al. 2001). The Service has long recognized the importance of natural habitat to wildlife. Approximately half of the Refuge System lands in the Midwest were being farmed before they became part of the Refuge System. Currently, however, only 1.6 percent of Refuge System lands are farmed (USFWS 2011). Croplands do provide food for migrating waterfowl, especially for geese. Most of the year, however, croplands are of limited value to wildlife.

4.3.2 Alternative B: This alternative would result in greater protection of priority species and important habitats leading to increased wildlife habitat. Effective restoration and management of all forests on CCNWR will provide important habitat for migrating birds, as well as amphibians, reptiles, fish and other wildlife. The existing bottomland hardwood forests on CCNWR provide important habitat for several high priority species of migrating waterfowl and nesting forest birds, in addition to serving as potential roosting areas for the federally endangered Indiana Bat and the state endangered Rafinesque's big-eared bat. It is important to maintain a system of forested wetlands that will continue to provide habitat for species of various life stages such as hibernation, reproduction, and migration.

Forest song birds have been negatively affected by forest fragmentation, resulting in reduced populations and lower reproductive success. In addition, forest bird species richness has been positively correlated with forest patch size (Hoover et. al. 1995). In small patches, forest birds are subjected to: (1) more competition with other species (2) increased parasitism from brown-headed cowbirds (Robinson and Wilcove 1994, Hoover et. al. 1995), (3) increased likelihood of predation (Andrén and Angelstam 1988; Marzluff and Restani, 1999), (4) greater disturbance from human activities (Knight and Gutzwiller, 1995), and (5) increased isolation and inhibition of dispersal (Doak et al. 1992).

In addition reptile and amphibian species such as the state-threatened copperbelly water snake congregate in shallowly flooded bottomland forest during the breeding season (March-June) and then require a matrix of wooded or vegetated corridors in order to migrate to other wetlands as seasonal wetlands become dry. Providing wetland and forest complexes at desirable spatial scales is important for the conservation of these species (Petranka et al., 2006).

4.3.3.Alternative C: : Effects from the implementation of Alternative C may be similar to as those of Alternative B, which would result in moderate positive effects (see 4.3.2 above). In areas where a seed source was available to naturally regenerate the forest, the short term positive effects of Alternative C may be higher as all farm land would be converted to a natural state immediately as opposed to restoration taking place over a period of years. During that time period of farming an area until the funding can be allocated for active restoration (such as under Alternative B), significant opportunities will be missed to provide habitat for Neotropical migratory birds (Twedt and Portwood 1997) and other wildlife (Wesley et al. 1981).

4.3.4.Alternative D: Effects from the implementation of Alternative D would be the similar to as those of Alternative B, which would result in moderate positive effects (see 4.3.2 above). In addition to those positive effects listed above, this alternative will supplement the natural food resources available to migrating waterfowl as part of the Refuge's waterfowl management program. Cultivated grains are often used in waterfowl management because agricultural seeds tend to have greater energy than many natural seeds (Kaminski et al. 2003) and agricultural crops have higher yield per unit area than natural wetland plants. Some waterfowl biologists recommend providing unharvested grain fields and natural wetlands for migrating and wintering waterfowl because seed resources are low in harvested agricultural fields. The Bellrose Waterfowl Reserve was established to support populations of waterfowl or migratory birds. Providing food for large populations of waterfowl is often accomplished by managing natural wetlands, moist soil impoundments, and cultivated grains.

4.4.Social and Economic Impacts

4.4.1 Alternative A (no action): Under this alternative, there would be not be any negative effect on the cooperative farmers, or social perceptions by the local farming community because no farming opportunities would be lost under this alternative.

There would be less opportunities for recreational use of the Refuge such as hiking and photography under this alternative as well as an increased chance that there may be negative social perceptions on the part of various recreational and wildlife groups who may question the use of farming practices on the Refuge and how they fit into the mission of the Service.

4.4.2 Alternative B: Under this alternative more opportunities for recreational activities would be available with restoration focused on forest and wetlands. Increased recreational areas might result in more people visiting the Refuge and greater public understanding of the bottomland forest ecosystem and the mission of the National Wildlife Refuge System.

This alternative may in turn have negative social effects on the local farming community's perception of the Service because the Refuge establishment Environmental Assessment states that up to 10% of Refuge Land could remain in agriculture. This expectation by the local community may remain and therefore cause negative reactions to this alternative.

This alternative will have direct and indirect impacts on cooperative farmers because all cooperative farmers would lose farming opportunities under this alternative.

This alternative would have direct and indirect negative economic impact on the Refuge as it will cost close to $ 500,000 (approximately $ 500/acre) over the next 10 years to actively restore the existing agricultural lands on the Refuge.

4.4.4 Alternative C: This alternative would have similar impact to Alternative B (see 4.4.3 above).

This alternative would have direct and indirect positive economic impact on the Refuge as it would cost close to $ 500,000 (approximately $ 500/acre) over the next 10 years to actively restore the existing agricultural lands on the Refuge.

4.4.4 Alternative D (preferred alternative): Under this alternative**,** all but 200 acres of farm lands are converted to natural habitats over the next 15 years. Under this alternative more opportunities for recreational activities would be available with restoration focused on forest and wetlands. Increased recreational areas might result in more people visiting the Refuge and greater public understanding of the bottomland forest ecosystem and the mission of the National Wildlife Refuge System.

This alternative has more direct, negative economic impacts on cooperative farmers because most farmers would lose farming opportunities under this alternative.

4.5. Environmental Justice

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Clinton on February 11,1994. Its purpose was to focus the attention of federal agencies on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities' access to public information and participation in matters relating to human health or the environment. None of the management alternatives described in this EA would disproportionately place any adverse environmental, economic, social, or health impacts on minority or low-income populations.

4.6 Cumulative Impacts Analysis

The phrase "cumulative impacts" refers to the overall effect of the proposed action or a series of similar actions in a landscape or regional setting.

4.6.1 Cumulative Impacts to the Physical Environment

Alternative A: Agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. Within the Refuge acquisition boundary of 35,320 acres, there are approximately 17,000 acres that are currently in agricultural production. If the Service acquired the entire acreage within the Refuge acquisition boundary, there could potentially be over 3500 acres of cropland maintained on the Refuge and 13,000 acres of cropland restored to forest and wetland within the Cache River Watershed, (just under 4% of the cropland within the watershed). Limited levels of cumulative negative effects due to soil disturbance and continued use of herbicide and fertilizers would result over time from the continued use of farming practices on up to 3,500 acres of Refuge land. The existing drainage ditches, associated with these farmed areas, increase sediment loads and run-off into tributary streams such as Cypress Creek and Big Creek as well the Cache River.

Alternative B: Within the Refuge acquisition boundary of 35,320 acres, there are approximately 17,000 acres that are currently in agricultural production. If the Service acquired the entire acreage within the Refuge acquisition boundary, this entire acreage (5% of the cropland within the watershed) would be restored to forest and wetland. Eliminating farming on the Refuge is likely to have significant positive cumulative impacts on the physical landscape with this type of increase in natural landscape (including forests, wetlands, and the wildlife dependent on these habitats) because there is so much less of this type currently within the

landscape. Within the current acquisition boundary there are only 6,595 acres of forest, and 2,475 acres of wetland. Restoring approximately 17,000 acres of forest and wetland would almost double the amount of these habitats within the watershed, and therefore result in significant positive cumulative effects.

Alternative C: The cumulative effects of this alternative would be very similar to Alternative B (see alternative B above**)**.

Alternative D: The cumulative effects of this alternative would be very similar to Alternative B (see alternative B above**)**. There would be no significance to the cumulative effects of farming 200 acres within the Bellrose Waterfowl Reserve because this acreage is only a small percentage of the agricultural land within the Acquisition boundary as well as the watershed. This acreage would either remain the same or decrease, but it would not increase over time with additional land acquisitions.

4.6.2 Cumulative Impacts to the Biological Resources

Alternative A: Under this alternative, farming would be maintained on approximately 10% (as much as 3500 acres potentially) of the Refuge. Farming has a great impact on biodiversity and impacts ecosystems by replacing natural habitats with vegetation that is nearly monotypic, as well as the continual use of herbicide and fertilizers. This would result in limited cumulative negative effects over time.

While some species in the Midwest have readily adapted to the large scale conversion of native habitats to cultivated farmland, many wildlife species have been negatively impacted by farming. Farming has a great impact on biodiversity and impacts ecosystems by replacing natural habitats with vegetation that is nearly monotypic, decreasing primary production, and using pesticides and fertilizers on a scale that influences ecosystem functioning, and directly affect plants and animals (Firbank et al. 2008, Tilman et al. 2001).

Alternative B: Restoration of a potential of up to 17,000 acres of natural habitat such as forest and wetland will almost double this type of habitat within the Cache River Watershed. Restoring natural wildlife habitat, as proposed in alternatives B and C, is generally considered to have positive environmental consequences. This project restores and protects native bottomland forests, which have experienced dramatic losses, as well as their associated streams and riverine communities, thus benefitting the wildlife that depend on these habitats. Complementary past conservation efforts include creation of the Refuge and the State's Cache River Natural Area. Any time newly forested acres are added to existing forested areas, it benefits species that are sensitive to edge habitat. The restoration of lost or degraded forests and wetlands in particular will have an overall positive impact on the surrounding region and the human environment, including water quality downstream.

Alternative C: The cumulative effects of this alternative would be very similar to Alternative B (see alternative B above**)**.

Alternative D: There would be no significance to the cumulative effects of farming 200 acres within the Bellrose Waterfowl Reserve because this acreage is only a small percentage of the agricultural land within the Refuge acquisition boundary, and within the watershed. This acreage would either remain the same or decrease, but it would not increase over time with additional land acquisitions.

4.6.3 Cumulative Impacts to the Social and Economic Resources

Alternative A: Agriculture has played a significant role in the Cache River watershed. The predominant land use in the basin is agriculture with more than 70% of the watershed (345,000 acres) in production. Within the Refuge acquisition boundary of 35,320 acres, there are approximately 17,000 acres that are currently in agricultural production. If the Service acquired the entire acreage within the Refuge acquisition boundary, there could potentially be over 3500 acres of cropland maintained on the Refuge and13,000 acres of cropland restored to forest and wetland within the Cache River Watershed, (just under 4% of the cropland within the watershed). It would seem that the land currently farmed on the Refuge is such a minimal part of the agricultural land within the watershed that this alternative would have minimal cumulative impacts on the farming economy when approached from a watershed or regional scale.

The cumulative social impacts would likely be minimal because under this alternative, the Service would be remaining consistent with the Refuge EA (1990), which states "approximately 10% of the most suitable and productive upland areas within Refuge ownership, could remain in agriculture to support Refuge habitat management goals. Until restoration can take place, agriculture through the cooperative farming has been utilized as an important tool to enhance and maintain wildlife habitat.

Alternative B: Under this alternative more opportunities for recreational activities would be available with restoration focused on forest and wetlands. Increased recreational areas might result in more people visiting the Refuge and greater public understanding of the bottomland forest ecosystem and the mission of the National Wildlife Refuge System.

This alternative may have negative social effects on the local farming community's perception of the Service because the Refuge establishment EA states that 10% of Refuge Land will remain in agriculture. This perception by the local community may remain and therefore cause negative social impacts under this Alternative.

Alternative C: : This alternative would have direct and indirect positive economic impact on the Refuge as it would cost close to $ 500,000 (approximately $ 500/acre) over the next 10 years to actively restore the existing agricultural lands on the Refuge.

Alternative D: The cumulative effects of this alternative would be very similar to Alternative B (see alternative B above**)**. There would be no significance to the cumulative effects of farming 200 acres within the Bellrose Waterfowl Reserve because this acreage would remain the same over time.

CHAPTER 5 REGULATORY COMPLIANCE

The National Wildlife Refuge Improvement Act of 1997 established for the first time a singular conservation mission for the National Wildlife Refuge System: *"To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans".*

Purposes of a refuge are those specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or a refuge sub-unit.

The relationship of the System mission and the purpose(s) of each refuge are defined in Section 3 of the FWS Director Order No. 132 which states:

"We view the System mission, goals, and unit purpose(s) as symbiotic; however, we give priority to achieving a unit's purpose(s) when conflicts with the System mission or a specific goal exist." Section 14 of this order indicates "When we acquire an addition to a unit under an authority different from the authority used to establish the original unit, the addition also takes on the purpose(s) of the original unit, but the original unit does not take on the purpose(s) of the addition".

Cypress Creek National Wildlife Refuge was established in 1990 for the following purposes:

…the conservation of wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions…16 U.S.C., Sec. 3901 (b) (Emergency Wetlands Resources Act of 1986)

Cypress Creek National Wildlife Refuge's purpose and importance to migratory birds, particularly waterfowl, were further described in the Service's Environmental Assessment for the proposed establishment of CCNWR (1990) and Approval Memorandum for refuge establishment:

1) to protect, restore and manage wetlands and bottomland forest habitats in support of the North American Waterfowl Management Plan; 2) to provide resting, nesting, feeding and wintering habitat for waterfowl and other migratory birds; 3) to protect endangered and threatened species and their habitats; 4) to provide for biodiversity; 5) to protect a National Natural Landmark, 6) and to increase public opportunities for compatible recreation and environmental education.

The legislation requires that the mission of the System and purposes of the individual refuges are carried out. Refuges must first address their establishing purposes, while at the same time contributing to the broader System and ecosystem needs.

CHAPTER 6 LIST OF PREPARERS

The following individuals cooperated in the preparation of this document:

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CHAPTER 7 PUBLIC COMMENTS ON DOCUMENTS:

This Environmental Assessment was released for public comment from August 30, 2012 until September 30, 2012. The EA was available to all interested parties through the Cypress Creek NWR website and in hard copy form by contacting the Refuge Office in Ullin, Illinois. News releases were sent out to area newspapers announcing the public comment period for the EA.

The following are comments received during the comment period.

Commenter 1

Comment a: Commenter offered supplemental information that they had personally collected as well as some correction to information on the following species: Bird-voiced tree frog (*Hyla avivoca),* Crawfish frog (*Rana areolata/Lithobates areolatus*), and Timber rattlesnake (*Crotalus horridus).*

Response a: The Refuge is appreciative of the information provided pertaining to the Bird-voiced tree frog, Crawfish Frog, and the Timber Rattlesnake. This information has been added to the HMP.

Comment b: Commenter expressed concern that upland forest management was not mentioned in the Management Objectives, Strategies, and Prescriptions.

Response b: Cypress Creek National Wildlife Refuge was established in 1990 for the following purpose "the conservation of wetlands of the Nation in order to maintain the public benefits they

provide and to help fulfill international obligations contained in various migratory bird treaties and conventions…16 U.S.C., Sec. 3901 (b) (Emergency Wetlands Resources Act of 1986)".

Because the establishing purposes and mission of the Refuge are associated with wetlands and their associated species, upland forest was not chosen as a priority resource of concern in the HMP. Upland forest habitat is considered an important part of the Refuge's natural community, and all upland areas on the Refuge are slated for restoration to forest and will be managed and protected as such.

Comment c: Commenter suggesting adding the Dusky Salamander (*Desmognathus fuscus*) to the List of Priority Resources of Concern

Response c: The Refuge recognizes that the range of the dusky salamander is limited in Illinois and only one other protected population occurs beyond the boundaries of the Refuge. Protection of this species on the Refuge is considered important and actions are being taken to protect any known populations of this species both within and in close proximity outside of the Refuge acquisition boundary through acquisition and protection of land where populations are known to exist. This species is currently not listed as a priority resource of concern because a) it is an upland species, (see response above) and b) it is likely that the habitat requirements of this species can be met simply by protecting the natural community within which it exists (mesic upland forest ravines). Most resources of concern that were chosen are wetland species or species which require additional habitat management to fulfill all of their habitat needs.

Comment d: Commenter asked what constitutes a "sandblow" on CCNWR

Response d: The term "sandblow" has been used to describe the geologic features found throughout the Cache that resemble the sandblows found within extremely sandy habitats such as sand prairies. The origin of these features within the Cache is still unknown and this name was given to them by hydrogeomorphologist Steve Gough when describing them (Gough 2005).

Commenter 2:

Commenter supplied helpful websites that provided information on various habitat management techniques.

Response:

The Refuge is appreciative for the habitat management information.

Commenter 3:

Commenter expressed concern that a decrease in agricultural lands on the Refuge will result in more wildlife seeking foods on private agricultural lands, as well as a decrease in duck and deer hunters that will come to the area.

Response: The Refuge needs to ensure that it is managing consistent with Service Policy which precludes the maintenance of non-native plant communities unless it is essential to meeting Refuge Purposes (U. S. Fish and Wildlife Service 2001). Farming is a management tool that helps the Refuge reach long-term habitat goals of restoring land to native forests and providing food for

migrating and wintering migratory waterfowl. Service policy calls for maintaining or restoring refuge habitats to historic conditions if doing so does not conflict with refuge purposes.

White tailed deer are generalist herbivores whose populations benefit from forest fragmentation (Abbas et al. 2010). With the current agricultural fields on the Refuge providing abundant food resources, deer densities have most likely been benefitting from the current cooperative farm program.

The Refuge will work with neighboring landowners to the extent possible with crop damage issues that may arise. Public deer hunting is allowed on all but 1000 acres (6%) of the Refuge. Deer densities in predominantly agricultural areas that provide refuge from hunting often exhibit enhanced carrying capacities.

Chapter 8 APPROVALS

Submitted by:

_____ _____

Wildlife Refuge Manager **Date**

Concur:

_____ _____

Refuge Supervisor Area 2 **Date**

_____ _____

Regional Chief **Date**

National Wildlife Refuge System

Approved:

_____ _____

Regional Director **Date**

Region 3, U.S. Fish and Wildlife Service

LITERATURE CITED

Abbas, f., N Morellet, A.J. Hewison, J. Merlet, B. Cargnelutti, B. Lourtet, J. Angibault, T. Daufresne, S. Aulagnier, H. Verheyden. 2010. Landscape fragmentation generates spatial variation of diet composition and quality in a generalist herbivore. Oecologia: 167: 401-411

Allgire, R. 1991. Comparison of 1987 and 1989 bed profile surveys of the Lower Cache River. Illinois State Water Survey, Urbana. Apr. 3 pages.

Andrén H, and P Angelstam 1988: Elevated predation rates as an edge effect on habitat islands: Experimental evidence. Ecology: 69: 544-547.

Doak, D.F., P.C. Marino, and P.M. Kareiva. 1992. Spatial scale mediates the influence of habitat fragmentation on dispersal success: Implications for conservation. Theoretical Population Biology. 41(3) 315-336.

Caudill, James. 2003. The Economic Effects of the Cypress Creek National Wildlife Refuge. Division of Economics, USFWS, Arlington VA.

Firbank, L.G., S. Petit, S. Smart, A. Blain, and R.J. Fuller. 2008. Assessing the impacts of agricultural intensification on biodiversity: a British perspective. Philosophical Transactions of the Royal Society 363:777-787.

Gough, Steve, 2005. Historic and prehistoric hydrology of the Cache River, Illinois 48pp.

Hodges, J.D., Development and ecology of bottomland hardwood sites, Forest Ecology and Management 90 (1997) 117-125.

Hoover, J.P., M.C. Brittingham and L.J. Goodrich, 1995. Effects of forest patch size on nesting success of Wood Thrushes, *Auk* **112** (1995), pp. 146–155.

Illinois Department of Natural Resources. 1997. Cache River Area Assessment, Volume 1,Hydrology, Air Quality, and Climate, 166 pp. + Appendices.

Illinois Department of Natural Resources. 2005. Comprehensive Wildlife Conservation Plan. 353 pp.

Illinois Natural Heritage Database. "Illinois Threatened and Endangered Species by County" August 25, 2010. <http://dnr.state.il.us/espb/

Illinois Natural history Survey, 2004. Endangered and Threaten Species of Illinois: Status and Distribution, Volume 2: Animals; Illinois Endangered Species Board.

Knight, R. and K.J. Gutzwiller. 1995. Island Press. Wildlife And Recreationists: Coexistence through management and research. 327 pp.

Kullen,et al. 1996. Cultural resources overview of Cypress Creek National Wildlife Refuge in Alexander, Johnson, Pulaski, and Union Counties, Illinois.

Marzluff, J. M., and M. Restani. 1999. The effects of forest fragmentation on avian nest predation. Pages 1 – 15 in J. A.Rochelle, L. A.Lehmann and J.Wisniewski, editors. *Forest fragmentation: wildlife and management implications*. Brill Academic Publishing, Leiden, The Netherlands.

National Wildlife Refuge System Improvement Act of 1997. 1997. 105th Congress. Public Law 05-5, Page 111 STAT. 1252.

Petranka , J.W., E.M. Harp, C.T. Holbrook, and J.A. Hamel. 2006. Long-term persistence of amphibian populations in a restored wetland complex. Biological Conservation. 138(3-4)371-380.

Ramsar, The Convention on Wetlands. 2010. August 9 2010. <http://www.ramsar.org/cda/en/ramsar-documents-list-annotated-ramsar-15774/main/ramsar/1-31-218%5E15774_4000_0

Robinson, S. K., and D. S. Wilcove. 1994. Forest fragmentation in the temperate zone and its effect on migratory songbirds. *Bird Conservation International* **4**:233 – 249.

Twedt D.J., W.B. Uihlein III, and A.B. Elliott. 2004. A Spatially Explicit Decision Support Model for Restoration of Forest Bird Habitat. Conservation Biology. 20(1): 100-110.

Tilman, D., J. Fargione, B. Wolff, C. D'Antonio, A. Dobson, R. Howarth, D. Schindler, W. H.U. S. Fish and Wildlife Service. 1990. Refuge EA

Twedt and Portwood. 1997. Bottomland hardwood reforestation for Neotropical migratory birds: Are we missing the forest for the trees? Wildlife Society Bulletin 25: 647-652.

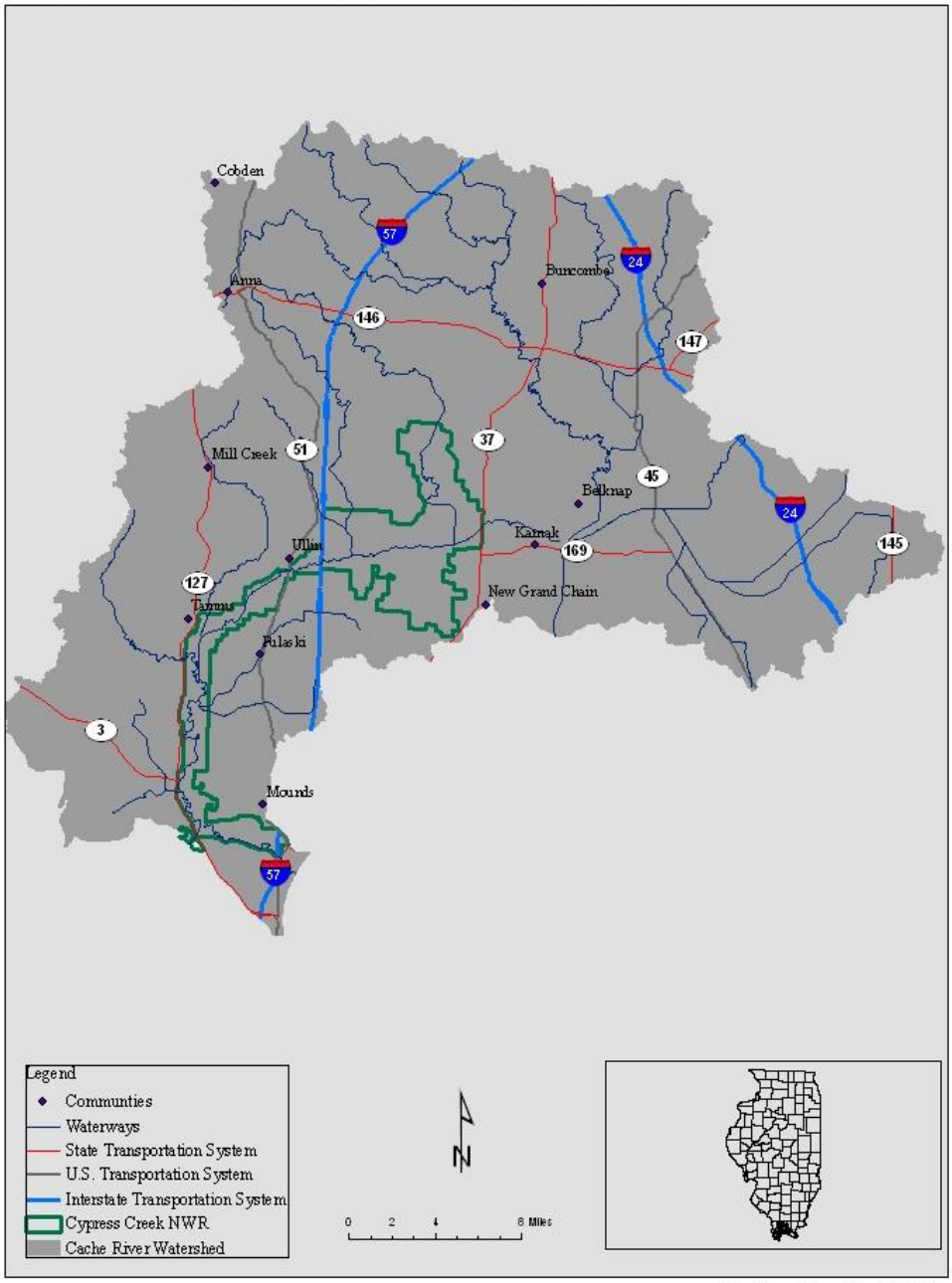
U.S. Department of the Interior. 1990. Environmental Assessment, Cypress Creek National Wildlife Refuge Master Plan. U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2001. Biological integrity, diversity, and environmental health. USFWS Policy 601 FW3. U.S. Fish and Wildlife Service, Washington, D.C.

U. S. Fish and Wildlife Service, 2011. Environmental Assessment of the Use of Row Crop Farming and Genetically-modified, Glyphosate-tolerant Corn and Soybeans on National Wildlife Refuges and Wetland Management Districts. 91 pages.

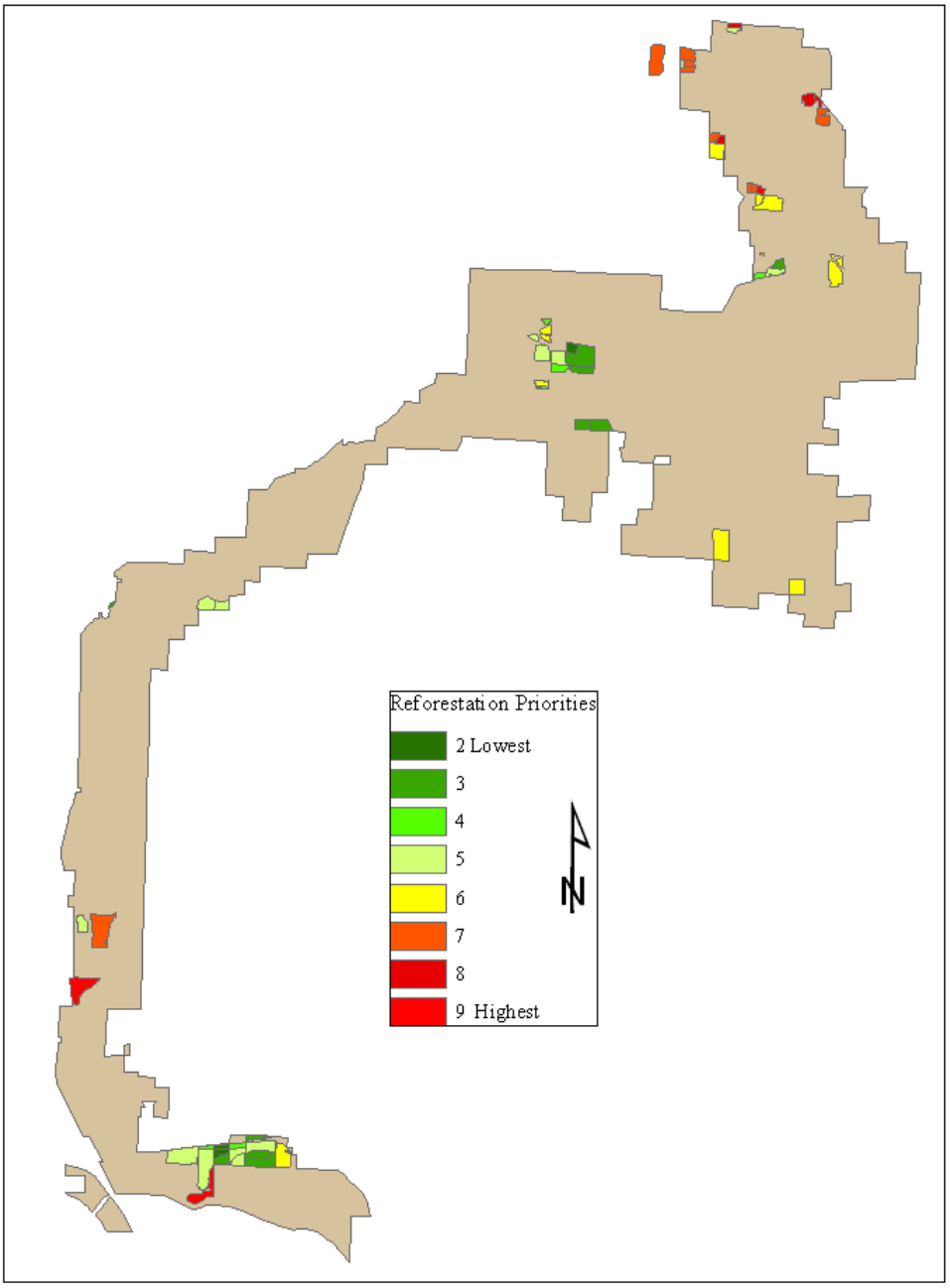
Wesley D.E., C.J. Perkins, and A.D. Sullivan 1981. Wildlife in cottonwood plantations. Southern Journal of Applied Forestry 5:37-42.

Figure 1. Cypress Creek National Wildlife Refuge: Cache River Watershed



Map Date: November 16, 2010

Figure 2. Potential Reforestation Land Suitability Model



Appendix E Literature Cited

Allgire, R. 1991. Comparison of 1987 and 1989 bed profile surveys of the Lower Cache River. Illinois State Water Survey, Urbana. Apr. 3 pages.

Allgire, R.L. and R.A. Cahill. 2001. Benchmark sedimentation survey of the Lower Cache River wetlands. Illinois State Water Survey Contract Report 2001-17.

Andrén H, and P Angelstam 1988: Elevated predation rates as an edge effect on habitat islands: Experimental evidence. Ecology: 69: 544-547.

Baldassarre, Guy A. & E. G. Bolen. 1994. Waterfowl Ecology and Management.

Battaglia 2007. Habitat Inventory of Cypress Creek National Wildlife Refuge. 2007. 17pp.

Brantley , C.G.and S.G. Platt. 2001. Canebrake Conservation in the southeastern United States. Wildlife Society Bulletin 29: 1175-1181

Brugam and Patterson 1996 Brugam, R.B. and M.J. Patterson. 1996. Application of a geographic information system to mapping Presettlement vegetation in southwestern Illinois. Transactions of the Illinois State Academy of Science 89:125-141.

Burr, B. M., K. M. Cook, D. J. Eisenhour, K. R. Piller, W. J. Ply, R. W. Sauer, C. A. Taylor, E. R. Atwood, and G. L. Seegert. 1996. Selected Illinois fishes in jeopardy: new records and status evaluations. Transactions of the Illinois State Academy of Science 89:169–186.

Cache River Watershed Resource Planning Committee, 1995. Resource Plan for the Cache River Watershed

Carter, T.C. 2006. Indiana Bats in the Midwest: The Importance of Hydric Habitats. Journal of Wildlife Management70(5) 1185-1190.

Chmurney, W.W. 1973. The ecology of the Middle Mississippi occupation of the American Bottom. Ph.D. Thesis, University of Illinois, Urbana, IL.

Cirtain, M.C., S.B. Franklin, and S.R. Pezeshki. 2004. Effects of nitrogen and moisture regimes on Arundinaria gigantea seedling growth. Natural Areas Journal 24: 251-257

Collot, V. 1826. A journey in North America. Published for Arthur Bertrand, Paris, France.

Conner and Sharitz 2005) Coulter, S.M. 1904. An ecological comparison of some typical swamp areas. Missouri Botanical Garden Annual Report 1904:39-71.

Dahl, T.E. 2000. Status and trends of wetlands in the coterminous United States 1986 to 1997. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. 82pp.

Delcourt, P.A. and H.R. Delcourt. 1981. Vegetation maps for eastern North America: 40,000 years B.P. to the present. Geobotany II:123-165.

Delcourt, P.A., H.R. Delcourt and R.T. Saucier. 1999. Later Quaternary vegetation dynamics in the Central Mississippi Valley. Pages 15-30 in R.C. Mainfort and M.D. Jeter, editors. Arkansas Archaeology. University of Arkansas Press, Fayetteville, AR.

Demissie, M., T.W. Soong, and R. Camacho 1990. Cache River Basin: Hydrology, Hydraulics, and Sediment Transport. Volume 1: Background, Data collection, and Analysis. Illinois State Water Survey Contract Report 485.

Demissie, M., H.V. Knapp. P.Parmar, and D.J. Kriesant. 2001. Hydrology of the Big Creek Watershed and Its influence on the Lower Cache River. Illinois State Water Survey Contract Report 2001-06

Doak, D.F., P.C. Marino, and P.M. Kareiva. 1992. Spatial scale mediates the influence of habitat fragmentation on dispersal success: Implications for conservation. Theoretical Population Biology. 41(3) 315-336.

Dugger, B. D., M.L.Moore, R.S. Finger, andM.J. Petrie, (2007), True Metabolizable Energy for Seeds of Common Moist-Soil Plant Species. The Journal of Wildlife Management, 71: 1964–1967. doi: 10.2193/2006-144

Eddleman, W.R., K.E. Evans, and W.H. Elder. 1980. Habitat Characteristics and Management

Fralish 1976, Fralish, J.S. 1976. Forest site-community relationships in the Shawnee Hills region, southern Illinois. Proceedings of the Central Hardwoods Forest Conference 1:65-87.

Fralish, J.S., F.B. Crooks, J.L. Chambers and F.M. Harty. 1991. Comparison of presettlement, second-growth and old-growth forest on six site types in the Illinois Shawnee Hills. American Midland Naturalist 125:294-309.

Franklin, S.B., T. Wasklewicz, J.C. Grubaugh and S. Greulich. 2003. Temporal periodicity of the Mississippi River before and after systemic channel modifications. Journal of the American Water Resources Association 39:637-648.

Fredrickson L.H., Taylor, T.S. 1982. Management of seasonally flooded impoundments for wildlife Washington D.C: U.S. Department of the Interior, Fish and Wildlife Service, Resource Publication no. 148

Fredrickson, L.H. 1979. Lowland hardwood wetlands: current status and habitat values for wildlife. Pages 296-306 in P.E. Greeson, J.R. Clark and J.E. Clark, editors. Wetland functions and values: the state of our understanding. Proceedings 1978 Symposium, Lake Buena Vista, Florida, American Water Resources Association

Fredrickson, L.H. 1996. Moist soil management, 30 years of field experimentation. Proceedings of the International Waterfowl Symposium. 7:168-177.

Gagnon, P.R. 2007. Population Biology and Disturbance Ecology of a native North American Bamboo (*Arundinaria gigantea*)

Gooding, G. and J.R.Langford 2004) Characteristics of tree roosts of Rofinesque's big eared bat and southeastern bat in northeastern Louisiana. Southwestern Naturalist. 49(1) 61-67.

Gough, Steve, 2005. Historic and prehistoric hydrology of the Cache River, Illinois 48pp.

Graves, G. R. 1996. Censusing wintering populations of Swainson's Warblers: Surveys in the blue mountains of Jamaica. The Wilson Bulletin 108(1): 94-103.

Gregg, M.L. 1975. Settlement morphology and production specialization: the Horseshoe Lake site, a case study. Ph.D. Dissertation, University of Wisconsin, Madison, WI.

N. M. Gruenhagen and L. H. Fredrickson, 1990. Food use by migratory female mallards in northwest Missouri. *The Journal of Wildlife Management* , Vol. 54, No. 4 (Oct., 1990) , pp. 622-626

Hands, H. M., M. R. Ryan, and J. W. Smith. 1991. Migrant shorebird use of marsh, moist-soil, and flooded agricultural habitats. Wildlife Soc. Bull. 19: 457-464.

Heemeyer, J.L., P.J. Williams, and M.J. Lannoo. 2012. Obligate crayfish burrow use and core habitat requirements of crawfish frogs. Journal of Wildlife Management DOI: 10.1002/jwmg.357

Heitmeyer, M.E., R.J. Cooper, J.G. Dickson and B.D. Leopold. 2005. Ecological relationships of warmblooded vertebrates in bottomland hardwood ecosystems. Pages 281-306 in L.H. Fredrickson, S.L. King and R.M. Kaminski, editors. Ecology and management of bottomland hardwood systems: the state of our understanding. University of Missouri-Columbia, Gaylord Memorial Laboratory Special Publication No. 10, Puxico, MO.

Heitmeyer, M.E., F.A. Nelson and L.H. Fredrickson. 2006. An evaluation of ecosystem restoration and management options for the Duck Creek/Mingo Basin area of southeast Missouri. University of Missouri-Columbia, Gaylord Memorial Laboratory Special Publication No. 12, Puxico, MO.

Heitmeyer, M.E. and K. Westphall. 2007. An evaluation of ecosystem restoration and management options for the Calhoun and Gilbert Lake Divisions of Two Rivers National Wildlife Refuge. University of Missouri-Columbia, Gaylord Memorial Laboratory Special Publication No. 13, Puxico, MO.

Heitmeyer, M.E. 2008. An evaluation of ecosystem restoration options for the Middle Mississippi River Regional Corridor. Greenbrier Wetland Services Report 08-02, Blue Heron Conservation Design and Printing, LLC., Bloomfield, MO.

Heitmeyer M.E., and K.E. Mangan 2012. Hrdologeomorphic Evaluation of Ecosystem Restoration Options for Cypress Creek National Wildlife Refuge, Illinois. 2012. 63pp.

Helmers, D. L. 1993. Enhancing the management of wetlands for migrant shorebirds. Trans. N. Am. Wildl. Nat. Resour. Conf. 58: 335-344.

Hendershott, A.J. 2004. A prairie in the swamp. Missouri Conservationist 65:

Herbert, N. R. (2003). Comparative Habitat Use of Two Water Snakes, *Nerodia erythrogaster neglecta* and *Nerodia sipedon sipedon*, and Implications for Conservation. MS Thesis, Purdue University.

Hoover, J.P., M.C. Brittingham and L.J. Goodrich, 1995. Effects of forest patch size on nesting success of Wood Thrushes, *Auk* 112 (1995), pp. 146–155.

Hoover, J.P., 2003. Decision rules for site fidelity in a migratory bird, the prothonotary warbler, Ecology 84 (2003), pp. 416–430

Hoover, J.P., 2006. Water depth influences nest predation for a wetland dependent bird in fragmented bottomland forests. Biological Conservation 127(1) 37-45.

Hosner and Minckler 1963 Hosner, J.F. and L.S. Minckler. 1963. Bottomland hardwood forests of southern Illinois – regeneration and succession. Ecology 44:29-41.

Http://www.herpcenter.ipfw.edu.html, accessed: 6 August, 2010

Hus, H. 1908. An ecological cross-section of the Mississippi River in the region of St. Louis. Missouri Botanical Garden 19:127-258.

Hutchins, T. 1784. A historical and topographical description of Louisiana and West Florida. Facsimile edition. Edited by J.G. Tregle, Jr. 1968. University of Florida, Gainesville, FL.

Hutchison, M. D. 1984. Lower Cache preservation plan. Natural Land Institute, Rockford, Illinois.

Hutchison, M. D. 1995. The story of the land. Natural Resources Conservation Service

Hutchinson, M.D. 2000. Hydrologic history of the Lower Cache River Natural Area in Southern Illinois. The Nature Conservancy, Ullin, IL.

Hyslop, N. L. (2001). Spatial Ecology and Habitat Use of the Copperbelly Water Snake (*Nerodiaerythrogaster neglecta*) in a Fragmented Landscape. MS Thesis, Purdue University. 109pp.

Illinois Department of Natural Resources. 1997. Cache River Area Assessment, Volume 1,Hydrology, Air Quality, and Climate, 166 pp. + Appendices.

Illinois Department of Natural Resources. 2005. Comprehensive Wildlife Conservation Plan. 353 pp.

Illinois Natural Heritage Database. "Illinois Threatened and Endangered Species by County" August 25, 2010. <http://dnr.state.il.us/espb/

Jones, R.H., Sharitz, P.R., Dixon P.M., Segal, D.S., and Schneider, R.L. 1994. Ecological Monographs 64: 345-367.

King 1981 King, J.E. 1981. Late Quaternary vegetational history of Illinois. Ecological Monographs 51:43-62.

Kingsbury, B.A. and C.J. Coppola. 2000. Hibernacula of the Copperbelly Water Snake in southern Indiana and Kentucky, journal of Herpetology 34(2): 294-298.

Klimas, C.V. 1987. Forest vegetation models for wildlife habitat assessment in the confined floodplain of the Lower Mississippi River. Ph.D. Dissertation, University of Missouri, Columbia, MO.

Klimas, C., E. Murray, T. Foti, J. Pagan, M. Williamson and H. Langston. 2009. An ecosystem restoration model for the Mississippi Alluvial Valley based on geomorphology, soils, and hydrology. Wetlands 29:430-450.

Knight, R. and K.J. Gutzwiller. 1995. Island Press. Wildlife And Recreationists: Coexistence through management and research. 327 pp.

Knox, J.C. 1984. Fluvial responses to small scale climate change. Pages 318-342 *in* J. Costa and P. Fleisher, editors. Developments and applications in geomorphology, Springer-Verla New York.

Knutson, M.G., J.P. Hoover and E.E. Klaas. 1996. The importance of floodplain forests in theconservation and management of Neotropical migratory birds in the Midwest. Pages 168-188 in F. Thompson, III, editor. Management of Midwestern landscapes for the conservation of Neotropical migratory birds. U.S. Forest Service General Technical Report NC-187.

Knox, J.C. 1999. Long-term episodic changes in magnitudes and frequencies of floods in the Upper Mississippi River Valley. Pages 255-282 *in* A.G. Brown and T.A. Quine, editors. Fluvial processes and environmental changes. Wiley and Sons, New York.

Kullen and Walitschek 1996) Kullen, D. and D. Walitschek. 1996. Cultural resource overview of Cypress Creek National Wildlife Refuge in Alexander, Johnson, Pulaski, and Union Counties, Illinois. Allied Archeology, Aurora, IL.

Laubhan, M. K. and L. H. Fredrickson. 1993. Integrated wetland management: concepts and opportunities. Trans. N. Am. Wildl. Nat. Resour. Conf. 58: 323-334.

Leitner, L.A. and M.T. Jackson. 1981. Presettlement forests of the unglaciated portion of southern Illinois. American Midland Naturalist 105:290-304.

Lewis, R.B. 1974. Mississippian exploitative strategies: a southeast Missouri example. Missouri Archaeological Society Research Series No. 11.

Lower Mississippi 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.

Marks, P.L. and P.A. Harcombe. 1981. Forest vegetation of the Big Thicket, southeast Texas. Ecology 56:1004-1008.

Marzluff and Restani 1999Marzluff, J. M., and M. Restani. 1999. The effects of forest fragmentation on avian nest predation. Pages 1 – 15 in J. A.Rochelle, L. A.Lehmann and J.Wisniewski, editors. *Forest fragmentation: wildlife and management implications*. Brill Academic Publishing, Leiden, The Netherlands.

Mattoon. W.R. 1916. The Southern Cypress. USDA Bull. 272. Washingotn D.C.

Middleton, B.A. 2000. Hydrochory, seed banks, and regeneration dynamics along the landscape boundaries of a forested wetland. Plant Ecology 146: 169-184.

Middleton, B.A. 2003. Soil seed banks and the potential restoration of forested wetlands after farming. Journal of Applied Ecology. 40(6): 1025-1034

Miller, R.B. and G.D. Fuller. 1921. Forest conditions in Alexander County, Illinois. Transactions of the Illinois Academy of Science 14:1-17.

Mohlenbrock, R. H. and J. W. Voigt. 1959. A flora of southern Illinois. Southern Ill. Univ. Press, Carbondale. 390 pages.

Mohlenbrock, R.H. 1989. Forest trees of Illinois. Illinois Department of Conservation, Springfield, IL.

National Wildlife Refuge System Improvement Act of 1997. 1997. 105th Congress. Public Law 05-5, Page 111 STAT. 1252.

Nelson, P. 2005. The terrestrial natural communities of Missouri, 2nd Edition. The Missouri Natural Areas Committee, Missouri Department of Natural Resources, Jefferson City, MO.

Nelson, F.2007. Shallow Bathymetry for Wetland Impoundments.

Noss, R.F., E.T. Laroe, III, and J.M. Scott. 1995. Endangered ecosystems of the United States: A preliminary assessment of loss and degradation. United States Department of Interior, National Biological Service, Biological Report 28, Washington D.C., USA.

Nuttall, T. 1821. A journal of travels into the Arkansas Territory during the year 1819. Edited by Savoie Lottinville. The University of Arkansas Press, Fayetteville, AR.

Papon, S.G. 2002. Distribution and abundance of resident and migrant songbirds in wetland forests of the Upper Mississippi Alluvial Valley. M.S. Thesis, University of Missouri, Columbia, MO.

Palis J.G. 2010. *Hyla avivoca* (Bird-voiced Treefrog) Distance from breeding site. Herpetological Review 41 (1): 63-64.

Petranka , J.W., E.M. Harp, C.T. Holbrook, and J.A. Hamel. 2006. Long-term persistence of amphibian populations in a restored wetland complex. Biological Conservation. 138(3-4)371-380.

Phillips, D.L. 1996. Plant species distribution of seep springs in the Cache River Region of Southern Illinois. M.S. Thesis, Southern Illinois University, Carbondale, IL.

Platt S.G., and C.G. Brantley. 1999. Canebrakes: An ecological and historical perspective. Castanea 62: 8-21.

Ramsar, The Convention on Wetlands. 2010. August 9 2010. <http://www.ramsar.org/cda/en/ramsar-documents-list-annotated-ramsar-15774/main/ramsar/1-31-218%5E15774_4000_0

Ringelman, J.K. Managing agricultural foods for waterfowl. Washington D.C.: U.S. Department of the Interior, Fish and Wildlife Service, Resource Publication no. 148.

Rodgers JA, Smith HT, 1995. Little blue heron. In:The birds of North America , no. 145 (Poole A, Gill FB, eds). Washington, DC: The Academy of Natural Sciences and The American Ornithologists' Union

Robinson, S. K., and D. S. Wilcove. 1994. Forest fragmentation in the temperate zone and its effect on migratory songbirds. *Bird Conservation International* 4:233 – 249.

Robertson, P.A., G.T. Weaver and J.A. Cavanaugh. 1978. Vegetation and tree species patterns near the northern terminus of the southern floodplain forest. Ecological Monographs 48:249-267.

Robertson, P.A., M.D. MacKenzie and L.F. Elliott. 1984. Gradient analysis and classification of the woody vegetation for four sites in southern Illinois and adjacent Missouri. Vegetatio 58:87-104.

Robinson et al. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267 (5206) 1987-1990

Saucier, R.T. 1994. Geomorphology and Quaternary geologic history of the Lower Mississippi Valley, Volumes I and II. U.S. Army Corps of Engineers, Vicksburg, MS.

Saugey, David. 1997. Bat Faunal Survey. Pine Bluff Arsenal, AR.

Schoonover, J.E., K.W.J. Williard, J.J. Zaczek, J.C. Mangun, and A.D. Carver. 2006. Agricultural Sediment Reduction by Giant Cane and Forest Riparian Buffers. Water, Air, and Soil Pollution 169: 303-315.

Schwegman, John 1991. Saving the Cache, Outdoor Highlights.

Shasteen, S.P., M.R. Matson, M.M. King, J.M. Levesque, G.L. Minton, S.J. Tripp and D.B. Muir. 1999. An intensive survey of the Cache River Basin: data summary, summer 1999. State of Illinois Environmental Protection Agency, Bureau of Water, Springfield, IL.

Skagen, S. K., P. B Sharpe, R. G. Waltermire, and M. B. Dillon. 1999. Biogeographical profiles of shorebird migration in midcontinental North America. U. S. Geological Survey Biol. Sci. Rep. USGS/BRD/RSR - 2000-2003. 167 pp.

Smith, David M. 1986. The Practice of Silviculture. John Wiley & Sons, Inc. New York, NY. 527 pp.

Sparks, R.E. 1995. Need for ecosystem management of large rivers and their floodplains. Bioscience 45:706-720.

The Nature Conservancy 1995. The Nature Conservancy. 1995. A classification and description of plant communities in southern Illinois, Volumes I and II.

The Nature Conservancy Southern Illinois Field Office, Ullin, IL and Midwest Regional Office, Minneapolis, MN.

The Nature Conservancy 2002. Cache River Macrosite: Site Conservation Plan, 24pp.

Telford, C.J. 1926. Third report on a forest survey of Illinois. Illinois Natural History Survey Bulletin 16.

Tucker, J.K. 2003. Nesting red-eared sliders (Trachemys scripta elegans) exhibit fidelity to their nesting areas. Journal of Herpetology 35:661-664.

Twedt D.J., W.B. Uihlein III, and A.B. Elliott. 2004. A Spatially Explicit Decision Support Model for Restoration of Forest Bird Habitat. Conservation Biology. 20(1): 100-110.

U.S. Corps of Engineers, St. Louis District. 1984. Initial Evaluation Report, Alexander and Pulaski Counties, Illinois.

USDA Soil Conservation Service, 1987. Cache River Basin Erosion and Sedimentation Report, Carbondale, IL.

U.S. Department of the Interior. 1990. Environmental Assessment, Cypress Creek National Wildlife Refuge Master Plan. U.S. Fish and Wildlife Service.

U.S. Environmental Protection Agency. 1993. Reregistration eligibility decision (RED). Glyphosate.

U.S. Environmental Protection Agency. 1997. "Glyphosate; pesticide tolerances. Final Rule." Federal Register: April 11, 1997 (Volume 62, Number 70). pp. 17723–17730.

U.S. Environmental Protection Agency. 2005. Reregistration eligibility decision for 2,4-D.

U.S. Environmental Protection Agency. 2009. Reregistration eligibility decision for dicamba and associated salts

U.S. Government Land Survey. 1804-1850. Field notes and plats of the original land survey for the state of Illinois. Original documents at the Illinois State Archives, Springfield, IL.

U. S. Fish and Wildlife Service. 1995. Migratory nongame birds of management concern in the United States: the 1995 list. U. S. Fish and Wildlife Service, Office of Migratory Bird Management, Washington, DC. 22 pp.

U.S. Fish and Wildlife Service. 2002. Fish and wildlife resource conservation priorities,

U.S. Fish and Wildlife Service. 2003. Biological integrity, diversity, and environmental health. USFWS Policy 601 FW3. U.S. Fish and Wildlife Service, Washington, D.C.

U.S. Fish and Wildlife Service 2009. *Range-wide Indiana Bat Protection and Enhancement Plan Guidelines*. Region 3, Version 2.0. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

U. S. Fish and Wildlife Service. 2011c. "Environmental assessment: Use of row crop farming and genetically-modified glyphosate-tolerant corn and soybeans on National Wildlife Refuges and Wetland Management Districts." Available on-line: http://www.fws.gov/midwest/planning/farmingNEPA/eafinal.pdf.

U.S. Fish and Wildlife Service 2014. 2014 Region 3 Pesticide Use Proposal Field Approval List

U.S. Shorebird Conservation Plan. 2004. High Priority Shorebirds ─ 2004. Unpublished Report, U. S. Fish and Wildlife Service, 4401 N. Fairfax Dr., MBSP 4107,Arlington, VA, 22203 U.S.A. 5 pp.

Voigt, J.W. and R.H. Mohlenbrock. 1964. Plant Communities of Southern Illinois. Southern Illinois University Press. Carbondale

(www.ramsar.org/cda/en/ramsar-ramsar-movie/main/ramsar/1%5E24724_4000_0__).

White, 1980. Big trees along the Cache River, Johnson and Pulaski counties, Illinois. Natural Land Institute, Rockford, Illinois. 2 pp.

Zaczek, J.J., R.L. Sexton, K.W.J. Williard, and J.W. Groninger. 2004. Propogation of Giant Cane (Arundinaria gigantean) for Riparian Habitat Restoration. Pages 103-106 USDA Forest Service Proceedings RMRS-P-33

Zawacki, A.A. and G. Hausfater. 1969. Early vegetation of the Lower Illinois River Valley. Illinois Valley Archaeological Program Research Papers, Volume I. Illinois State Museum Reports of Investigations No. 17, Springfield, IL.