Conservation Targets, Attributes and Indicators for the Cache River Watershed

July 2012

prothonotary warbler © Michael Jeffords

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

The Nature Conservancy
Protecting nature. Preserving life.™

NRCS Natural Resources Conservation Service

"…as we understand it, you're in the Cache because you want to restore a theatre where the drama of this ecoregion's evolution can continue, with as many of its hometown actors as possible, and with as little maintenance of the infrastructure as possible."

— Brian Richter and David Braun, memo to The Nature Conservancy, 1995

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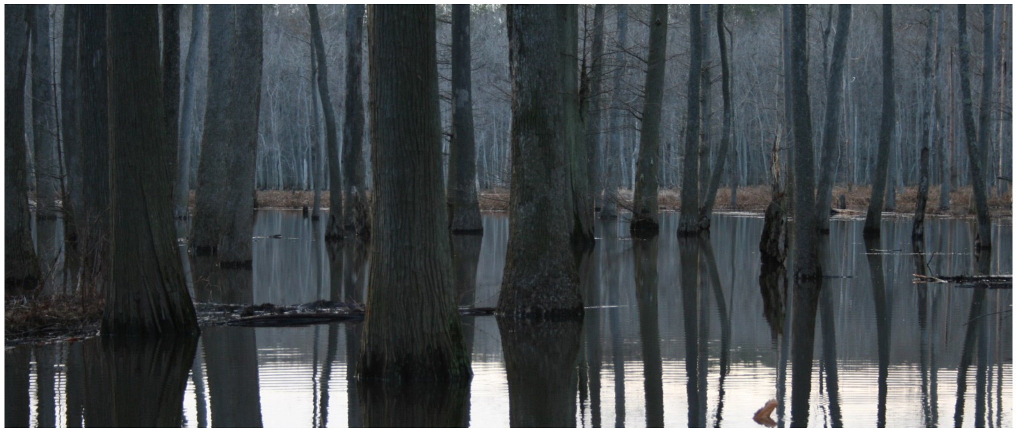
great blue skimmer dragonfly © Carrie Walczak

Significance of the Cache River Wetlands



winter, Cache River State Natural Area © Carrie Walczak

Few wild places exist in North America today that exhibit such a wide diversity of flora, fauna, and geomorphic conditions as the Cache River Basin in Southern Illinois. Moreover, few such areas have withstood the on-going onslaught of humanity's attempts to "tame" the land. Still fewer wild places are given the opportunity to return from the brink of elimination.

— Cypress Creek National Wildlife Refuge Comprehensive Management Plan

The Cache River area is an ecological gem. It is one of only six places in the United States where four or more physiographic regions overlap (Loomis, 1937). This rare convergence of landscapes led to and sustains tremendous species diversity in the Cache River area — making it possible to find plants and animal usually regarded as belonging to Louisiana and Minnesota, the southwest or east central sections of the nation, all jumbled together within shouting distance.

The diversity of the Cache River area truly is impressive. Floodplain forests along the Cache River contain a greater variety of bottomland tree species than any other stream in Illinois (Illinois Department of Natural Resouces, 1997c), including individual bald cypress trees more than 1,000 years old and 12 individual trees recorded as state champions (Illinois Department of Natural Resources, 1997).

In fact, surveys have found 86 freshwater fish species, 230 macroinvertebrates, 10 species of crayfish and shrimp, 52 species of amphibians and reptiles (Phillippi, Burr, & Brandon, 1986), 23 species of mussels (Illinois Natural History Survey, 2011), 128 breeding songbird species and 49 species of mammals (Illinois Department of Natural Resources, 1997c). Finally, the Illinois Natural Heritage database records 99 species considered critically imperiled (66 classified as endangered, 33 as threatened) in the Cache River watershed.

Because of its tremendous biological diversity and uniqueness, the Cache River area has earned several significant distinctions. The Cache River Wetlands are recognized internationally by The Ramsar Convention on Wetlands as a "Wetland of International Importance"; the Cache is one of 34 sites in the United States (The Ramsar Convention on Wetlands). Nationally, a portion of the Lower Cache Swamp (including Buttonland Swamp and Section 8 Woods) and Little Black Slough are designated a National Natural Landmark by the U.S. National Park Service in recognition of those areas' "national significance in illustrating the natural heritage of the United States" (National Natural Landmark Program).

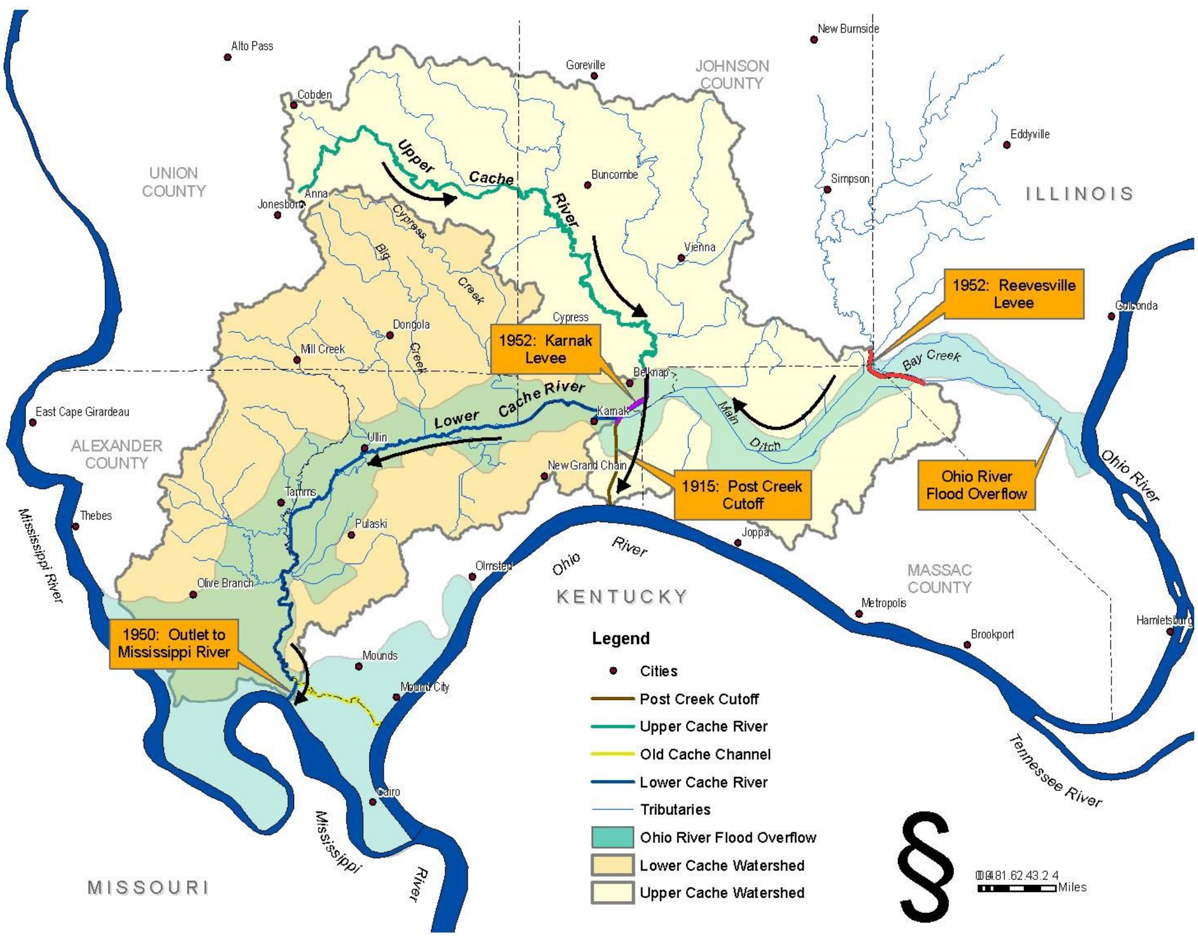
As a testament to the area's statewide significance, there are 62 areas within the Cache watershed recognized by the Illinois Nature Preserves Commission as important for their natural character, including eight dedicated Nature Preserves and 60 Illinois Natural Area Inventory sites. Although the Cache River basin makes up only 1.5 percent of the land area in Illinois, the inventory also found that it contains 23 percent of the state's remaining high-quality barrens habitat, 11.5 percent of the high-quality floodplain forest habitat and 91 percent of the high-quality forested swamp.

prairie kingsnake © Michael Jeffords

The Project Area: The Cache River and Its Watershed

The Cache River begins near Anna and flows 25 miles eastward, turning south below Vienna and leaving the Shawnee Hills near the village of Belknap. After passing Belknap, virtually all of the waters from the upper Cache flow south down the Post Creek Cutoff, constructed in 1915, and into the Ohio River. What remains of the Cache enters a broad, flat valley and flows slowly southwest through scattered remnants of bottomland forest and cypress and tupelo swamp, including Buttonland Swamp, a National Natural Landmark. West of Ullin, the river turns south and empties into the Mississippi River, through the Mounds Diversion channel, constructed in 1950. Eleven square miles of the lower Cache still drain into the Ohio River through its original channel. In all, the watershed spans 471,680 acres (watershed details per Demissie, Keefer, Lian, Yue, & Larson, 2008).

Plant life in the region before European settlement included a diverse group of natural communities, including upland, bottomland and swamp forests, open woodlands, barrens and glades. In 1800, about 80 percent of the Cache River watershed basin was densely forested (Hutchison 1987), including about 250,000 acres of wetlands (Illinois Department of Natural



© Illinois State Water Survey

Resources, 1997). The forests on dry upland sites graded into barrens and glades where the soils were thin, steep and rocky, and the tree canopy was open. Wet bottomland forest stands graded into swamps, canebrakes, lakes and ponds.

visitors on tour of Cache River Wetlands explore plant life © Michael Jeffords

The most distinctive feature of the watershed is the wide, flat Cache River valley, formed about 10,000 years ago when the Ohio River shifted south to its present location (Graham, 1985). This shift left a wide, flat alluvial valley fed by several relatively small, steep watersheds to the north. The valley often was flooded by the Ohio River, creating and maintaining the distinct wetland-riverine ecosystem of the Cache Valley. During this period, and possibly within the last 1,000 years, a tectonic event may have sunk lands in the region, creating cypress-tupelo swamps (Gough, 2005). The largest of these was Big Black Slough, which spanned 11,000 acres (Hutchison, 1987).

Conservation efforts in the Cache River watershed occur on private and public lands throughout the watershed. Nearly 42,000 acres are in conservation ownership, with the majority of the land nested along the Cache River channel. The Illinois Department of Natural Resources protects more than 27,000 acres in the watershed, including Cache River State Natural Area, Horseshoe Lake and Mermet Lake State Fish and Wildlife Areas (Illinois state parks and other conservation areas). U.S. Fish & Wildlife Service protects 15,000 acres as part of the Cypress Creek National Wildlife Refuge (Cypress Creek National Wildlife Refuge). The Nature Conservancy, a non-profit conservation organization, protects 3,200 acres, including Grassy Slough Preserve (Mike Baltz, pers. comm.). Additionally, Natural Resource Conservation Service has enrolled about 13,500 acres in the watershed in its Wetland Reserve Program. Many landowners are using a variety of best-management conservation practices, such as no-till conservation tillage, grassed waterways and reforestation; many of these practices are implemented through NRCS' Environmental Quality Incentives and Wildlife Habitat Programs. In all, more than 45,000 acres of private lands are using some sort of NRCS conservation program in the Cache River Watershed (pers. comm., Don McCallon). This brings the total amount of land in conservation ownership or easement within the watershed to more than 87,000 acres.

Soils in the Watershed

Loess, outwash, and alluvium deposited during the Quaternary Period are the main soil parent materials in southern Illinois. Soils in this part of the state developed in a humid, temperate climate under forest vegetation. Most forest soils are Alfisols. Alfisols are generally lighter colored and lower in organic matter content and base saturation than their prairie counterpart (mollisols).

marbled salamander © Tony Gerard

Some soils in southern Illinois are strongly developed because of greater effective age, or relative exposure to weathering during, as well as since the deposition of parent material. A warmer more humid climate in this part of the state also accelerated soil forming processes. Most soil associations in southern Illinois are poorly to well drained depending on slope, landscape position, and groundwater levels (Parks & Fehrenbacher, 1968).

Soils in southern Johnson, Massac, and Pulaski counties developed from a variety of parent materials. The bottomlands and floodplains developed from alluvium and lake bed sediments, while the upland soils developed from loess, and residuum from weathering bedrock. Soil fertility levels in southern Illinois range from very high to low.

An Introduction to Cache River Conservation Targets, Attributes and Indicators

This conservation planning process was initiated by The Nature Conservancy and, later, supported by Shawnee Resource Conservation and Development. But, the concept behind the work was entirely driven by innovative concepts developed by The Nature Conservancy and its partners. It was then used at the Conservancy's Emiquon Preserve, where it helped focus conservation efforts and provide measurements towards ecological integrity.

The Emiquon process resulted in a document: "Key Attributes and Indicators for Illinois River Conservation Targets at The Nature Conservancy's Emiquon Preserve." In it, the Conservancy describes the process, which is reprinted here with their permission.

Excerpt thanks to The Nature Conservancy

The Nature Conservancy and its partners developed a framework for evaluating the success of our conservation work (Parrish et al. 2003). The framework includes the following four core components: (1) identification of a limited number of focal conservation targets, (2) identification of key ecological attributes for these targets, (3) identification of an acceptable range of variation for each attribute as measured by properly selected indicators, and (4) the rating of target status based on whether the target's key attributes are within acceptable ranges of variation. The approach provides a foundation for setting conservation objectives, assessing threats to targets, identifying monitoring and research needs, and evaluating conservation progress.

female ruby-throated hummingbird © Carrie Walczak

Identifying the key ecological attributes for conservation targets — To identify what is most important to manage for the conservation of biodiversity in focal areas, we first identify a limited number of biological characteristics, ecological processes, and/or interactions with the physical environment—along with the critical causal links among them—that distinguish the target from others, shape its natural variation over time and space, and typify an exemplary reference occurrence (Maddox et al. 2001). Some of these characteristics are especially important, influencing many other characteristics of the target and its long-term persistence. We label these characteristics of a target its key ecological attributes.

The main premise of The Nature Conservancy's conservation framework is that key ecological attributes must be managed and conserved to sustain each conservation target (Parish et al. 2003). By explicitly identifying such attributes, land managers can specify what elements of a specific conservation target are important to manage and monitor in order to assess conservation

Cache River © Michael Jeffords

progress.

The key ecological attributes of a conservation target include not only its biological composition (and crucial patterns of variation in this composition over space) but also the biotic interactions and processes (including disturbance and succession dynamics), environmental regimes and constraints (again including disturbance dynamics), and attributes of landscape structure and architecture that sustain the target's composition and its natural dynamics (Noss 1990, 1996, Noss et al. 1995, Christensen et al. 1996, Schwartz 1999, Poiani et al. 2000, TNC 2000, Young and Sanzone 2002). Identifying key attributes that address more than just biotic composition is important for two reasons. First, the abundance and composition of a target may lag in its responses to environmental impairments. Data on biotic interactions, environmental regimes, and landscape structure can help ensure the early detection of threats and changes resulting from human activities. Second, conserving the focal targets is not the ultimate goal but a means for conserving all native biodiversity in an area. Consideration of these additional types of key ecological attributes will further ensure that crucial aspects of ecological integrity are managed for the conservation of all native biodiversity.

The identification of key ecological attributes also requires the identification of the specific kinds of information, or indicators, that can be measured to inform managers of changes in the status of those attributes (Parish et al. 1993). Conservation planners should select for each attribute one or more indicators that meet several well-established criteria (Noss 1990, Margoluis and Salafsky 1998, Dale and Beyeler 2001).

The final step in the process involves the identification of the desired range within which the indicator should occur. Species, natural communities, and ecological systems all evolve over time within dynamic environments, and most of their ecological attributes have some temporal variation associated with them (Landres et al. 1999). This variation is not random; rather, it is limited to a particular range that is recognized as either (a) natural and consistent with the long-term persistence of each target or (b) outside the natural range because of human influences (e.g., fire suppression in fire-maintained systems) or other major environmental change. Further, the natural variation of the physical environment and biotic interactions with that environment create a dynamic template that shapes how species evolve and what species may (or may not) be able to persist in a given area (Parish et al 2003). Managing conservation targets based on the concept of an acceptable range of variation is important both for ensuring the persistence and integrity of the area's biological diversity and for safeguarding species' evolutionary potential (Christensen et al. 1996, Holling and Meffe 1996, Poff et al. 1997). Desired ranges, therefore, incorporate the indicator's natural range of variation, and explicitly identify the target ranges necessary to ensure long-term persistence of the target.

Selection of Cache River Conservation Targets

Scientists and land managers came together for a series of meetings that spanned five years to produce the information contained in this document. They first began with the selection of the watershed's conservation targets, then chose to expand on them in 2011, using the above mentioned framework to guide the work. Taken together, if these conservation targets are sufficiently protected, restored and managed, scienst and land managers believe it will ensure the viability of the majority of the ecologically significant natural features of the Cache River watershed.

The targets identified are:

1. Bottomland Forests
2. Giant Cane
3. Cypress and Tupelo Swamp
4. Migratory Birds
5. Riverine Habitat

Their selection represents a 'course filter – fine filter' approach to selecting conservation targets. River systems (riverine habitat) and plant communities (bottomland forest, giant cane and cypress and tupelo swamp) represent the course filter and individual species or species groups (migratory birds) represent fine filter targets. Information about each target is included in the following pages, and details on their key attributes and indicators are located in tables 1-5.

Noss (1997) estimated that 85-90 percent of species can be protected by conserving samples of natural communities without separate inventory and management of each species. Species not effectively captured by a course filter, such as those with species-specific management needs, are protected or managed for individually. One of the most compelling arguments for a course-filter, or ecosystem approach, is its efficiency and cost-effectiveness; ecosystem conservation may also reconcile conflicts between separate management strategies for individual species (DellaSala, Noss, & Perry, 2000).

Lastly, the information contained in this document is expected to be dynamic, that is, it can and should be updated as new scientific information becomes available that can better define the conservation targets and their attributes and indicators.

Key Attributes and Indicators for Bottomland Forests in the Cache River Watershed (Table1)
List of Bottomland Forest Species in Greatest Need of Conservation (Appendix A)

Bottomland forests once snaked from Southern Illinois to the Gulf of Mexico and covered almost 25 million acres; it was America's largest forested wetlands (Haynes, 2004). Of that once-vibrant system, known as the Mississippi Alluvial Valley, about 24 percent remains forested, with most lands being converted to agriculture (Twedt & Loesch, 1999). Ronnie Haynes (2004), after looking more deeply at forest loss and health, proclaimed this an "ecosystem in peril" (p. 170).

The Cache River, the northern most reach of the Mississippi Alluvial Valley, also suffered great losses — a 98 percent reduction of its bottomland forests (Tiner, 1984). Also lost is the natural interaction between the river and its floodplain, which is critical to maintaining this habitat and the communities that depend on it (Junk, Baley & Sparks, 1989).

Of the early accounts of the Cache River bottomland forests, perhaps no one captures it so colorfully as W.H. Russell: "The rail suddenly plunges into an unmistakable swamp, where a forest of dead trees wave their ghastly, leafless arms over their buried trunks, like plumes over a hearse – a cheerless, miserable place" (Illinois Department of Natural Resources, 1997b, p. 25). During that 1861 train trip, Russell would have seen dense forests, with about 80 percent of the watershed being so (Hutchison, 1987).

aerial view of a bottomland forest © Michael Jeffords

Today, efforts are underway to restore this landscape. A thin ribbon of bottomland forests now can be found along portions of the Cache. In some cases, larger blocks of forests are in the process of being restored. This restoration is part of a larger trend of bottomland restoration in the Mississippi Alluvial

Valley. With the increased understanding of the importance of this ecosystem, the Lower Mississippi Valley Joint Venture, a partnership of state and federal agencies and private conservation organizations, set the ambitious goal of restoring 2 million acres by 2020 (LMVJV Forest Resource Conservation Working Group, 2007). A variety of recent research, much inspired by the Lower Mississippi Valley Joint Venture's plan, is showing creating forest blocks and practicing wildlife-based forest prescriptions do make a difference (such as Twedt & Somershoe, 2009; Twedt & Wilson, 2007; and Robbins, 1979).

What likely will be more challenging, in the Cache and the larger system, is to restore the variable highs and lows of water that once were a key driver in this system. King and Keeland (1999) agree, saying: "Broad-scale hydrologic restoration is needed to fully restore the structural and functional attributes of these systems, but because of drastic and widespread hydrologic alterations and socioeconomic constraints, this goal is generally not realistic" (p. 348).

cypress tree © Mike Baltz

Giant Cane

Key Attributes and Indicators for Giant Cane
in the Cache River Watershed (Table 2)
List of Giant Cane Species in
Greatest Need of Conservation (Appendix B)

giant cane © Tracy Fidler

Sometimes referred to as America's bamboo, giant cane once spanned much of the Southeastern United States. Today, less than 2 percent of this unique habitat remains, earning it the dubious distinction of "critically endangered" (U.S. Department of the Interior, 1995). It's unknown how widespread cane once was in the Cache River watershed, but accounts from early European visitors describe cane that was almost impenetrable, while early public land surveyors (1806-1807) found dense stands, also known as canebrakes, a mile wide (Illinois Department of Natural Resources, 1997). We do know that cane was – and remains – an important part of bottomland forests in the Mississippi River Alluvial Valley (Platt & Brantley, 2001).

Researchers believe cane helped support the diversity of life for which the area is renowned. In fact, cane's benefits to fauna are well-documented; swamp rabbit, Swainson's warbler, white-tailed deer and wild turkeys are a few examples of species that thrive on cane (Platt & Brantley, 2001).

Today, giant cane is part of the mosaic of the Cache River watershed. It can be found in canebrakes and as part of forest understory. About 141 stands of canebrakes have been documented, with most being found on level ground and within 40 meters of a stream (A. Nelson, personal communication). It is currently unknown how widespread its inclusion is within the forest understory, though it certainly exists.

With more than 70 percent of the watershed in agricultural production (Illinois Department of Natural Resources, 1997), cane is poised to play a critical role in future conservation efforts. This is owing to cane's ability to trap sediment and reduce nutrients coming from agricultural fields, while also reducing nitrates found in groundwater (Schoonover et al, 2006; Schoonover et al 2005; Schoonover & Williard, 2003).

Giant cane, perhaps more than any other conservation target, will require land managers and scientists to work in concert, as the research into cane continues to blossom.

Cypress and Tupelo Swamp

Key Attributes and Indicators for Cypress and Tupelo Swamp in the Cache River Watershed (Table 3)
List of Cypress and Tupelo Swamp Species in Greatest Need of Conservation (Appendix C)

cypress tree knees © Carrie Walczak

The Cache River is known for its ability to seemingly transport visitors to the bayou – without the alligators, of course. That's no surprise, as the Cache is America's northernmost cypress and tupelo swamp. The swamp once spanned an impressive 250,000 acres (Illinois Department of Natural Resources, 1997), flanking the Cache River and its larger tributaries, such as Big Creek and Cypress Creek. In fact, when all the swamps, sloughs and bottomland forests were still in place, water that fell in the uplands slowly meandered through the swamps, taking several days to reach the river. Now, it takes mere hours (Illinois Department of Natural Resources, 1998).

About 2 percent of this expansive network of swamp remains (Illinois Department of Natural Resources, 1997b). Still, its quality is impressive, as the Cache contains 91 percent of Illinois' high quality swamp and 42 percent of its shrub swamp, as well as giving home to thousand-year-old trees (Illinois Department of Natural Resources, 1998). The largest, high-quality remnants are found at Heron Pond-Little Black Slough Nature Preserve (more than 1,300 acres), Lower Cache River Swamp Natural Area (350 acres), Cypress Pond (more than 140 acres) and Horseshoe Lake Nature Preserve (100 acres).

Southern Illinois' swamps are part of a network of swamps that extend south through the Mississippi Alluvial Valley and along the lower east coast, also known as the Coastal Plain. Like other Southern swamps, the Cache is home to deepwater swamps that have "surface water throughout most or all of the growing season" and shallow swamps, which are "inundated for only short periods during the growing season" (Penfound, 1952, p. 516). Mitsch & Gosselink classify the Cache's swamps as alluvial river swamps, which are found on "permanently flooded depressions on floodplains, such as abandoned river channels (oxbows) or elongated swamps that usually parallel the river (sloughs)" (2000, p. 478).

Despite the expansive range, southern swamps have a lot in common. Bald cypress prefer flowing water (Brandt & Ewel, 1989) and provide refuge for reptiles, amphibians and invertebrates (Mitsch & Gosselink, 2000). Wild turkey, squirrels, grosbeaks, waterfowl and wading birds are some of the wildlife that eat the seeds of bald cypress trees (Burns, & Honkala, 1990; Brunswig, Wilson & Hamel, 1983).

As with the bottomland forests conservation target, the largest conservation challenges associated with cypress and tupelo swamps are restoring and maintaining a more natural hydrology. Other important considerations is the abundance and spatial distributions of this habitat throughout the watershed. As Ewel (1990) states: "Because wildlife often use a variety of ecosystems in a region, depending to some extent on all of them, it is difficult to evaluate the contribution of a single swamp. The density of swamps in a landscape may be as important as the presence or absence of an individual swamp" (p. 662).

tupelo trees © Tracy Fidler

Migratory Birds

Key Attributes and Indicators for Migratory Birds in the Cache River Watershed (Table 4)
List of Migratory Bird Species in Greatest Need of Conservation (Appendix D)

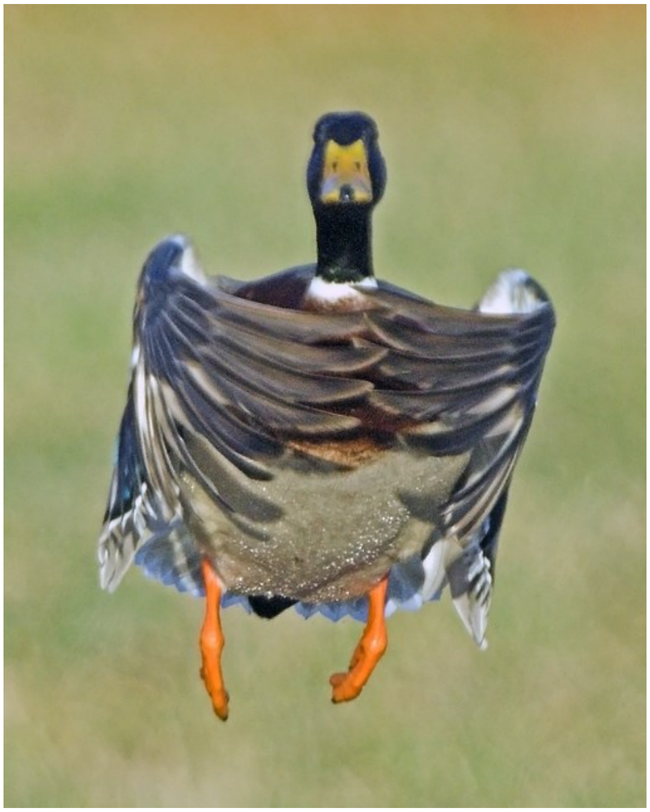
The migration of birds is an awesome feat, with many traveling upwards of 20,000 miles during their journeys. It also presents a conservation challenge – with nesting, wintering and important migration sites spread such great distances. Yet, the current statuses of many of these species – from songbirds to waterbirds – require specific and unique conservation actions.

Songbirds are on the decline (Sauer, Hines, Fallon, Pardieck & Ziolkowski, 2011), as are shorebirds (Morrison et al, 2006). In fact, the decline of shorebirds is recognized as an international phenomenon (International Wader Study Group, 2003).

But, there is good news to be found among migratory birds. Ducks, geese and swans are on the rebound, thanks to conservation efforts that span Canada, Mexico and the United States (U.S. Department of the Interior, 1998). The success of the North American Waterfowl Management Plan demonstrates cooperation and strategic conservation efforts work.

The Cache River long has been noted for its importance to these birds. In fact, John James Audubon speaks of "swans by the hundreds, and white as rich cream" during a 1808 visit

sandpiper © U.S. Fish & Wildlife Service



mallard © Dave Brewer

to the region (Henson, 1947). Today, the Cache is home to songbirds and ducks, geese and herons, egrets and shorebirds, and bitterns and rails, with many of the birds coming to the region via the Mississippi Flyway (IWSG, 2003; Wilson & Twedt, 2003). The number and diversity of birds using the watershed region is notable and includes the use of about 150 forest songbird species (U.S. Fish & Wildlife Service, 2012) and annual waterfowl numbers reaching upwards of 88,000 (per the Christmas Bird Count, conducted since 1993).

A great deal of information exists about what migratory birds require on their journeys. For example, neotropical songbirds prefer large, blocks of unbroken forest with a complex structure (Twedt & Portwood, 1997; Hoover, Brittingham, & Goodrich, 1995; and Robbins, 1979). And, shorebirds need shallow wetlands during the spring and autumn migrations, in part due to displacement from traditional resting sites (Twedt, Nelms, Rettig & Aycock, 1998).

Taken together, the complex habitat needs of migratory birds present a conservation puzzle, requiring a multitude of strategies and approaches. Because of the international nature of this conservation effort, continued monitoring of national plans and research will be critical.

Further, the refinement of the waterfowl component of this initial plan is needed. Longtime conservation partners, including Ducks Unlimited, are committed to working with land managers and scientists to identify and strengthen the key attributes and indicators for waterfowl. New research underway in the Cache River Watershed will provided additional data that can be used during this process, which is expected to be completed in 2013.

Key Attributes and Indicators for Riverine Habitat
in the Cache River Watershed (Table 5)
List of Riverine Habitat Species in
Greatest Need of Conservation (Appendix E)

assessment of sportfish in the Cache River © Illinois Natural History Survey

Legend has it a Frenchman gave the Cache River its name. While crossing a considerable logjam, the river could be heard but not seen, leading him to remark, "Ce criq,ue est Cache" or "This creek is hidden" (Illinois Department of Natural Resources, 1197b, p 34). Thanks to slow-moving water and a sinuous channel, logjams were common in the lower Cache, where water rushing from the uplands spread out over a vast floodplain, the ancient bed of the Ohio River (Gough, 2005). A 1905 Cache River Drainage Commission report called the Cache "exceedingly crooked and winding" (Illinois Department of Natural Resources, 1997b, p 2-31). The author of that report, along with others, described ways to straighten the Cache and drain its wetlands. Largely, they succeeded.

Water streaming off the upper Cache's 235,520 acres was funneled down Post Creek Cutoff to the Ohio River (Illinois Department of Natural Resources, 1997). Water from the lower Cache was diverted to the Mississippi River, with a small meander of the original Cache still draining into the Ohio. In all, the river and its tributaries were shortened by 223.9 miles (Muir, Hite, King, Matson, 1992).

Despite these changes, the Cache River remains one of Illinois' most important streams and "supports one of the most diverse assemblages of fauna found in any area of the state" (Illinois Department of Natural Resources, 1997). In fact, surveys have found 86 freshwa-

fish assessment; channel catfish above and white crappie below
© Illinois Natural History Survey

ter fish species, 230 macroinvertebrates, 10 species of crayfish and shrimp, 52 species of amphibians and reptiles (Phillippi, Burr, & Brandon, 1986), and 23 species of mussels (Illinois Natural History Survey, 2011). Some of the aquatic species in greatest need of conservation include rock pocketbook and the state-threatened little spectaclecase mussels and the state-endangered cypress minnow, bigeye shiner and redspotted sunfish, and the state-threatened bantam sunfish. As recent as the 1960s, an outstanding sport fishery existed in the Cache, featuring largemouth bass, crappie, bluegill and catfish (pers. comm. with multiple landowners).

Recent research, however, suggests fish in the Cache River might be suffering from the changes to the watershed. For example, a group of fish that depends on bottomland forests has disappeared from the Cache River, likely due to influx of sediment and decreases in water flow (Pitts, 2012). Additionally, hypoxic conditions have been documented in the lower Cache (pers. comm.., Heidi Rantala), which can be extremely harmful to fish as well as a diversity of invertebrates, including crayfish and mussels. An Illinois Natural History Survey sportfish assessment, currently underway, should shed more light on the Cache's aquatic dynamics, as should continuing research by Southern Illinois University - Carbondale. Additional research on this conservation target should be supported.

Other Communities of Special Interest

As scientists and land managers grappled with the selection of conservation targets, naturally, not everything was chosen. But two ideas for conservation targets remained so compelling, that it seemed important to include their mention. They are 1) barrens and glades and 2) successional grassland and shrubland dependent species.

In the Cache River watershed, barrens and glades are found embedded within upland forest or large patch communities. They often have an open canopy with an understory of grasses and herbs. There is evidence that prior to their disappearance in the Cache, bison and elk grazing helped maintain this natural community. Fire periodically swept through these areas, killing woody vegetation and encouraging herbaceous growth. In the absence of these natural disturbances, barrens and glades became overgrown with woody species and were absorbed into the surrounding dry, upland forest.

Extensive reforestation efforts in the Cache River watershed created several thousand acres of successional grasslands and shrublands. These transitory habitats attract a variety of grassland and shrubland specialists, most notably several species of birds that historically were uncommon or even absent in the Cache River watershed. Because several of these species are considered on the state's threatened and endangered species list, some management attention will be paid to these species while they occur in the watershed. However, it is not anticipated that special management actions will be taken to create additional or unnatural grasslands or shrublands in the watershed.

rock outcropping adjacent to barren © Illinois Department of Natural Resources

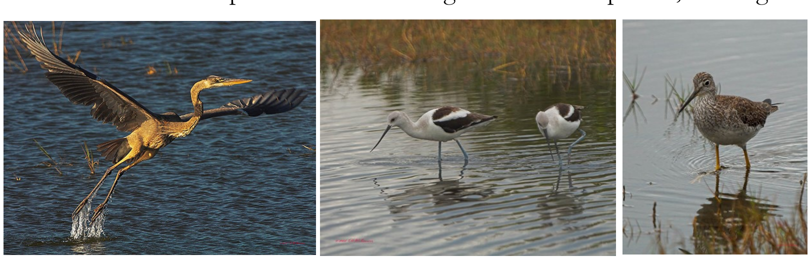
A rich tapestry of people have made the Cache what it is today — from the earliest involvement of citizens, largely through the Citizens Committee to Save Cache River, to the formation of the Cache River Wetlands Joint Venture Partnership. That tapestry of individuals, organizations and agencies remains crucial to the achievement of ecological integrity, as outlined in this document.

Because of the scale and complexity of this endeavor, much of the work will fall to the Cache River Wetlands Joint Venture Partnership, which brings together some of the most prominent conservation organizations in Illinois. Today, Ducks Unlimited, the Illinois Department of Natural Resources, The Nature Conservancy, the U.S. Department of Agriculture-Natural Resources Conservation Service and the U.S. Fish and Wildlife Service form the nucleus of the partnership.

Other prominent contributors to this effort include the U.S. Army Corps of Engineers, scientists and students from Southern Illinois University, the Illinois Natural History Survey, the Illinois State Water Survey, a collection of local farmers and conservation professionals who banded together to form the Cache River Watershed Resource Planning Committee, the Citizens Committee to Save the Cache River, the Friends of the Cache River Watershed, Sierra Club, American Land Conservancy, Shawnee Audubon and Southern Illinois Audubon Society, as well as numerous other organizations and individuals representing a diverse collection of backgrounds and interests.

The foremost characteristic common to this group of conservation minded entities is a commitment to tackle very tough issues. The fact that such a wide variety of interests have come together acknowledges there are serious ecological problems within the Cache River Watershed, and that these problems affect more than just farmers or conservationists.

This unity also reflects the value of, and threat to, the resources involved. The functional integrity of the entire drainage network has degraded and threatens to eliminate the natural character and productivity of one of this country's most significant wetland resources. Because of the complexity of environmental and socioeconomic factors involved, the cost of watershed scale restoration, and the local and global implications of such an effort, this project would not be possible without federal, state and private sector approval and cooperation. The involvement of multiple stakeholders brings with it the expertise, funding and technical support, which will be required to implement significant and sustainable changes on the landscape.



great blue heron, American avocet and greater yellow legs © Dave Brewer

The Partnership: A Restoration Vision

The restoration of the Cache River watershed is an enormous undertaking and is one of the most ambitious conservation efforts in North America. The restoration of the Cache River, by necessity, includes all the land within the watershed. So, the restoration project covers 471,680 acres (or 737 square miles) and spans Union, Johnson, Alexander, Pulaski, Massac and Pope counties in southern Illinois.

For restoration to succeed, an area of this size must unite a diversity of interests. For the Cache River Watershed to be successful, everyone involved in the effort must contribute. Farmers, area residents, hunters, fishermen, conservationists, naturalists, birdwatchers, tourists and a host of other people living within this watershed will all be affected in some way. Even members of the Joint Venture Partnership have their own specific goals, and strategies to achieve these goals. The following is a list of the mission statements of the Joint Venture Partners to illustrate the diversity of interests involved.

- **Ducks Unlimited**: To fulfill the annual life cycle needs of North American Waterfowl by protecting, enhancing, and restoring and managing important wetlands and associated uplands.
- **Illinois Department of Natural Resources**: To preserve, protect, and enhance the natural resources while providing the opportunity for quality outdoor recreation. Critical habitat is managed to preserve and protect endangered, threatened, and rare plants and animals.
- **The Nature Conservancy**: Conserving the lands and waters on which all life depends.
- **U.S. Department of Agriculture-Natural Resources Conservation Service**: Helping people help the land.
- **U.S. Fish and Wildlife Service**: The mission of the National Wildlife Refuge system is 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.

While each organization has specific goals and practices being implemented on lands they manage, the group is collaborating on three large, watershed-scale methods. These methods are costly and expand across great swaths of the region, ignoring social and political boundaries. Their very nature requires conservation interests to work closely together in their execution.

These methods are:

- **Restoring habitat—**Forest and wetland restoration restores function to a river's floodplain, increases habitat for wildlife and reduces sediment entering the river – all things the Cache needs. So far, 31,000 acres of conservation-owned lands have been restored. And local landowners, through Wetland Reserve Program easements with NRCS, have protected an additional 13,500 acres of restored wetlands.
- **Reducing Sediment—**Sediment enters the Cache many ways, which is why efforts to reduce it have taken many different forms. Efforts include working with landowners to use best management practices, including conservation tillage and constructing strategically-located flow retention ponds. From 1987 to 1995, for example, erosion on more than 175,000 acres in the Cache River Watershed was reduced by more than 1 million tons annually.
- **Restoring Low Water Flow—**The Cache, like other rivers, needs flowing water to be healthy. A gentle current brings oxygen and dissolved nutrients, while also moving pollutants out of the system. For the lower Cache to remain healthy for future generations, some amount of flow and physical connectivity must be re-established between its upper and lower segments.

It is believed that by collaborating on these three large areas, the partnership will help preserve the area's biological diversity and restore a landscape supporting viable 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.

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Conservation Targets and the Illinois Wildlife Action Plan

The Illinois Wildlife Action Plan sought to establish a common vision for the conservation of Illinois' wildlife and habitats. The plan identified a variety of components, from biologically-diverse hotspots in the state to specific conservation goals, noting that it has become "increasingly difficult for conservationists to identify priorities, efficiently direct funding and staffing to address priorities, and effectively evaluate the success of efforts" (Illinois Department of Natural Resources, 2005, p. 5). As a way to tackle the awesome conservation task before the residents of Illinois, the plan identified Conservation Opportunity Areas (COAs) – areas where "partners are willing to plan, implement and evaluate conservation actions, where financial and human resources are available, and where conservation is motivated by an agreed-upon conservation philosophy and set of objectives," (Illinois Department of Natural Resources, 2005, p. 18-19). The specific pathways to the achievement of these goals, including their impediments was the focus of a Southern Illinois University research report that examined factors for success, which encompassed stakeholders, planning, implementation, expectations, priorities and threats. Not surprisingly, community and financial support emerged as the two most important items for COAs success. Additionally, the report found successful implementation of the Illinois Wildlife Action Plan in COAs also depends largely on coordinated efforts and strong leadership (Mountjoy, Davenport, Myers & Whiles, 2009).

The importance of leadership in achieving conservation success is well recognized. In fact, it has been called the "most important attribute in the tool kit of a conservation biologist" (Dietz et al, 2003, p. 274). In specific, some of the most valued leadership characteristics for conservation actions include having a long-term vision, offering an organized way to approach and focus on conservation actions, and the ability to build coalitions (Dietz et al, 2003). Yet, the selection of the right actions can be quite difficult (Salafsky, Margoluis, Redford & Robinson, 2002), leading to a re-

short-eared owl © U.S. Fish & Wildlife Service search-implementation gap in conservation planning (Knight t al, 2008), or an "implementation crisis" (Knight, Cowling & Campbell, 2006). In fact, Knight et al (2006) cautions that "Systematic assessments … can never, alone, lead to the implementation of conservation action" (p. 416).

The Cache River-Cypress Creek COA is poised to bridge this gap through its work to identify biodiversity conservation targets (hereafter conservation targets, sensu Noss, 1996b; The Nature Conservancy 2001; Salafsky, Margoluis, Redford, Robinson, 2002). Using a model outlined in Bioscience and implemented regionally at The Nature Conservancy's Emiquon project, the Cache River-Cypress Creek COA identified conservation targets, determined attributes necessary for ecological integrity and assessed ranges for them. The Bioscience article (Parrish, Braun & Unnasch, 2003, p. 859) that outlined this framework identified six reasons for this approach to science planning, including:

- It focuses strategy development along ecological, rather than jurisdictional, boundaries.
- It provides consistency and specificity in setting conservation objectives
- It enhances the identification and anticipation of threats to biodiversity.
- It promotes the development of comprehensive conservation strategies
- It helps identify crucial research needs.
- It promotes focused and efficient monitoring programs

This framework offers a way to focus broad conservation actions outlined in the WAP. For example, the WAP calls for land in the Cache River-Cypress Creek COA in public ownership to increase from about 32,000 acres to 60,000 acres but says little about how this goal should be achieved, or where to target land for acquisition. Further, it does not take into account the importance of private land protection in the Cache River-Cypress Creek COA. As conservationists know, "nearly half of all species threatened with extinction occur on private lands, and nearly all threatened species have at least part of their distribution on private lands" (Knight, 1999, p.223). The Cache River-Cypress Creek COA conservation target process provides specificity to the WAP while offering a roadmap for collaboration. It does this by providing measurable and specific goals, such as prescribing the need for 7,000-acre forest blocks. It also outlines the specific number of upland and bottomland blocks needed to reach the minimum acceptable for ecological integrity (two in the uplands and two in the bottomlands), as well as goals for "good" and "excellent." This level of detail, then, can be used to focus and justify the acquisition of either land or conservation easements in specific areas of the watershed.

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copper-bellied watersnake © Illinois Department of Natural Resources

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Table I: Key Attributes and Indicators for Bottomland Forests in the Cache River Watershed

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Animal Species Composition & Abundance	Density of Focus Bird Species	**Number of Birds:** **Minimal Acceptable:** Acadian Flycatcher: 1.20 pairs per hectare (or 2.97 per acre) Prothonotary Warbler: 0.50 pairs per hectare (or 1.24 per acre) Kentucky Warbler: 0.19 pairs per hectare (or 0.47 per acre) Wood Thrush: 0.16 pairs per hectare (or 0.4 per acre) Summer Tanager: 0.06 pairs per hectare (or 0.15 per acre) Louisiana Waterthrush: 0.05 pairs per hectare (or 0.12 per acre) **Fair:** 25% increase over "Minimal Acceptable" **Good:** 35% increase over "Minimal Acceptable" **Excellent:** 50% increase over "Minimal Acceptable" **Nest Predation Rates:** Less than 50% for nest predation, and less than 40% for cowbird parasitism.	Hoover. Focus species includes: prothonotary warbler, Louisiana waterthrush, acadian flycatcher, wood thrush, summer tanager and Kentucky warbler. Per Hoover, 25%, 35% and 50% differences will be detectable when averaging over several sites and years in 3-year intervals.	Note: This suite of birds was selected because existing research is available to monitor this attribute/ indicator, and also because it is a good indicator overall of diversity.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Species Composition & Abundance: Diversity and Abundance of Oaks	Overwintering populations of red-headed woodpeckers	Based on 20 year average, should expect to see no decreases in population.	Literature values per Jeff Hoover. The Christmas Bird Count (CBC) has not been conducted long enough to develop a solid goal, which is why the current desired range is phrased in the negative. Over the now 19 years of the count, the average number of Red-headed woodpeckers seen in the Cache is around 150 (range=6 to 738). The values are sensitive to inclement weather on the day of the count as well as acorn mast available.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Plant Species Composition & Abundance	Desired Stand Conditions	**Desired stand conditions are defined as:** **Primary Management Factors:** Overstory canopy cover: 60-70% Midstory cover: 25-40% Basal Area: 13.7 – 16 m2/ha with ≥25% in older age classes Tree Stocking: 60-70% **Secondary Management Factors:** Dominant Trees: >5/ha Understory cover: 35-40% Regeneration: 30-40 % Coarse woody debris (>25cm diameter): ≥14 m^3/ha Small cavities (hole <25cm diameter): >10 visible holes/ha or >10 “snag” stems/ha ≥ 10cm dbh or ≥5 stems/ha > 51cm dbh Den trees/large cavities (hole >25cm diameter): One visible hole/4 ha or ≥5 stems/ha ≥ 66cm dbh (≥1.8 m^2 BA/ha ≥ 66cm dbh) Standing dead and/or stressed trees: >15 stems/ha ≥ 25cm dbh or ≥5 stems/ha ≥ 51cm dbh (>0.9 m^2 BA/ha > 25cm dbh)	See literature notes. Also, according to the guidelines, up to 30 % of bottomland forest can be “passively managed.” The desired condition includes oak regeneration. However, for oaks, this would mainly apply to fairly mature forests on site types where oaks are normally found.	Lower Mississippi JV: Forest Resource Conservation Working Group. Ranges from Table 2.The plan can be accessed here: https://docs.google.com/viewer?a=v&pid=explorer&chrome=true&srcid=0B-9LSlGS1khEZ-WVjMzNjMWQtZDYxOS00YTRmLWJkOWQtYmU0MGI3Yzg3ZjJi&hl=en_US.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Plant Species Composition & Abundance	Desired Stand Conditions	Ranges for meeting desired conditions are: **Poor:** Less than 35% of desired conditions. **Minimally Acceptable:** At least 35% of desired conditions. **Good:** 50% of desired conditions. **Excellent:** More than 50% of desired conditions.	See literature notes. Also, according to the guidelines, up to 30% of bottomland forest can be "passively managed." The desired condition includes oak regeneration. However, for oaks, this would mainly apply to fairly mature forests on site types where oaks are normally found.	Lower Mississippi JV: Forest Resource Conservation Working Group. Ranges from Table 2.The plan can be accessed here: https://docs.google.com/viewer?a=v&pid=explorer&chrome=true&srcid=0B-9LSlGS1khEZ-WVjMzNjMWQtZDYxOS00YTRmLWJkOWQtYmU0MGI3Yzg3ZjJi&hl=en_US.
Plant Species Composition & Abundance	Composition	Favor hard mast species (such as oak) with minimum of 10-20 dominant/codominant trees/acre in mature stands		Lower Mississippi JV: Forest Resource Conservation Working Group

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Connectivity	Forest habitat connectivity - width of riparian corridors	This metric is a definition that is used when working with riparian buffers. A riparian buffer is defined through this process as 200 feet in width. It was taken from USDA's Buffer Guidelines.	Detail extracted from USDA Buffer Guidelines. Used largest of minimum suggested for wildlife, excluding large mammals and large predator mammals. Retrieved from: http://www.unl.edu/nac/bufferguidelines/index.html.	Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station. 110 p.
Connectivity	Habitat connectivity - riparian corridors	Additional research will be needed to refine this item.		

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Block or Patch - Size	This metric is a definition that is used when working with forest blocks. A forest block was defined through this process as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius. A block should consist of no less than 70 percent forested lands, with the remaining 30 percent of the block composed of lands deemed “friendly” to songbirds. In general, bigger is better and wider is better than narrow.	The 7,000-acre block size is smaller than the 10,000 acre block referenced in Mississippi Alluvial Plan (see citation). It is based off Hoover’s research on the Heron Pond/Little Black Slough complex, which is roughly 7,000 acres, and has been documented as being a source (as opposed to a sink) for neotropicals. Also, published research of Hoover shows that the percent forest cover within a 3-km radius is a good predictor of cowbird parasitism.	LMVJV Forest Resource Conservation Working Group. 2007. Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Block or Patch - Number of	**Poor**: 0 forest blocks **Minimal Acceptable**: 2 forest blocks **Good**: 4 forest blocks **Excellent**: 6 forest blocks	Using some information from the Cache River Watershed (Critical Trends Assessment Project: Phase II, Inventory of the Resource Rich Areas in Illinois, Suloway et al. 1996), the watershed once contained roughly 436,000 acres of upland forest and 441,000 acres of bottomland forest. It now contains 117,759 acres (or 27% of the original extent) of upland forests and 35,327 acres (or 8% of the original) in bottomland forests.	
Species Composition & Abundance	Invasives	Forest blocks are defined as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius. **Poor:** Less than 60% of the forest block is free of key invasives or minimally invaded (invasive species restricted to forest edges or small or low-density infestations). **Minimally acceptable:** Between 80% and 60% of the forest block is free of key invasives or minimally invaded. **Good:** Between 90% and 80% of the forest block is free of key invasives or minimally invaded. **Excellent:** Greater that 90% of the forest block is free of key invasives or minimally invaded. Key invasives are those target species of concern identified by the River to River Cooperative Weed Management Area.		River to River Cooperative Weed Management Area maintains a list of species of concern for the region. That list is available at http://www.rtrcwma.org/species.html

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Natural hydrologic regime (depth and duration)	Appropriate seasonal fluctuations in forest blocks	Because it is hard to determine appropriate seasonal fluctuations, a determination will need to be made by a forester/biologist on whether a given forest block has a “more natural regime.” More natural does not mean the entire forest block has a natural regime, but that it is natural enough to support the processes one would expect to find in bottomland forests. **Poor:** 0 blocks with a more natural regime **Minimal Acceptable:** 2 blocks with a more natural regime **Good:** 4 blocks with a more natural regime **Excellent:** 6 blocks with a more natural regime		

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Species Composition and Abundance	White-eyed Vireo, Hooded Warbler and Indigo Bunting	**Unacceptable:** less than 1 breeding pair of bunting and white-eyed vireo per patch (assuming patch is between .5-1 hectare OR 1.24-2.47 acre) **Acceptable:** 1 breeding pair of bunting and white-eyed vireo per patch (assuming patch is between .5-1 hectare OR 1.24-2.47 acre) **Good:** more than 1 breeding pair of bunting and white-eyed vireo per patch (assuming patch is between .5-1 hectare OR 1.24-2.47 acre)	Hoover: Other bird species that use the canebrakes include: White-eyed Vireo (WEVI), Hooded Warbler, and Indigo Bunting (INBU). All three species are associated with disturbance and structural complexity within forested ecosystems. The WEVI and INBU are found along forest edges without cane, but occur at higher densities in association with cane along edges, and are found more commonly in the forest if there are canebrakes (or other similar disturbance related vegetational structure) in the forest.	
Disturbance	Density	It should be 15-40 culms per square meter.	Literature values per Jon Schoonover. He stated: We found canebrake densities to average from 188,964 to 351,429 culms per hectare (18-35 culms per square meter)in the Cache. These data were collected from both open- and forest-grown canebrakes and were based on ~60-70 square meter plots in ~25 canebrakes over the past 10 years. In Nelson's latitudinal study (from LA to IL) her average density for the canebrakes was 175,925 culms per hectare. … It looks like a range of 15 to 40 culms per square meter would be a starting point	

Key Ecological Attri bute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat location	Proximity to forest habitat or stream (hydrologic connection)	More than half located adjacent and within a forest OR more than half located within 40 meters of a stream.	Literature values based on Amanda Nelson's unpublished research. Note: During discussions the group asked whether proximity to forests important to the Swainson's Warbler. Per Hoover: Yes, it should be within a forest but could be adjacent to it. The group noted that cane located in floodplain would allow ridges to reform. It is important to water quality.	
Habitat Size	Amount of watershed	Undertermined. Conduct sampling and make deterimination within three years.		
Habitat Structure	Large Patches (1 acre)	**Poor:** 0 "large" patches **Minimal Acceptable:** 1-2 "large" patches **Good:** 3 "large" patches **Excellent:** 4+ "large" patches	Per Amanda Nelson: 141 patches currently documented. Large patches, ideally, would be situated by Mississippi River for flyaway.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Block or Patch Size	This metric is a definition that is used when working with forest blocks. A forest block was defined through this process as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius.	A block should consist of no less than 70 percent forested lands, with the remaining 30 percent of the block composed of lands deemed “friendly” to songbirds. In general, bigger is better and wider is better than narrow. Ideally, blocks should be 5-6 kilometers in width, as cowbirds will forage up to 3 kilometers from nest sites. The higher the percentage of forested land and lower the percentage of pasture or row crops within 3 km, the lower the cowbird parasitism rate. The 7,000-acre block size is smaller than the 10,000 acre block referenced in Mississippi Alluvial Plan (see citation). It is based off Hoover’s research on the Heron Pond/Little Black Slough complex, which is roughly 7,000 acres, and has been documented as being a source (as opposed to a sink) for neotropicals. Also, published research of Hoover shows that the percent forest cover within a 3-km radius is a good predictor of cowbird parasitism.	LMVJV Forest Resource Conservation Working Group. 2007. Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Structure	Part of a forest matrix	Forest blocks are defined as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius **Poor:** 0 forest blocks with cane present as part of the forest matrix **Minimal Acceptable:** 2 forest blocks with cane present as part of the forest matrix **Good:** 4 forest blocks with cane present as part of the forest matrix **Excellent:** 6 forest blocks with cane present as part of the forest matrix Additional specificity is desired in this range.	Cane should exist as part of a forest canopy cover gradient, from open to nearly closed, i.e. cane as part of a matrix	

Table III: Key Attributes and Indicators for Cypress and Tupelo Swamps in the Cache River Watershed

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Animal Species Composition & Abundance	Density of Focus Bird Species	**Number of Birds:** **Minimal Acceptable:** Prothonotary Warbler: 0.50 pairs per hectare (or 1.24 per acre) Yellow-throated Warbler: 0.3 pairs per hectare (or 0.74 per acre) **Fair:** 25% increase over "Minimal Acceptable" **Good:** 35% increase over "Minimal Acceptable" **Excellent:** 50% increase over "Minimal Acceptable" **Nest Predation Rates:** Less than 50% for nest predation, and less than 40% for cowbird parasitism.	Jeff Hoover: The "Minimal Acceptable" numbers come from Hoover's first two years of bird surveys in the Cache in the early 1990s. Note: This suite of birds was selected because existing research is available to monitor this attribute/ indicator, and also because it is a good indicator overall of diversity.	
Animal Species Composition & Abundance	Wood duck abundance & breeding vital rates	Wood duck duckling survival 21% and brood survival 64%	Literature values per Mike Eichholz, who stated no data exists on hooded merganser duckling survival	
Plant Species Composition & Abundance	Underdeveloped shrub and herb layers.	**Poor:** Shrub and herb layers located in swamp at a rate higher than 50%. **Acceptable:** Shrub and herb layers located in swamp, within range of 20% to 50%. **Good:** Shrub and herb layers restricted to perimeter of swamp or less than 20% of the swamp.	INAI and NatureServe.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Depth of bald-cypress swamp and water-tupelo swamp communities	**Unacceptable:** Swamp is not permanently flooded and is intermittently exposed, with water depth 0 > 6.6 feet. **Acceptable:** Permanently flooded, intermittently exposed and semipermanently flooded water regimes, with water depth 0 > 6.6 feet.	Community types per NatureServe. Detail on water depth per Cowardin, Carter, & LaRoe (1979). Classification of Wetlands and Deepwater Habitats of the United States. Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior. Washington, D.C. 20240. FWS/OBS-79/31. 103 pages.	-
Habitat Size/ Specifications	Size of swamp; use of word swamp as defined by the Illinois Natural Areas Inventory, which states that "a swamp is a forested, permanent or semi-permanent body of water." NatureServe says Illinois definition is "broad."	**Poor:** Less than 12,500 acres in the watershed, with a reduction in grade A or B habitat, which the Illinois Natural Areas Inventory classifies as about 2,000 acres. **Minimum Acceptable:** 12,500 acres in the watershed, with no reduction in grade A or B habitat, which the Illinois Natural Areas Inventory classifies as about 2,000 acres. **Good:** 37,500 acres in the watershed, with no reduction in grade A or B habitat, which the Illinois Natural Areas Inventory classifies as about 2,000 acres. **Excellent:** More than 50,000 acres in the watershed, with no reduction in grade A or B habitat, which the Illinois Natural Areas Inventory classifies as about 2,000 acres.	Review of historic distribution (250,000 acres) and current distribution. According to the Wetland Resources of Illinois: An Analysis and Atlas, Suloway and Hubbell, 1994, the lower Cache River has 2,762 acres of swamp and the upper Cache has 2,779 acres of swamp.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Hydrology	Cypress Tree Regeneration in Seasonally Flooded Areas	**Unacceptable:** Cypress tree regeneration does not occur in every forest block and/or along riparian waterways. **Acceptable:** Cypress tree regeneration can be document in each and every forest block and along riparian waterways.	Cypress tree regeneration is being used as an indicator of hydrology in this metric. This metric recognized that regeneration likely will happen in zones, with some exhibiting higher frequency that others. Middleton's current study sites include Deer Pond, Section 8 Woods, Heron Pond, Snake Hole and Wildcat Bluff.	
Hydrology	Species Composition and Abundance/ Absence of Understory Trees in Swamp, as defined in the Illinois Natural Areas Inventory. "A swamp is a forested, permanent or semi-permanent body of water."	For Bald-Cypress Swamp (as specified by NatureServe): **Acceptable:** Species composition includes bald cypress and buttonbush, with occurrence of water tupelo restricted to occasional individuals. **Unacceptable:** Species composition still includes bald cypress, buttonbush and water tupelo, but begins to contain swamp red maple, swamp cottonwood and black willow.		Nature Serve. Community detail accessible at http://www.natureserve.org/explorer/servlet/NatureServe?searchCommunityUid=ELEMENT_GLOBAL.2.683252

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Hydrology	Species Composition and Abundance/Absence of Understory Trees in Swamp, as defined in the Illinois Natural Areas Inventory. "A swamp is a forested, permanent or semi-permanent body of water."	For Water-tupelo swamp (as specified by NatureServe): **Acceptable:** Species composition includes bald cypress and water tupelo, acting as the understory. **Unacceptable:** Species composition does not feature bald cypress in the overstory because water tupelo is the dominant species.		Nature Serve. Community detail incomplete on site, but detail included in Missouri subset: http://www.natureserve.org/library/missourisubset.pdf (page 210)

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Hydrology - depth and duration	Nesting success of prothonotary warbler	Acceptable: 0.50 pairs of prothonotary warblers per hectare (or 1.24 per acre) AND nest predation rates of less than 50%.	Literature values per Jeff Hoover. Note: A portion of this metric is used to reflect species composition and abundance as it relates to bird diversity in the conservation target cypress and tupelo swamp. However, by zeroing in on prothonotary warblers and nest predation rates, it provides a way to zero in on hydrologic regime.	

Table IV: Key Attributes and Indicators for Migratory Birds in the Cache River Watershed

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Animal Species Composition & Abundance	(Waterfowl) Wood ducks and hooded mergansers	Undetermined. Data gap identified here.	Hoover, Eichholz and Woolard say this data does not exist.	
Species Composition & Abundance: Diversity and Abundance of Oaks	Over-wintering populations of red-headed woodpeckers	Based on 20 year average, should expect to see no decreases in population.	Literature values per Jeff Hoover. The Christmas Bird Count (CBC) has not been conducted long enough to develop a solid goal, which is why the current desired range is phrased in the negative. Over the now 19 years of the count, the average number of Red-headed woodpeckers seen in the Cache is around 150 (range=6 to 738). The values are sensitive to inclement weather on the day of the count as well as acorn mast available.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Complexity of Habitat	Diversity of Bird Species, as indicated through nesting rates of focus species	**Number of Birds:** **Minimal Acceptable:** Acadian Flycatcher: 1.20 pairs per hectare (or 2.97 per acre) Prothonotary Warbler: 0.50 pairs per hectare (or 1.24 per acre) Kentucky Warbler: 0.19 pairs per hectare (or 0.47 per acre) Wood Thrush: 0.16 pairs per hectare (or 0.4 per acre) Summer Tanager: 0.06 pairs per hectare (or 0.15 per acre) Louisiana Waterthrush: 0.05 pairs per hectare (or 0.12 per acre) **Fair:** 25% increase over "Minimal Acceptable" **Good:** 35% increase over "Minimal Acceptable" **Excellent:** 50% increase over "Minimal Acceptable" **Nest Predation Rates:** Less than 50% for nest predation, and less than 40% for cowbird parasitism.		Literature values per Jeff Hoover.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Productivity (kg per ha)	(waterfowl) Duck Use Days (DUDS) of food	Range needs to be determined.	Mike Eichholz provided: emergent palustrine (and mudflats) 230 ± 19 (SE) kg/ha of seeds and 45 ± 5 kg/ha of invertebrates in forested habitat 62 ± 7 kg/ha of seeds and 32 ± 4 kg/ha of invertebrates	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Block or Patch Size	This metric is a definition that is used when working with forest blocks. A forest block was defined through this process as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius.	A block should consist of no less than 70 percent forested lands, with the remaining 30 percent of the block composed of lands deemed “friendly” to songbirds. In general, bigger is better and wider is better than narrow. Ideally, blocks should be 5-6 kilometers in width, as cowbirds will forage up to 3 kilometers from nest sites. The higher the percentage of forested land and lower the percentage of pasture or row crops within 3 km, the lower the cowbird parasitism rate. The 7,000-acre block size is smaller than the 10,000 acre block referenced in Mississippi Alluvial Plan (see citation). It is based off Hoover’s research on the Heron Pond/Little Black Slough complex, which is roughly 7,000 acres, and has been documented as being a source (as opposed to a sink) for neotropicals. Also, published research of Hoover shows that the percent forest cover within a 3-km radius is a good predictor of cowbird parasitism.	LMVJV Forest Resource Conservation Working Group. 2007. Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt.

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Block or Patch - Number of upland and number of bottomland	Forest blocks are defined as 7,000 acres that lies within a circle with a 1.86 mile (or 3-km) radius. **Poor:** 0 upland forest blocks **Minimal Acceptable:** 2 upland forest blocks **Good:** 4 upland forest blocks **Excellent:** 6 upland forest blocks **Poor:** 0 bottomland forest blocks **Minimal Acceptable:** 2 bottomland forest blocks **Good:** 4 bottomland forest blocks **Excellent:** 6 bottomland forest blocks (Bottomland forest blocks also are listed as a conservation attribute for bottomland forests. It is cross listed here.)	Per literature, the watershed once contained roughly 436,000 acres of upland forest and 441,000 acres of bottomland forest. It now contains 117,759 acres (or 27% of the original extent) of upland forests and 35,327 acres (or 8% of the original) in bottomland forests. (Please note, this does not document blocks, just current coverage.)	Critical Trends Assessment Project: Phase II, Inventory of the Resource Rich Areas in Illinois, Suloway et al. 1996

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size & Temporal Distribution of Habitat	Moist Soil Vegetation and Mud Flats (for waterfowl and shorebirds)	Undertermined. Make a recommendation within three years using new research coming online.	In moist soil vegetation and mud flats, at least 50% cover of "good"or "fair" plants and/or produce a minimum of 400 pounds of readily available moist-soil seeds per acre in each impoundment. This moist-soil objective of 400 pounds per acre is at least partially derived from the Lower Mississippi Valley Joint Venture (LMVJV). In addition, they calculated the number of ducks that could obtain daily food requirements (duck use days) from using moist soil habitat to be 1,386 (per acre). In calculating the duck use-day value for moist-soil habitat, the LMVJV assumed an average of about 400 pounds per acre of native seeds were available to waterfowl. These numbers are from the Moist Soil Management Guidelines for the USFWS, Southeast Region.	

Table V: Key Attributes and Indicators for Riverine Habitat in the Cache River Watershed

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Species Composition & Abundance	Invertebrates	**Large woody debris:** The establishment of a criterion for the densities of large woody debris habitat has not been scientifically determined as of yet; no range suggested at this point. **Invertebrates:** In the spring (mid-March to mid-April): Taxa richness of 50 total species an EPT richness of 5 biotic index of 7.6 In the autumn (mid-September to mid-October): Taxa richness of 63 total species an EPT richness of 11 biotic index of 6.9	Per literature review and values from Heidi Rantala: Large woody debris: Given there is no scientific background in the establishment of a criterion for the densities of large woody debris habitat, it would be hasty to set a criterion without more information. Invertebrates: Using information gathered from the biocriteria programs from the States of Iowa and Missouri, it is recommended that the Cache River Watershed, Illinois, adopt the criteria developed by the state of Missouri for Level III Ecoregion 72 (Designated the Mississippi Alluvial Basin in Missouri).	
Species Composition & Abundance	Mussels - presence of Host Fish	Host fish exist for each mussels species with downstream distribution.	An analysis is needed to further refine the range.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Species Composition & Abundance	Mussels - species richness and community composition	Using the Illinois Natural History Survey's freshwater mussel resource categories based on species richness, abundance, and population structure, the standards are as follows: **Poor:** Reduction in current classifications of mussel bed sites, which is: Unique: 1 Highly Valued: 1 Moderate Resource: 7 Limited Resource: 2 Restricted Resource: 6 **Acceptable:** Maintenance of current classifications of mussel bed sites. **Good:** Increase in quality of four resources rated moderate, limited or restricted. **Excellent:** Increase in quality of six resources rated moderate, limited or restricted. Note: This metric likely will need a review in 2013, as INHS will rework the index.	Per INHS community index and Diane Shasteen, Steve Shults.	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Species Composition & Abundance	Native fish species vs exotic species	75 species (to include flier and slough darter), >75% biomass	Flier and slough darter (Bottomland hardwood wetlands) Blacksided darter and dusky darter (intolerant species – sensitive to environmental change) Suckermouth minnow and red shiner (specialist feeders, insectivore cyprinids increase with sufficient invertebrate food source) Spotted sucker and creek chubsucker (long-lived fishes sensitive to environmental perturbation)	Theiling et.al. (1999) indicate flooding and hydrologic fluctuation can increase fish diversity.
Species Composition & Abundance	Presence of generalists vs. specialists in lower Cache	Presence/ absence of mottled sculpin and diversity of slough darter, flier and banded pygmy sunfish	Illinois streams metrics need to be developed; see MDNR reports on this topic for example. MDNR has 7 reference streams in this ecoregion. Some ideas generated included: Presence/ absence of mottled sculpin and diversity of slough darter, flier and banded pygmy sunfish Diversity of darter species	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Aquatic connectivity (especially for fishes and mussels)	Biological connection between mainstem and within tributaries that allows for the movement of aquatic species within the tributary system (in the absence of flood, when connectivity exists)	**Unacceptable:** Connection does not exist, such as the drying out of the tributaries, which would inhibit fishes movement and the establishment of mussel beds **Acceptable:** Connection exists, i.e. tributaries remain hydrated		

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Aquatic connectivity (especially for fishes and mussels)	Biological connection that allows for the movement of aquatic species between the upper and lower segments of the river (in the absence of flood, when connectivity exists)	Desired range in the absence of flooding: **Unacceptable:** Connection does not exist **Acceptable:** Managed connection permanently exists (where species movement is restricted by management/manipulation of river structures) **Excellent:** Connection permanently exists (where species movement is not restricted by management/manipulation of structures)		
Connectivity	Hydrologic connection between upper and lower segments of the river except during flood.	**Unacceptable:** Connection does not exist **Acceptable:** Managed connection permanently exists **Excellent:** Connection permanently exists	Deemed desirable for overall river health (macroinverts, fish communities, etc).	
Connectivity	Laterally (with the floodplain)	Needs to be developed.	Remo provided detail.	Jacobson et al, 2011
Connectivity	Mainstem of Lower Cache	River remains connected, i.e. not a series of pools.		

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Size	Deep water habitat in the river	Depths of 2-15 feet in the lower Cache and depth of 4-8 feet in the upper Cache		Pickles and Leonard; Bell's survey early 1900s
Habitat Structure	Bank stability in mainstem of Upper Cache	Banks stable	Pitts and Stoebner 2011 survey, Jonathan Remo with Bell survey	
Habitat Structure	Bank stability in tributaries.	Banks stable	Pitts and Stoebner 2011 survey, Jonathan Remo with Bell survey	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Habitat Structure	Ratio of pools and riffles in upland tributaries	Analysis needed to determine.	Notes provided in development: Establish zones, looking at habitat and fish. The transition between uplands verse bottoms lands stream morphology can be defined geomorphically by change in physical character or by the maximum bed elevation of Pleistocene lakes which likely inundated upper Cache River and its upland tributaries. The transition between these geomorphic regions should discernable from the digital elevation model generate from the LIDAR.	Leopold
Habitat Structure	Woody debris	Unable to make a recommendation at this point given lack of science.	Heidi Rantala, Big and Cypress - Guetersloh. # log jams / km. Basis: Rantala, Big and Cypress - Guetersloh	

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Hydrology	Flow Regime	Historic Flow Regime as defined by ISWS	Flow regime encompasses frequency, depth, duration, magnitude, peak flow, timing, velocity and discharge.	Literature values per ISWS/ Keefer, Poff et al. 1997; Richter et al. 1997.
Water Quality	Dissolved Oxygen	March-July, DO cannot be below 5.0 mg/l at any time. The 7-day avg cannot be below 6.0 mg/l. From Aug to Feb, DO cannot be below 3.5 at any time, the 7-day mean below 4.0, and the 30-day mean below 5.5		

Key Ecological Attribute	Indicator	Desired Range	Basis for Range	Literature Notes
Water Quality	Sediment	**Acceptable:** No increases in current rate of sedimentation, which is 0.07 inches a year **Unacceptable:** Increases in the current rate of sedimentation, which is 0.07 inches a year		
Water Quality	Turbidity for the watershed	13 NTU for the watershed.	Literature values per Heidi Rantala: Based on the data collected in the Cache watershed, the reference condition for turbidity is 13 NTU (25th percentile of measurements per the EPA method). Therefore, the goal for turbidity for the watershed should be 13 NTU. This is slightly lower than the EPA reference condition for the Level III Ecoregion 72, in which the Cache River watershed is classified (EPA 2000).	Numerous including IEPA (2011); Lenhart, Brooks, Heneley, & Magner (2010); Pitt, & Batzer (2011); Ruzycki (2010).

Appendix A.

List of Bottomland Forest Species in Greatest Need of Conservation

Name and Listed Status	**Habitat Association**
*Anas rubripes (*American black duck)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
Ardia alba (great egret)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
*Aythya affinis (*lesser scaup)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
*Athya valisineria (*canvasback)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
Buteo lineatus (red-shouldered hawk)	Bottomland Forest
*Certhia Americana (*brown creeper)	Bottomland Forest
*Corynorhinus rafinesquii (*Rafinesque's big-eared bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Crotalus horridus (*timber rattlesnake) *threatened*	Bottomland Forest, Cane
Dendroica cerulea (cerulean warbler) *threatened*	Bottomland Forest
*Egretta caerulea (*little blue heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Egretta thula (*snowy egret) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Euphagus carolinus (*rusty blackbird)	Bottomland Forest, Cypress and Tupelo Swamp
*Gallinula chloropus (*common moorhen) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Hyla avivoca (bird-voiced treefrog) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
*Limnothlypis swainsonii (*Swainson's warbler) *endangered*	Cane, Bottomland Forest
*Myotis austroriparius (*southeastern myotis) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Myotis grisescens (gray bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Myotis sodalis (*Indiana bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Nerodia eryhrogaster var. neglecta (*copperbelly watersnake)	Bottomland Forest, Cypress and Tupelo Swamp
Nyctanassa violacea (yellow-crowned night heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Ochrotomys nuttalli (golden mouse) *threatened*	Bottomland Forest, Cane
Oryzomys palustris (rice rat) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
Peromyscus gossypinus (cotton mouse)	Bottomland Forest, Cypress and Tupelo Swamp
Protonotaria citrea (prothonotary warbler)	Bottomland Forest, Cypress and Tupelo Swamp
Sylvilagus aquaticus (swamp rabbit)	Bottomland Forest, Cypress and Tupelo Swamp
*Thamnophis sauritus (*eastern ribbon snake) *threatened*	Bottomland Forest
*Thryomanes bewickii (*Bewick's wren) *endangered*	Bottomland Forest, Cane
*Tyto alba (*barn owl) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp

Source: ILLINOIS COMPREHENSIVE WILDLIFE CONSERVATION PLAN & STRATEGY Version 1.0

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Appendix B.

List of Giant Cane Species in Greatest Need of Conservation

Name and Listed Status	**Habitat Association**
*Crotalus horridus (*timber rattlesnake) *threatened*	Bottomland Forest, Cane
*Limnothlypis swainsonii (*Swainson's warbler) *endangered*	Cane, Bottomland Forest
*Ochrotomys nuttalli (*golden mouse) *threatened*	Bottomland Forest, Cane
*Thryomanes bewickii (*Bewick's wren) *endangered*	Bottomland Forest, Cane

Source: ILLINOIS COMPREHENSIVE WILDLIFE CONSERVATION PLAN & STRATEGY Version 1.0
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Appendix C.

List of Cypress and Tupelo Species in Greatest Need of Conservation

Name and Listed Status	Habitat Association
*Anas rubripes (*American black duck)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
Ardia alba (great egret)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
*Aythya affinis (*lesser scaup)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
Athya valisineria (canvasback)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
*Corynorhinus rafinesquii (*Rafinesque's big-eared bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Egretta caerulea (*little blue heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Egretta thula (*snowy egret) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Euphagus carolinus (rusty blackbird)	Bottomland Forest, Cypress and Tupelo Swamp
*Gallinula chloropus (*common moorhen) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Hybognathus hayi (cypress minnow) *endangered*	Riverine, Cypress and Tupelo Swamp
*Hyla avivoca (*bird-voiced treefrog) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
*Ictinia mississippiensis (*Mississippi kite) *threatened*	Riverine, Cypress and Tupelo Swamp
*Ixobrychus exilis (*least bittern) *threatened*	Cypress and Tupelo Swamp
*Lepomis miniatus (*redspotted sunfish) *endangered*	Riverine, Cypress and Tupelo Swamp
*Lepomis symmetricus (*Bantam sunfish) *threatened*	Riverine, Cypress and Tupelo Swamp
*Macrochelys temminckii (*alligator snapping turtle) *endangered*	Riverine, Cypress and Tupelo Swamp
*Myotis austroriparius (*southeastern myotis) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Myotis grisescens (gray bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Myotis sodalist (*Indiana bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Nerodia cyclopion (*Mississippi green water snake) *threatened*	Riverine, Cypress and Tupelo Swamp
*Nerodia eryhrogaster var. neglecta (*copperbelly watersnake)	Bottomland Forest, Cypress and Tupelo Swamp
*Nerodia fasciata (*broad-banded water snake) *endangered*	Riverine, Cypress and Tupelo Swamp
Nyctanassa violacea (yellow-crowned night heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Nyctocorax nyctocorax (*black-crowned night heron) *endangered*	Cypress and Tupelo Swamp
*Oryzomys palustris (*rice rat) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
*Pandion haliaetus (*osprey) *endangered*	Riverine, Cypress and Tupelo Swamp
*Peromyscus gossypinus (*cotton mouse)	Bottomland Forest, Cypress and Tupelo Swamp
*Protonotaria citrea (*Prothonotary warbler)	Bottomland Forest, Cypress and Tupelo Swamp
*Sylvilagus aquaticus (*swamp rabbit)	Bottomland Forest, Cypress and Tupelo Swamp
*Tyto alba (*barn owl) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp

Source: ILLINOIS COMPREHENSIVE WILDLIFE CONSERVATION PLAN & STRATEGY Version 1.0 Appendix I PP 306-309

Appendix D.

List of Migratory Bird Species in Greatest Need of Conservation

Name and Listed Status	**Habitat Association**
Ammodramus savannarum (grasshopper sparrow)	Grassland
Anas rubripes (American black duck)	Bottomland Forest, Cypress and Tupelo, Riverine
Ardea alba (great egret)	Bottomland Forest, Cypress and Tupelo, Riverine
Asio flammeus (short-eared owl) *endangered*	Grassland
Aythya affinis (lesser scaup)	Riverine, Lakes
Aythya valisineria (canvasback)	Riverine, lakes
Bartramia longicauda (upland sandpiper) *endangered*	Grassland
Botaurus lentiginosus (American bittern) *endangered*	Riverine, Cypress and Tupelo, Marsh
Buteo lineatus (red-shouldered hawk)	Bottomland Forest, Forest
Buteo platypterus (broad-winged hawk)	Bottomland Forest, Forest
Buteo swainsoni (Swainson's hawk) *endangered*	Savanna, grassland, agriculture
Calcarius pictus (Smith's longspur)	Agricultural, grassland
Calidris himantopus (stilt sandpiper)	Vernal pool, mudflat, marsh
Caprimulgus carolinensis (Chuck-will's-widow)	Forest
Caprimulgus vociferous (Whip-poor-will)	Forest, Successional
Certhia Americana (brown creeper)	Bottomland Forest, Forest
Chaetura pelagica (chimney swift)	Cypress and Tupelo, Swamp, Urban
Charadrius melodus (piping plover)	Beach
Chlidonias niger (black tern) *endangered*	Marsh
Chordeiles minor (common nighthawk)	Urban, Barren, Grassland
Circus cyaneus (northern harrier) *endangered*	Grassland, Marsh
Cistothorus palustris (marsh wren)	Marsh
Cistothorus platensis (sedge wren)	Grassland, Marsh
Coccyzus americanus (yellow-billed cuckoo)	Bottomland Forest, Forest, Savanna
Coccyzus erythropthalmus (black-billed cuckoo)	Bottomland Forest, Forest
Colaptes auratus (northern flicker)	Savanna, Grassland
Dendroica cerulean (cerulean warbler) *threatened*	Bottomland Forest
Dendroica discolor (prairie warbler)	Successional
Dolichonyx oryzivorus (bobolink)	Grassland
Egretta caerulea (little blue heron) *endangered*	Bottomland Forest, Cypress and Tupelo, Riverine, Forested Streams, Lakes
Egretta thula (snowy egret) *endangered*	Bottomland Forest, Cypress and Tupelo, Riverine, Forested Streams, Lakes
Empidonax trailli (willow flycatcher)	Marsh, Successional
Empidonax virescens (acadian flycatcher)	Bottomland Forest, Forest
Falco peregrinus (Peregrine falcon) *threatened*	Urban, Cliffs
Gallinula chloropus (common moorhen) *threatened*	Marsh
Gallinago delicatata (Wilson's snipe)	Marsh, vernal pool
Grus Canadensis (sandhill crane) *threatened*	Marsh
Helmitheros vermiforma (worm-eating warbler)	Forest
Hylocichla mustelina (wood thrush)	Forest
Icteria virens (yellow-breasted chat)	Successional Fields, Edges
Ictinia mississippiensis (Mississippi kite) *endangered*	Riverine, Forested Streams, Lakes

Name and Listed Status	Habitat Association
Ixobrychus exilis (least bittern) *threatened*	Marsh
Lanius ludovicianus (loggerhead shrike) *threatened*	Grassland
Laterallus jamaicensis (black rail) *endangered*	Marsh
Limnodromus griseus (short-billed dowitcher)	Marsh, vernal pool, mudflat
Limnothlypis swainsonii (Swainson's warbler) *endangered*	Bottomland forest
Melanerpes erythrocephalus (red-headed woodpecker)	Savanna
Nyctanassa violacea (yellow-crowned night heron) *endangered*	Cypress and Tupelo, Riverine, Swamp
*Nycticorax nycticorax (*black-crowned night heron) *endangered*	Cypress and Tupelo, Riverine, Swamp
Oporornis agilis (Connecticut warbler)	Forest
Oporornis formosus (Kentucky warbler)	Forest
Pandion haliaetus (Osprey) *endangered*	Forested Streams, Lakes
Passerculus sandwichensis (Savannah sparrow)	Grassland, Agricultural
Phalaropus tricolor (Wilson's phalarope) *endangered*	Marsh, Vernal Pool
Pluvialis dominica (American golden-plover)	Agricultural, Mudflat, Grassland
Podilymbus podiceps (pied-billed grebe)	Riverine, Cypress and Tupelo, Marsh, Lakes
Protonotaria citrea (prothonotary warbler)	Bottomland Forest, Cypress and Tupelo
Rallus elegans (king rail) *endangered*	Marsh, Grassland
Seiurus aurocapillus (ovenbird)	Forest
Spiza americana (dickcissel)	Grassland
Spizella pusilla (field sparrow)	Successional
*Sterna antillarum (*least tern) *endangered*	Migratory Birds, Riverine – sand bars
Sterna forsteri (Forster's rern)	Marsh
Sterna hirundo (common tern) *endangered*	Beach
*Thryomanes bewickii (*Bewick's wren) *endangered*	Migratory Birds, Bottomland Forest, Cane
Tringa melanoleuca (greater yellowlegs)	Vernal Pool, Mudflat, Marsh
Vermiforma pinus (blue-winged warbler)	Successional, Forest

Source: ILLINOIS COMPREHENSIVE WILDLIFE CONSERVATION PLAN & STRATEGY Version 1.0
Appendix I PP 306-309

List of Riverine Habitat Species in Greatest Need of Conservation

Name and Listed Status	**Habitat Association**
*Acipenser fulvescens (*lake sturgeon) *endangered*	Riverine
*Anas rubripes (*American black duck)	Riverine, Bottomland Forest, Cypress and Tupelo Swamp
*Aythya affinis (*lesser scaup)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
Athya valisineria (canvasback)	Bottomland Forest, Cypress and Tupelo Swamp, Riverine
*Crangonyx packardi (*Packard's cave amphipod) *endangered*	Riverine
*Cumberlandia monodonta (*spectaclecase) *endagered*	Riverine
*Cyclonaias tuberculata (*purple wartyback) *threatened*	Riverine
*Ellipsaria lineolata (*butterfly) *threatened*	Riverine
*Elliptio crassidens (*elephant-ear) *threatened*	Riverine
*Elliptio dilatata (*spike) *threatened*	Riverine
*Fusconaia ebena (*ebonyshell) *threatened*	Riverine
*Ictinia mississippiensis (*Mississippi kite) *threatened*	Riverine, Cypress and Tupelo Swamp
*Lepomis miniatus (*redspotted sunfish) *endangered*	Riverine, Cypress and Tupelo Swamp
*Lepomis symmetricus (*bantam sunfish) *threatened*	Riverine, Cypress and Tupelo Swamp
*Ligumia recta (*black sandshell) *threatened*	Riverine
*Macrochelys temminckii (*alligator snapping turtle) *endangered*	Riverine, Cypress and Tupelo Swamp
Nerodia cyclopion (Mississippi green water snake) *threatened*	Riverine, Cypress and Tupelo Swamp
*Nerodia fasciata (*broad-banded water snake) *endangered*	Riverine, Cypress and Tupelo Swamp
*Notropis boops (*bigeye shiner) *endangered*	Riverine
Nyctanassa violacea (yellow-crowned night heron) *endangered*	Cypress and Tupelo, Riverine, Swamp
Nycticorax nycticorax (black-crowned night heron) *endangered*	Cypress and Tupelo, Riverine, Swamp
*Orconectes lancifer (*shrimp crayfish) *endangered*	Riverine
*Orconectes placidus (*bigclaw crayfish) *endangered*	Riverine
*Pandion haliaetus (*osprey) *endangered*	Riverine, Cypress and Tupelo Swamp
*Plethobasus cooperianus (*orange-foot pimpleback) *endangered*	Riverine
*Plethobasus cyphyus (*sheepnose) *endagered*	Riverine
*Pleurobema cordatum (*Ohio pigtoe) *endangered*	Riverine
*Pleurobema rubrum (*pyramid pigtoe) *endagered*	Riverine
Podilymbus podiceps (pied-billed grebe)	Riverine, Cypress and Tupelo, Marsh, Lakes
*Potamilus capax (*fat pocketbook) *endangered*	Riverine
*Pseudacris illinoensis (*Illinois chorus frog) *threatened*	Riverine, open sandy ridges
*Pseudemys concinna (*river cooter) *endangered*	Riverine
*Quadrula cylindrica (*rabbitsfoot) *endangered*	Riverine
*Sternula antillarum (*least tern) *endangered*	Riverine – sand bars

Source: ILLINOIS COMPREHENSIVE WILDLIFE CONSERVATION PLAN & STRATEGY Version 1.0
Appendix I PP 306-309

Appendix F

List of Threatened and Endangered Species for

Alexander, Massac, Pulaski, Union and Johnson counties

Name and Listed Status	Habitat Association
*Aristolochia serpentaria Var. hastate (*Virginia Snakeroot) *threatened*	Bottomland Forest
*Asplenium resiliens (*black spleenwort) *endangered*	Glades, Barrens-Limestone
*Bartonia paniculata (*screwstem) *endangered*	Seep Springs (peat, sand)
*Carex decomposita (*cypress-knee sedge) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Carex gigantea (*large sedge) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Carex intumescens (*swollen sedge) threatened	Bottomland Forest, Cypress and Tupelo Swamp
*Carex oxylepis (*sharp-scaled sedge) threatened	Bottomland Forest, Cypress and Tupelo Swamp
*Carex reniformis (*Sedge) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Carya aquatic (*water hickory) *threatened*	Bottomland Forest
Carya *pallida (*pale hickory) *endangered*	Dry Upland Forest
*Cimicifuga rubifolia (*black cohosh) *threatened*	Mesic Upland Forest
*Cladrastis lutea (*yellowwood) *endangered*	Mesic Upland Forest – Calcareous Bluffs
*Clematis crispa (*blue jasmine) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Clematis viorna (*leatherflower) *endangered*	Bottomland Forest, Cane
*Cyperus lancastriensis (*Galingale) *threatened*	Bottomland Forest
*Dennstaedtia punctilobula (*hay-scented fern) *threatened*	Mesic Upland Forest
*Dichanthelium joorii (*panic grass) *endangered*	Bottomland Forest
*Dryopteris celsa (*log fern) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Eryngium prostratum (*eryngo) endangered	Bottomland Forest, Cypress and Tupelo Swamp
*Euonymus americanus (*American strawberry bush) *endangered*	Bottomland Forest
*Glyceria arkansana (*manna grass) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Halesia carolina (*silverbell tree) *endagered*	Upland Forest - Mesic
*Helianthus angustifolius (*narrow-leaved sunflower) *endangered*	Bottomland Forest (Flatwoods)
*Heteranthera reniformis (*mud plantain) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Hydrocotyle ranunculoides (*water pennywort) *endangered*	Cypress and Tupelo Swamp
*Hydrolea uniflora (*one-flowered hydrola) *endangered*	Cypress and Tupelo Swamp
*Iresine rhizomatosa (*bloodleaf) *endangered*	Bottomland Forest
*Justicia ovata (*water willow) *endangered*	Cypress and Tupelo Swamp
*Lysimachia radicans (*creeping loosestrife) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Melanthera nivea (*white melanthera) *endangered*	Upland Forest - Mesic
*Melica mutica (*two-flowered melic grass) *endangered*	Bottomland Forest
*Melothria pendula (*squirting cucumber) *threatened*	Gravelly Thickets, Stream Beds, Cane
*Panicum joorii (*panic grass) *endangered*	Cypress and Tupelo Swamp
*Phaeophyscia leana (*Lea's bog lichen) *threatened*	Bottomland Forest
Planera aquatica (water elm) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
Platanthera flava var. flava (tubercled orchid) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Quercus montana (rock chestnut oak) *threatened*	Dry Upland Forest

Name and Listed Status	Habitat Association
Quercus phellos (willow oak) *threatened*	Bottomland Forest
Quercus texana (Nuttall's oak) *endangered*	Bottomland Forest
Rhynchospora glomerata (clustered beaked rush) *endangered*	Bottomland Forest (Flatwoods)
Salvia azurea ssp. pitcheri (blue sage) *threatened*	Glades, Barrens - Limestone
Scirpus polyphyllus (bulrush) *threatened*	Upland Forests (seeps)
Spiranthes vernalis (spring ladies' tresses) *endangered*	Glades, Barrens - Acid
Stenanthium gramineum (grass-leaved lily) *endangered*	Bottomland Forests
Styrax americana (storax) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
Styrax grandifolia (bigleaf snowbell bush) *endangered*	Upland Forest - Mesic
Thalia dealbata (powdery thalia) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Tilia heterophylla (white basswood) *endangered*	Upland Forest - Mesic
Urtica chamaedryoides (nettle) *threatened*	Bottomland Forest
ANIMALS	
Acipenser fulvescens (lake sturgeon) *endangered*	Riverine
Circus cyaneus (northern harrier) *endangered*	Migratory Birds - Grassland
Corynorhinus rafinesquii (rafinesque's big-eared bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Crangonyx packardi (Packard's cave amphipod) *endangered*	Riverine Habitat
Crotalus horridus (timber rattlesnake) *threatened*	Bottomland Forest, Cane
Cumberlandia monodonta (spectaclecase) *endangered*	Riverine
Cyclonaias tuberculata (purple wartyback) *threatened*	Riverine
Dendroica cerulea (cerulean warbler) *threatened*	Bottomland Forest
Desmognathus conanti (spotted dusky salamander) *endangered*	Upland Forest - Streams
Egretta caerulea (little blue heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Ellipsaria lineolata (butterfly) *threatened*	Riverine
Elliptio crassidens (elephant-ear) *threatened*	Riverine
Elliptio dilatata (spike) *threatened*	Riverine
Fusconaia ebena (ebonyshell) *threatened*	Riverine
Gallinula chloropus (common moorhen) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Gammarus bousfieldi (amphipod) *threatened*	Cave - Aquatic
Hybognathus hayi (cypress minnow) *endangered*	Riverine, Cypress and Tupelo Swamp
Hyla avivoca (bird-voiced treefrog) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
Ictinia mississippiensis (Mississippi kite) *threatened*	Riverine, Cypress and Tupelo Swamp
Ixobrychus exilis (least bittern) *threatened*	Cypress and Tupelo Swamp
Lanius ludovicianus (loggerhead shrike) *endangered*	Migratory Bird - Grassland, Thicket
Lepomis miniatus (redspotted sunfish) *endangered*	Riverine, Cypress and Tupelo Swamp
Lepomis symmetricus (bantam sunfish) *threatened*	Riverine, Cypress and Tupelo Swamp
Ligumia recta (black sandshell) *threatened*	Riverine

Name and Listed Status	Habitat Association
*Limnothlypis swainsonii (*Swainson's warbler) *endangered*	Cane, Bottomland Forest
*Macrochelys temminckii (*alligator snapping turtle) *endangered*	Riverine, Cypress and Tupelo Swamp
*Myotis austroriparius (*southeastern myotis) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Myotis grisescens (gray bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Myotis sodalis (*Indiana Bat) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
*Nerodia cyclopion (*Mississippi green water snake) *threatened*	Riverine, Cypress and Tupelo Swamp
*Nerodia fasciata (*broad-banded water snake) *endangered*	Riverine, Cypress and Tupelo Swamp
*Notropis boops (*bigeye shiner) *endangered*	Riverine
*Nyctanassa violacea (*yellow-crowned night heron) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp
Ochrotomys nuttalli (golden mouse) *threatened*	Bottomland Forest, Cane
*Orconectes lancifer (*shrimp crayfish) *endangered*	Riverine
*Orconectes placidus (*bigclaw crayfish) *endangered*	Riverine
*Oryzomys palustris (*rice rat) *threatened*	Bottomland Forest, Cypress and Tupelo Swamp
*Pandion haliaetus (*osprey) *endangered*	Riverine, Cypress and Tupelo Swamp
Plethobasus cooperianus (orange-foot pimpleback) *endangered*	Riverine
Plethobasus cyphyus (sheepnose) *endangered*	Riverine
*Pleurobema cordatum (*Ohio pigtoe) *endangered*	Riverine
*Pleurobema rubrum (*pyramid pigtoe) *endangered*	Riverine
*Potamilus capax (*fat pocketbook) *endangered*	Riverine
*Pseudacris illinoensis (*Illinois chorus frog) *threatened*	Riverine, open sandy ridges
*Pseudemys concinna (*river cooter) *endangered*	Riverine
*Quadrula cylindrica (*rabbitsfoot) *endangered*	Riverine
*Sternula antillarum (*least tern) *endangered*	Riverine – sand bars
*Thamnophis sauritus (*eastern ribbon snake) *threatened*	Bottomland Forest
*Thryomanes bewickii (*Bewick's wren) *endangered*	Bottomland Forest, Cane
Tyto alba (barn owl) *endangered*	Bottomland Forest, Cypress and Tupelo Swamp

Appendix G

List of Cache River Science Advisory Council Participants

Name	Affiliation
Casey Bryan	Americorps
Mandy Wolfe	Americorps
Bill Reynolds	Illinois Department of Natural Resources
Dan Woolard	Illinois Department of Natural Resources
David Allen	Illinois Department of Natural Resources
Gary Stratton	Illinois Department of Natural Resources
Jim Waycuilis	Illinois Department of Natural Resources
Jody Shimp	Illinois Department of Natural Resources
Mark Guetersloh	Illinois Department of Natural Resources
Steve Shults	Illinois Department of Natural Resources
Tom Wilson	Illinois Department of Natural Resources
Jeff Hoover	Illinois Natural History Survey
Wendy Schelsky	Illinois Natural History Survey
Laura Keefer	Illinois State Water Survey
Lily Hwang	Little River Research and Design
Steve Gough	Little River Research and Design
Danette Cross	Natural Resource Conservation Service
John Schuler	Natural Resource Conservation Service
Patty Coffman	Natural Resource Conservation Service
Tracy Boutelle Fidler	Shawnee RC&D/Cache River Wetlands Joint Venture Partnership
Amanda Nelson	Southern Illinois University - Carbondale
Cathy Hayen	Southern Illinois University - Carbondale
Greg Whitledge	Southern Illinois University - Carbondale
Heidi Rantala	Southern Illinois University - Carbondale
Jim Zaczek	Southern Illinois University - Carbondale
John Groninger	Southern Illinois University - Carbondale
Jon Schoonover	Southern Illinois University - Carbondale
Jonathan Remo	Southern Illinois University - Carbondale
Karl Williard	Southern Illinois University - Carbondale
Kristen Pitts	Southern Illinois University - Carbondale
Margaret Anderson	Southern Illinois University - Carbondale
Matt Whiles	Southern Illinois University - Carbondale
Micah Bennett	Southern Illinois University - Carbondale
Timothy Stoebner	Southern Illinois University - Carbondale
Doug Blodgett	The Nature Conservancy

Name	Affiliation
Jeff Walk	The Nature Conservancy
Karen Tharp	The Nature Conservancy
Mike Baltz	The Nature Conservancy
Jim Herkert	The Nature Conservancy (currently Illinois Department of Natural Resources)
Max Hutchison	The Nature Conservancy (retired)
Dennis Sharp	U.S. Fish & Wildlife Service
Karen Mangan	U.S. Fish & Wildlife Service
Mike Brown	U.S. Fish & Wildlife Service