STATE OF ILLINOIS
DEPARTMENT OF NATURAL RESOURCES

PROJECT PERFORMANCE REPORT

I. Project Information:

Project Title: Strategic Regional Coordination and Implementation for Southern Illinois Conservation Opportunity Areas (COAs) and Streams and Forests campaigns, as delineated in the Illinois Wildlife Action Plan (WAP).

Project Number: T-80-D-001

Federal Program: PR, DJ, SWG, Section 6, CVA, BIG-P, NCWC, _____
(circle or write in the name of the federal assistance funding source)

Reporting Entity: Shawnee Resource Conservation and Development Area, Inc.

Name:

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Date Report Prepared: 11/20/2018

II. Performance Report Information:

Type of Performance Report: Quarterly, Annual or Final (circle type of report)

Reporting Period: 09/01/2012 **to** 8/31/2018

Actual Accomplishments vs Project Objectives:

Project Objective: Use current mapping to develop at least two restoration areas of at least one acre and monitor for presence/absence of swamp rabbit, state-endangered Swainson's warbler, state-threatened golden mouse and the state-threatened canebrake rattlesnake.

Actual Accomplishment: Completed review of existing mapping and determined population density. Created and submitted population density data chart.

Project Objective: Work with Shawnee National Forest, the Central Hardwoods Joint Venture Partnership and other cooperators to identify opportunities to restore and enhance woodlands and barrens communities in the Cretaceous Hills; barrens are listed as key habitat in the WAP. Because of the prevalence of invasive species in this key habitat, coordinate with the Invasive Species Campaign and Central Hardwoods Invasive Plant Network because invasive species pose a particular threat to this plant community.

Actual Accomplishment: Provided coordination for a July tour of US Forest Service's Cretaceous hills Ecological Restoration project. To share Southern Illinois forest efforts, developed and presented "Using collaboration to overcome the ecological and social hurdles of forest management" (2015) at the Natural Areas Conference in Little Rock, Arkansas. The presentation reviewed the Let the Sun Shine In campaign and research upon which it was built. Authored white nose syndrome story about bat decline for Illinois Forestry Association, which featured tips to landowners on how to manage their

forested lands for bats. Participated in effort to develop a multi-state wildlife grant, being led by Kentucky, to enhance conservation of woodland and barren communities. Supported coordination of information transfer to The Nature Conservancy. Developed a handout for Giant City State Park on prescribed burns. Developed a proposal for the State and private Forestry FY2016 Northeastern Area Landscape Scale Restoration Competitive Process, which was titled *Let the Sun Shine In: Managing Forest Landscapes for Oaks, Priority Bird Species and Biological Diversity.* Development included working with partners to develop the project, conduct appropriate assessments, budget development and coordination. Also executed July tour of US Forest Service's Cretaceous hills Ecological Restoration project with regional conservation partners-and conservation-interested parties, supported Southern Illinois University in developing and finalizing brochure about the oak decline in Southern Illinois and presented to US Forest Service leadership on relevant human dimensions research in regard to Trail of Tears State Forest collaboration.

Project Objective: Support the development and implementation of a Forest Habitat Management Plan for Trail of Tears State Forest through a stakeholder meeting that results in identified strategies for cooperator action. The Trail of Tears State Forest is identified in the Forest Campaign as a priority site for Larue-Pine Hills-Western Shawnee-Trail of Tears COA and has been named a pilot site for the Forest Campaign.

Actual Accomplishment: Communication is an important element in the development and implementation of the Forest Habitat Management Plan for Trail of Tears State Forest. To support communication, Shawnee RC&D worked with the Illinois Forestry Association to promote (and attended) a daylong workshop, Catching Fire: Oak Restoration in Illinois. Shawnee RC&D also developed fact sheet handouts on "barrens, woodlands and glades," "southern Illinois birds" and "ecological history" of the site. Additional communications support was given in the creation of Web site information and media materials for Trail of Tears, including a question and answer document, media release, media alert, key messages and media interview tip sheet. Worked with IDNR media team to review planned outreach efforts for Southern Illinois and to determine possibilities for coordination and support. Provided one-on-one media training to IDNR staff person. Also communicated with partners about conservation issues related to this project and participated in two meetings about communicating effectively. The Shawnee RC&D presented at the IDNR forest division meeting and an on-site Trail of Tears meeting, authored articles for Illinois Forestry Development Council and Oak Woodlands and Forests Fire Consortium, and toured Chicago Woodlands project in Lake County.

Project Objective: Using GIS, develop an assessment of current forest blocks that quantifies size of existing forest blocks and identifies potential opportunities for the creation of new ones.

Actual Accomplishment: Completed forest block assessment utilizing GIS. Worked with cooperators and stakeholders to review/assess information and assisted in development of GIS analysis tool.

Project Objective: Develop tools to support land managers in understanding water level management, including providing support to Southern Illinois University in the refinement of the Buttonland Swamp Model and research into the historical extent of the swamp.

Actual Accomplishment: Presented *Illinois' Cache River: The Ecological and Social Hurdles of Restoring A More Natural Hydrology to a Severed River* at the 2015 Biennial Symposium of the International Society for River Science in LaCrosse, Wisconsin.

Project Objective: Continue to support the department and community/regional cooperators in seeking grant funds for the repair of the Karnak Levee, which has been documented as a threat to lower Cache River fish communities in greatest need of conservation because its failure has resulted in the loss of oxygen-rich water needed to support these species. The Congressional Water and Resources Development Act 2007 recognized the ecological importance of this levee by adding conservation to the levee's rason d'etre. Section 3059 reads: "The Cache River Levee constructed for flood control at the Cache River, Illinois, and authorized by the Act of June 28, 1938 952 Stat. 1217), is modified to add environmental restoration as a project purpose."

Actual Accomplishment: Developed a list of farmers in Alexander and Pulaski counties receiving farm subsidies for potential outreach strategy. Refined work on an intergovernmental agreement that authorizes IDNR to oversee and fund the levee's repair. Conducted GIS analysis of current and proposed flood impacts in the Cache River using new analysis from FEMA

Project Objective: Building upon work of U.S. Fish & Wildlife Service, conduct an aerial survey during wintertime to ascertain potential canebrakes located on the eastern/upper eastern portion of the watershed; USFWS has already completed this survey for the western/western/lower portion of the watershed. With this aerial survey, support on-going research at Southern Illinois University to reflect this addition.

Actual Accomplishment: Coordinated gathering and sharing of existing data, which eliminates need for an aerial survey. Cost estimates for analysis of aerial data currently out-of-budget.

Project Objective: Direct coordination and support of Phase III research with Illinois State Water Survey, which will provide additional detail about the hydrologic and hydraulic understanding of the Cache River.

Actual Accomplishment: Received draft report by Illinois State Water Survey and provided analysis of implications to project to conservation partners.

Project Objective: Research historical and existing data on the distribution of cane in the Cache River Watershed

Actual Accomplishment: Gathered and reviewed historical data and utilized it to guide research activities in partnership with Southern Illinois University Carbondale.

Project Objective: Provide a literature review and develop a summary document for regional cooperators that includes identification of best management techniques/practices and clearly identifies (through literature) importance of cane habitat regionally to species listed in greatest need of conservation.

Actual Accomplishment: Summary document begun but not completed due to expiration of agreement with IDNR. All data is still possessed and available to provide support to future projects and documents.

Project Objective: Using aerial imagery, map, then ground-truth, location of existing cypress and tupelo swamps. Then, evaluate swamps as habitat for all listed species in greatest need of conservation, including assessment of the environmental flow since this key habitat type often acts as a nursery for fish species in greatest need of conservation

Actual Accomplishment: Coordinated gathering and sharing of existing data, which eliminated need for an aerial survey. Costs for aerial survey exceeded budgeted funds so alternative methods were required.

Project Objective: Develop assessment of headcutting in the Cache River and tributaries and support regional cooperators in developing strategies to abate this threat, including the development of a monitoring plan and providing grant support. The headcutting of the lower Cache and its tributaries are deemed a threat to the loss of wetlands – a key habitat and important to species in greatest need of conservation.

Actual Accomplishment: Assessed headcut and provided information to IDNR. In brief, a headcut from the Karnak Levee has moved west and is being stabilized by Tunnel Hill State Trail, a bike path on an abandoned railway.

Project Objective: As part of the effort to support repair of the levee, refine levee matrix (designed to guide repair) with new information being developed by Southern Illinois University and Illinois State Water Survey. This levee matrix delves into, among other things, ways the levee could be repaired that would support fish passage of species in greatest need of conservation

Actual Accomplishment: Matrix updated with data from the Illinois State Water Survey "Phase III" report

Project Objective: Using the mapping, meet with stakeholders to develop strategies for the enhancement of this key habitat, as defined in the WAP, including (but not limited to) strategies for acquiring conservation easements from private landowners or inclusion in public ownership (especially prime habitat for the river cooter, a species in greatest need of conservation).

Actual Accomplishment: (See other notes on Structured Decision-Making Process) Through work on Buttonland Swamp, conservation agencies and organizations have developed a conflict about the definition of this community and agreement of its location on the landscape. Efforts are underway, as part of the SDM process, to ascertain community details. The outcome of these efforts will be critical to the successful completion of this effort. Based on the current workloads and discussions, the group expects to develop an agreement about where on the landscape this community is or should be and conservation objectives.

Project Objective: Support professional fish-related research, especially as it relates to Illinois' Streams Campaign as identified in the WAP and conservation targets for the Cache River.

Actual Accomplishment: Provided ongoing support and shared resources to conservation partners. Coordinated discussions with the Illinois EPA to supply additional data

Project Objective: Support The Nature Conservancy and its partners in the evaluation of water passage through its Grassy Slough Preserve and/or alternate pathways, designed to restore a more natural hydrology to the lower Cache, which suffers from hypoxic conditions, which are causing stress to fish species in the greatest need of conservation

Actual Accomplishment: Data layers and relevant data were provided to OWR to support this project. Worked with IDNR to develop language that would allow this project to move from planning into execution. Shared information from the Cache River Wetlands Joint Venture Partnership (Especially NRCS) to IDNR's Office of Water Resources. Further, during the timeline of this grant, the Cache River Wetlands Joint Venture Partnership approved, with the support of Shawnee RC&D, a conservation plan that calls for the restoration of a more natural hydrology, using the Grassy Slough corridor for that purpose. Lastly, Shawnee RC&D supported the Illinois Department of Natural Resources' Office of Water Resources in an inspection of the levee that runs through Grassy Slough. This levee is expected to be the conduit through which "reconnection" would occur. The levee, in specific, has several points where failure is possible. Such points were examined to ascertain whether a structure should be placed here.

Project Objective: Develop strategies (building off best techniques developed earlier in the project) for Larue-Pine Hills-Western Shawnee-Trail of Tears COA and Eastern Shawnee COA, which will result in reduction of forest fragmentation. Forest is a key habitat, and its fragmentation was listed in the WAP as a specific threat to its integrity.

Actual Accomplishment: Although strategy discussions were conducted, during the project period, concerns shifted to the need/desire for improved management of forest communities. Specifically, the mesophication of Southern Illinois forests remains a paramount concern. Further, the analysis, conducted at the beginning of this grant, shows that forest fragmentation is not as bad as initially perceived. For that reason a formal written strategy was not developed.

Project Objective: As identified in the Cache River Watershed science process, develop targeted areas for riparian restoration and work with regional cooperators to develop specific tactics for conservation and restoration of identified corridors

Actual Accomplishment: Shawnee RC&D collaborated with members of the Cache River Wetlands Joint Venture Partnership in a Structured Decision-Making process, which is designed to outline areas of mutual conservation concern and opportunities for restoration. Though the details are currently confidential, the work group has invested time and energy into identifying areas for riparian restoration. In addition to meeting participation, Shawnee RC&D took the lead in supporting the team in drafting its final report. Once it has been approved by all parties, it will be released and provided herein.

Project Objective: Develop strategies for the completion of a long-term West Swamp Structure and work-with regional cooperators to implement; this structure is deemed critical to the maintenance of swamp habitat, defined as a key habitat through the wetland entry in the WAP.

Actual Accomplishment: The Shawnee RC&D collaborated with members of the Cache River Wetlands Joint Venture Partnership in a Structured Decision-Making process, which was designed to outline areas of mutual conservation concern and opportunities for restoration. The work group invested time and energy into additional thought about a West Swamp Structure.

Project Objective: Provide a literature review and develop a summary document for regional cooperators that includes identification of best management techniques/practices for restoring and maintain healthy cypress and tupelo swamp and march habitat.

Actual Accomplishment: The literature review was completed, though the summary document was not.

Project Objective: Support IDNR review processes, as defined, to review COA materials, including preparing them for the final document, and providing guidance on future assessment of actions

Project Objective: Lead review of the WAP revision for 2015 with stakeholders and collaborators; provide summary document of activities documented and status of Cache River Watershed science document

Actual Accomplishment: The above two goals meshed together and grew into something bigger than first envisioned. To support the Illinois Department of Natural Resources in its 2015 revision of the Wildlife Action Plan, interviews with

campaign leads and GIS analysis was conducted to ascertain synergy between campaigns and Conservation Opportunity Areas. Additionally, a statewide survey was conducted, in collaboration with Bluestem, to ascertain how best to communicate with conservation professionals and how they were using the current Wildlife Action Plan. This analysis provided a framework for how Conservation Opportunity Areas would be included in the revision, which is being approached as a 10-year implementation guide. From these discussions, a decision was made to include a full chapter on Conservation Opportunity Areas in the revision (as opposed to the previously envisioned appendices). To accomplish this revision, Shawnee RC&D started working with statewide stakeholders and collaborators, as opposed to the region-specific coordination first envisioned. To support this work, a survey of 900 conservation professionals about the status, threats and opportunities in COAs was conducted and a draft report prepared. A second draft chapter for the IWAP revision was prepared; GIS analysis was created to support this and investigate COAs further.

Project Objective: Develop strategies that identify potential areas of restoration for fish and mussels species within the streams of the watershed. Research by Pitts (2012) documented spatial changes in fish assemblages, which are associated with degraded habitat so detailed information exists on which to base the development of these strategies

Actual Accomplishment: Several the proposed restoration measures in "Supporting Natural Communities of the Middle Cache River through Co-management" would benefit these species. Additionally, early in this grant, we identified that there was a data gap that exists for these species in the lower Cache River. Efforts were launched to fill this data gap by requesting incident reports of the four species in question, though the level of detail required to develop strategies eluded us. A grant was submitted and received, in collaboration with the Illinois Natural History Survey, that would investigate the status/presence of bottomland guild of fishes in the lower Cache River. Data was collected Summer 2014 and Summer 2015. The final report from INHS – Survey of historic populations of slackwater fish: Species in Greatest Need of Conservation in the Cache River watershed – was submitted.

Project Objective: Conduct review of the Cache River Watershed science document

Actual Accomplishment: Shawnee RC&D collaborated with members of the Cache River Wetlands Joint Venture Partnership in a Structured Decision-Making process, which is designed to outline areas of mutual conservation concern and opportunities for restoration. The work group invested time and energy into reviewing the conservation targets outlined in the Cache River Watershed science document. Shawnee RC&D took the lead in supporting the team in drafting its final report. "Supporting Natural Communities of the Middle Cache River through Co-management" was completed and submitted in prior quarterly report.

Project Objective: Provide suggested updates of the WAP to IDNR

Actual Accomplishment: Shawnee RC&D provided IDNR with a report titled Stakeholder perspectives on the status of Illinois' Conservation Opportunity Areas, a decade after their formation. This report sought to provide a snapshot of the level of coordination, activity and conservation effort underway in Illinois' Conservation Opportunity Areas, of which there are 33. That data was then used to formulate a draft chapter for the state on COAs, focused on the COA component of implementation. During this project, Shawnee RC&D supported IDNR's efforts to update its implementation guide by 1) providing an updated chapter on Conservation Opportunity Areas, 2) drafting summary documents for discussion 3) developing and providing a database of conservationists working in Conservation Opportunities Areas around the state; and 4) sharing findings from a survey of stakeholders working in Conservation Opportunity Areas via a webinar "Illinois' Conservation Opportunity Areas, a decade after their formation" to Vital Lands, a consortium of Illinois conservationists. The data from this report was used to formulate a draft chapter for the state on COAs, focused on the COA component of implementation.

Project Objective: Continue to support the department and community/regional cooperators in achievement of the goal of dredging the Cache River with the intention of creating deep water habitat, deemed necessary for fish refugia because of documented hypoxic condition in the lower Cache. The lower Cache provides important habitat for the state-endangered cypress minnow, bigeye shiner and redspotted sunfish, and the state-threatened bantam sunfish, as well as other fish species of greatest need of conservation.

Actual Accomplishment: Shawnee RC&D collaborated with members of the Cache River Wetlands Joint Venture Partnership in a Structured Decision-Making process. Dredging received considerable support from all conservation partners, as it positively affects the river and is supported locally by Cache River stakeholders; it is in the final report "Supporting Natural Communities of the Middle Cache River through Co-management." It also was affirmed in December 2014 by the partners, when they formally voted to endorse Restoring the Cache: Low Water Flow and Connectivity. This document outlines the partners' commitment to restoring water flow and outlines the specific restoration measures that are a part of that effort. This document was revised by the coordinator for this grant. The approval of this document represented a consensus-

building effort within the conservation partners working on the Cache River. Additionally, coordination, assessment and permitting were completed for the containment basins for holding the dredged materials and for a portion of the dredging project; A budget was prepared for the State of Illinois and was preliminarily included as a capital expense.

Project Objective: Work with cooperators and stakeholders to review/assess information contained in science plan for additional opportunities for forest restoration

Actual Accomplishment: Began research and drafted reports for each of the three Southern Illinois Conservation Opportunity Areas. Reports utilized findings from the assessment and provide a science-based rationale for the strategic plan

Project Objective: Replicate research on fish assemblages to other priority areas to determine presence/absence of the bottomland fish guild and identify spatial changes in other assemblages. Since fish assemblage work conducted in the watershed by Kristen Pitts(2012) has proved instrumental in assessing the integrity of stream habitat for fish species of greatest need, the replication of this work in other key streams is expected to result in similarly important findings for fish species of greatest need located in the Larue-Pine Hills-Western Shawnee-Trail of Tears COA and the Eastern Shawnee COA

Actual Accomplishment: Discussed need for conservation action with stakeholders. Provided science-based resources to improve understanding of community members.

Project Objective: Develop and enact a monitoring plan for the Bottomland fisheries guild, which research recently identified as extirpated from the river system (Pitts, 2012). Working with cooperators, develop a plan to improve habitat needed for this cadre of fishes, which includes the four state-listed species, i.e. species listed in greatest need of conservation in the WAP.

Actual Accomplishment: Early in the grant, we identified that there was a data gap that exists for these species in the lower Cache River. Efforts were launched to fill this data gap by requesting incident reports of the four species in question, though the level of detail required to develop strategies eluded us. A grant was submitted and received, in collaboration with the Illinois Natural History Survey, that would investigate the status/presence of bottomland guild of fishes in the lower Cache River. Data was collected Summer 2014 and Summer 2015. The final report from INHS – Survey of historic populations of slackwater fish: Species in Greatest Need of Conservation in the Cache River watershed was created as part of this project.

Project Objective: Support Southern Illinois University researchers in their work into cane, as further information on this habitat type is desired for more precise management in the future

Actual Accomplishment: Worked closely with SIUC researchers, providing data and new innovations in cane management and propagation to further cooperator research.

Project Objective: Initiate a study that delves into connectivity of off-channel wetlands with the intention of identifying areas in the greatest need of conservation, i.e. wetlands that are now disconnect from the river/tributary system and no longer functioning as nurseries for fishes. This connectivity is important to fish species in greatest need of conservation, particularly the four species listed with the state.

Actual Accomplishment: met with cooperators and partners but no final study developed.

Reasons Estimated Goals were not Met:

(In accordance with 2 CFR 200.328 (b)(2)(ii), the level of detail required for this section of the performance report is, if applicable, is the reasons why the applicable goals were not met within the given performance reporting period. Otherwise, indicate this was not an issue during the given reporting period by stating, “Not Applicable”.)

Project Objective: Building upon work of U.S. Fish & Wildlife Service, conduct an aerial survey during wintertime to ascertain potential canebrakes located on the eastern/upper eastern portion of the watershed; USFWS has already completed this survey for the western/western/lower portion of the watershed. With this aerial survey, support on-going research at Southern Illinois University to reflect this addition.

Actual Accomplishment: Coordinated gathering and sharing of existing data, which eliminates need for an aeial survey. Cost estimates for analysis of aerial data currently out-of-budget. Future funding for aerial photography may be sought in future agreements, however using existing data did provide valuable insight.

Project Objective: Provide a literature review and develop a summary document for regional cooperators that includes identification of best management techniques/practices and clearly identifies (through literature) importance of cane habitat regionally to species listed in greatest need of conservation.

Actual Accomplishment: Summary document begun but not completed due to expiration of agreement with IDNR. All data is still possessed and available to provide support to future projects and documents.

Project Objective: Develop strategies (building off best techniques developed earlier in the project) for Larue-Pine Hills-Western Shawnee-Trail of Tears COA and Eastern Shawnee COA, which will result in reduction of forest fragmentation. Forest is a key habitat, and its fragmentation was listed in the WAP as a specific threat to its integrity.

Actual Accomplishment: Although strategy discussions were conducted, during the project period, concerns shifted to the need/desire for improved management of forest communities. Specifically, the mesophication of Southern Illinois forests remains a paramount concern. Further, the analysis, conducted at the beginning of this grant, shows that forest fragmentation is not as bad as initially perceived. For that reason a formal written strategy was not developed.

Project Objective: Initiate a study that delves into connectivity of off-channel wetlands with the intention of identifying areas in the greatest need of conservation, i.e. wetlands that are now disconnect from the river/tributary system and no longer functioning as nurseries for fishes. This connectivity is important to fish species in greatest need of conservation, particularly the four species listed with the state.

Actual Accomplishment: Lost primary investigator due to loss of IDNR budget stability and all SIUC contracts were frozen. There was not enough time to properly formulate the study as needed.

Additional Pertinent Information:

(In accordance with 2 CFR 200.328 (b)(2)(iii), the level of detail required for this section of the performance report is, depending on the type of project (i.e. Research, Implementation, etc.) and whether it is an Annual or Final Performance Report, is to include additional information relevant to the project, such as: analysis and explanation of cost overruns or high unit costs; included Photographs, Maps, Data, Publications, Management Implications, Recommendations, etc. Otherwise, indicate this was not an issue during the given reporting period by stating, "Not Applicable.)

While some of the project deliverables could not be completed under this award, the Shawnee RC&D was able to procure funding for a related project, "*Let the Sun Shine In"*. This project leverages partnerships and data obtained during this project to continue valuable work with the US Forest Service.

Significant Developments:

(In accordance with 2 CFR 200.328(d) the level of detail required for this section of the performance report is to address when events occur between the scheduled performance reporting dates that have significant impact upon the supported activity. In such cases, the non-Federal entity must inform the Federal awarding agency or pass-through entity as soon as the following types of conditions become known: (1) Problems, delays, or adverse conditions which will materially impair the ability to meet the objective of the Federal award. This disclosure must include a statement of the action taken, or contemplated, and any assistance needed to resolve the situation. (2) Favorable developments which enable meeting time schedules and objectives sooner or at less cost than anticipated or producing more or different beneficial results than originally planned. Otherwise, indicate this was not an issue during the given reporting period by stating, "Not Applicable.)

Executive Summary:

(Regardless of the date when the federal agreement for the funding of this project was executed, ALL annual and final Performance Reports must contain this section. The executive summary should be less than four pages in length and contain relevant literature citations, when applicable. Executive summary for planning or research projects shall include a summary of the study objectives, research methods, major accomplishments and findings. Executive summary for implementation projects shall include a summary of activities, work location(s), and major accomplishments.)

Many of the objectives of this grant — Strategic Regional Coordination and Implementation for Southern Illinois Conservation Opportunity Areas (COAs) and Streams and Forests campaigns, as delineated in the Illinois Wildlife Action Plan (WAP) — detail advancements in conservation needed for the Cache River. The Structured Decision Making process, which launched June 2014, is the main vehicle through which conservation objectives are being achieved. After much effort, the team released this quarter its concluding document "Supporting Natural Communities of the Middle Cache River through Co-management." Shawnee RC&D played a critical role in this process, including conducting literature reviews and authoring the final report. The SDM process focused on 1) developing a shared understanding of the desired future condition for the middle Cache River, 2) identifying potential management actions for said region; and 3) briefly outlining each agency's role in fulfilling those management goals. As an invited participant, Shawnee RC&D focused conservation attention some of the larger goals contained within this grant. The final report identifies conservation projects and leadership for them. The SDM effort has included two workshops and near-weekly meetings since its launch more than a year ago.
This quarter also saw the release of a second important report: Survey of historic populations of slackwater fish: Species in Greatest Need

of Conservation in the Cache River watershed. Shawnee RC&D collaborate with INHS and funded equipment necessary to complete this assessment and analysis. This information fills an important data gap that existed for the Bottomland fisheries guild, which research identified as extirpated from the river system (Pitts, 2012). Through this effort, we were able to locate many of these critical species, though changes in the watershed have negatively affected these species. This report will allow us to develop and enact a monitoring plan for these species and determine potential areas of stream restoration that could benefit them.

Two important elements of efforts to protect and restore species in greatest need of conservation and the SDM process are repair of the Karnak Levee, the evaluation of water passage through conservation lands to restore a more natural hydrology to the lower Cache and dredging of the river. Important successes took place this quarter for these efforts, including the refinement of an intergovernmental agreement that authorizes IDNR to oversee and fund the levee's repair; and the organization of significant internal meetings within IDNR in regards to dredging and water passage.

During the project, Shawnee RC&D released a report titled Stakeholder perspectives on the status of Illinois' Conservation Opportunity Areas, a decade after their formation. This report provided a snapshot of the level of coordination, activity and conservation effort underway in Illinois' Conservation Opportunity Areas, of which there are 33. Interest in this report continues to grow. Most recently, Shawnee RC&D provided a webinar "Illinois' Conservation Opportunity Areas, a decade after their formation" to share the findings from this survey with Vital Lands, a consortium of Illinois conservationists. This research was an important element in the 2015 revision of the Illinois Wildlife Action Plan. Shawnee RC&D continues to support the state with its revision, often called an implementation guide, by developing and providing a database of conservationists working in Conservation Opportunities Areas around the state and developing an updated chapter for said guide (attached).

In addition to the Cache River, this grant includes important deliverables to advance woodland and barren conservation due to their importance for species in greatest need of conservation. Important success were shared via "Using collaboration to overcome the ecological and social hurdles of forest management" (2015), which was presented at the Natural Areas Conference in Little Rock, Arkansas. The presentation reviewed the Let the Sun Shine In campaign and research upon which it was built. Communication is an important element in this work. To support communication, Shawnee RC&D worked with the Illinois Forestry Association to promote (and attended) a daylong workshop, Catching Fire: Oak Restoration in Illinois, develop fact sheets, Web site information and key media documents. Communication efforts were coordinated with IDNR staff, including its media team. Additional effort including authoring a story for Illinois Forestry Association, which featured tips to landowners on how to manage their forested lands for bats, and participation in effort to develop a multi-state wildlife grant.

Despite the hurdles presented by the suspension of Shawnee RC&D's contract with IDNR, it is our belief that we have been able to effectively advance Southern Illinois COA conservation and the state's revision of the WAP and successfully execute this grant.

SUPPORTING NATURAL COMMUNITIES OF THE MIDDLE CACHE RIVER THROUGH CO-MANAGEMENT

A REPORT OF THE CACHE RIVER WETLANDS JOINT VENTURE PARTNERSHIP

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EXECUTIVE SUMMARY

A working group of the Cache River Wetlands Joint Venture Partnership (JVP) for the middle Cache River region of Illinois proposed and ranked a set of 34 potential conservation actions that would:

1) Improve the management capability needed to restore and protect ecosystem health

2) Protect or enhance the existing biological integrity and diversity of the middle Cache River, while,

3) Ensuring the system provides compatible recreation opportunities.

The working group, including representatives from Illinois Department of Natural Resources, Natural Resources Conservation Service, The Nature Conservancy and U.S. Fish and Wildlife Service, was established to address management goals for a portion of the Cache River. The area of consideration included the reach from the Post Creek Cutoff, east of the town of Karnak, IL, west to Big Creek near Ullin, IL (hereafter referred to as middle Cache River). Initially, 34 projects were proposed. Similar projects were combined, leaving 28 projects. They are listed in order of importance in Appendix D.

The JVP recognizes there are additional management objectives beyond supporting biodiversity and compatible recreation for this section of the river, including drainage and flood protection. While important to the JVP, addressing such non-biodiversity needs were not the focus of this process, but non-biodiversity related needs were considered to ensure negative impacts would be minimized or avoided by the recommended management actions. Many of the proposed actions discussed in this report should result in improved drainage, flood protection and recreation.

INTRODUCTION

A working group of the Cache River Wetlands Joint Venture Partnership (JVP), including representatives from Illinois Department of Natural Resources, Natural Resources Conservation Service, The Nature Conservancy and U.S. Fish and Wildlife Service, engaged in a process to address management goals for a portion of the Cache River. The area of consideration ranged from the Post Creek Cutoff, east of the town of Karnak, IL, west to Big Creek near Ullin, IL (hereafter referred to as middle Cache River; Fig. 1). The group focused on management concerns expressed by various members of the JVP working group during several teleconferences and two workshops (one held at Cypress Creek National Wildlife Refuge/Shawnee Community College in Ullin, Illinois in June 2014 and one held at Crab Orchard National Wildlife Refuge's Visitors Center in Marion, Illinois in October 2014). Their goals were to:

1. develop a common understanding about the presettlement conditions for the middle Cache River and, in particular, the lower Cache River Land and Water Reserve, a National Natural Landmark, referred to locally and hereafter as Buttonland Swamp;
2. develop a shared understanding of the desired future condition for portions of the middle Cache River;
3. identify potential management actions for the middle Cache River region;
4. outline each agency's role in fulfilling those management goals; and to
5. recommend potential management actions considered important for obtaining the desired future condition for the middle Cache River region to the JVP.

A fundamental goal of the JVP is to preserve, restore and support the natural communities of the region and to restore ecosystem function to the extent possible. Additionally, the JVP wants to ensure that agricultural and social resources are considered in management of the area. All working group members agree that an essential component of the restoration effort is to improve the hydrologic functioning of the middle Cache River.

During the next 10-15 years, the JVP will implement a jointly crafted set of recommended conservation actions for the middle Cache River to protect the existing native biodiversity and restore, to the extent practical, ecosystem processes in the middle Cache River region.

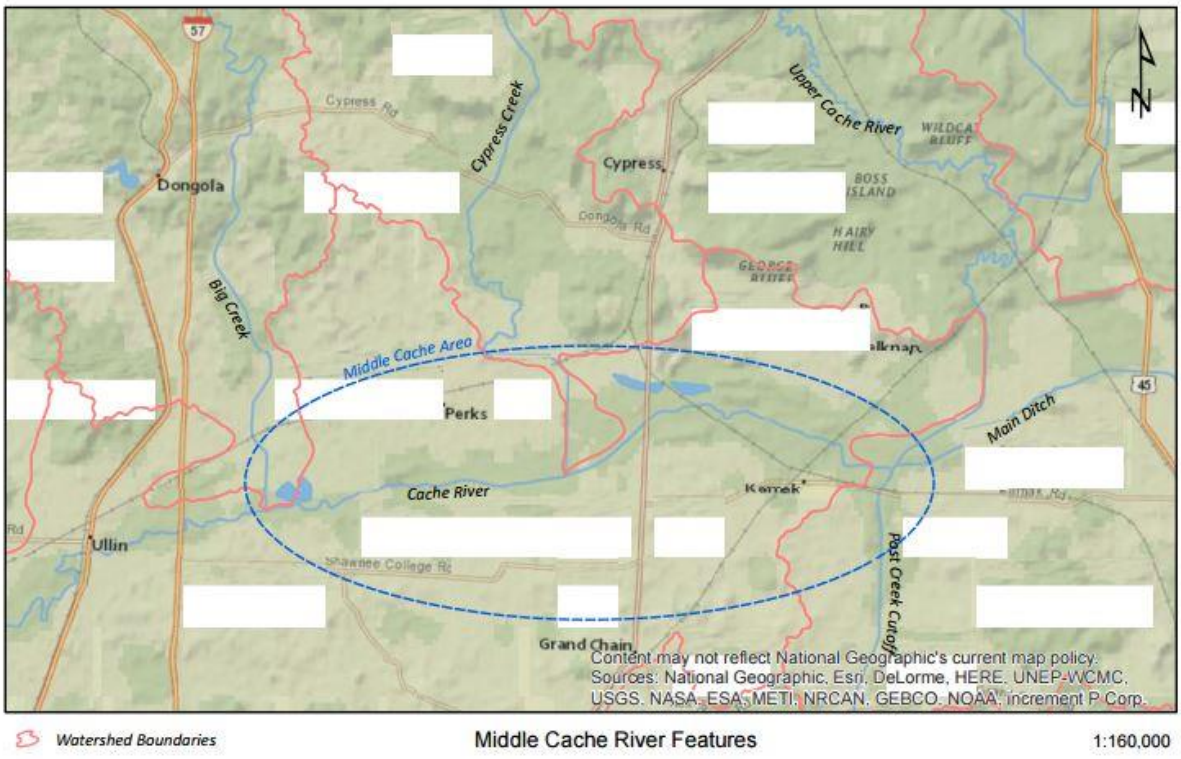

Figure 1. Area discussed in this report, the middle Cache River region of southern Illinois, 2015. The area of consideration ranged from the Post Creek Cutoff, east of the town of Karnak, IL, west to Big Creek near Ullin, IL (See area encircled on the map).

This report provides a summary of the discussions held during the past year and a set of recommended actions for the river and surrounding watershed that, when implemented, would support the existing natural communities of the area and improve the ecological functioning of the system. These recommendations serve as a guide for members of the JVP who will work within their individual authorities to take further supportive action to improve the ecological condition of the middle Cache River. The JVP recognizes there are additional management objectives beyond supporting biodiversity and compatible recreation for this section of the

river, such as drainage and flood protection. While important to the JVP, addressing these needs were not the focus of this process.

BACKGROUND

The middle Cache River is 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). The region contains important forest and wetland resources that have been recognized nationally and internationally with multiple designations: a National Natural Landmark (the Lower Cache River Swamp), an Illinois Land and Water Reserve, a Wetland of International Importance (Ramsar Convention 2009). It also is part of the Cache River State Natural Area and Cypress Creek National Wildlife Refuge. However, maintaining the biological diversity of the area is a huge challenge. Changing land use practices and multiple hydraulic alterations to the river and its tributaries during the last century have significantly affected the biological diversity, ecological integrity and functioning of the system (Demissie et al. 2010). Natural resource professionals striving to improve, protect, and restore the river's biological integrity and ecosystem health share a similar vision for the Cache River Watershed. However, resource professionals are unsure about the restorability of certain locations in the middle Cache River, which makes it difficult for partners to coordinate management actions in the river system.

Of the many hydraulic changes to the system, the most influential change occurred when the upper Cache River was severed from the lower portion of the river, forcing its headwaters to drain into the Ohio River via the Post Creek Cutoff (Fig. 2). This segregation altered the timing, frequency, volume, velocity and direction of flow of water in the lower Cache River, effectively eliminating the major formative processes upon which the system depended (Illinois Department of Natural Resources 1997, Demissie et al. 2008).

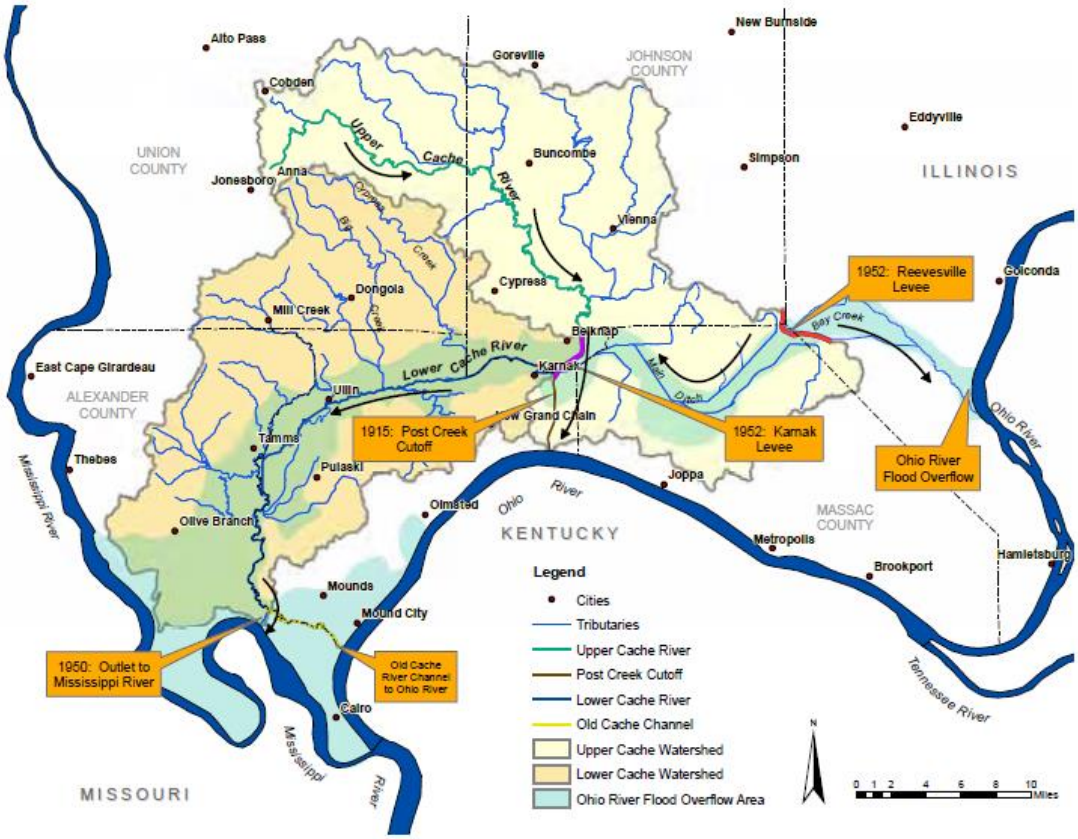

Figure 2. Major changes to the hydrological flow of the Cache River that resulted from the decoupling of the upper Cache River from the lower Cache River (From Demissie et al. 2008).

In the early 1990s, the JVP developed plans to restore a more natural hydrology between the upper and lower Cache River, ensuring a more reliable east-to-west flow of water in this section of the river. This action is often locally referred to as a “reconnection,” though the proposed project would only restore limited water flow. Restoring limited flow in the middle and lower Cache River would be especially beneficial during summer low flow periods. If executed, this project would improve water flow and connectivity between the upper and middle segments of the river, bringing additional dissolved oxygen and nutrients to the system and improving water management capability. The working group agrees that restoring water flow will benefit natural resources of the lower Cache River.

The completion of two reports by the Illinois State Water Survey (Demissie et al. 2008, Demissie et al. 2010) moved the reconnection initiative closer to implementation. The initial plan called for creation or modification of adjustable structures for improved water level management (USACE 2000, Cache River Wetlands Joint Venture Partnership 2014). However, as the partial reconnection concept progressed, a divergence of opinion developed regarding water level management until reconnection could be achieved. The divergence then focused on current management of the middle Cache River, an approximately 2.5 mile section of the river between the Post Creek Cutoff and the mouth of Big Creek.

The JVP agreed to pursue ecological restoration of the middle Cache River, including partial reconnection of the upper and lower river segments (Cache River Joint Venture Partnership 2014). In this 2014 report, the JVP briefly reviewed the ecological condition of the middle Cache River from the Post Creek Cut Off (located east of Karnak, IL) to just below Cache Chapel Road and agreed to implement a series of conservation measures. Within this report, our working group identifies the primary areas of concern among the group members and proposes watershed-scale management recommendations to help sustain biological diversity and improve the ecological functioning of the middle Cache River region.

In addition, the partners agreed to jointly explore future water level management of Buttonland Swamp at a later date. The partners will examine the objectives, management alternatives, and tradeoffs among alternative management actions for the Buttonland Swamp area. They will evaluate the consequences associated with specific actions, and the potential for establishing an adaptive management framework to promote learning in the event that desired future conditions are not being achieved. The outcomes of this work will be captured in a second report from the working group.

CURRENT CONDITIONS

CONSERVATION ESTATE

Within the Cache River Watershed, Illinois Department of Natural Resources, The Nature Conservancy and U.S. Fish and Wildlife Service own land for natural resource protection.

Natural Resources Conservation Service supports conservation through a variety of programs, such as the Wetland Reserve Program (now the Agricultural Conservation Easements Program (ACEP)). Conservation lands form a state natural area, preserve, refuge, and privately restored wetlands. They are:

- The 6,391ha Cache River State Natural Area spans Johnson, Massac and Pulaski counties and includes three distinct management units, which are Little Black Slough, Middle Cache River Swamps and Glass Hill. The lower Cache River swamps management unit includes high quality wetlands, such as Buttonland Swamp.
- The 1,155ha Grassy Slough Preserve, The Nature Conservancy's signature project in the Cache River Wetlands, once was mostly forested wetland and efforts are underway to restore the site to some semblance of its original condition.
- The 6,475ha Cypress Creek National Wildlife Refuge is located in southern Illinois just north of the confluence of the Ohio and Mississippi rivers. It includes seven management units; the Cache River unit encompasses a small portion of the Buttonland Swamp and lands that buffer it.
- The 5,463ha of privately restored wetlands through the Natural Resources Conservation Service's Agricultural Conservation Easements Program are in key locations throughout the watershed.

Also through the Natural Resources Conservation Service (NRCS), landowners are using a variety of conservation practices, such as conservation tillage, buffer strips, grassed waterways and reforestation. Many of these practices are through NRCS' Environmental Quality Incentive Program and Wildlife Habitat Incentive Program. In all, more than 18,210 hectares of private lands in the Cache River Watershed are using some sort of NRCS conservation program.

WATER RESOURCES

The Cache River has been dissected into three segments. The upper Cache drains into the Ohio River through the Post Creek Cutoff. The middle Cache drains through a diversion to the Mississippi River; it also can drain into the Post Creek Cutoff because of the breach in the Karnak Levee. The lower Cache, a section of the river that was abandoned when the diversion was constructed, drains into the Ohio River. (See Fig. 2 for graphic showing major river

modifications). The dissection of the upper Cache from the middle and lower Cache River has put the biodiversity and ecological integrity of the system at risk. Unnatural reductions in the volume, frequency and timing of water flow negatively affect biotic and abiotic processes that in turn affect wetland and aquatic communities (McKay and King 2006, McIntosh et al. 2002). For example, low oxygen levels in the river have been documented, including frequently hypoxic conditions that have led to fish kills (Rantala et al. 2013). Duckweed (*Lemna minor*) cover has increased in the system, likely due to reduced flow and high nutrient levels (Giblin et al. 2014), lowering dissolved oxygen levels (Houser et al. 2013) as plants respire and senesce (Parr and Mason 2003).

Scouring and deposition of sediments during flood events historically formed a meandering, braided river system where "the real channel, [was] scarcely to be defined" (Cache River Drainage Commissioners of Illinois 1905). Extreme flood events and higher velocity flows continuously carved new channels and back waters and sculpted contours in the river bed. This erosion and deposition of sediments formed the basis for the natural communities found in the middle Cache River today. Overall, an altered water regime and increased sedimentation, primarily due to human activities, have affected natural communities of the middle Cache River.

The modern Ohio River flooded the Cache every nine to 18 years prior to the construction of the Reevesville and Karnak levees (Gough 2005). Furthermore, sediment carried in via channelized tributaries has filled old channel scars and other river bottom contours. Continuing sedimentation, low dissolved oxygen, lack of flowing water and deep (>.6 m) and prolonged, or continuous flooding can affect bald cypress (*Taxodium distichum*) mortality (Penfound 1949, Eggler and Moore 1961), recruitment (Williston et al. 1980), and vigor (Dickson and Broyer, 1972, Bratkovich et al. 1994, Hooker and Rogers 1994, Middleton and McKee 2005, Keim and Amos 2012). In addition, modifications to the river also affected fish assemblages (Pitts et al. 2011; Bouska and Whitledge 2014, mussels (INHS 2011), and invertebrates (Rantala et al. 2013) historically associated with these habitats.

Today, concerns about the loss of structural diversity resulting from these perturbations are commonly voiced. Even the existing Cache River channel in the Buttonland Swamp area of the middle Cache River is "probably a remnant of … channelization and dredging" in the 1960s

(Demissie et al. 1990) with altered abiotic processes (i.e., hydrology, sediment deposition) that structure aquatic and plant communities (Oswalt and King 2005).

A variety of other factors influence water in the middle Cache River. Since the division of the Cache River basin into two watersheds, the middle Cache only receives flow from the upper Cache River during large flood events. During low or moderate flows, the middle Cache River section east of the mouth of Cypress Creek cannot sustain flow to the west, the former downstream direction (Demissie et al. 2008). From roughly the confluence of Cypress Creek and Cache River, water flows eastward and out through the breach in the Karnak Levee and into the Post Creek Cutoff, effectively de-watering this section of the river and leaving it completely dry during summer months.

Tributaries to the middle Cache River have had their hydraulics directly modified and their water quality negatively affected by surrounding land-use practices. These tributaries — especially Big Creek — are now the main source of sediment for the middle Cache River (Demissie 1989). Conservation projects in the Big Creek tributary purportedly have resulted in substantial reductions in the amount of sediment entering the middle Cache. Initially, when the authors of this report reviewed recent aerial photographs, visual cues suggested that Limekiln Slough may also be a significant source of sediment to the middle Cache River (Appendix A – aerial mosaic of the middle Cache River) requiring further investigation. After review of Demissie (1989) and consultation with the USFWS Regional Hydrologist, we agree that Limekiln has limited sediment transport capabilities (Josh Eash, Pers. Comm. USFWS, Bloomington, MN).

Within the Cache River Watershed the placement of infrastructure such as culverts, roadways, bridge and railroad abutments, and water control structures have contributed to the reduction of velocity of flowing water and changes to historic deposition of sediment. West of Karnak Levee and the Tunnel Hill weir, two additional weirs influence water levels in Buttonland Swamp (Lower Cache River Swamp National Natural Landmark; Fig. 3), beginning near Route 37 and continuing west past Long Reach Road. Of these two weirs, IDNR manages one weir, and the second weir (the Diehl structure) is managed by IDNR through a memorandum of understanding with a private landowner, who has reserved ultimate authority on the structure's operation and maintenance. Currently, the Diehl Structure is performing as

designed, mitigating the speed of drying that results from drainage activities and extending the duration of the wet period, but is not capable of holding water in the system indefinitely. When water is above 328.4', it spills over the structure and flows west.

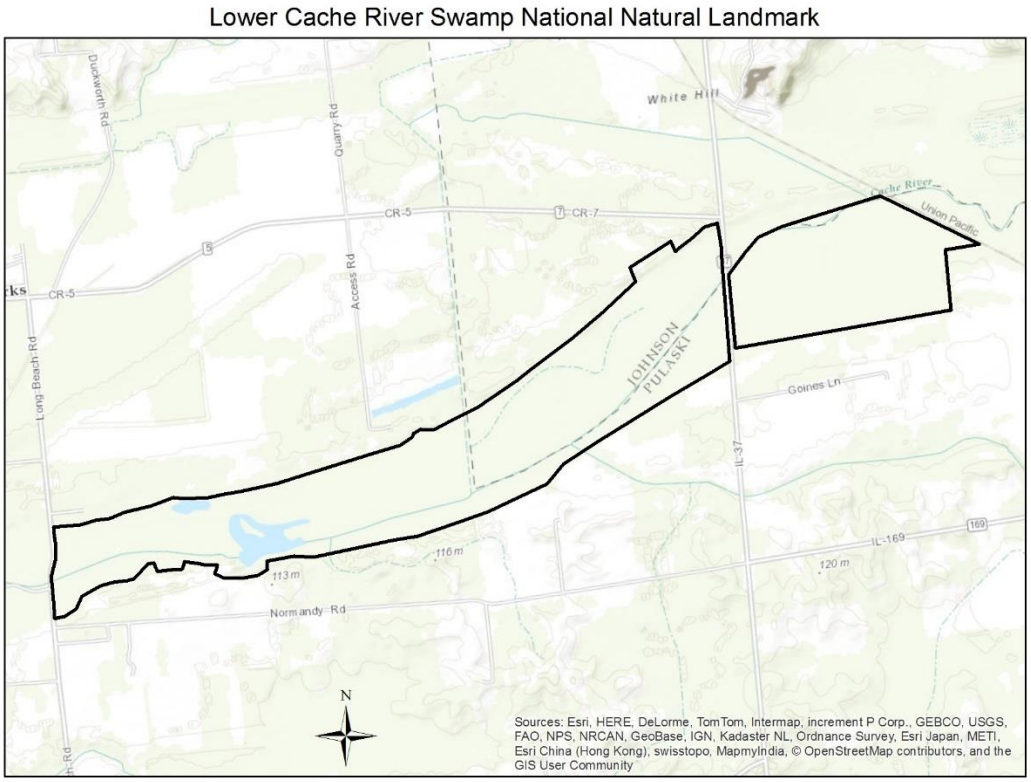

Figure 3. Location of the Lower Cache River Swamp National Natural Landmark, Cache River, IL.

BIOLOGICAL RESOURCES

In spite of all the changes to the system, 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 Resources 1997). Buttonland Swamp hosts bald cypress trees more than 1,000 years old, and 12 individual trees have been recorded as state champions (Illinois Department of Natural Resources 1997).

Reports from surveys conducted in the middle Cache River region list 86 species of freshwater fish, 230 macroinvertebrates, 10 crayfish and shrimp, 52 amphibians and reptiles (Phillippi et al. 1986), 23 mussels (Shasteen 2011), 128 breeding songbirds and 49 mammals (Illinois Department of Natural Resources 1997, Illinois Department of Natural Resources 2011). The Illinois Natural Heritage database records 99 species considered critically imperiled (66 classified as endangered, and 33 as threatened) in the Cache River Watershed (see Appendix B for complete list of species). Additionally, the region hosts a suite of species in greatest need of conservation (Appendix C). *The Illinois Comprehensive Wildlife Conservation Plan & Strategy* recognized the middle Cache River for its "small populations, declining populations, populations dependent on rare or vulnerable habitats, and indicative of the health and diversity of the state's wildlife and habitat resources." (Illinois Department of Natural Resources 2005).

One group of fish species in greatest need of conservation was the focus of a recent study. An analysis of fish in the Cache revealed that the bottomland guild, which depends on bottomland forests, is no longer intact. This is at least partially due to heavy sedimentation and hydrologic alteration of the river (Pitts et al. 2011, Bouska and Whitledge 2014). Preliminary data, collected during the summer of 2014, shows some of the species associated with low to no flow conditions (slack water) remain present in the Cache watershed; additional sampling and a final report is expected in late 2015 following additional spring sampling.

As a testament to the area's statewide significance, there are 62 sites 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, inventory results indicate 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 (Illinois Department of Natural Resources 1997).

LEGAL CONTEXT

The Cache River Wetlands Joint Venture Partnership is composed of Ducks Unlimited Inc., Illinois Department of Natural Resources, Natural Resources Conservation Service, The Nature

Conservancy and U.S. Fish and Wildlife Service. Each of the five organizations, has a unique mission as follows:

- Ducks Unlimited Inc.: Ducks Unlimited conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people.
- Illinois Department of Natural Resources: To manage, conserve and protect Illinois' natural, recreational and cultural resources, further the public's understanding and appreciation of those resources, and promote the education, science and public safety of Illinois' natural resources for present and future generations.
    - Lands legally protected by the Illinois Nature Preserves Commission (INPC) are found within the middle Cache River. The mission of the INPC is to assist private and public landowners in protecting high quality natural areas and habitats of endangered and threatened species in perpetuity, through voluntary dedication or registration of such lands into the Illinois Nature Preserves System. The Commission promotes the preservation of these significant lands and provides leadership in their stewardship, management and protection. Lands can be protected through the INPC as an Illinois Nature Preserve, an Illinois Land and Water Reserve or Natural Heritage Landmark. The middle Cache includes lands protected through the Nature Preserve and Land and Water Reserve programs.
    - Nature preserves are managed to preserve and enhance natural communities and populations of native plants and animals typical of presettlement conditions, using a variety of management techniques. The objectives of the Nature Preserve System are (1) to provide habitat for native plants and animals, (2) to preserve adequate examples of all significant types of natural communities and features occurring in the State (3) to allow and facilitate, dependent upon the landowners' permission, the visitation of the nature preserves for nature observation, study, education, and aesthetic appreciation, in such manner and to such degree as will not modify natural conditions and (4) to provide perpetual protection for the preserve against intrusions.

- The Land and Water Reserves program protects and manages for lands and waters supporting significant natural heritage or archaeological resources. Examples of lands and waters eligible for registration are: (1) Lands and waters included on the Illinois Natural Areas Inventory, (2) habitats of state listed threatened species of animals or plants, (3) areas supporting unusual concentrations of wildlife such as nesting colonies; hibernating colonies; and migration stopover, feeding and rest sites, and (4) restorations of natural communities of plants and animals that existed in Illinois at the time of settlement by immigrants from Europe for which no high quality examples are known within the region.

- Natural Resources Conservation Service: NRCS is committed to "helping people help the land"—their mission is to provide resources to farmers and landowners to aid them with conservation. Ensuring productive lands in harmony with a healthy environment is their priority. With operations in the United States, the Virgin Islands, Puerto Rico, and Guam, their agency touches the lives of a diverse range of individuals.
- The Nature Conservancy: The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends.
- U.S. Fish and Wildlife Service: The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.
  - 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.
  - U.S. Fish and Wildlife Service adheres to a biological integrity, diversity, and environmental health policy, which is an additional directive for refuge managers to follow while achieving refuge purposes and system mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems.

There are a series of structures and a levee controlling water movement within the middle Cache that have different ownership and management. They include:

- The Karnak Levee was constructed in 1952 for flood control by the Cache River Drainage District. In 1965, operation and maintenance was transferred to Big Creek Drainage District #2. Currently, a portion of the levee, located near the community of Karnak, has been breached, and the U.S. Army Corps of Engineers now considers it in "unacceptable" condition, meaning that it no longer is eligible for federal rehabilitation assistance under Public Law 84-99 for any flood related damages the levee might sustain in the future. The breached section of the levee originally included two 48" pipes, designed to handle local drainage. The single-directional culverts allowed local drainage to flow east to the Post Creek Cutoff/Ohio River but prevented upper Cache and Ohio waters from flowing west and entering the middle Cache River.
- An in-stream stabilization structure, located immediately west of Tunnel Hill Trail, was installed by IDNR at a crest elevation of 326' but has degraded to 324.7'.
- A second in-stream weir, located immediately west of Route 37, is owned and operated by IDNR. The crest elevation is permitted at 328.4', but has degraded to about 327.5'.
- A third in-stream weir is located west of Long Reach Road on private property. The weir, sometimes referred to as the Diehl Dam or the Diehl Structure, is cooperatively managed by IDNR and a private landowner, who has reserved ultimate authority for the structure's operation and maintenance. Its crest elevation is permitted at 328.4'.

CONSENSUS POINTS

The Background section of this document outlines areas of concern among the JVP that initiated the facilitated decision process described in this report so that participants could develop management options for a section of the middle Cache River (Note: Buttonland Swamp will be addressed at a future workshop). Through a series of teleconferences and workshops, participants either reached or re-affirmed mutual consent, or agreement on shared values for the areas, shared concerns about current or future management actions, and identified a

variety of potential restoration measures. The following list captures those points of agreement among partners.

1. The Cache River is a diverse, dynamic system, and, within that system, Buttonland Swamp is a unique and valuable resource that is special to many individuals. Lands within Buttonland Swamp are part of a National Natural Landmark, part of a Ramsar Convention wetland of international importance, and the area is designated as an Illinois Land and Water Reserve. The latter confers some legal protection. The registration agreement states the reserve was established for "the preservation and restoration of wetland and aquatic natural communities along the riparian corridor of the Cache River." Additionally, other lands in the middle Cache are afforded similar protection as an Illinois Land and Water Reserve. And, Section 8 Woods is an Illinois Nature Preserve, which provides an even higher level of protection.
    a. The community of bald cypress (*Taxodium distichum*) and tupelo (*Nyssa sylvatica*) trees found in this stretch of the river is very rare in Illinois, as is the deep water swamp, the only one of its kind in Illinois.
    b. Buttonland Swamp includes a unique assemblage of species. (See Appendix C for a list of species in greatest need of conservation).
    c. The habitat of a Southern deep water swamp is capable of supporting associated fishery (nursery and production).
2. The Cache River sports a diverse array of other natural communities/habitat types, and it is the desire of the working group that the ecological integrity of these communities and the greater watershed is restored to the greatest extent possible (Defined as: "…ecological systems, communities, and species…with sufficient natural composition, structure and function to persist over the long term" *From* Parrish et al. 2003)
3. Continuous flooding and stagnant water are not desirable for wetland communities, such as swamps that depend on seasonal and year-to-year variations in hydrology for growth and regeneration (Dicke and Toliver 1990).
4. Flowing water moves sediments out of the system, while also incorporating oxygen in the river. Both are needed for the health of the system.

5. Ideally the river channel should contain water in all but extreme drought conditions. Improving water flow and biological and hydrological connectivity between the upper and middle segment of Cache River could allow organisms to move between the two. Restoring a more natural hydrologic regime would provide for greater connectivity between the river and its floodplain.
6. The Cache River system once contained greater structural diversity such as meanders, deep water pools, riffles, etc., and there is a desire to restore some of that structure in the system. For example, previous dredging created unnatural banks that impeded connection with the floodplain – these banks could be removed. Restoring more natural contours (e.g. by dredging) within the Cache River channel and off-channel areas, especially where deeper pools historically were located, would remove deposited sediments and restore deep water refugia. Dredging would be particularly beneficial in the area known locally as Long Reach.
7. It is desirable to have the ability to periodically dry out certain natural communities, such as those found in Buttonland Swamp and Limekiln Slough, with the use of adaptively managed structures to achieve desired, yet-to-be-determined conditions. Participants agreed the desired periodicity and timing are unknown at this point. There was discussion that current structures could be used or a new/modified configuration could be employed to allow for greater flexibility in water level management, reducing potential conflict between partners by allowing some areas to be managed independently. The working group's desire was to improve the current hydrologic regime and associated flow with as little reengineering of the system as possible.
8. Some structures on the eastern end of the middle Cache River are acting as grade control structures due to stream instability introduced by the breach in the Karnak Levee. Those structures, including the Tunnel Hill bike trail, should be hardened so that this instability does not further threaten the river and adjacent natural communities.
9. The reduction of undesirable levels of sedimentation entering the middle Cache River via tributaries continues to be a priority.

10. There is interest in further investigating if the density of buttonbush affects recruitment or health of bald cypress, possibly through allopathic properties. Reducing the density of buttonbush has been discussed as a means of supporting tree regeneration, species diversity and improving water flow.

PATH TO A SOLUTION

DESIRED FUTURE CONDITIONS

When the group first met, participants agreed on the area of consideration, identified desired future conditions in the form of goals and objectives for the area, identified potential constraints, and set criteria by which to measure conservation success (Table 1).

Constraints/issues include:

- Managers only partially control the system's hydrology.
- Uncertainty regarding ecological functioning of the middle Cache River prior to river modifications (Fig. 2).
- Natural communities legally protected through the Illinois Nature Preserves Commission.
- North American Waterfowl Management Plan
- Farm Bill policies governing restoration and management actions
- Species recovery plans (e.g. Alligator snapping turtle)

Table 1. Cache River Joint Venture Partnership watershed objectives, criteria for success, general measures, and system drivers.

AGENCY	CRITERIA FOR SUCCESS	OBJECTIVES	METRICS	SYSTEM DRIVERS
Ducks Unlimited	Provide waterfowl and wetland waterfowl hunting opportunities	High quality habitat for waterfowl	Number of waterfowl species or waterfowl use days	Hydrology; food resting resources
U.S. Fish and Wildlife Service	Protect wetlands and bottomland hardwoods, biodiversity, endangered species. Provide for public access and recreational opportunities	High biological diversity (presettlement benchmark). Provide compatible recreational opportunities	Number of natural species/communities, community quality measure, Visitor satisfaction	Hydrology, management actions, system alterations, climate, weather
Illinois DNR (Illinois Nature Preserves Commission)	Protect State Natural Area resources and species of greatest conservation need. Ensure the natural quality of natural communities is not degraded. Passive forms of recreation are provided	Presettlement natural communities are protected, and they are healthy and have ecological integrity. Protect threatened and endangered species and species of greatest need of conservation. Provide for compatible recreation	% invasive species, water quality (DO, sediment contaminants), connectivity within the river, % fragmented. Mosaic of natural communities. Evidence of breeding success and dispersal.	Hydrology, management actions, system alterations, climate, weather
Natural Resources Conservation Service	Conservation on private land supports soil health, water quality, air quality, native biodiversity and ecosystems	Sedimentation and nutrients are controlled in Buttonland Swamp. Complementary conservation efforts are made on adjacent private lands, soils are healthy, Wetlands are restored	Soil health, reduce sedimentation and nutrient levels	Hydrology, system alterations
The Nature Conservancy	Protect and restore native biodiversity, as practical provide the full complement of native communities sustained by natural processes, large spatial scale and over time will allow for movement and evolutionary processes	Conservation targets are supported, threats minimized and supportive strategies are in place on the landscape. Support natural communities	Species abundance, species richness, species density. Habitat quality measures.	Hydrology, system alterations

The JVPs objectives are a reflection of the partners' collective values and are restated below as fundamental objectives in regard to desired future conditions (Fig. 4). They are as follows:

Fundamental objective 1: Restore and Protect Ecosystem Health of the middle Cache River Region

- Presettlement ecosystem functioning should be restored where practical
    - Historic hydrograph restored
        - water elevations, flow and timing should mimic presettlement conditions
    - Dynamic wet-dry cycles are restored
    - Dynamic river erosion-deposition processes restored
- Surrounding landscape supports and retains healthy soils
    - Sediment and nutrient inputs to the middle Cache River are reduced to presettlement levels

Fundamental objective 2: Protect Existing Biological Integrity and Diversity of the middle Cache River region

- Natural communities are represented and vigorous (as defined by the Illinois Natural Areas Inventory).
    - Swamp (Specifically, Southern Deep Water Swamp)
    - Shrub Swamp
    - Pond
    - Wet floodplain forest
    - Wet-mesic floodplain forest
    - Mesic floodplain forest
    - Southern flatwoods
    - Mesic upland forest
    - Dry-mesic upland forest
    - Spring
    - Low-gradient river

    - Low-gradient creek
- Conservation targets are represented and vigorous (per "Conservation targets, attributes," The Nature Conservancy 2012)
    - Bottomland Forests
    - Giant Cane
    - Cypress and Tupelo Swamp
    - Migratory Birds
    - Riverine Habitat
- State-listed Threated and Endangered Species are protected (See Appendix B for a complete list of species.)
- Species in Greatest Need of Conservation are protected
    - Large numbers of waterfowl and other migratory and resident birds
    - Natural riverine fish communities represented and healthy
    - Natural riverine invertebrates represented and healthy

Fundamental Objective 3: System provides for compatible recreation opportunities

- Hunting
- Fishing
- Paddling
- Hiking
- Bicycling
- Wildlife observation
- Photography

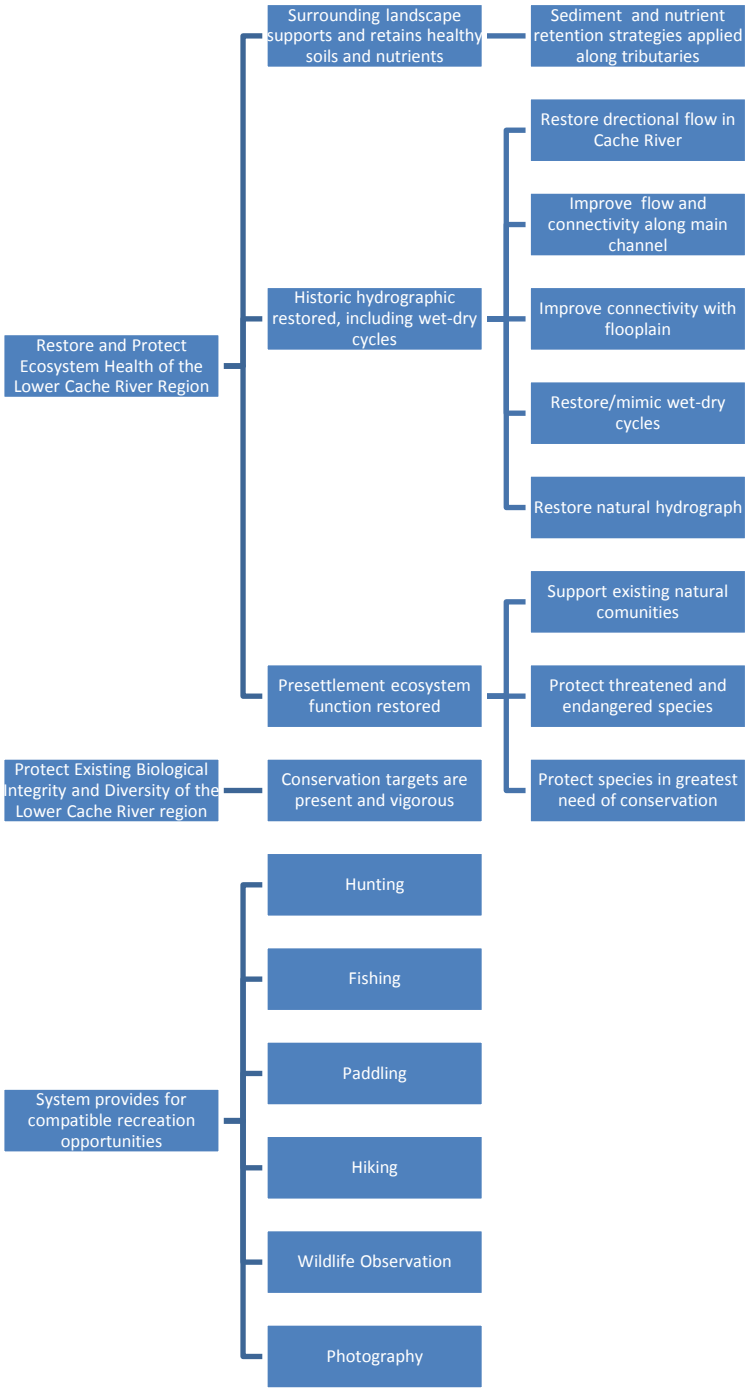

Figure 4. Initial objectives hierarchy for the middle Cache River based on the Cache River Joint Venture desired future condition. Most fundamental objectives are on the left. More detail about the fundamental objectives is provided on the right side of the diagram.

The fundamental objectives, including some that arose from the mission, policies, laws, mandates, and vision of each partner organization, are reflections of the values each organization and individual hold. This set of objectives is for the middle Cache River system as a whole. A future effort will be undertaken to focus on a desired future condition and specific objectives for the Buttonland Swamp area. Understanding collective values and having a well-documented process for prioritizing allowed the group to take a coordinated approach to planning while being forth-coming within the partnership and with stakeholders. Further, understanding priorities will allow the partnership to focus its limited resources on the most critical ecosystem components and will allow them to monitor for desired outcomes and change practices if warranted to ensure success.

CONSERVATION PROJECTS

Based on these objectives, the working group conducted an exercise wherein they carefully examined the middle Cache River system, including its tributaries. For the exercise, the group broke into teams of two. Each team was asked to look at an aerial photo mosaic of the middle Cache River (Appendix A) and identify what, from their perspective, needed to happen within the watershed to achieve the conservation goals the working group identified above. Each team was to act as though they had unlimited resources and blanket support and approval from all stakeholders for any conservation action they deemed important.

In the end, the group identified an initial suite of 34 projects that would address their shared conservation goals (Appendix D). Through the ranking and evaluation process projects with similar themes were combined with like projects resulting in the final list of 28 potential actions described below. Many of these potential projects are conceptual in nature and require further information and analysis before action is taken, whereas a handful have been assessed and are ready to advance into execution. The list of projects defined below include some that have been combined with another action based on similarity of the actions resulting in a reduced number of projects. Combinations are identified in the list. One project was removed from the list because it did not result in ecological improvement but is described in the text due to its importance from a human dimensions perspective. Note that although usually one agency is listed as the lead for a project, all partners share the responsibility of contributing to

the success of each project as their resources and legal authorities permit. See Appendix A for a map of the proposed projects. The number of each project below coincides with the numbering on the figure unless otherwise noted in the description.

1. **Cache Chapel Road Structure:** In the U.S. Army Corps of Engineers' draft *Feasibility Study Report with Integrated Environmental Impact Statement: Alexander and Pulaski Counties Study* (USACE 2000), the Corps examined ecosystem restoration of the Cache River with the goal of mitigating the "degradational effects on the Cache River's fish and wildlife resources" caused by "the adverse impacts from and altered water regime" as a result of prior Corps projects. The draft report suggested the installation of several water control structures. The group proposed a structure be installed at Cache Chapel Road, potentially replacing the current west swamp weir known as the Diehl Structure. The replacement would provide water-level management over a larger portion of the wetlands including Buttonland Swamp and Limekiln Slough. Moving the structure from private to federal property provides greater long-term management stability. Alternately, the Diehl Structure could be retained to provide additional flexibility in water-level management by allowing for different regimes on federal and state properties. A feasibility assessment is not required, as it was modeled by the Illinois State Water Survey. USFWS would be lead for this project.
2. **Long Reach Road Structure:** Relocate the west swamp weir (the Diehl Structure) from its current location (about 0.5 miles west of Long Reach Road) to Long Reach Road. This would provide easier access for maintenance and operations. It also could provide more water-level flexibility by allowing for different regimes on federal and state properties. Depending on the precise location of where this structure is constructed, which could occur on private property, there likely would be benefits in terms of long-term management stability. An assessment is required. IDNR would be the lead.
3. **Diehl Structure Improvement:** As an alternative to projects No. 1 and 2, improve the current west swamp weir (the Diehl Structure). The working group suggested investigating the obtainment of property rights (fee title or easement) for the current location. This would provide greater long-term management stability. Additionally, the

group recommended assessing the structure to determine if physical modifications could improve operations, management or maintenance. This project could be eliminated, depending on the outcomes of Projects No. 1 and 2. Or, it could be retained along with Project No. 1 providing additional flexibility in water-level management by allowing for different regimes on federal and state properties. An assessment is not required, as it was modeled by the Illinois State Water Survey. IDNR would be the lead.

4. **Natural Spring Restoration:** Restore natural springs in Limekiln Slough and other areas to improve flowing water quantity in the Cache River. The springs would be restored by excavating areas that have been covered with silt. Before this project could be initiated, investigating how spring restoration would impact low flows in the Cache River would need to be conducted. Lead would be USFWS.
5. **Limekiln Slough Outlet:** Restore an outlet from Limekiln Slough into the Cache River to allow U.S. Fish & Wildlife Service to manage the system for a mixture of bottomland hardwoods and cypress-tupelo swamp. Some believe past drainage activities (the construction of a berm to support a drag line) resulted in the elimination of a Limekiln Slough outlet, while others believe it historically had a diffuse outlet. Regardless, the current condition may cause periods of prolonged flooding, which then alters the vegetation in the adjacent wetlands. The lack of an outlet likely increases sedimentation rates in the wetlands and certainly is a nuisance to farmers, as it may impede drainage of adjacent agricultural lands. A future outlet could be located near or on a Wetland Reserve Program easement and/or private property. An assessment is required. Lead would be USFWS.
6. **Strategic Management Conservation Protection near Cache Chapel Road (Not pictured):** Restore natural vegetation on agricultural land acquired from willing sellers for conservation protection. These actions may be critical to the success of Project No. 5 (restoring an outlet for Limekiln Slough). Certain parcels may be critical to the success of Project No. 1 (water control structure at Cache Chapel Road) and require the acquisition of flowage rights. Some parcels are currently in the Agricultural Conservation Easement Program, so authorization from USDA NRCS may be required. Prior to European

settlement, some parcels were primarily wetland (bottomland hardwoods, cypress-tupelo swamp, and shrub-scrub) and located near the historic mouth of Big Creek, making this area desirable for restoration. NRCS would be the lead.

7. **Limekiln Slough Sediment Management:** Construct sediment management structures for Limekiln Slough. Determine if it would be useful to build sediment traps to decrease the amount of sediment transported to the wetlands adjacent to the Cache River. The precise form of the sediment traps remains to be determined but could include a catchment basin or created wetlands. An assessment is required. Lead would be USFWS working in collaboration with NRCS.
8. **Limekiln Slough and Goose Pond Dredging:** Investigate dredging of Limekiln Slough channel and Goose Pond, which is a cypress-tupelo area in Limekiln Slough that is adjacent to Cache River. Dredging would remove sediment bars, flow impediments, damaging levels of sedimentation and would provide for improved water flow and transportation of sediment. An assessment is required. USFWS would be lead.
9. **High-priority Conservation Protection (Not pictured):** Increase the buffer of conservation protected lands along the Cache River, with special focus on lands that were wetland prior to European settlement. All agencies will look for acquisition or easement opportunities.
10. **Egner Tract Management:** Create an outlet for U.S. Fish & Wildlife Service's Egner tract that empties into the Cache River below the current west swamp weir (the Diehl Structure). An outlet would allow this area to be managed independently by USFWS for drier conditions to favor bottomland hardwoods. Currently, it has an open canopy of cypress trees. An assessment is required. USFWS would be the lead.
11. **Flood Flow Culverts:** Install additional culverts under Long Reach Road, Route 37 and Urbana/Porterhouse Road to allow for the passage of flood pulses. This should allow flood pulses to pass through the system more quickly and potentially transport more sediment. It is possible it could disperse the flow and reduce flow and energy in the main channel, which may worsen the sedimentation issues in the thalweg (i.e. main channel). An assessment is required. This project would need the authorization and

oversight of county road commission and possibly the State Department of Transportation. IDNR would facilitate discussions and move the process along**.**

12. **Cache River Dredging:** Dredge the existing Cache River thalweg. This would restore the present-day low flow channel and deep water habitat that has been lost due to high levels of sedimentation, thereby improving oxygen levels in the river and allowing for more efficient removal of sediment. This could be important for fish and other aquatic resources, especially during periods of low water. This project would not, however, restore the natural sinuosity of this river. An assessment has been completed. IDNR would be lead.
13. **Unnatural Levee Removal:** Remove unnatural levees along Cypress Creek near its mouth at the Cache River, which theoretically would allow high water flows to disperse through the restored ribbon of forest. This project could bring oxygenated water to this portion of the floodplain. By dispersing the flow, it also would reduce velocity and energy in the main channel affecting sediment deposition rates. Before this project could be executed, an assessment is required to ascertain how water levels might affect forested wetlands and whether the delivery of sediments is affected. IDNR would be lead.
14. **Historic Channel Restoration – Cache River:** Restore old river meanders and side channels along the entire middle Cache River where historic river channels (including oxbows) existed and ensure connectivity to thalweg habitat. This would recreate some of the deep water habitat that has been lost due to high levels of sedimentation, improve oxygen levels in the river and increase habitat heterogeneity. This could be important for fish and other aquatic resources, especially during periods of low water and droughts. An assessment is required. IDNR would be lead.
15. **Buttonbush Removal:** Remove buttonbush in areas of the swamp where open water is desired. Buttonbush may be competing with more desirable species and impacting flow rates and oxygen levels. IDNR would be the lead.
16. **Cypress Creek Riffle Weirs:** Add riffle weirs in Cypress Creek to increase oxygen levels in the water that is entering the Cache River and potentially stabilize the streambanks.

During the driest summer months, Cypress Creek is the sole source of water to Buttonland Swamp and is one of the ways in which additional oxygenation can be provided during drier time periods. In this section of the middle Cache, low oxygen has been documented, as have fish kills. This project could be located in either the current Cypress Creek or a restored historic channel (Project No. 21). An assessment is required. IDNR would be lead.

17. **Historic Channel Restoration - Cypress Creek:** Restore historic Cypress Creek channel, which could re-hydrate wetlands, increase oxygen levels and increase habitat heterogeneity. It would provide important production habitat for invertebrates, a food resource for fishes. It also would provide spawning habitat for fish, including the rare bottomland guild of fish. IDNR would facilitate this action.
18. **Cypress Creek Well:** Install a well along Cypress Creek. This well could pump water into Cypress Creek during periods of no or low flow. This could increase flow rates and oxygen levels to provide better habitat for fish and other aquatic resources; this project would benefit from being paired with Project No. 20, which would speed the normalization of temperature and oxygen levels. This project could be designed to push water into the current Cypress Creek or a restored historic channel (Project No. 21). It too would require an assessment. IDNR would facilitate this action.
19. **Cypress Creek Sediment Management:** Implement conservation practices to decrease the amount of sediments carried by Cypress Creek into the middle Cache River. Some examples of projects include stream bank stabilization, buffers, weirs and retention basins. Some assessments, such as a hydraulic model, have been completed, but additional assessments likely are required. NRCS would be the lead.
20. **Removal of Route 37 Structure:** Remove the Route 37 structure from the Cache River. This weir currently holds water in Buttonland Swamp. The removal of this structure depends on the construction of the east swamp structure (Project No. 28), and the completion of Project No. 1, 2 or 3. An assessment is not required, as it was modeled by the Illinois State Water Survey. IDNR would be lead.

21. **Cache River Streambank Stabilization:** Install weirs in the Cache River to stabilize the streambank between Tunnel Hill Trail and the Karnak Levee. The breach in the Karnak Levee has allowed the Post Creek Cutoff to form a new head cut that is moving westward and threatens forested wetlands owned by Illinois Department of Natural Resources, as well as road and bridge stability. Affected wetlands are registered as a Land and Water Reserve with the Illinois Natures Preserves Commission. A preliminary assessment has been completed, though a project assessment is required. (This project may be unnecessary if the breach in the levee is repaired, see Project No. 29.) IDNR would be the lead.
22. **East Swamp Structure:** The *U.S. Army Corps of Engineers' draft Feasibility Study Report with Integrated Environmental Impact Statement: Alexander and Pulaski Counties Study* called for an east outlet structure, so named because it would allow high water to move quickly off the land and flow eastward through the Karnak Levee and into the Post Creek Cutoff/Ohio River. This structure also would hold water at a specified height, thereby establishing the gradient needed to force water to flow westward during normal and low-flow conditions. This project would place that structure in the Cache River at the Tunnel Hill Trail. An assessment is not required, as it was modeled by the Illinois State Water Survey. IDNR would lead.
23. **Karnak Levee Repair:** Repair the breach in the Karnak levee, which would prevent flood waters and sedimentation from high-magnitude floods, such as 2008 and 2012, from entering the middle Cache River from the Post Creek Cutoff. The Water Resources Development Act of 2007 included language that added a conservation element for the levee's raison d'être. Section 3059 reads: "The Cache River Levee constructed for flood control at the Cache River, Illinois, and authorized by the Act of June 28, 1938 (52 Stat. 1217), is modified to add environmental restoration as a project purpose." Repair of the levee would stabilize the streambank by helping arrest the headcut in this portion of the Cache River, provide flood protection to local communities and rehydrate adjacent wetlands, which are registered as a Land and Water Reserve with the Illinois Natures Preserves Commission. The levee's repair also would prevent Ohio River flood pulses

from entering the middle Cache River, which historically contributed additional sediment dynamics (erosion and deposition) to the Cache. An assessment is not required, as it was modeled by the Illinois State Water Survey. This project would need the authorization and oversight / management of drainage district and potentially others. Therefore, IDNR could facilitate the project discussions and shepherd the process along.

24. **Reconnection Water Flow Structure and Weir:** The *U.S. Army Corps of Engineers' draft Feasibility Study Report with Integrated Environmental Impact Statement: Alexander and Pulaski Counties Study* (USACE 2000) also suggested the construction of a water flow structure and weir**.** While the East Swamp Structure (Project No. 28) would re-establish an east-west gradient, allowing water to flow westward as it once did naturally, it wouldn't provide the "extra" water needed to sustain these flows, particularly during summertime when the Cache River suffers from its lowest dissolved oxygen levels. That "extra" water could come from a water flow structure located on the western portion of The Nature Conservancy's Grassy Slough Preserve, and a weir, located in the Forman Floodway. The diverted water would increase flow rates and oxygen levels in the middle Cache River, especially during periods of little or no flow and may provide a biological connection between the middle and upper Cache River for aquatic organisms. An assessment is not required, as it was modeled by the Illinois State Water Survey. IDNR would be lead.
25. **Historic Channel Restoration – Braided Cache River:** Create a secondary connection pathway to recreate the braided river system, which once flowed in this section of the Cache River. Direct water from the Foreman Floodway to the Cache River through old channels located between Karnak and Belknap. This would require the completion of Projects No. 28 and 30, and likely No. 32. An assessment is required. IDNR would lead.
26. **Conservation Protection at Grassy Slough (Not pictured):** Work with willing sellers to acquire private lands or conservation easements to allow for improved management flexibility. Doing so could provide future flexibility for reconnection alternatives and also

is crucially important for better management at Grassy Slough Preserve. The Nature Conservancy would be the lead.

27. **Big Creek Sediment Management:** Complete additional conservation measures in the Big Creek watershed. Implement conservation practices to decrease the amount of sediments carried by Big Creek into the middle Cache River. Some examples of projects include stream bank stabilization, buffers, weirs and retention basins. Some assessments have been completed, but additional assessments likely are required. NRCS would be the lead.
28. **Big Creek Stabilization:** Stabilize Big Creek, which may include repair or replacement of in-stream weirs and creation of new stream weirs. The weirs of concern were installed after the lower portion of Big Creek was channelized and straightened. The weirs prevent head cutting, provide for stream bank stabilization and reduce the amount of sediment transported into the middle Cache River. Illinois State Water Survey has documented that these weirs are failing. IDNR would be the lead.

One additional project was not included with this list but bears mentioning and it is: **Flood protection improvements for the Village of Karnak (Appendix D, #29).** Community flood protection measures are unlikely to directly enhance the ecology of the middle Cache River, but increased flood protection for the Village of Karnak may make support of other projects more likely. A preliminary assessment has been completed, and IDNR's Office of Water Resources has suggested specific measures. IDNR would facilitate these actions.

Evaluation of Actions

Given the large number of potential actions it was useful to evaluate each of the projects in light of the values or fundamental objectives that the working group articulated early on and in regard to the practicality of implementation. To evaluate projects, the group developed and agreed on six criteria to be used in conjunction with a simple multi-attribute rating technique (SMART) to help prioritize actions within the watershed. Criteria are listed under themes 1 – 6 below. The simple multi-attribute rating technique is based on a linear additive model. The overall value of a given action was calculated as the total sum of a performance score for each

criterion, multiplied by the weight of that criterion. Each criterion is grouped under themes describing the desired actions' general contribution to the protection and conservation of the natural resources of the middle Cache River. The rating values (e.g. 1-2, 1-3, or 1-4, etc.) used to score each action are given for each criterion. Clarification and examples for interpreting each criterion are provided. The weighting process was based on a modified Delphi technique called "direct rating" (Goodwin and Wright 2011). The most important criterion, determined by group consensus, was assigned an importance of 100. The next most important criterion was assigned a weight reflecting its importance relative to the most important criterion and so on. A criterion with no relative importance in the evaluation of an action was given a "0", effectively excluding the criterion from further consideration. It was expected that different individuals in the group could have different relative ratings. We then calculated a weighted average of the values assigned to each action. This step allowed for normalization of the relative importance of the weights summing to 1. Actions were then ordered from most important to those considered less important to the overall conservation of the region.

1. **Theme: Legal Mandates**

    A. **Protects listed species or listed natural communities (Maximize; 1-4)**

    Score each proposed action by evaluating the *degree of impact* an action may have on a particular species or natural community federally listed under ESA, state listed (threatened or endangered only) or ranked by the IL Natural Heritage Program.

    1. Negative impact on listed species or natural communities
    2. No or low impact on listed species or natural communities
    3. Moderate improvement on listed species or natural communities
    4. Great improvement listed species or natural communities

    B. **Protects biological diversity and ecosystem health (Maximize; 1-4)**
    Score each proposed action based on the degree to which you believe the action will either promote or degrade biological diversity and/or restore or degrade ecosystem health.

    1. Negative impact on diversity and ecosystem health
    2. No or low impact on diversity and ecosystem health

3. Moderate improvement on diversity and ecosystem health
4. Great improvement diversity and ecosystem health

2. Immediacy of Need

A. **Degree of public and agency or organizational acceptance (Maximize; 1-4)**

Does the action reduce a socially or politically sensitive issue among the partners or with the public?

1. Known controversy; this action will not resolve a sensitive issue
2. Not currently controversial, but potentially or suspected of raising a controversy
3. Known controversy; this action will resolves a sensitive issue
4. Not controversial and little to no potential for raising a controversy

B. **Threat or Urgency (Maximize; 1-4)**

Does the action mitigate a known or suspected threat to natural resources in the river?

1. No existing threat or potential for a threat to natural resources.
2. Addresses a potential threat to the natural resources but can be dealt with later.
3. Addresses a known threat to the natural resources but can be dealt with later.
4. Urgently needed to stop a known threat to natural resources.

3. Ecology of the System

A. **Ecological Processes**

Does the action restore, improve, mimic or protect (e.g., water flow, timing, velocity, quality (DO, sediment load, nutrient load), elevation) ecological processes or function (e.g., removes sediments/contaminants; creates/restores important habitats such as deep water pools, etc.)?

1. No, little restoration, improvement or protection of ecological processes
2. Medium, restoration, improvement or protection of ecological processes
3. High, restoration, improvement or protection of ecological processes

4. Sustainability

A. **Project is sustainable from a practical standpoint**

Agencies seek to implement an action that will have lasting or long term, positive effects. Thus please score each project based on whether or not you believe the project will require a long term commitment of operating staff or operation and maintenance dollars to keep it functioning as intended.

1. Requires regular upkeep such as maintaining ecological function or operation and management (e.g. Diehl structure requires annual O&M long term)
2. Requires periodic upkeep (e.g. periodic dredging needed to maintain deep water habitats)
3. Self-sustaining, little upkeep projected

5. Cost

A. **Cost ($) of initial project completion.**

Some things maybe be easier to fund than others.

1. High > 1M
2. Medium $200k-1M
3. Low = 0 > Project <200K
4. No

B. **Ecological Cost**

Often actions have negative as well as positive impacts. It is desirable to minimize tradeoffs, such as possible secondary effects. An example may be creating deep water habitat for recreational fishing but that may come at a cost to green tree reservoir type habitat unless managed carefully. The focus here is on long-term consequences, if there are any, to a project in terms of one sort of resource winning while another loses out.

1. Long term negative effects on non-target resources.
2. Temporary or short-term effect on non-target resources
3. No negative effects on non-target resource

6. Project dependency/sequencing.

A. **Project Depends on Another**

A project may be dependent upon another project being completed.

1. Project is dependent on others being done first

2. This is an independent project, does not depend and no projects are dependent on this one.
3. Other projects are dependent on this one

Once the above criteria were finalized, the group then developed a rating scale for each of the criteria, to reflect relative importance among the six items listed. This is the relative weight given to each criteria. Each action was then scored individually by each team member using the 6 criteria and their weights. Scores were then normalized, weighted and summed for each action resulting in a numerical ranking of projects from highest to lowest value based on the criteria.

From this ranked list of actions (Appendix D), the group then developed suites or categories of actions that could be completed in concert to best address their fundamental objectives for the middle Cache River rather than taking each action sequentially. The categories are listed below. Additionally, there is a category called "on-going" that lists projects dealing with conservation protection of lands that are by their very nature opportunistic, dependent on funding, and are free from being directly tied to project work.

RECOMMENDATIONS

CONSERVATION PROJECTS – LISTED BY PRIORITY

Many of these potential projects are still conceptual and require further information and analysis before action is taken, whereas a few have been assessed and are ready to advance to execution. Therefore, projects that currently rank high in priority may be removed or have their priority downgraded as additional information is acquired. In the meantime, the categories provide an initial direction for conservation actions that can be taken now to improve the overall quality of the middle Cache River ecosystem while other proposed projects receive further evaluation.

CATEGORY ONE

Category One projects include those that would have the greatest positive affect on the natural resources of the middle Cache River. These include:

- **Cache River Dredging**
- **Historic Channel Restoration – Cache River**
- **Big Creek Stabilization**
- **Hydrological and Biological Reconnection: Water Flow Structure and Weir**
- **East Swamp Structure**

CATEGORY TWO

These projects are important for stopping sediments before they enter the middle Cache River and stymie the efforts outlined in category one projects.

- **Big Creek Sediment Management**
- **Cypress Creek Sediment Management**
- **Limekiln Slough Sediment Management**

CATEGORY THREE

This project would allow the USFWS to independently manage the Egner Tract.

- **Egner Tract Management**

Strategic Management Conservation Protection near Cache Chapel Road: Agricultural land for conservation protection. This may be critical for project No. 5 (restoring an outlet for Limekiln Slough). Further, the southern end of this parcel may be critical for project No. 1 (water control structure at Cache Chapel Road) for the acquisition of flowage rights. Lastly, the southern end of this parcel is in the Wetland Reserve Program, so authorization from USDA NRCS may be required. The remainder – and majority – of this parcel is being farmed. Prior to European settlement, this parcel was nearly all wetland (bottomland hardwoods, cypress-tupelo swamp, and shrub-scrub) and is the location of the historic mouth of Big Creek, making this area desirable for restoration.

High-priority Conservation Protection: Increase the buffer of conservation protected lands along the Cache River, with special focus on lands that were wetland prior to European settlement.

INFORMATION NEEDS

A few information needs were identified through this process. Needs related to the management or ecology of Buttonland Swamp will be addressed in a follow up workshop. Information needs include determining:

1. if there is evidence of cypress tree regeneration in Buttonland Swamp and providing managers with a better understanding of what controls regeneration.
2. vegetative response of the cypress and tupelo and other natural communities in Buttonland Swamp if land managers dewatered the site periodically.
3. indicators for monitoring improvements in tree health in Buttonland Swamp following management.
4. how sedimentation is affecting cypress trees within Limekiln Slough.
5. if the function of the natural springs at Limekiln is impeded by sedimentation and if so, determining if the springs would benefit from restoration efforts.
6. Ascertain whether or not buttonbush are preventing cypress and tupelo and other plants from regenerating.

UNCERTAINTY

ETIOLOGICAL UNCERTAINTY

It isn't fully known how many of the proposed actions will affect the system or how the system will affect future decisions because of practical, cultural and social issues within the watershed. Managers need to be aware of this type of uncertainty. Monitoring will be invaluable for helping resolve etiological uncertainty.

Partial controllability or Implementation uncertainties

There is uncertainty around the partial controllability of water levels and water flow in the system and further how climate change might affect the system over time. There is uncertainty about the current health of cypress and tupelo in Buttonland Swamp. There is uncertainty about the degree to which sediments and nutrients can be retained in the uplands through restoration actions. Monitoring designed to provide information about the success of projects will be important for learning about and measuring our success and adjusting our management actions.

Partial Observability

Uncertainties related to partial observability arise because components of the system being managed may be measured or observed indirectly. In particular, there is some uncertainty about the presettlement condition and functioning of the Buttonland Swamp. Additionally, the system's ecological drivers have been highly altered, which contributes to uncertainty regarding predicted responses of the system to management actions.

Setting up an Adaptive Management Framework

Adaptive management is appropriate when there is uncertainty about outcomes and/or how to best achieve stated conservation goals and objectives and there is some degree of controllability in situations where management decisions will be made repeatedly, either temporally or spatially. In short, to resolve uncertainty and improve management, there is a need to evaluate the outcomes of management actions and decisions. The structuring of the management problem, the explicit way in which alternatives and outcomes are defined, and the use of monitoring to reduce uncertainty over time, is what differentiates adaptive management from other forms of management followed by monitoring. The partnership's concern about the ecological health of Buttonland Swamp and its associated resources of concern make it well suited for adaptive management. Buttonland Swamp will be dealt with in a future workshop.

NEXT STEPS

In summary, the working group set out to address the following goals:

1. develop a common understanding about the presettlement conditions for the middle Cache River;
2. develop a shared understanding of the desired future condition for portions of the middle Cache River;
3. identify potential management actions for the middle Cache River region;
4. briefly outline each agency's role in fulfilling those management goals; and to
5. make recommendations about the management actions needed to obtain the desired future condition for the middle Cache River region.

All but goal one were reached and detailed in this report. Significant headway was made on goal number one during this exercise. Discussions regarding the middle Cache River indicated that there was agreement about the ecology and history for much of the area. The group agreed to continue to work together to explore future management opportunities for Buttonland Swamp. The outcomes of that future workshop will be captured in a second report from the working group.

Many of the projects outlined in this report are complex and require collaboration within the Cache River Wetlands Joint Venture Partnership (JVP) and, often, external partners. This report should serve as a guide for conservation actions among the JVP, though the specific action taken may be different than what is outlined. As noted previously, many projects are conceptual in nature and additional assessments are needed to fully develop them. For these projects to advance through assessment and into execution, a conservation partner will need to shepherd them through the process. The working group took the liberty of identifying potential leads for each of the recommended actions but recognize that each partner will contribute to the greatest extent possible within their legal mandates and available resources. A full listing, in ranked order, of the initial projects (1-34) is provided in Appendix D.

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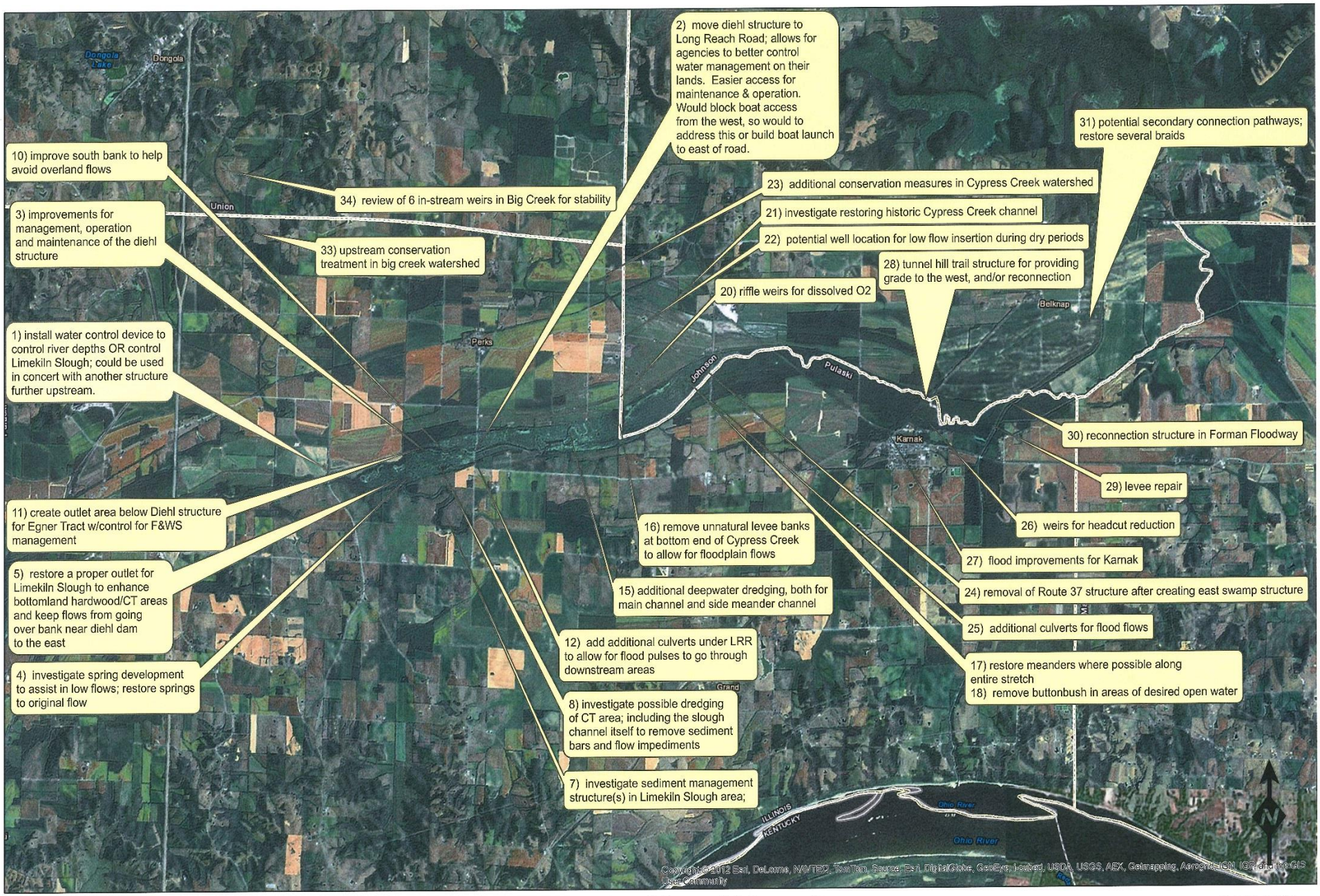
APPENDIX A

General location of proposed conservation actions within the middle Cache River region of southern Illinois, 2015. Aerial photography is circa 2011 (March 16).



Location Map of Alternatives

1:70,000

APPENDIX B

List of state-threatened and endangered species within the Cache River Watershed (per The Nature Conservancy, *Conservation Targets, Attributes and Indicators for the Cache River Watershed,* 2012 and Illinois Endangered Species Board's *Checklist of endangered and threatened animals and plants of Illinois*. 2011)

PLANTS

*Aristolochia serpentaria Var. hastate (*Virginia Snakeroot) *threatened*

*Asplenium resiliens (*black spleenwort) *endangered*

*Bartonia paniculata (*screwstem) *endangered*

*Carex decomposita (*cypress-knee sedge) *endangered*

*Carex gigantea (*large sedge) *endangered*

*Carex intumescens (*swollen sedge) *threatened*

*Carex oxylepis (*sharp-scaled sedge) *threatened*

*Carex reniformis (*Sedge) *endangered*

*Carya aquatic (*water hickory) *threatened*

C*arya pallida (*pale hickory) *endangered*

*Cimicifuga rubifolia (*black cohosh) *threatened*

*Cladrastis lutea (*yellowwood) *endangered*

*Clematis crispa (*blue jasmine) *endangered*

*Clematis viorna (*leatherflower) *endangered*

*Cyperus lancastriensis (*Galingale) *threatened*

*Dennstaedtia punctilobula (*hay-scented fern) *threatened*

*Dichanthelium joorii (*panic grass) *endangered*

*Dryopteris celsa (*log fern) *endangered*

*Eryngium prostratum (*eryngo) *endangered*

*Euonymus americanus (*American strawberry bush) *endangered*

*Glyceria arkansana (*manna grass) *endangered*

*Halesia carolina (*silverbell tree) *endagered*

*Helianthus angustifolius (*narrow-leaved sunflower) *endangered*

*Heteranthera reniformis (*mud plantain) *endangered*

*Hydrocotyle ranunculoides (*water pennywort) *endangered*

*Hydrolea uniflora (*one-flowered hydrola) *endangered*

*Iresine rhizomatosa (*bloodleaf) *endangered*

*Justicia ovata (*water willow) *endangered*

*Lysimachia radicans (*creeping loosestrife) *endangered*

*Melanthera nivea (*white melanthera) *endangered*

*Melica mutica (*two-flowered melic grass) *endangered*

*Melothria pendula (*squirting cucumber) *threatened*

*Panicum joorii (*panic grass) *endangered*

*Phaeophyscia leana (*Lea's bog lichen) *threatened*

*Planera aquatica (*water elm) *threatened*

Platanthera flava var. flava (tubercled orchid) *endangered*

*Quercus montana (*rock chestnut oak) *threatened*

*Quercus phellos (*willow oak) *threatened*

*Quercus texana (*Nuttall's oak) *endangered*

*Rhynchospora glomerata (*clustered beaked rush) *endangered*

*Salvia azurea ssp. pitcheri (*blue sage) *threatened*

*Scirpus polyphyllus (*bulrush) *threatened*

*Spiranthes vernalis (*spring ladies' tresses) *endangered*

*Stenanthium gramineum (*grass-leaved lily) *endangered*

*Styrax americana (*storax) *threatened*

*Styrax grandifolia (*bigleaf snowbell bush) *endangered*

*Thalia dealbata (*powdery thalia) *endangered*

*Tilia heterophylla (*white basswood) *endangered*

*Urtica chamaedryoides (*nettle) *threatened*

ANIMALS

*Acipenser fulvescens (*lake sturgeon) *endangered*

*Circus cyaneus (*northern harrier) *endangered*

Corynorhinus rafinesquii (rafinesque's big-eared bat) *endangered*

*Crangonyx packardi (*Packard's cave amphipod) *endangered*

*Crotalus horridus (*timber rattlesnake) *threatened*

*Cumberlandia monodonta (*spectaclecase) *endangered*

*Cyclonaias tuberculata (*purple wartyback) *threatened*

*Dendroica cerulea (*cerulean warbler) *threatened*

*Desmognathus conanti (*spotted dusky salamander) *endangered*

*Egretta caerulea (*little blue heron) *endangered*

*Ellipsaria lineolata (*butterfly) *threatened*

*Elliptio crassidens (*elephant-ear) *threatened*

*Elliptio dilatata (*spike) *threatened*

*Fusconaia ebena (*ebonyshell) *threatened*

*Gallinula chloropus (*common moorhen) *endangered*

*Gammarus bousfieldi (*amphipod) *threatened*

*Hybognathus hayi (*cypress minnow) *endangered*

*Hyla avivoca (*bird-voiced treefrog) *threatened*

*Ictinia mississippiensis (*Mississippi kite) *threatened*

Ixobrychus exilis (least bittern) *threatened*

*Lanius ludovicianus (*loggerhead shrike) *endangered*

*Lepomis miniatus (*redspotted sunfish) *endangered*

*Lepomis symmetricus (*bantam sunfish) *threatened*

Ligumia recta (black sandshell) *threatened*

*Limnothlypis swainsonii (*Swainson's warbler) *endangered*

*Macrochelys temminckii (*alligator snapping turtle) *endangered*

*Myotis austroriparius (*southeastern myotis) *endangered*

*Myotis grisescens (*gray bat) *endangered*

*Myotis sodalis (*Indiana Bat) *endangered*

*Nerodia cyclopion (*Mississippi green water snake) *threatened*

*Nerodia fasciata (*broad-banded water snake) *endangered*

*Notropis boops (*bigeye shiner) *endangered* Riverine

*Nyctanassa violacea (*yellow-crowned night heron) *endangered*

*Ochrotomys nuttalli (*golden mouse) *threatened*

*Orconectes lancifer (*shrimp crayfish) *endangered*

*Orconectes placidus (*bigclaw crayfish) *endangered*

*Oryzomys palustris (*rice rat) *threatened*

*Pandion haliaetus (*osprey) *endangered*

*Plethobasus cooperianus (*orange-foot pimpleback) *endangered*

*Plethobasus cyphyus (*sheepnose) *endangered*

*Pleurobema cordatum (*Ohio pigtoe) *endangered*

*Pleurobema rubrum (*pyramid pigtoe) *endangered*

*Potamilus capax (*fat pocketbook) *endangered*

*Pseudacris illinoensis (*Illinois chorus frog) *threatened*

*Pseudemys concinna (*river cooter) *endangered*

*Quadrula cylindrica (*rabbitsfoot) *endangered*

*Sternula antillarum (*least tern) *endangered*

*Thamnophis sauritus (*eastern ribbon snake) *threatened*

*Thryomanes bewickii (*Bewick's wren) *endangered*

Tyto alba (barn owl) *endangered*

APPENDIX C

List of species in greatest need of conservation within the Cache River Watershed (per The Nature Conservancy, *Conservation Targets, Attributes and Indicators for the Cache River Watershed,* 2012; Source: Illinois Comprehensive Wildlife Conservation Plan & Strategy, Version 1.0, Appendix I, pp. 306-309.)

Acipenser fulvescens (lake sturgeon) *endangered*

Ammodramus savannarum (grasshopper sparrow)

Anas rubripes (American black duck)

Ardea alba (great egret)

Asio flammeus (short-eared owl) *endangered*

Athya valisineria (canvasback)

Aythya affinis (lesser scaup)

Aythya valisineria (canvasback)

Bartramia longicauda (upland sandpiper) *endangered*

Botaurus lentiginosus (American bittern) *endangered*

Buteo lineatus (red-shouldered hawk)

Buteo platypterus (broad-winged hawk)

Buteo swainsoni (Swainson's hawk) *endangered*

Calcarius pictus (Smith's longspur)

Calidris himantopus (stilt sandpiper)

Caprimulgus carolinensis (Chuck-will's-widow)

Caprimulgus vociferous (Whip-poor-will)

Certhia Americana (brown creeper)

Chaetura pelagica (chimney swift)

Charadrius melodus (piping plover)

Chlidonias niger (black tern) *endangered*

Chordeiles minor (common nighthawk)

Circus cyaneus (northern harrier) *endangered*

Cistothorus palustris (marsh wren)

Cistothorus platensis (sedge wren)

Coccyzus americanus (yellow-billed cuckoo)

Coccyzus erythropthalmus (black-billed cuckoo)

Colaptes auratus (northern flicker)

Corynorhinus rafinesquii (Rafinesque's big-eared bat) *endangered*

Crangonyx packardi (Packard's cave amphipod) *endangered*

Crotalus horridus (timber rattlesnake) *threatened*

Cumberlandia monodonta (spectaclecase) *endangered*

Cyclonaias tuberculata (purple wartyback) *threatened*

Dendroica cerulea (cerulean warbler) *threatened*

Dendroica discolor (prairie warbler)

Dolichonyx oryzivorus (bobolink)

Egretta caerulea (little blue heron) *endangered*

Egretta thula (snowy egret) *endangered*

Ellipsaria lineolata (butterfly) *threatened*

Elliptio crassidens (elephant-ear) *threatened*

Elliptio dilatata (spike) *threatened*

Empidonax trailli (willow flycatcher)

Empidonax virescens (acadian flycatcher)

Euphagus carolinus (rusty blackbird)

Falco peregrinus (Peregrine falcon) *threatened*

Fusconaia ebena (ebonyshell) *threatened*

Gallinago delicatata (Wilson’s snipe)

Gallinula chloropus (common moorhen) *endangered*

Grus Canadensis (sandhill crane) *threatened*

Helmitheros vermiforma (worm-eating warbler)

Hybognathus hayi (cypress minnow) *endangered*

Hyla avivoca (bird-voiced treefrog) *threatened*

Hylocichla mustelina (wood thrush)

Icteria virens (yellow-breasted chat)

Ictinia mississippiensis (Mississippi kite) *endangered*

Ixobrychus exilis (least bittern) *threatened*

Lanius ludovicianus (loggerhead shrike) *threatened*

Laterallus jamaicensis (black rail) *endangered*

Lepomis miniatus (redspotted sunfish) *endangered*

Lepomis symmetricus (Bantam sunfish) *threatened*

Ligumia recta (black sandshell) *threatened*

Limnodromus griseus (short-billed dowitcher)

Limnothlypis swainsonii (Swainson's warbler) *endangered*

Macrochelys temminckii (alligator snapping turtle) *endangered*

Melanerpes erythrocephalus (red-headed woodpecker)

Myotis austroriparius (southeastern myotis) *endangered*

Myotis grisescens (gray bat) *endangered*

Myotis sodalis (Indiana bat) *endangered*

Nerodia cyclopion (Mississippi green water snake) *threatened*

Nerodia eryhrogaster var. neglecta (copperbelly watersnake)

Nerodia fasciata (broad-banded water snake) *endangered*

Notropis boops (bigeye shiner) *endangered*

Nyctanassa violacea (yellow-crowned night heron) *endangered*

Nycticorax nycticorax (black-crowned night heron) *endangered*

Ochrotomys nuttalli (golden mouse) *threatened*

Oporornis agilis (Connecticut warbler)

Oporornis formosus (Kentucky warbler)

Orconectes lancifer (shrimp crayfish) *endangered*

Orconectes placidus (bigclaw crayfish) *endangered*

Oryzomys palustris (rice rat) *threatened*

Pandion haliaetus (Osprey) *endangered*

Passerculus sandwichensis (Savannah sparrow)

Peromyscus gossypinus (cotton mouse)

Phalaropus tricolor (Wilson's phalarope) *endangered*

Plethobasus cooperianus (orange-foot pimpleback) *endangered*

Plethobasus cyphyus (sheepnose) *endangered*

Pleurobema cordatum (Ohio pigtoe) *endangered*

Pleurobema rubrum (pyramid pigtoe) *endangered*

Pluvialis dominica (American golden-plover)

Podilymbus podiceps (pied-billed grebe)

Potamilus capax (fat pocketbook) *endangered*

Protonotaria citrea (prothonotary warbler)

Pseudacris illinoensis (Illinois chorus frog) *threatened*

Pseudemys concinna (river cooter) *endangered*

Quadrula cylindrica (rabbitsfoot) *endangered*

Rallus elegans (king rail) *endangered*

Seiurus aurocapillus (ovenbird)

Spiza americana (dickcissel)

Spizella pusilla (field sparrow)

Sterna antillarum (least tern) *endangered*

Sterna forsteri (Forster's rern)

Sterna hirundo (common tern) *endangered*

Sternula antillarum (least tern) *endangered*

Sylvilagus aquaticus (swamp rabbit)

Thamnophis sauritus (eastern ribbon snake) *threatened*

Thryomanes bewickii (Bewick's wren) *endangered*

Tringa melanoleuca (greater yellowlegs)

Tyto alba (barn owl) *endangered*

Vermiforma pinus (blue-winged warbler)

APPENDIX D

Initial ranking of all projects. The 3 categories of projects arose from this ranking and are the working group's best valuation of how to focus limited resources.

Final Ranking Order	Original Project Number[1]	Project description	Weighted Score
1	15	Cache River Dredging	0.80
2	33	Big Creek Sediment Management	0.75
3	34	Big Creek Stabilization	0.70
4	28	East Swamp Structure	0.69
5	23	Cypress Creek Sediment Management	0.68
6	20	Cypress Creek Riffle Weirs	0.68
7	17	Historic Channel Restoration - Cache River	0.67
8	32	Conservation Protection at Grassy Slough	0.65
9	21	Historic Channel Restoration - Cypress Creek	0.65
10	30	Reconnection Water Flow Structure and Weir - Foreman Floodway	0.65
11	6	Strategic Management- Conservation Protection Near Cache Chapel Road	0.63
12	26	Cache River Streambank Stabilization	0.60
13	7	Limekiln Slough Sediment Management	0.60
14	9	High-priority Conservation Protection along Cache River	0.60
15	14	Project Nos. 9, 13, 14, 19 were combined (See #9)	0.59
16	13	Project Nos. 9, 13, 14, 19 were combined (See #9)	0.57
17	19	Project Nos. 9, 13, 14, 19 were combined (See #9)	0.56
18	8	Limekiln Slough and Goose Pond Dredging	0.56
19	29	Karnak Levee Repair	0.56
20	5	Limekiln Slough Outlet	0.54
21	31	Historic Channel restoration - Braided Cache River	0.52
22	1	Cache Chapel Road Structure	0.50
23	24	Remove Rt. 37 Structure	0.47
24	3	Diehl Structure Improvement	0.47
25	4	Natural Spring Restoration - Limekiln	0.47
26	22	Cypress Creek Well	0.46
27	16	Unnatural Levee Removal	0.45
28	25	Combined this project with #13, 14, 19 and 9 (See #9)	0.43
29	12	Flood Flow Culverts	0.42
30	11	Egner Tract Management	0.42
31	2	Long Reach Road Structure	0.39
32	10	This project was dropped	0.30
33	18	Remove buttonbush in areas of desired open water	0.27
34	27	Flood control improvements - Karnak: This project dropped from the ranking process but is retained as a note in the report	0.16

[1] These numbers coincide with numbered projects on the figure in Appendix C.

ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Survey of historic populations of slackwater fish Species in Greatest Need of Conservation in the Cache River watershed

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Project Title: Survey of historic populations of slackwater fish Species in Greatest Need of Conservation in the Cache River watershed.

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Project Summary

The Cache River watershed has a unique community of slackwater fishes which are associated with low gradient, low velocity backwater habitats that typically have silt and organic detritus substrata. Most of these slackwater fishes are classified as Species in Greatest Need of Conservation (SGNC) because of their rare and declining status in Illinois. Historic records of 13 slackwater fish SGNC were used to determine species presence at locations with records over 10 years old and identify new locations. The lack of recent records for slackwater fishes may have resulted from deficiency in sampling bottomland habitats, or partially due to habitat loss, heavy sedimentation and hydrologic alteration. Survey sites were selected by identifying historic locations with multiple target species (> 2 species) and by identifying stream reaches with similar habitat characteristics to sites with known locations of target fish species. Similar habitat characteristics were determined by using existing ArcGIS data layers associated with stream structure (e.g., discharge, watershed land use) and modeled to all streams within the Cache River watershed. Nine out of thirteen slackwater species were present at slackwater survey sites including five species at modeled locations. Modeling stream characteristics to locate fish SGNC was successful and this technique could be applied to future research to assist with filling ecological and distribution information gaps of rare species in need of conservation. This research also supports the need for targeted surveys as a valuable supplement to existing fish sampling programs that do not regularly sample habitats that are specific to some fish SGNC.

Table of Contents

Introduction

The Cache River watershed includes portions of Cypress-Tupelo swamps, lowland river and upland stream habitats which accounts for its diverse ichthyofauna. Eighty-five native fish species have been found within the watershed, representing 42% of all native fish found in Illinois (Burr 1992, Bennett et al. 2001). This includes a unique assemblage of bottomland guild fishes that are associated with slackwater habitats and depend upon floodplains for reproduction, vegetated peripheries for juvenile and adult life history stages, and channels for migration (Bennett et al. 2001). Slackwater habitats are described as low gradient, low velocity backwaters of adjacent main channels with typically sand, silt, and organic detritus substrata (Bennett et al. 2001).

The Cache River has a history of alteration and channelization (Karr et al. 1985, Demissie et al. 1990). Numerous alterations have impacted the landscape and hydrology of the watershed, including the construction of the Post-Creek Cutoff, a large ditch which drains the upper portion of the Cache River and its eastern tributaries and associated wetlands into the Ohio River (Cache River Watershed Resource Planning Committee 1995). This alteration has essentially split the river and watershed into two distinct sections for nearly a century. Several species are known to be negatively affected by sedimentation, channelization and loss of wetlands in the watershed, including Fringed Darter, Cypress Minnow and Bantam Sunfish (Poly and Wilson 1998, Bennett et al. 2001, Burr et al. 1996). Along large rivers, sedimentation has degraded and reduced backwater habitats available for use by fishes (Brown and Coon 1994).

Bouska and Whitledge (2014) found there was an absence of a bottomland guild after analyzing IDNR fish community samples from 1992-2009. Presently, the Cache River watershed has two distinct assemblages; one associated with the lower Cache River mainstem and another with tributaries throughout the watershed and the upper Cache River mainstem (Bouska and Whitledge 2014). The lack of a bottomland guild (hereafter referred as slackwater species) may have resulted from not comprehensively sampling bottomland habitats, or partially due to habitat loss, heavy sedimentation and hydrologic alteration (Burr et al. 1996, Warren and Burr 1989, Bennett et al. 2001).

A main component of the Illinois Wildlife Action Plan (WAP) is protection of rare and imperiled species collectively referred to as Species in Greatest Need of Conservation (SGNC). Metzke and Hinz Jr. (2012) recently identified several fish SGNC that have not been observed (potentially extirpated) from some portion of their historic ranges. However, it is unknown whether these species are, in fact, extirpated or they have not been recorded during recent collection efforts. Given the structured sampling protocols for fisheries collection programs within the state (e.g., IDNR basin surveys, LTEF and LTRMP programs), it is possible that populations of these species remain where surveys have not been conducted over ten years. For this survey, thirteen slackwater fish SGNC were selected based on previous studies (Table 1; Bennett et al. 2001, Metzke and Hinz Jr. 2012).

The objective of this study was to survey historic and identify new locations of slackwater fish species by modeling stream habitat characteristics of known locations. Habitat and fish community survey results were assessed to determine associations with target species presence. This study is an effort to supplement the fisheries sampling programs and update distribution information of rare fish species.

Site selection

Fifteen survey sites were sampled in Cache River watershed in southern Illinois during fall of 2014 (Table 2). Survey sites were selected from known locations of target species and had records older than ten years. Target slackwater species locations were mapped from Metzke and Hinz Jr. (2012) records and separated into two categories; recent (2000 and later) and historic (before 2000) records. Metzke

and Hinz Jr. (2012) compiled species records from multiple databases including IDNR Fisheries Analysis System (FAS), the Illinois Natural History Survey (INHS) Museum Collections, the INHS Long-Term Resource Monitoring Program (LTRMP) and the Southern Illinois University-Carbondale fisheries collection. Historic locations with multiple target species (> 3 species) or threatened and endangered species records were prioritized for sampling.

Additional survey sites with the potential to have targeted species were identified based on stream habitat characteristics of known slackwater fish locations. Stream reaches with multiple target species were selected and habitat characteristics were summarized for the local watershed using existing geographic information system (GIS) data layers associated with stream structure (e.g., gradient, size, discharge, and adjacent land use). Thirty three watersheds with multiple target species were identified and summarized. The standard error upper and lower limits of the means were evaluated to determine the greatest potential to locate target species. Survey sites were selected by modeling streams with upper limit of annual low discharge (Q90 < 0.14 cms) and lower limit of percent watershed wetland land use (wetland > 15.3%) (Figure 1). Modeling identified 235.6 km of potential stream habitat in the Cache River watershed (total streams = 4,491.9 km). Based on historic records and modeling selection criteria, twenty five sites were proposed for the survey. Proposed sites were scouted and reduced to fifteen survey sites due to equipment and personnel restrictions. Final selection consisted of ten historic record sites and five modeled stream sites (Table 2, Figure 2).

Concurrent with the slackwater fish survey, IDNR Fisheries surveyed 17 sites in the Cache River watershed as part of their Intensive Basin Survey five-year rotation from May through August of 2014 (Figure 2). The most appropriate fish sampling gear (e.g., boat electrofishing, seines, or electric seines) was used to survey. Additionally, IDNR conducted a separate sampling effort in the Buttonland Swamp area (10 sites) during 2011-2013 (Figure 3). IDNR Fisheries survey results are presented with the slackwater survey.

Methods

Slackwater sites were surveyed using the most appropriate technique (e.g., backpack electrofishing and dip nets, or seines) depending upon stream size and site accessibility and conditions. Amount of effort expended at each site was dependent upon size and complexity of the survey site (Table 3). Water quality (dissolved oxygen, specific conductance, temperature) and habitat (substrate composition, channel form, riparian structure) parameters were recorded at each survey location to characterize instream and riparian habitat structure for slackwater fish communities. All collected fish were identified, recorded, and released after sampling except for voucher specimens. Voucher specimens were preserved in 90% Ethanol and later verified and deposited into the University of Illinois – INHS fisheries collection. Collected threatened or endangered species were photographed before release and occurrence records were submitted to BIOTICS database managers.

Habitat structure and fish assemblages were evaluated at slackwater and IDNR Fisheries survey sites separately and then collectively. Habitat attributes (stream order, gradient, discharge, drainage area) were derived from GIS data layers (1:24,000 stream linework) for analyses. Also, proportional land use (open water, urban, forest, agriculture, and wetland) was summarized from 2011 USGS National Land Cover Database at the local watershed (i.e., catchment of stream reach) and total watershed (i.e., drainage area) scale (Holtrop and Collins 2015). Additional habitat attributes that were collected during survey (substrate, water quality, and riparian structure) were assessed only at slackwater sites. Non-metric multidimensional scaling analysis (NMDS) was used to assess patterns of fish assemblages and habitat structure of survey sites with target species presence (Primer, version 6; Primer-E,

Plymouth, UK). Analyses were done on the survey site × taxon matrix and results were transformed for presence/absence. Abundance results were not used for analyses because survey methods were directed at locating target species, and thus, abundance could not be estimated accurately. Habitat attributes were normalized to account for differences in value ranges and overlaid with NMDS plots. BEST analysis was used to determine habitat variables that strongly influence fish assemblages (Clarke 1993, Clarke and Gorley 2006). Habitat attributes that did not have a strong association with fish assemblage were removed to simplify plots.

Results

Collectively, 42 sites were surveyed in the Cache River watershed by this slackwater survey and IDNR Fisheries surveys. Ten out of thirteen target slackwater species were present at 26 survey sites including five species at slackwater survey modeled locations (Table 3). Six out of the ten species found were collected by both survey sampling efforts. Cypress Minnow (*Hybognathus hayi*), Ribbon Shiner (*Lythrurus fumeus*), Cypress Darter (*Etheostoma proeliare*), and Bluntnose Darter (*E. chlorosomum*) were collected only with the slackwater survey while Pugnose Minnow (*Opsopoeodus emiliae*) was collected only with IDNR Fisheries buttonland swamp survey. One target threatened or endangered species, Cypress Minnow, was observed during the study period. Bigeye Shiner (*Notropis boops*), Redspotted Sunfish (*Lepomis punctatus*), and Bantam Sunfish (*L. symmetricus*) were not observed during either slackwater or IDNR Fisheries surveys. Overall, Flier (*Centrarchus macropterus*) was most frequently collected (24% of survey sites) followed by Pugnose Minnow and Banded Pygmy Sunfish (*Elassoma zonatum*) (17% of survey sites). Pugnose minnow collection was restricted to buttonland swamp area while other species were more broadly distributed (see Appendix for detailed distribution maps). Several species were recorded at one (Central Mudminnow [*Umbra limi*]) or multiple (Banded Pygmy Sunfish, Flier, Bluntnose Darter, and Cypress Darter) new locations with slackwater survey including the five modeled locations (see Appendix). Some target species were not collected at historic record locations (Bigeye Shiner, Pugnose Minnow, Cypress Darter) or only at one historic location (Cypress Minnow, Banded Sculpin) with slackwater survey sampling efforts. Redspotted (*Lepomis punctatus*) and Bantam Sunfish (*L. symmetricus*) were mostly likely not collected during survey efforts because they have been observed at only a few locations in Cache River watershed and these locations were not sampled. Target species were not collected at three (20%) slackwater sites or 11 (41%) IDNR Fisheries survey sites.

Slackwater survey sites were relatively smaller with a mean drainage area of 35.4 km^2 and mean stream order of 3.5 (Table 4) compared to IDNR Fisheries sites with mean drainage area of 144.4 km^2 and mean stream order of 4.2 (Table 5). The mean gradient for all survey sites was 0.0011 km/km (range -0.003 – 0.007 km/km). Local watersheds were dominated by forest (40%, 32%) and agricultural (38%, 30%) proportional land use followed by wetland (13%, 20%) at slackwater survey (Table 6) and IDNR Fisheries sites (Table 7), respectively. Total watershed proportional land use was dominated by agriculture (48%, 46%) then by forested (41%, 38%) proportional land use at slackwater survey (Table 6) and IDNR Fisheries (Table 7) sites, respectively, with similar proportions of land use distributed among wetland (4-6%), urban (6-9%), and open water (1%). Modeled discharge was estimated relatively lower at slackwater survey sites with a mean of 0.05 cms at moderate flow and 0.002 cms at low flow (Table 4) compared to IDNR Fisheries survey sites with a mean of 0.21 cms at moderate flow and 0.02 cms at low flow (Table 5).

Slackwater survey site habitats were characterized by estimating various instream attributes including substrate composition, channel structure, habitat type, flow, riparian cover, and aquatic vegetation and bank composition (Table 8) to evaluate habitat patterns associated with target species distribution.

Substrate composition was similar across all slackwater survey sites and was mostly comprised of clay/silt (54%), gravel (20.4%), and detritus (18.3%). Channel structure varied across all sites with a mean depth of 0.54 m (range 0.15 – 1 m) and mean wetted width of 14.7 m (range 2.4 – 100 m). Discharge could not be measured at majority of sites due to no flow. Survey sites with flow had a mean discharge of 0.02 cms (Table 8). Pools (77%) were the dominant stream habitat type at sites followed by runs (14.7%) and then riffles (9%). Overhanging (36.1%), algae (31%), and emergent (27.1%) were the most common instream vegetation type at slackwater sites followed by floating (duckweed, 18%) and submergent (10%) aquatic vegetation (Table 9). Bank composition across all slackwater sites was comprised of woody material (down trees, 26.7%), trees (22%), and herbaceous vegetation (20.7%) with a mean of Riparian shading ranged from 20 to 95% canopy cover with a mean of 70% at sites with target species and 46.7% at those without (Table 9). Overall, slackwater survey sites with target species had similar instream and riparian structure to sites without target species, except buttonland swamp sites. Buttonland swamp survey sites had higher mean width (53.3 m), pool habitat (100%), and lower riparian shading (26.7%) compared to the other slackwater survey sites (mean width 5.04 m, 71% pool, and 75% riparian cover). These attributes demonstrate that buttonland swamp sites are structured more as large, open canopy wetland systems that require different sampling techniques (i.e., seine) which might have been less effective at collecting target species compared to techniques used to sample the smaller, more closed canopy slackwater stream sites (i.e., backpack electrofishing).

Water quality was recorded at most slackwater survey locations (Table 10). Dissolved oxygen (DO) concentration greatly varied across slackwater sites ranging from 0.19 – 10.19 mg/L with a mean of 5.38 mg/L. The lowest DO measurement was at buttonland swamp site that is predominately covered with duckweed year round. Similarly, conductivity varied across sites ranging from 123.9 – 622 µS/cm with a mean of 335.3 µS/cm. Temperature was relatively similar across slackwater sites with a mean of 17 ^{o}C (range 14.6 – 20.2 ^{o}C). Clarity was a mean of 0.34 m (range 0.05 – 0.85 m); however, clarity exceeded mean water depth at most survey sites with deep pools and shallow runs (Table 10).

Fish assemblage similarity among slackwater survey sites was assessed with NMDS separately from IDNR survey sites and then combined with IDNR Fisheries sites (MDS, Bray-Curtis; Primer-E, Plymouth, UK). Fish assemblage similarity (i.e., plot separation) among sites with none, single, or multiple target species was not noticeable for slackwater survey sites with or without the additional IDNR Fisheries sites (Figure 4). However, target fish assemblage similarity between sites with single or multiple target species was noticeable for slackwater survey sites with (Figure 6) and without the additional IDNR survey sites (Figure 5) where sites with target species were clustered together and separate from sites without target species. Buttonland_001 site was consistently separate from other slackwater sites because only one species was collected, Mosquitofish (*Gambusia affinis*).

Thirty-three environmental variables were utilized to overlay with slackwater survey NMDS, and reduced to 13 habitat attributes that strongly influenced fish assemblages (BEST, Spearman; Primer-E, Plymouth, UK). Fish assemblages at slackwater sites with multiple target species were positively influenced by clay/slit substrate, modeled low discharge, and proportion of total wetland land use, while negatively influenced by gradient and gravel substrate (Rho = 0.82, p = 0.001) (Figure 4). Evaluating only target species, slackwater sites with multiple target species were positively influenced by clay/silt substrate and riffle habitat while negatively correlated with mean stream width (Rho = 0.59, p = 0.02). Buttonland_001 site was strongly influenced by local watershed proportion of open water and mean stream width. Twenty-three environmental variables were utilized to overlay with the combined slackwater and IDNR survey NMDS, and reduced to nine habitat variables that influenced fish assemblages. Assessing only target species, slackwater and IDNR sites with multiple target

species were positively correlated with proportion of total watershed agricultural land use and negatively correlated with proportion of total watershed urban and forest land use (Rho = 0.43, p = 0.001).

Conclusions

Majority of the target slackwater species presence was confirmed in the Cache River watershed, but their potential habitat range is limited to 5.2% of streams according to modeling results. However, slackwater species may have a broader range of habitat tolerance than the criteria selected for modeling. For instance, slackwater species presence in streams ranging from forested wetlands to agricultural watersheds suggests that these species are adaptive or their distribution is not strongly influenced by watershed land use. It is possible that other environmental or ecological variables (e.g., annual temperature and flow variability, daily diel cycles, prey availability or predator presence) may be more important for determining target species distribution, but were not assessed in this study. Likewise, connectivity of upper and lower mainstems and associated wetland habitats is a main concern for conservation of slackwater fish species in the Cache River watershed, but was not evaluated in this study. Connectivity provides individuals with the ability to disperse and colonize new locations or recolonize locations where extirpation has occurred. The Cache River has a history of landscape and hydrological alterations that negatively affects species of conservation concern (Poly and Wilson 1998, Burr et al. 1996) and may limit species distribution. Future studies should consider examining additional ecological and environmental variables to determine limitations of slackwater species distribution.

Sampling efforts of this slackwater survey had a higher success (80%) of locating target species compared to IDNR Fisheries survey (59%) and found four additional target species verifying that targeted surveys are a valuable supplement to existing sampling programs. It is necessary to update and fill ecological and distributional information gaps of rare species in order to identify and prioritize conservation efforts. This study demonstrates that targeted surveys can assist standard sampling programs with filling distribution information gaps of rare species. Other targeted survey efforts in Illinois have also recorded rare fish species which are not routinely or never have been collected during standard sampling programs (Tiemann 2012, Thomas et al. 2013, Metzke and Holtrop 2014). Modeling stream characteristics from known rare species historic locations can further contribute to filling distribution gaps by identifying new potential locations of rare species. At least one target species was located at each modeled location indicating that a simple model of two stream habitat characteristics (i.e., discharge and proportion of wetland land use) can be successful in identifying potential rare species locations. Thus, habitat modeling could be applied to future research to efficiently direct survey efforts towards our ecological and distributional understanding of rare species in need of conservation.

Even though several new locations were recorded with this study, some target species were not present or observed at only one historic location suggesting that these species are extirpated from portions of their historic ranges. Since it is more difficult to prove absence than presence, it is possible that target species still inhabit historic locations. Presence may not have been detected for various reasons such as inadequate sampling gear, complexity of the site (i.e., debris dams), seasonality, or adverse weather conditions that may reduce the success of detecting target species. Furthermore, a relatively small number of slackwater sites were surveyed and a larger-scale, more comprehensive survey could have determined if species were truly extirpated from historic locations. Future studies of slackwater fish species should expand spatially and temporally (e.g., multiple seasons) to determine species presence or absence.

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Table 1: List of slackwater fish Species of Greatest Need of Conservation (SGNC) target species and their current status based on Metzke and Hinz Jr. (2011).

Common name	Scientific name	DNR fish code	Family	SGNC	SGNC trend	T&E
Banded Sculpin	*Cottus carolinae*	BAS	Cottidae	Yes	Rare	
Central Mudminnow	*Umbra limi*	CEM	Umbridae	Yes	Rare	
Cypress Minnow	*Hybognathus hayi*	CYM	Cyprinidae	Yes	Rare & declining	SE
Ribbon Shiner	*Lythrurus fumeus*	RBS	Cyprinidae	Yes	Rare	
Bigeye Shiner	*Notropis boops*	BGS	Cyprinidae	Yes	Rare	SE
Pugnose Minnow	*Opsopoeodus emiliae*	PUM	Cyprinidae	Yes	Rare	
Banded Pygmy Sunfish	*Elassoma zonatum*	BPS	Elassomatidae	Yes	Rare	
Flier	*Centrarchus macropterus*	FLR	Centrarchidae	Yes	Rare	
Redspotted Sunfish	*Lepomis punctatus*	SSF	Centrarchidae	Yes	Rare	SE
Bantam Sunfish	*Lepomis symmetricus*	BSF	Centrarchidae	Yes	Rare & declining	ST
Bluntnose Darter	*Etheostoma chlorosomum*	BUD	Percidae	Yes	Rare	
Fringed Darter	*Etheostoma crossopterum*	FGD	Percidae	Yes	Rare & declining	
Cypress Darter	*Etheostoma proeliare*	CYD	Percidae	Yes	Rare & declining	

Table 2: Description of slackwater fish survey sites sampled in the Cache River watershed and reason for survey site selection.

Site code	Stream name	Latitude	Longitude	Location description	Reason
Cache_Up_001	Bradshaw Creek	37.52945	-89.14928	Wing Hill Road crossing; Sampled ~50m upstream of bridge	Sampled < 1993; BAS and BUD records upstream
Cache_Up_003	Lick Creek	37.47925	-89.01607	Allen Road crossing; Sampled upstream of bridge; sampled around really deep pools	Similar attributes to streams with SGNC
Cache_Up_004	Little Black Slough	37.36303	-88.93851	Access past Cache field station house; Used hiking trail to Boss Island; Sampled upstream of road crossing to Boss Island	Similar attributes to streams with SGNC; BPS record downstream
Cache_Up_008	Cave Creek	37.35801	-88.88692	Sampled downstream of bridge of Route 45; parked in FWS/IDNR hunter parking lot	Sampled < 1993; FLR and BPS records
Cache_Low_009	Tributary to Big Cypress	37.3266	-88.9871	Off of Lincoln Green Road/W Eden Rd; Difficult to see from road; culvert; Sampled downstream	Similar attributes to streams with SGNC
Cache_Low_010	Adds Branch	37.3714	-89.09461	Johnson Dairy Road crossing; Sampled downstream of bridge	Upstream to similar attributes to streams with SGNC; CYM record downstream
Cache_Low_015	West Branch Sandy Creek	37.22400	-89.32288	Olive Branch Road crossing; Sampled upstream of bridge	Sampled < 1993; BGS record downstream
Cache_Low_017	Cypress Slough	37.18826	-89.24792	Morris Road crossing; Hidden behind overgrown vegetation; Sampled downstream of culvert	Similar attributes to streams with SGNC; RBS record in tributary
Cache_Low_018	Tributary to Lake Creek	37.13174	-89.28375	Off Route 3; parking on east side; Sampled US of bridge	BGS, BUD, and RBS records; BGS, PUM, and RBS records upstream
Cache_Low_020	Lake Creek	37.11749	-89.30724	Roth Crossing & Promiseland Rd; outlet of Horseshoe Lake; sampled upstream of bridge	BPS, BUD, CEM, and CYM records upstream

Table 2 (continued):

Site code	Stream name	Latitude	Longitude	Location description	Reason
Cache_Low_021	Mill Creek tributary	37.36613	-89.26425	Route 127 crossing; Parked by Shawnee Stone Quarry sign; Sampled upstream of bridge	Sampled < 1993; BAS and FGD records
Cache_Low_022	Mill Creek	37.3672	-89.24899	Near quarry; Miller Rd. wooden crossing; Sampled upstream of bridge	BAS and FGD records; CYD record downstream
Buttonland_001	Buttonland Swamp	37.297015	-89.05304	At the end of Access Road; sampled at the end of the boat ramp	5 SGNC (DS)
Buttonland_002	Limekiln Slough (East)	37.28269	-89.09764	Off of Nature Rd; hiked down trail; trail leads to slough	Sampled < 1993; FLR, BPS, and CYM records
Buttonland_003	Limekiln Slough (West)	37.28344	-89.09859	Off of Nature Rd; hiked down trail; trail leads to slough	Sampled < 1993; FLR, BPS, and CYM records

Table 3: Sampling effort and fish survey richness of total community and Species of Greatest Need of Conservation (SGNC) at slackwater survey sites.

Site code	Method	Survey length (m)	Survey time (min)	Total richness	SGNC richness
Cache_Up_001	Backpack electrofishing	77.3	20.60	15	1
Cache_Up_003	Backpack electrofishing	70.1	25.95	13	1
Cache_Up_004	Backpack electrofishing	91.4	36.23	12	1
Cache_Up_008	Backpack electrofishing	91.4	26.30	12	2
Cache_Low_009	Backpack electrofishing	61.0	13.88	10	1
Cache_Low_010	Backpack electrofishing	61.3	23.75	12	1
Cache_Low_015	Backpack electrofishing	73.2	23.77	11	0
Cache_Low_017	Backpack electrofishing	21.3	8.62	13	4
Cache_Low_018	Backpack electrofishing	103.6	28.52	19	4
Cache_Low_020	Backpack electrofishing	97.5	21.67	21	5
Cache_Low_021	Backpack electrofishing	67.1	17.28	11	1
Cache_Low_022	Backpack electrofishing	86.6	23.95	7	1
Buttonland_001	Seine - 2 passes from boat ramp	20 m^2	15.00	1	0
Buttonland_002	Seine - 2 passes from bank	20 m^2	15.00	6	1
Buttonland_003	Seine - 2 passes from bank	20 m^2	15.00	10	0

Table 4: Slackwater survey site stream characteristics based on 1:24,000 stream linework. Discharge was estimated with models developed by Seelbach et al. (2011) adjusted to 1:24,000 stream linework (Holtrop and Collins 2015) for annual 50% (moderate) and 90% (low) exceedance discharges.

Site code	Drainage area (km^2)	Stream order	Gradient (km/km)	Modeled moderate discharge (cms)	Modeled low discharge (cms)
Cache_Up_001	22.4	4	0.0029	0.0165	0.0001
Cache_Up_003	102.3	5	0.0008	0.0907	0.0022
Cache_Up_004	30.6	4	0.0005	0.0432	0.0004
Cache_Up_008	16.8	3	0.0025	0.0127	0.0001
Cache_Low_009	4.1	2	0.0016	0.0034	0.00001
Cache_Low_010	7.8	3	0.0016	0.008	0.0001
Cache_Low_015	13.0	3	0.0015	0.0149	0.0012
Cache_Low_017	10.0	2	0.0009	0.0107	0.00001
Cache_Low_018	32.0	3	0.0008	0.0322	0.0001
Cache_Low_020	59.4	4	0.0007	0.1774	0.0197
Cache_Low_021	7.1	3	0.002	0.009	0.0004
Cache_Low_022	6.6	3	0.0072	0.0061	0.0001
Buttonland_001	112.6	5	-0.0005	0.1591	0.0072
Buttonland_002	53.0	4	-0.0017	0.0606	0.0017
Buttonland_003	53.0	4	-0.0017	0.0606	0.0017

Table 5: Illinois Department of Natural Resource basin survey site stream characteristics based on 1:24,000 stream linework. Discharge was estimated with models developed by Seelbach et al. (2011) adjusted to 1:24,000 stream linework (Holtrop and Collins 2015) for annual 50% (moderate) and 90% (low) exceedance discharges.

Site code	Drainage area (km^2)	Stream order	Gradient (km/km)	Modeled moderate discharge (cms)	Modeled low discharge (cms)
AD-06	57.0	4	0.0014	0.0576	0.0014
ADCA-01	19.0	4	0.0047	0.0156	0.0001
ADCD-01	48.8	4	0.0002	0.0745	0.0033
ADCF-01	45.3	4	-0.0033	0.0808	0.0032
ADX-02	8.3	3	0.005	0.0073	0.0001
ADY-01	2.8	3	0.0003	0.0002	0
IX-03	399.8	6	-0.00001	0.6139	0.0578
IX-05	170.5	5	-0.0002	0.2363	0.0081
IX-06	769.5	6	0.0069	1.2022	0.2344
IX-08	644.1	6	-0.0001	0.9987	0.1866
IXCC-02	41.4	3	0.0013	0.0479	0.0013
IXD-02	13.4	3	0.002	0.0164	0.0017
IXF-02	76.6	4	0.0006	0.1094	0.0189
IXI-01	91.7	4	0.0028	0.1355	0.0243
IXJ-02	21.5	3	0.0027	0.0213	0.0003
IXJC-01	17.4	3	0.0037	0.0172	0.0003
IXMA-01	7.8	3	0.0016	0.008	0.0001
IX 1-1	167.6	5	-0.0005	0.2227	0.0072
IX 1-2	167.6	5	-0.0005	0.2227	0.0072
IX 2-1	167.6	5	-0.0005	0.2227	0.0072
IX 2-2	112.6	5	-0.001	0.1591	0.0062
IX 3-1	167.6	5	-0.0005	0.2227	0.0072
IX 3-2	167.6	5	-0.0005	0.2227	0.0072
IX-05 1-1	170.5	5	-0.0002	0.2363	0.0081
IX-05 1-2	170.5	5	-0.0002	0.2363	0.0081
IX-05 2-1	170.5	5	-0.0002	0.2363	0.0081
IX-05 2-2	170.5	5	-0.0002	0.2363	0.0081

Table 6: Slackwater survey site local and total watershed land use characteristics based on 1:24,000 watershed polygons.

	Local Watershed Proportional Land Use					Total Watershed Proportional Land Use				
Site code	Open Water	Urban	Forest	Agriculture	Wetland	Open Water	Urban	Forest	Agriculture	Wetland
Cache_Up_001	0	0.1818	0.5987	0.2195	0	0.0036	0.0608	0.5629	0.3727	0
Cache_Up_003	0.0043	0.0434	0.3354	0.5485	0.0684	0.0033	0.0701	0.6171	0.3044	0.0043
Cache_Up_004	0	0	0.8187	0	0.1813	0.0031	0.0618	0.4312	0.3802	0.1221
Cache_Up_008	0	0.2568	0.3087	0	0.4345	0.0030	0.0657	0.4939	0.4269	0.0038
Cache_Low_009	0	0.0477	0.0844	0.8679	0	0	0.0713	0.2319	0.6941	0
Cache_Low_010	0	0.1331	0.0498	0.8171	0	0.00004	0.0526	0.2897	0.6577	0
Cache_Low_015	0	0.0273	0.7346	0.2117	0.0263	0.0007	0.0279	0.8761	0.0945	0.0008
Cache_Low_017	0	0.0254	0.2223	0.6303	0.1220	0.0019	0.0312	0.1355	0.7439	0.0875
Cache_Low_018	0.0339	0.1037	0.0219	0.5271	0.3134	0.0180	0.0531	0.2135	0.5698	0.1451
Cache_Low_020	0.0047	0.0683	0.2794	0.3085	0.3390	0.1110	0.0700	0.3207	0.3689	0.1294
Cache_Low_021	0.0065	0.0943	0.7247	0.1745	0	0.0010	0.0953	0.5582	0.3436	0
Cache_Low_022	0.0004	0.1283	0.4369	0.3377	0	0.0014	0.0612	0.5994	0.3154	0
Buttonland_001	0.0672	0	0.4857	0.0709	0.3223	0.0180	0.0508	0.3578	0.5193	0.0520
Buttonland_002	0	0	0.4348	0.5	0.0652	0.0110	0.0547	0.2028	0.7071	0.0230
Buttonland_003	0	0	0.4348	0.5	0.0652	0.0110	0.0547	0.2028	0.7071	0.0230

Table 7: Illinois Department of Natural Resource basin survey site local and total watershed land use characteristics based on 1:24,000 watershed polygons.

	Local Watershed Proportional Land Use					Total Watershed Proportional Land Use				
Site code	Open Water	Urban	Forest	Agriculture	Wetland	Open Water	Urban	Forest	Agriculture	Wetland
AD-06	0	0.0472	0.3167	0.6362	0	0.0107	0.2167	0.4255	0.3362	0
ADCA-01	0	0.0194	0.0183	0.9623	0	0.0018	0.0581	0.3315	0.6064	0.0010
ADCD-01	0	0.0148	0.038	0.9408	0.0014	0.0059	0.0859	0.2330	0.6577	0.0145
ADCF-01	0	0.9702	0.0298	0	0	0.0397	0.0759	0.2488	0.5681	0.0665
ADX-02	0	0.0298	0.4411	0.5291	0	0.0018	0.3692	0.3593	0.2697	0
ADY-01	0	0.2727	0.3818	0	0.3455	0.0103	0.0722	0.5637	0.0389	0.3149
IX-03	0.0024	0.4676	0.3338	0.0282	0.1681	0.0158	0.0762	0.2917	0.5714	0.0437
IX-05	0.0876	0.0267	0.3502	0.1636	0.3719	0.0191	0.0583	0.3140	0.5392	0.0678
IX-06	0	0.2370	0.4272	0	0.3358	0.0096	0.0735	0.3725	0.5008	0.0422
IX-08	0.0268	0	0.1501	0.2491	0.5739	0.0108	0.0734	0.3958	0.4764	0.0419
IXCC-02	0	0.0614	0.1107	0.7768	0.0511	0.0014	0.0910	0.2489	0.6236	0.0350
IXD-02	0	0.1230	0.6642	0.1969	0.0158	0.0011	0.0579	0.8838	0.0500	0.0008
IXF-02	0	0.0551	0.1683	0.773	0.0036	0.0040	0.0667	0.6216	0.3031	0.0022
IXI-01	0	0.5244	0.1376	0.3119	0.0261	0.0041	0.0716	0.5689	0.3488	0.0045
IXJ-02	0	0.0411	0.5283	0.4306	0	0.0093	0.1016	0.4227	0.4614	0
IXJC-01	0	0.1917	0.5165	0.2918	0	0.0042	0.1851	0.3325	0.4779	0
IXMA-01	0	0.1331	0.0498	0.8171	0	0.0000	0.0526	0.2897	0.6577	0
IX 1-1	0.1212	0	0.4857	0.0709	0.3223	0.0181	0.0588	0.3141	0.5442	0.0632
IX 1-2	0.1212	0	0.4857	0.0709	0.3223	0.0181	0.0588	0.3141	0.5442	0.0632
IX 2-1	0.1212	0	0.4857	0.0709	0.3223	0.0181	0.0588	0.3141	0.5442	0.0632
IX 2-2	0.0672	0.0277	0.2316	0.2072	0.4663	0.0180	0.0508	0.3578	0.5193	0.0520
IX 3-1	0.1212	0	0.4857	0.0709	0.3223	0.0181	0.0588	0.3141	0.5442	0.0632
IX 3-2	0.1212	0	0.4857	0.0709	0.3223	0.0181	0.0588	0.3141	0.5442	0.0632
IX-05 1-1	0.0876	0.0267	0.3502	0.1636	0.3719	0.0191	0.0583	0.3140	0.5392	0.0678
IX-05 1-2	0.0060	0.0609	0.5133	0.0090	0.4107	0.0060	0.0609	0.5133	0.0090	0.4107
IX-05 2-1	0.0876	0.0267	0.3502	0.1636	0.3719	0.0191	0.0583	0.3140	0.5392	0.0678
IX-05 2-2	0.0876	0.0267	0.3502	0.1636	0.3719	0.0191	0.0583	0.3140	0.5392	0.0678

Table 8: Stream physical habitat characteristics at slackwater survey sites.

	Substrate Composition (%)							Instream Channel			Habitat (%)		
Site code	Clay/silt	Claypan	Sand	Gravel	Cobble	Bedrock	Detritus	Mean depth (m)	Mean width (m)	Discharge (cms)	Run	Riffle	Pool
Cache_Up_001			10	50	30	10		0.5	6.3	0.0008		10	90
Cache_Up_003	60						40	0.65	6.1	0	10		90
Cache_Up_004	40						60	0.55	6.9	0	10		90
Cache_Up_008	70			10			20	0.55	7.2	0	20		80
Cache_Low_009	75	20		5				0.6	4.1	-			100
Cache_Low_010	80						20	0.75	4.2	0		10	90
Cache_Low_015				60	30		10	0.2	7.4	0.0014	40	60	10
Cache_Low_017	70			20			10	0.3	3.0	0			100
Cache_Low_018	80			20				0.3	5.0	0.033	20	5	75
Cache_Low_020	80						20	0.6	4.9	0			100
Cache_Low_021	15			80			5	0.15	2.4	0.0008	50	30	20
Cache_Low_022	20			60			20	0.25	3.2	0.0391	70	20	10
Buttonland_001	60				10		30	0.95	> 100.0	0			100
Buttonland_002	80						20	1.0	30.0	0			100
Buttonland_003	80						20	0.8	30.0	0			100

Table 9: Aquatic vegetation and stream bank composition, and percent riparian cover at slackwater survey sites.

	Aquatic Vegetation Type (%)					Bank Composition (%)						
Site	Emergent	Submergent	Overhanging	Floating	Algae	Bare	Rock	Herbaceous	Woody	Trees	Grass	Riparian cover (%)
Cache_Up_001			10		80	10	60	30				80
Cache_Up_003			60		40	30		40		30		80
Cache_Up_004			40		5	40		30	30			80
Cache_Up_008			5			60		20	20			90
Cache_Low_009			80		10				30		70	30
Cache_Low_010				20	20	50		40		10		90
Cache_Low_015	30		40			30		10		60		90
Cache_Low_017	5							40	60			95
Cache_Low_018	5					10		10	70	10		80
Cache_Low_020	10		30	10		40			20	40		20
Cache_Low_021			40						30	10	60	70
Cache_Low_022			20					10	80	10		95
Buttonland_001	50	10		40				20	60	20		20
Buttonland_002	40			10				30		70		30
Buttonland_003	50			10				30		70		30

Table 10: Slackwater survey site water quality characteristics. Logistical issues prevented some water quailty measurements to be recorded at some locations.

Site code	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Temperature (^{o}C)	Water Clarity (m)
Cache_Up_001	6.44	272.0	14.6	0.8
Cache_Up_003	3.79	-	18.1	0.65
Cache_Up_004	1.32	139.8	15.9	0.1
Cache_Up_008	5.53	240.0	15.8	0.07
Cache_Low_009	6.09	423.0	18.4	0.5
Cache_Low_010	3.24	360.0	17.1	0.85
Cache_Low_015	7.09	184.7	16.1	0.2
Cache_Low_017	4.76	622.0	16.1	0.05
Cache_Low_018	10.19	333.0	19.8	0.75
Cache_Low_020	4.98	442.0	17.0	0.05
Cache_Low_021	6.66	407.0	15.3	0.2
Cache_Low_022	9.63	476.0	16.2	0.2
Buttonland_001	0.19	123.9	20.2	0.25
Buttonland_002	-	-	-	0.2
Buttonland_003	-	-	-	0.2

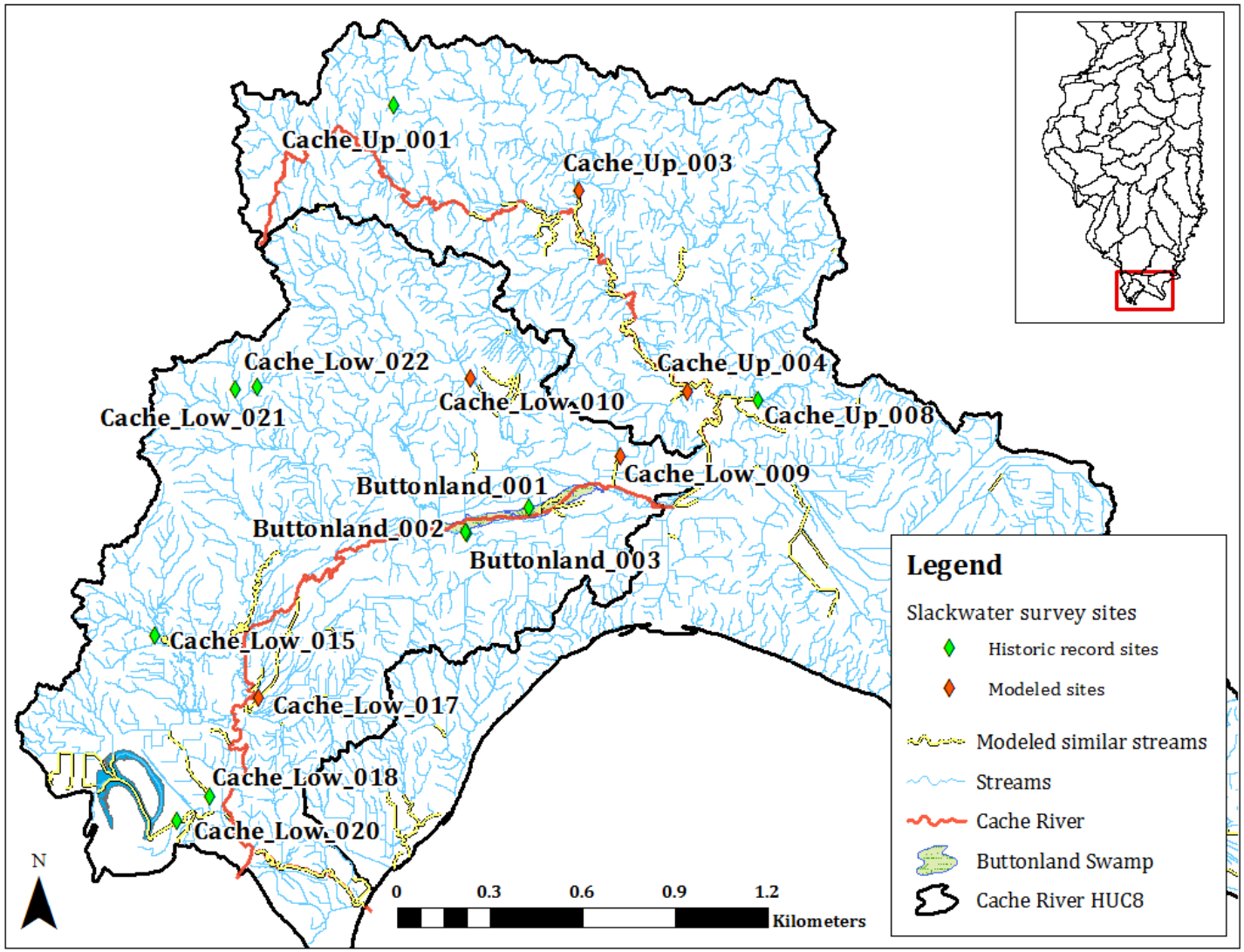


Figure 1: Map of slackwater survey sites in the Cache River watershed that were selected based on historic target species records (green diamonds), or new sites that were modeled with similar stream characteristics (low discharge and proportion of wetland land use) as known locations (red diamonds). Modeled similar streams are highlighted in yellow.

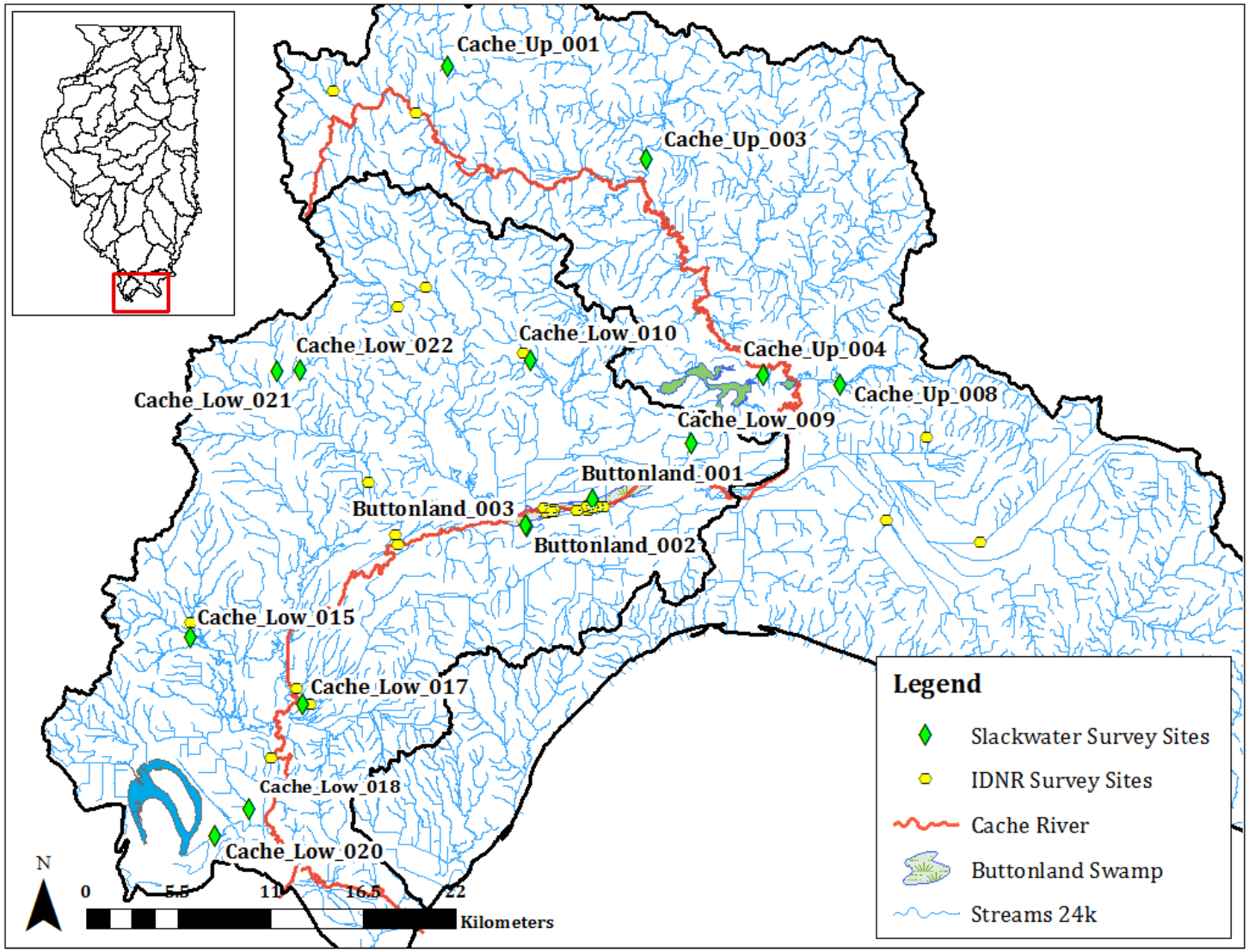


Figure 2: Map of slackwater survey (green diamonds) and Illinois Department of Natural Resouces (IDNR) Fisheries survey (yellow hexagons) sites sampled in the Cache River watershed during fall and summer of 2014. Inset: map of Illinois with the study area outlined by a red rectangle.

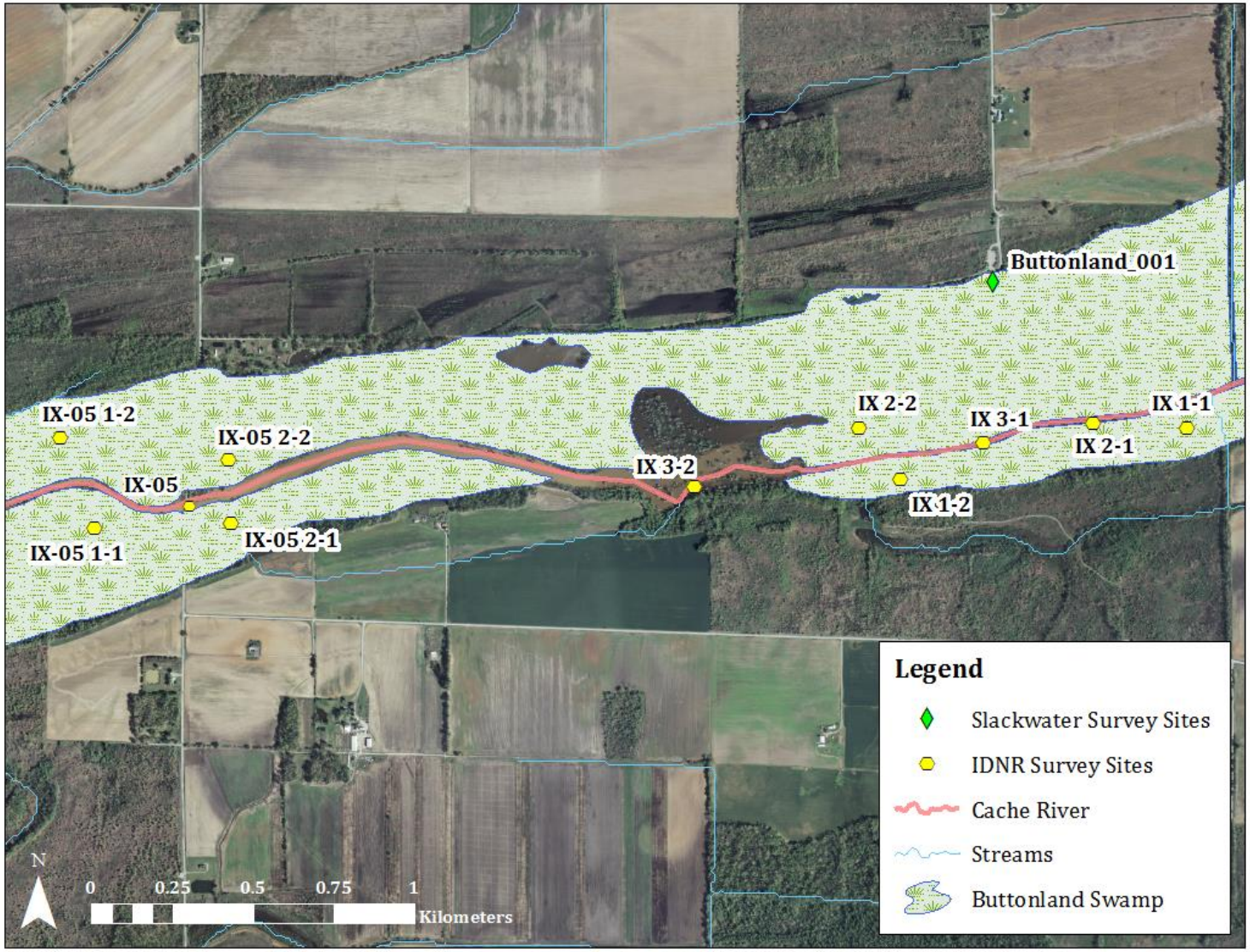


Figure 3: Map of slackwater survey (green diamond) and Illinois Department of Natural Resouces (IDNR) Fisheries survey (yellow hexagons) sites sampled in the Cache River (red line) and associated buttonland swamp (green polygon) during 2011-2014.

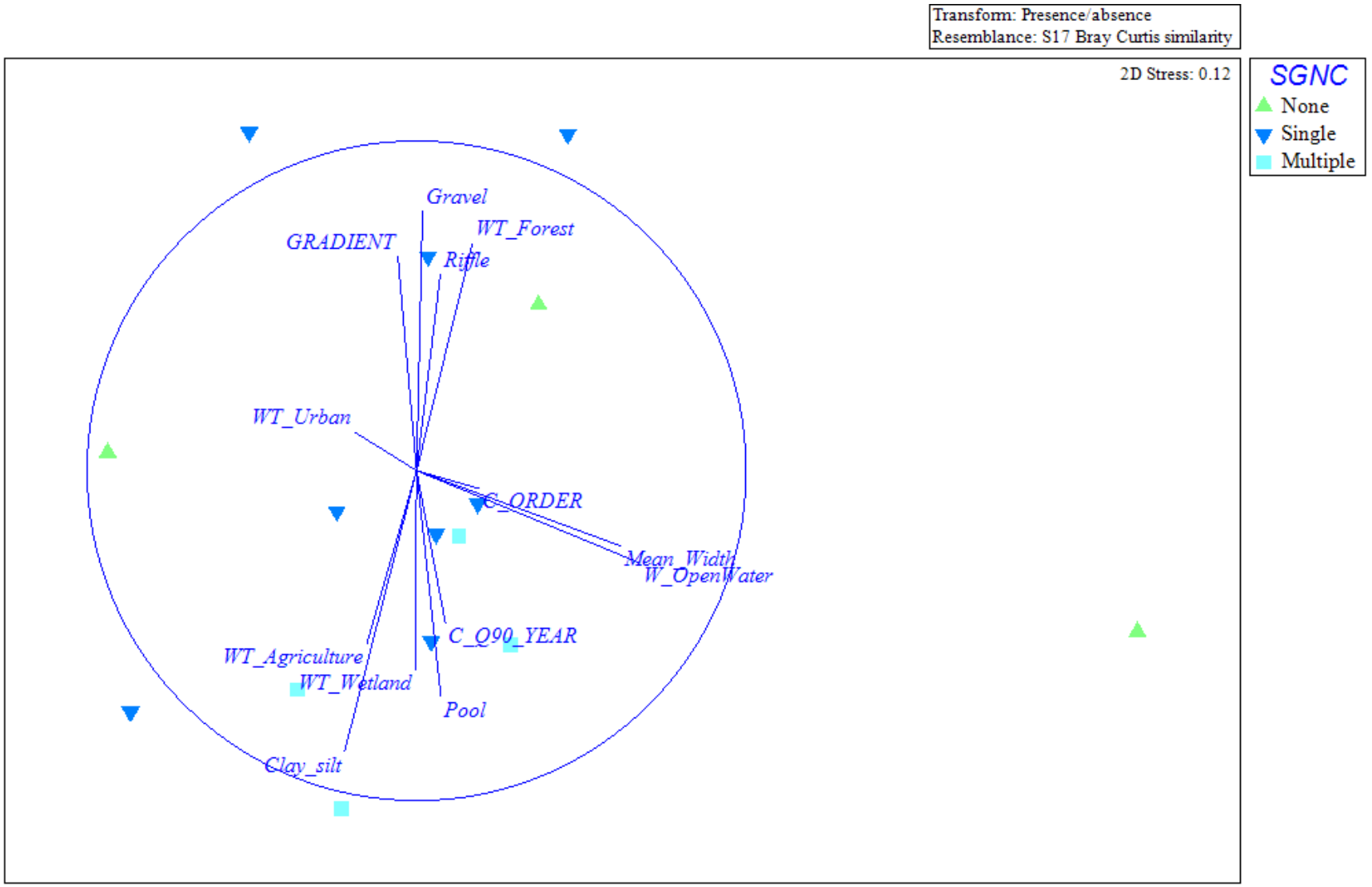


Figure 4: Non-metric multidimensional scaling plot of slackwater survey site fish assemblage (i.e., all species presence) with sites symbolized by multiple target Species in Greatest Need of Conservation (SGNC) collected (light blue square), single SGNC collected (blue upside down triangle), or none collected (green triangle). Habitat attributes are represented by lines with direction and length representing the influence of variable on the fish assemblage.

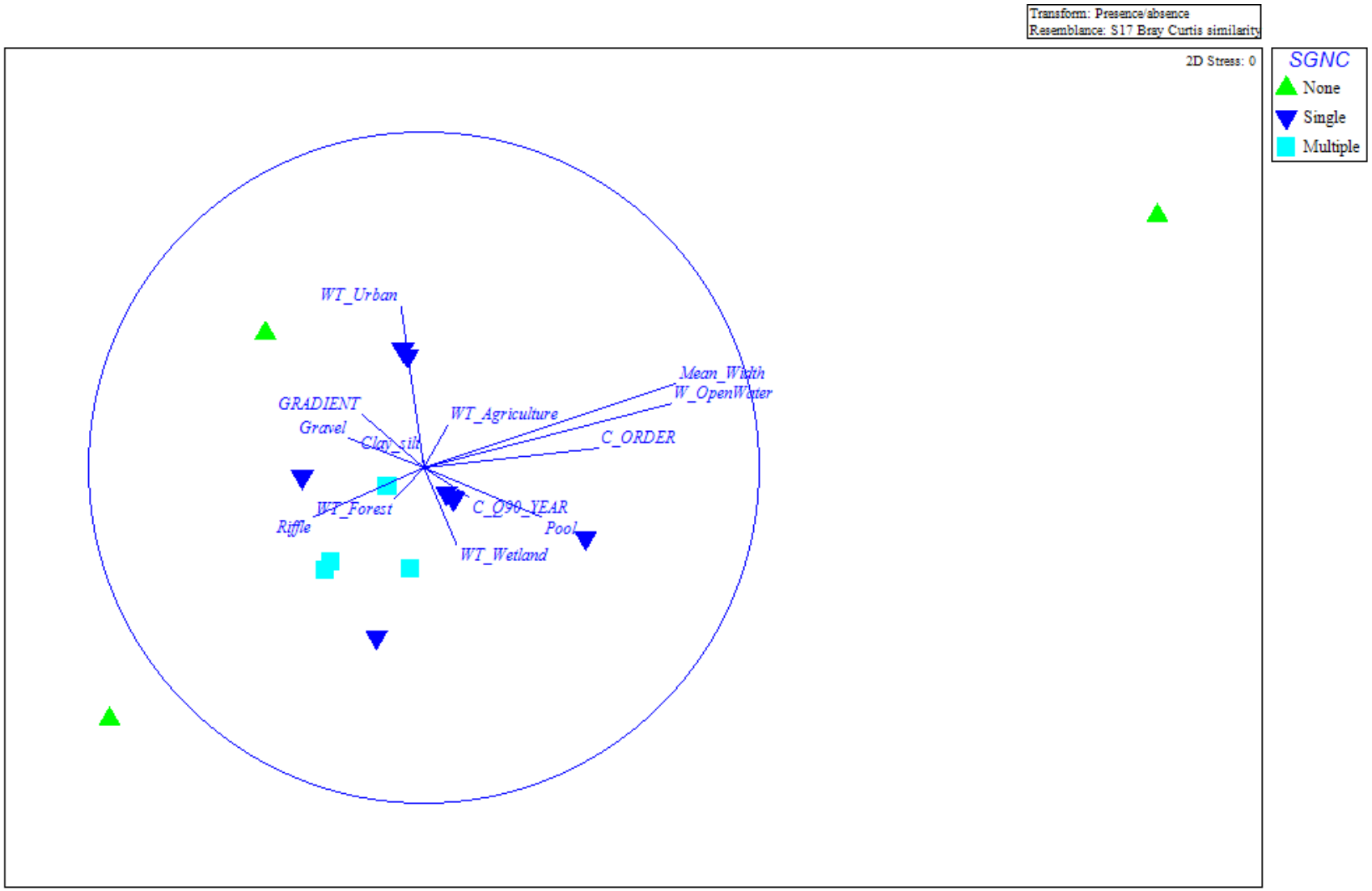


Figure 5: Non-metric multidimensional scaling plot of slackwater survey site target fish assemblage (i.e., target species presence) with sites symbolized by multiple target Species in Greatest Need of Conservation (SGNC) collected (light blue square), single SGNC collected (blue upside down triangle), or none collected (green triangle). Habitat attributes are represented by lines with direction and length representing the influence of variable on the fish assemblage.

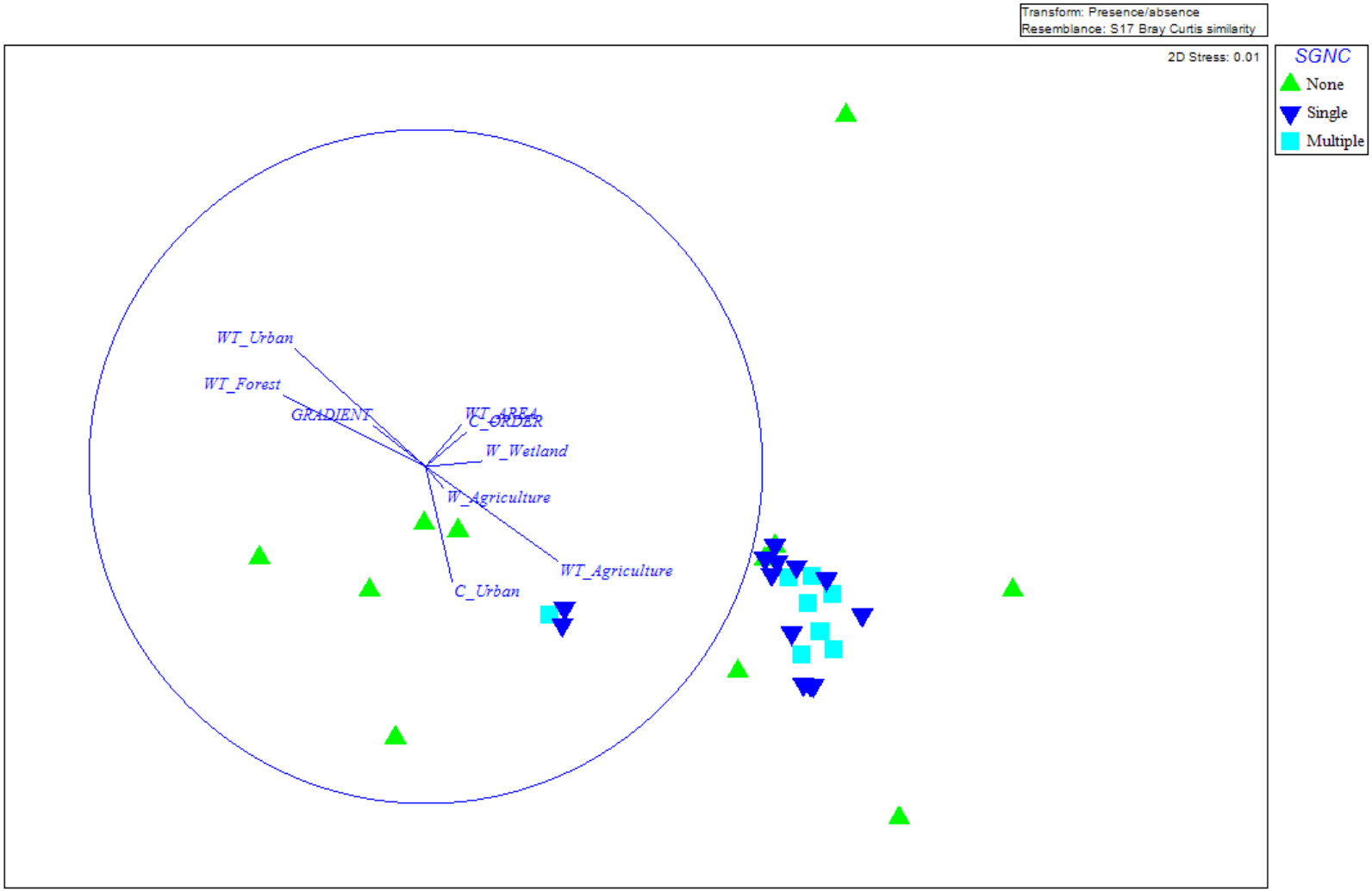
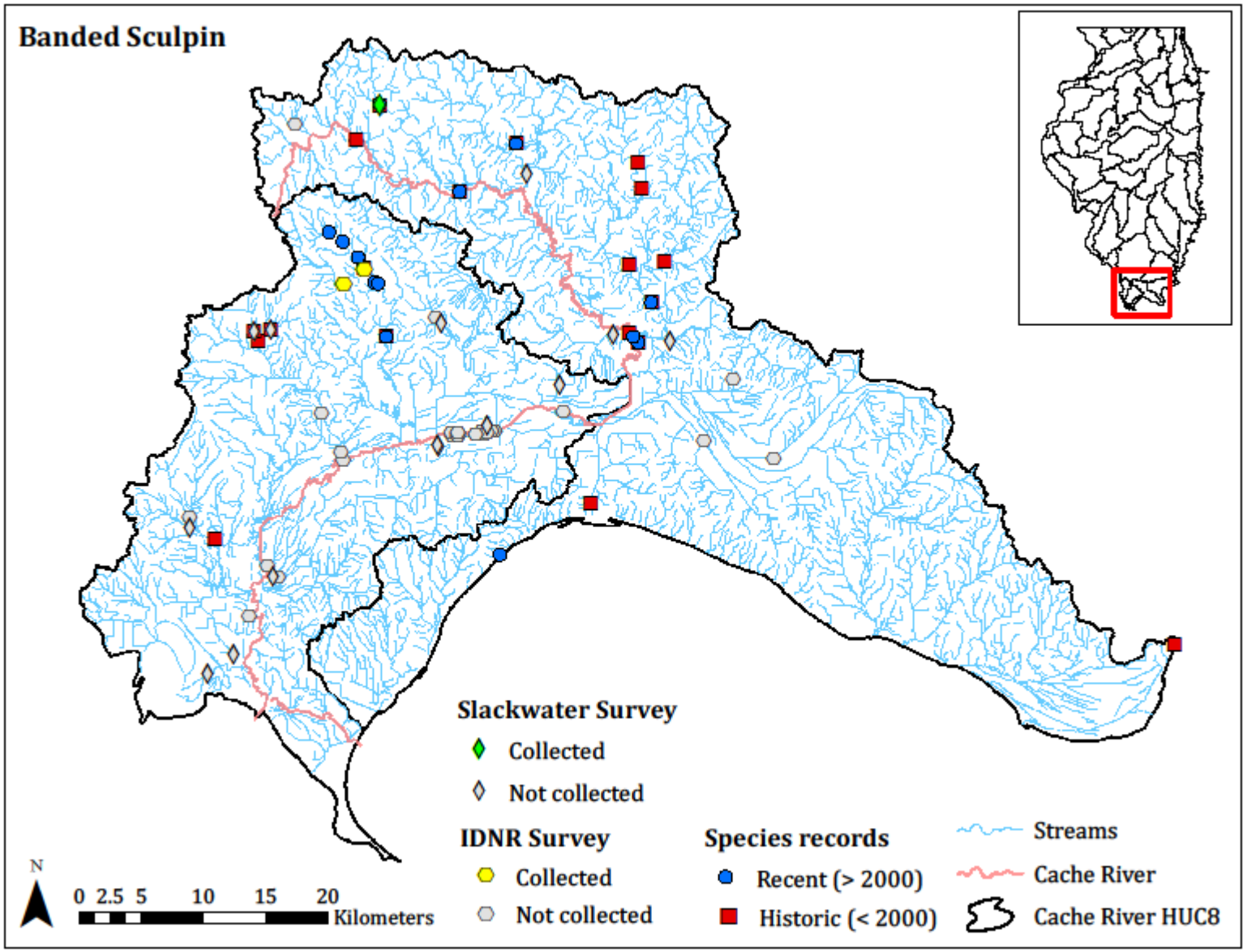
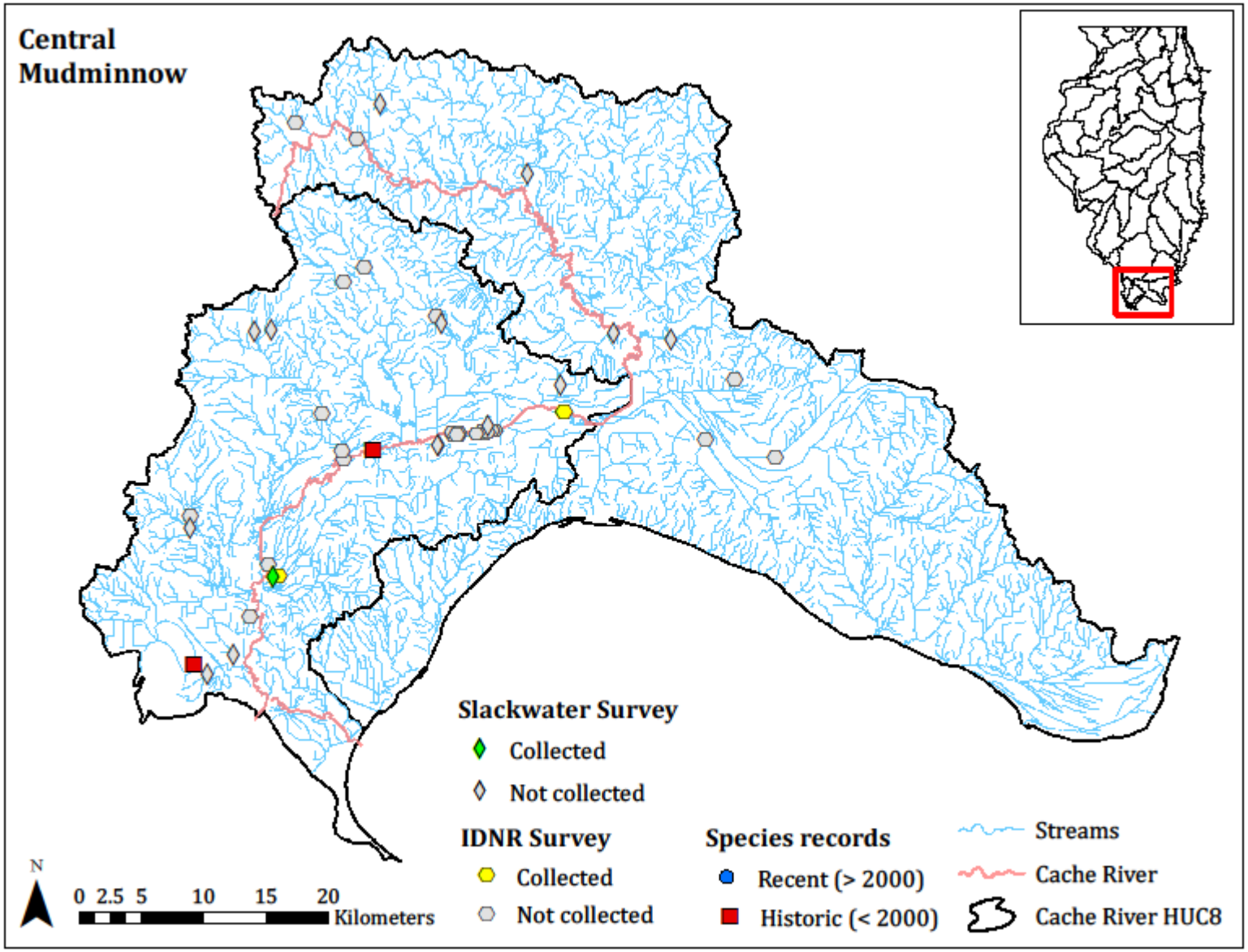


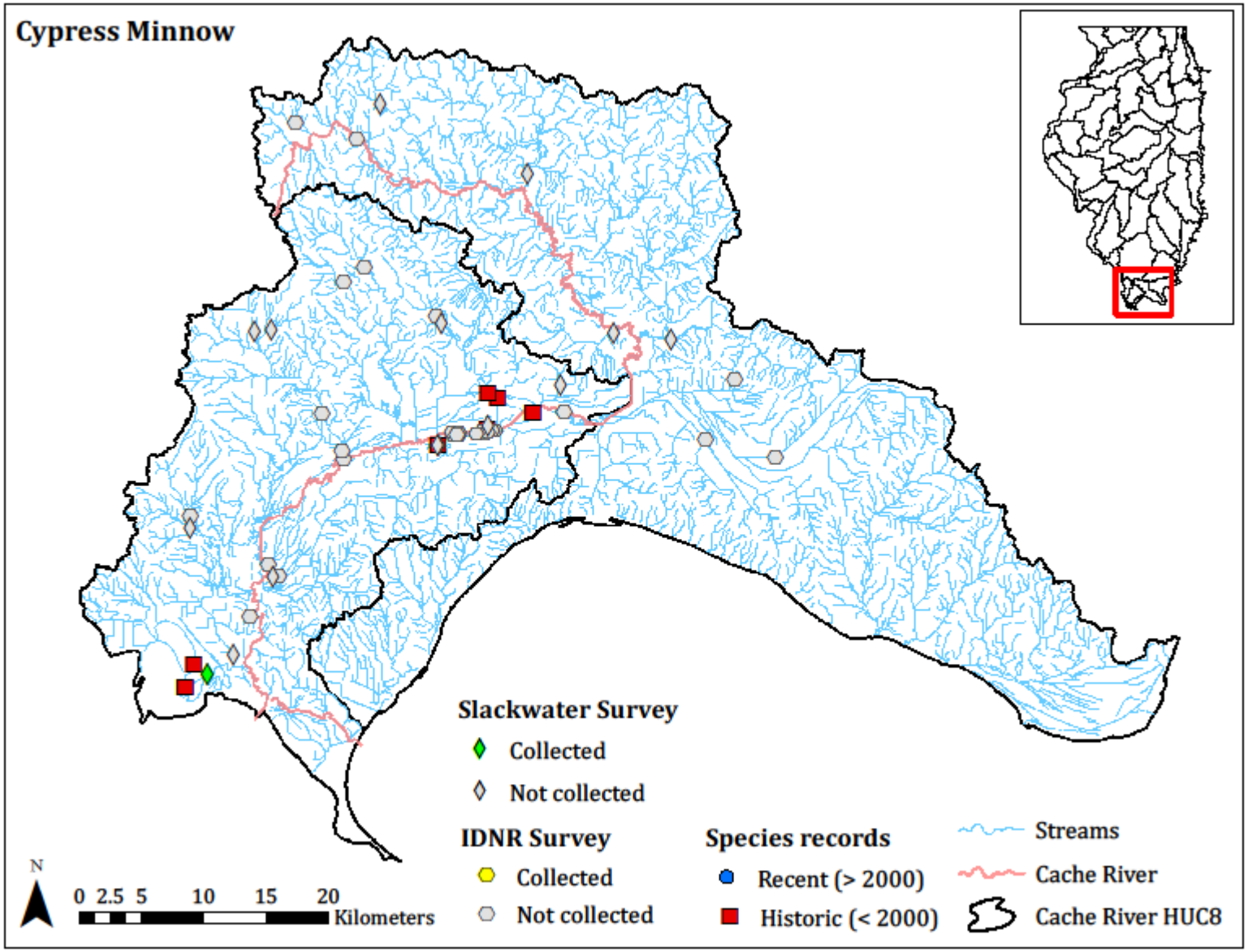
Figure 6: Non-metric multidimensional scaling plot of slackwater and IDNR Fisheries survey site target fish assemblage (i.e., target species presence) with sites symbolized by multiple target Species in Greatest Need of Conservation (SGNC) collected (light blue square), single SGNC collected (blue upside down triangle), or none collected (green triangle). Habitat attributes are represented by lines with direction and length representing the influence of variable on the fish assemblage.

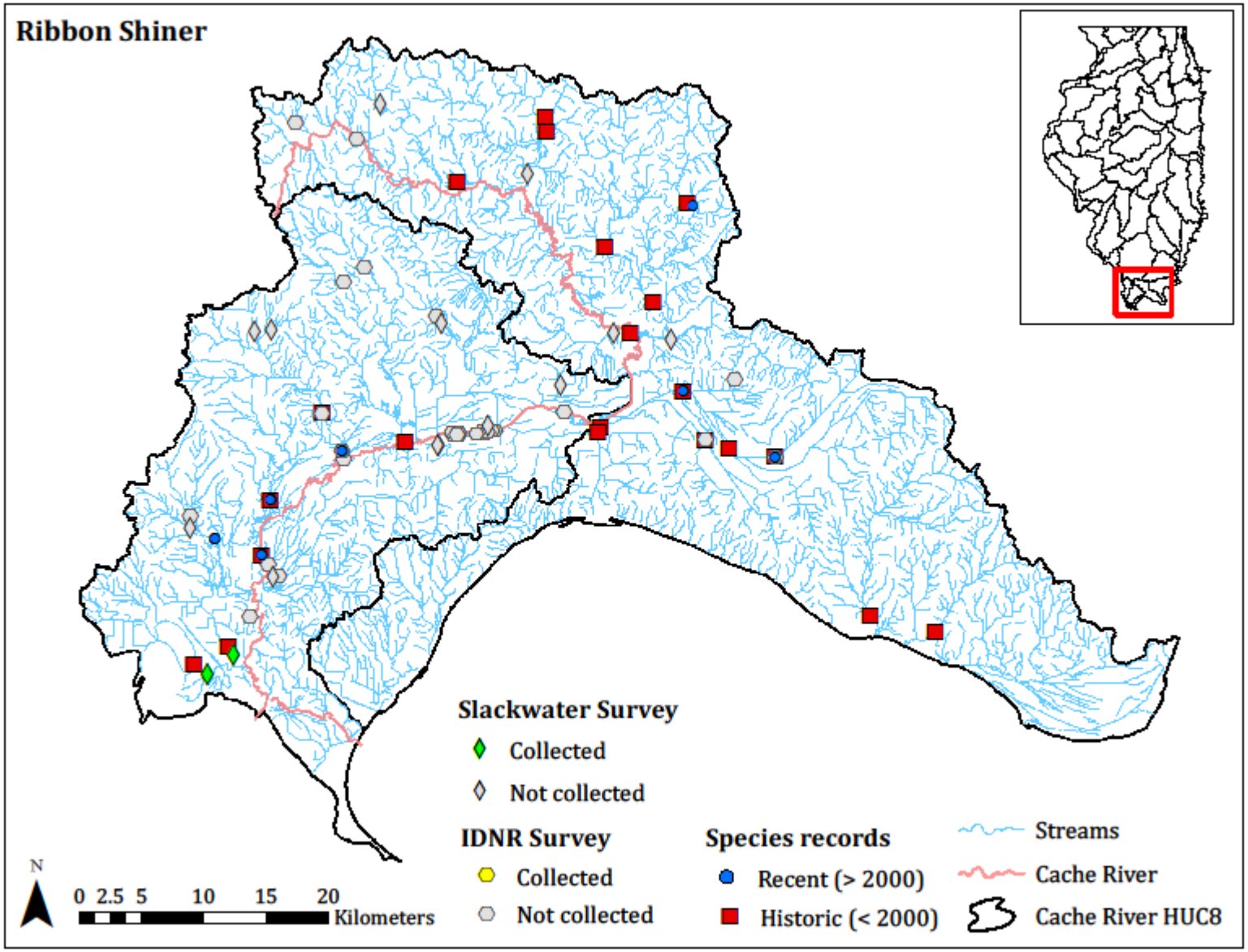
Appendix

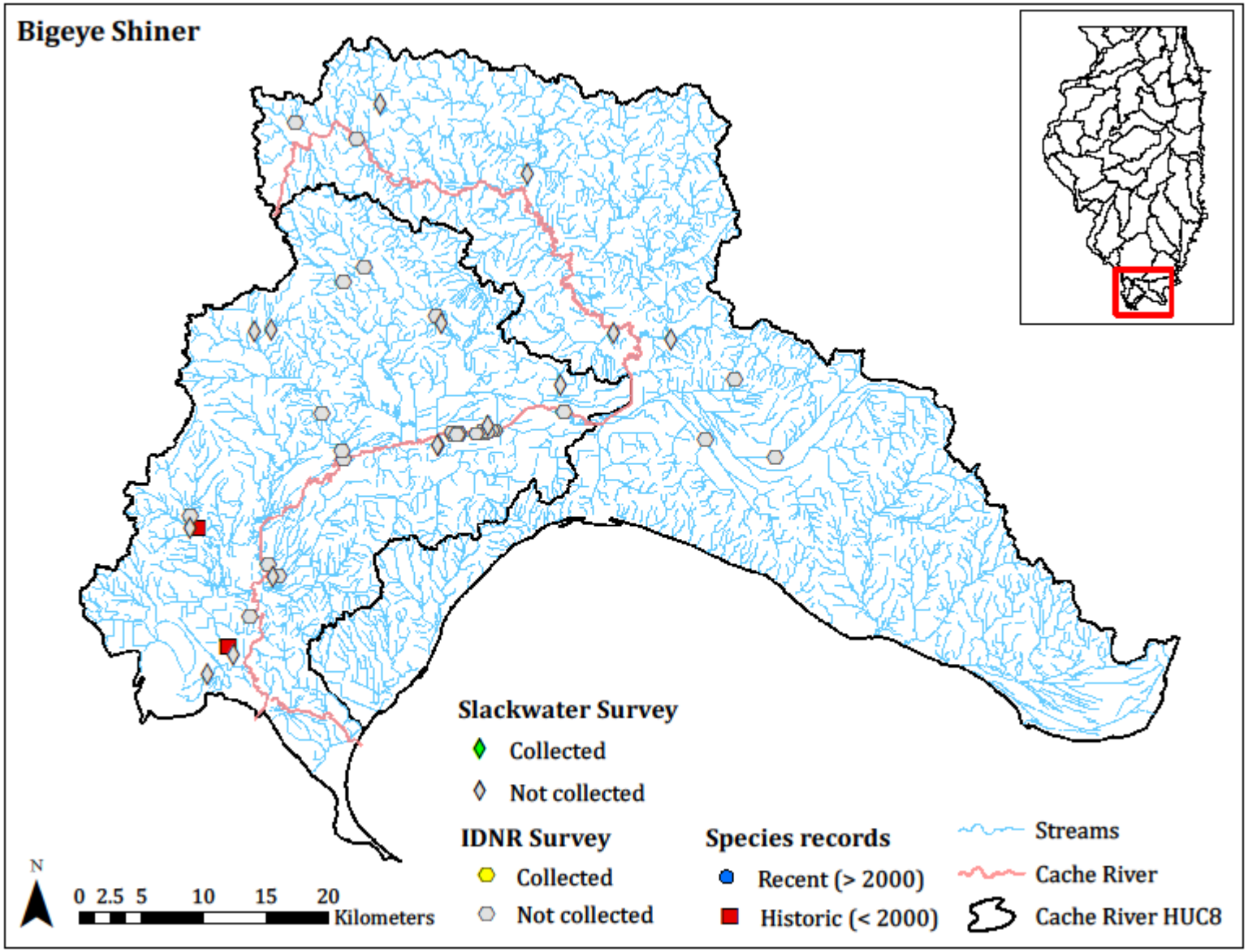
Distribution maps of target slackwater fish Species in Greatest Need of Conservation (SGNC) in the Cache River watershed of collection records before 2000 (historic; red squares) and after 2000 (recent; blue circles). Slackwater survey (diamonds) and Illinois Department of Natural Resources (IDNR) Fisheries survey (hexagons) results of species collected (green or yellow) or not collected (gray) during 2014 sample effort. Inset: map of Illinois with the study area outlined by a red rectangle.

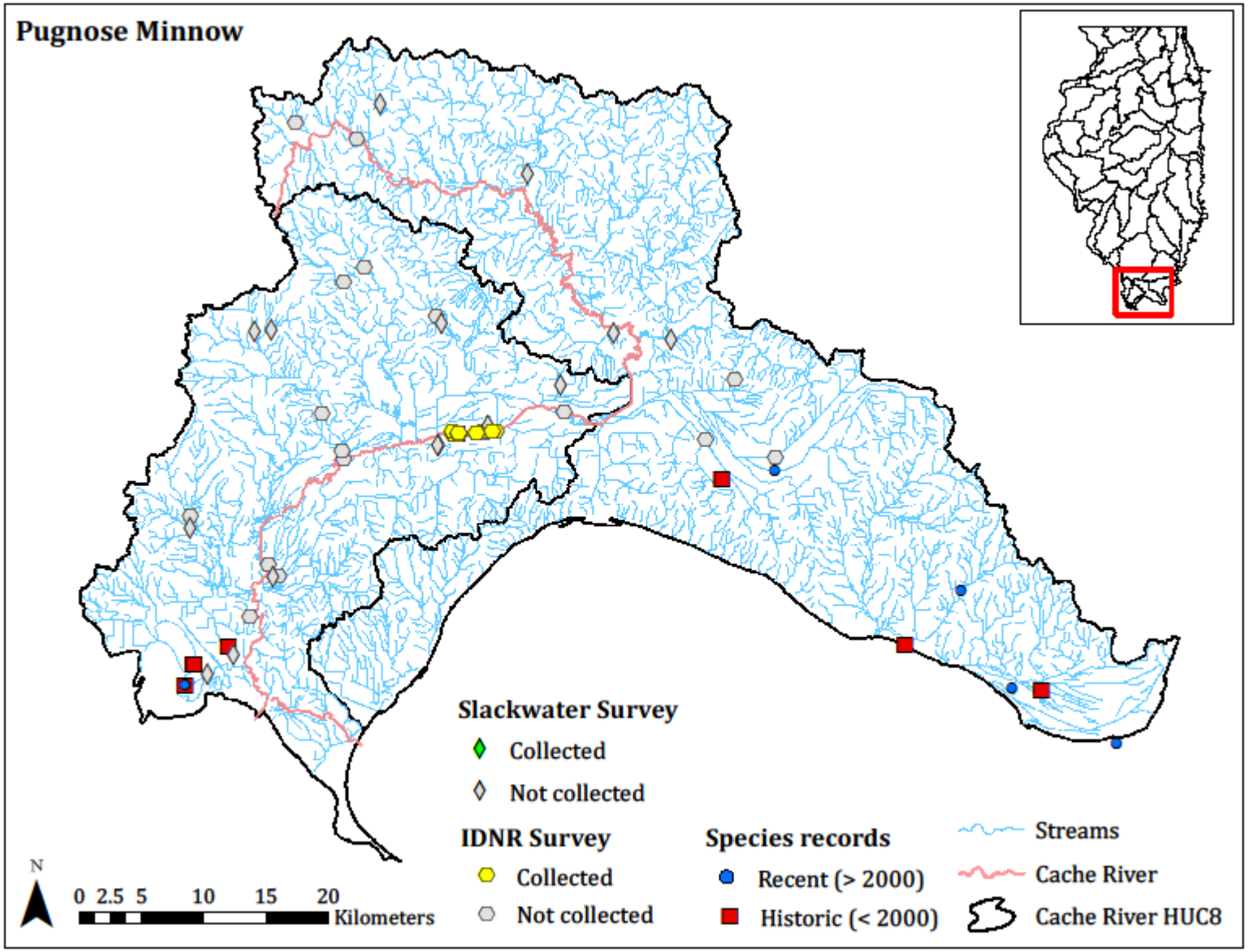

Banded Sculpin
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

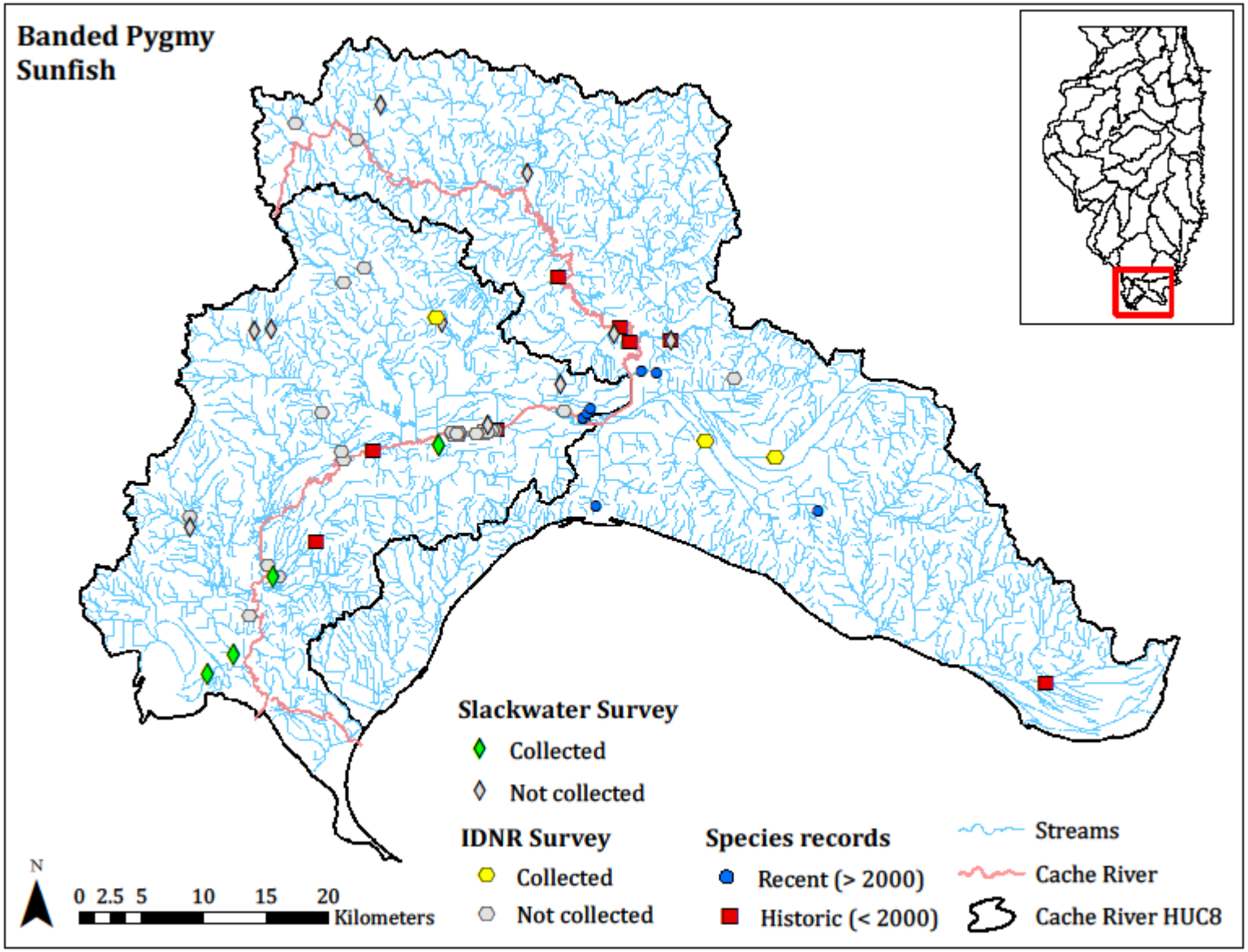

Central
Mudminnow
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

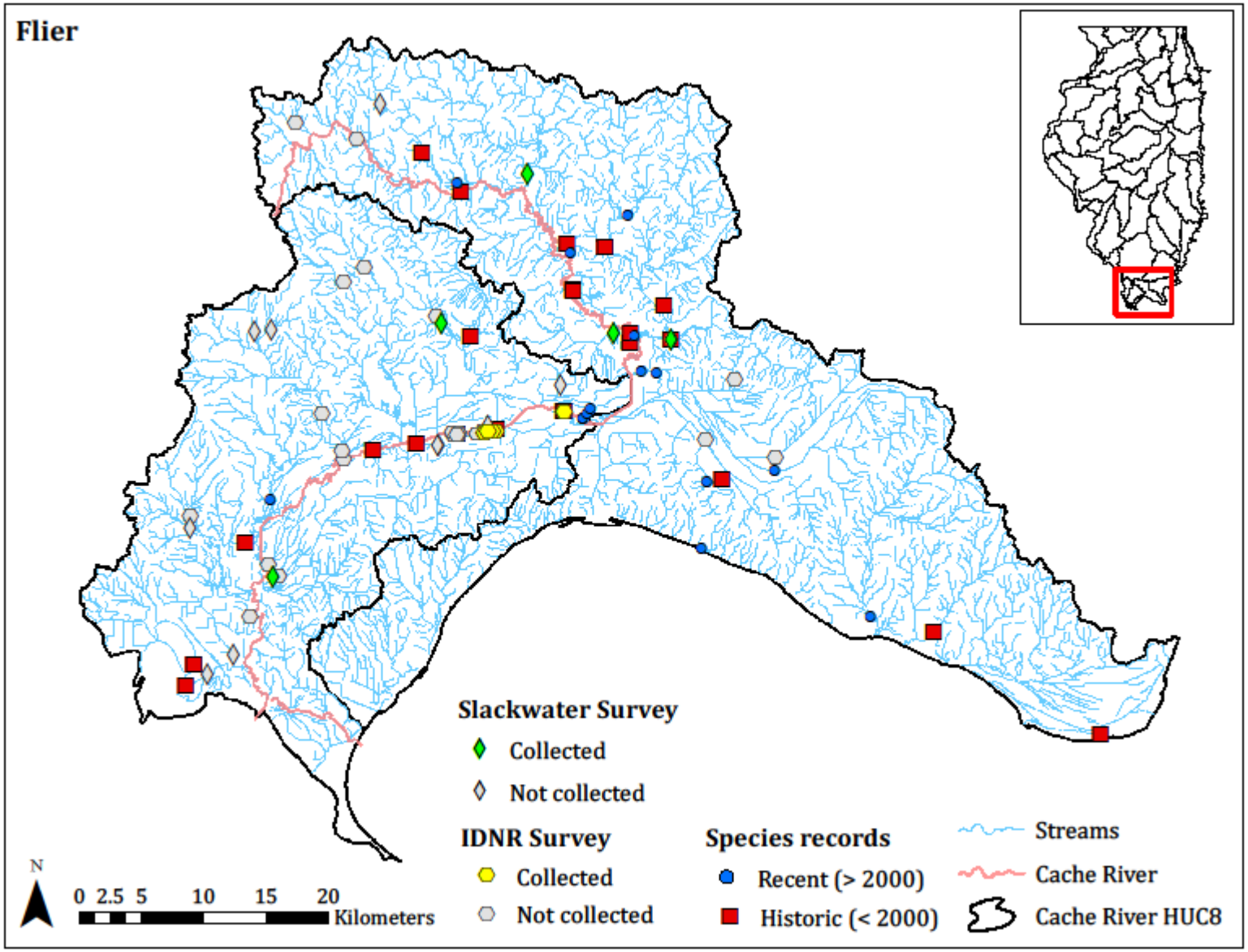

Cypress Minnow
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

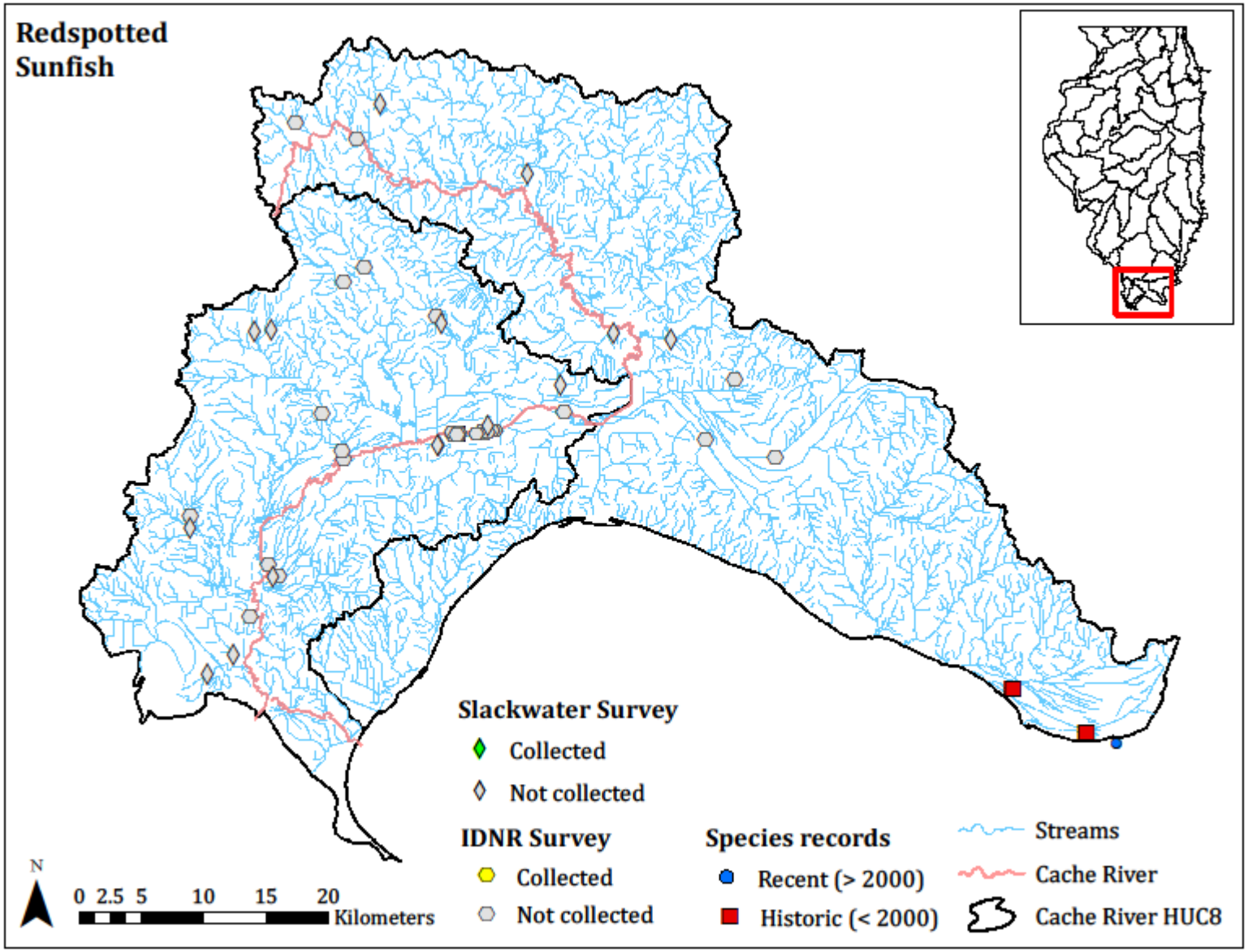

Ribbon Shiner
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

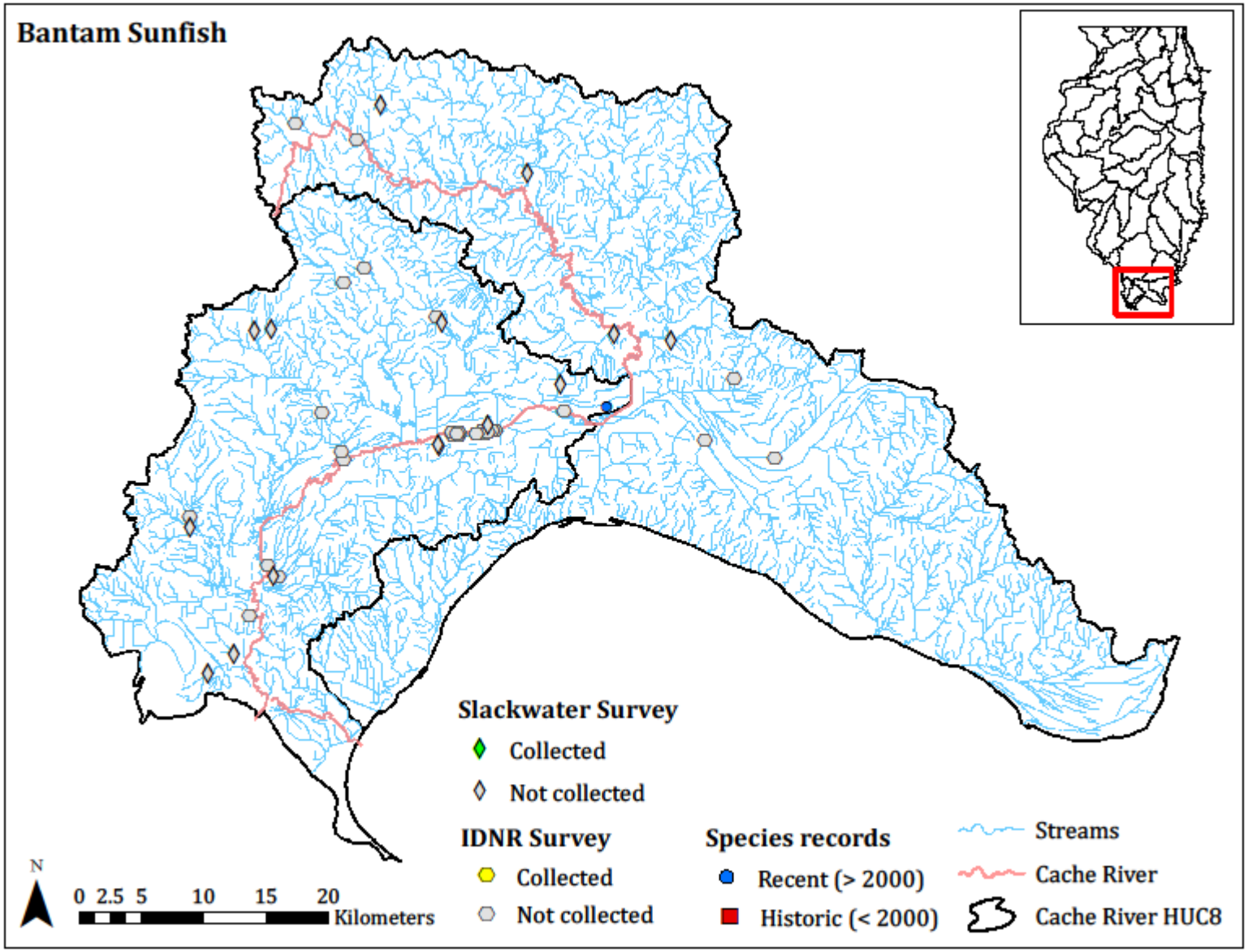

Bigeye Shiner
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

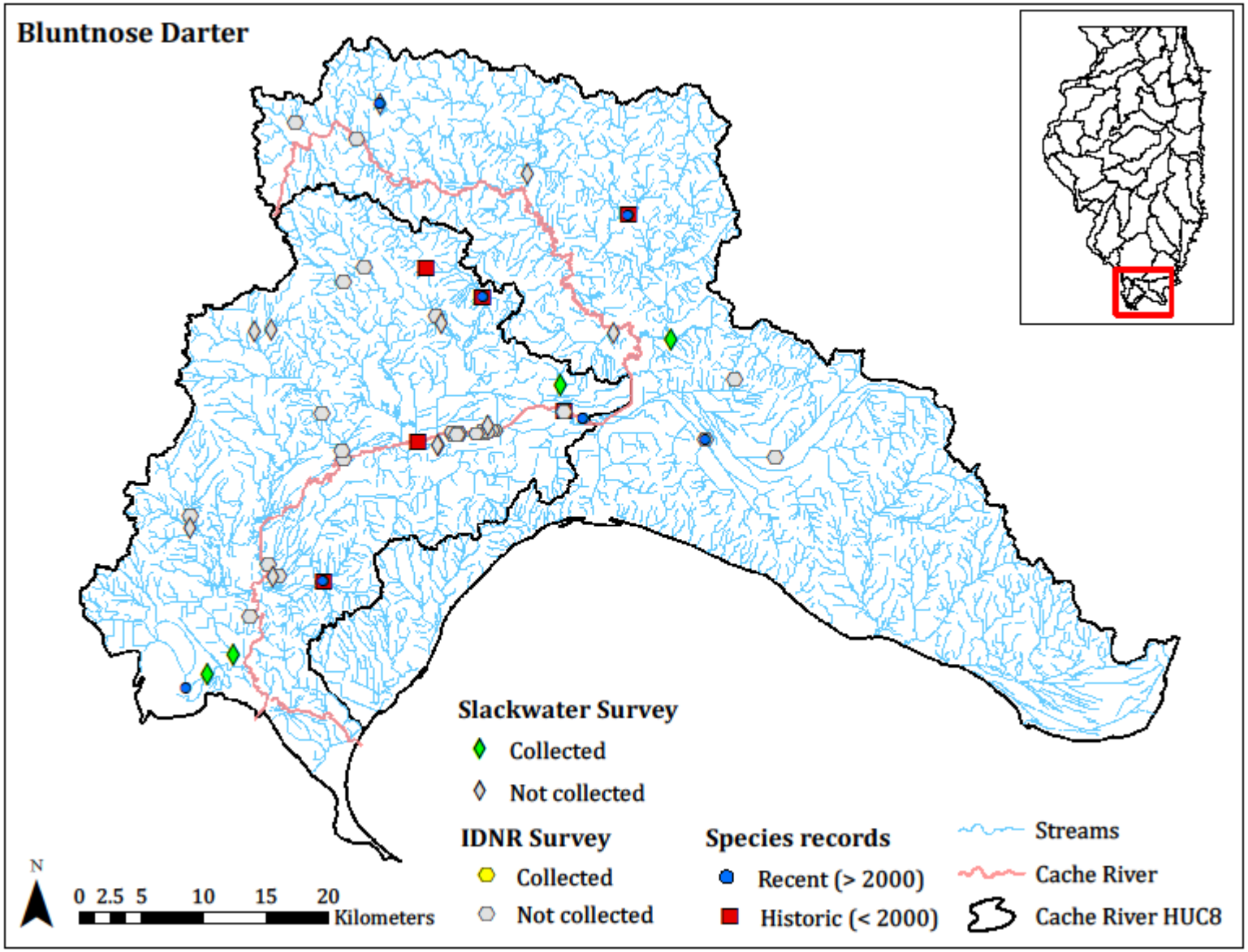

Pugnose Minnow
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

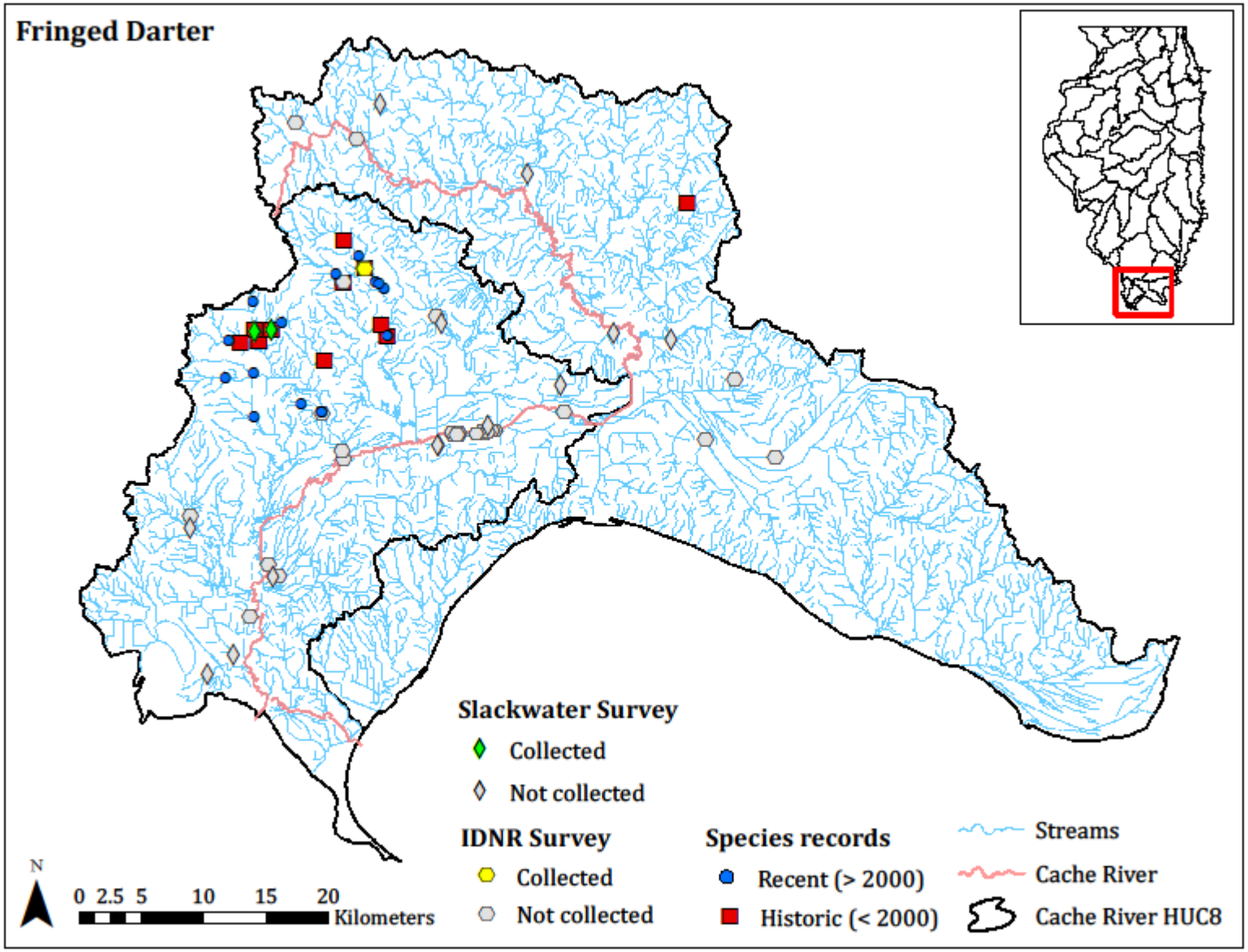

Banded Pygmy Sunfish
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

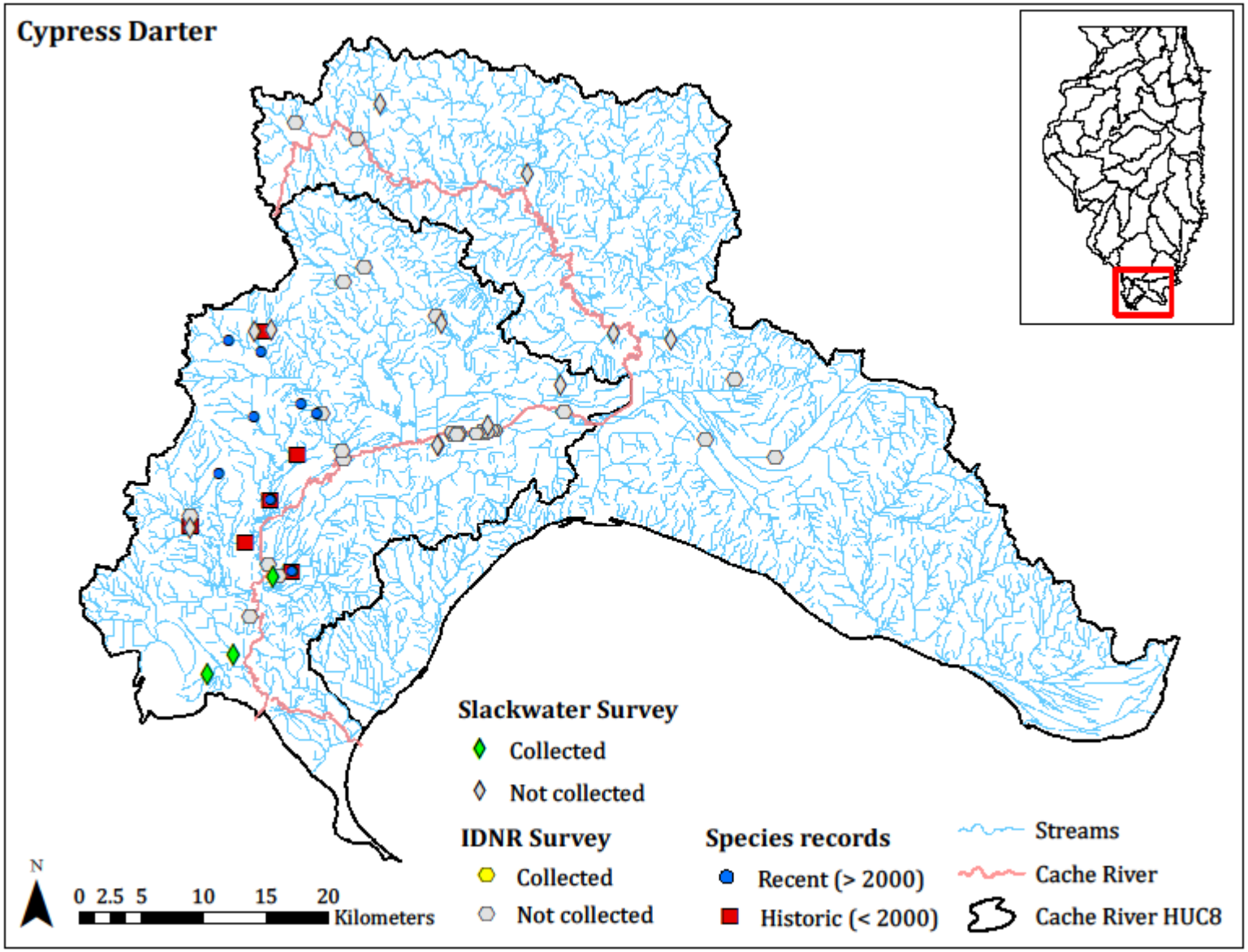

Flier
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers


Redspotted
Sunfish
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers


Bantam Sunfish
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers


Bluntnose Darter
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers


Fringed Darter
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers


Cypress Darter
Slackwater Survey
Collected
Not collected
IDNR Survey
Collected
Not collected
Species records
Recent (> 2000)
Historic (< 2000)
Streams
Cache River
Cache River HUC8
N
0 2.5 5 10 15 20
Kilometers

Conservation Opportunity Areas - DRAFT

Description

The Illinois Wildlife Action Plan establishes a common vision for the conservation of Illinois' wildlife and natural habitat. The plan identifies 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" (IDNR, 2005, p. 5). As a way to tackle the awesome conservation task before the residents of Illinois, the plan proposed a series of Conservation Opportunity Areas (COAs).

This section of the implementation guide seeks to capture what it means to be a Conservation Opportunity Area, along with the conservation priorities and challenges they face. Finally, this guide outlines ways people working in these areas can coordinate efforts to best support conservation on behalf of Illinois' species in greatest need of conservation.

What are Conservation Opportunity Areas?

Conservation Opportunity Areas are, quite simply, places in Illinois:

- with significant existing or potential wildlife and habitat resources;
- 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 purpose and set of objectives.

To create a list of places in the state fitting this description, scientists with Illinois Natural History Survey identified priority areas for conservation, using a variety of tools, such as Audubon's Important Bird Areas and The Nature Conservancy's portfolio sites. The centerpiece of their analyses, however, was a dataset showing the state's key blocks of habitat (called hubs) and the corridors that connect them. The Illinois Natural History Survey then convened conservation partners to review the analyses of key habitat and sites to ascertain whether these sites represented the above definition for a Conservation Opportunity Area. Conservation partners, you see, have special insight into the attributes that define these areas, such as whether conservation partners exist, whether resources are available to do the work and whether conservation has an agreed-upon conservation purpose and set of objectives. In the end, conservation partners strongly agreed with the analyses.

Although the Illinois Wildlife Action Plan (2005) proposed a series of conservation areas, their formal acceptance came afterwards. As part of that process, conservationists worked with Illinois Department of Natural Resources staff to develop boundaries for COAs. To more effectively manage COAs, the Illinois Fish and Wildlife Action Team established a Task Force to work on administrative issues. The Task Force, which is a committee composed of conservation partners and IDNR staff, reviews COA requests and makes recommendations to the Action Team for formal adoption.

Through these processes, Illinois:

- Mapped and formally adopted the COAs proposed in the 2005 plan.
- Formed a new Conservation Opportunity Area: Middle Mississippi River.
- Revised the boundaries for six COAs: Green River, Kishwaukee River, Lake McHenry Wetlands, Mason County Sands Area, Rock River and Upper Mississippi River.

Efforts also are underway to formally merge the Southern Hill Prairie Corridor and Sinkhole Plain COAs, and proposals to form new COAs are being created by conservation partners.

Today, Illinois is home to 33 Conservation Opportunity Areas; see Figure No. 1 for a map and list of those COAs. In this report, COA names may have been shortened or altered to accommodate local colloquialisms (also noted in Figure No. 1).

Status as of 2015

Illinois' natural place form a rich tapestry, from its northern prairies to southern forests. Each of the state's natural areas are unique, as are the challenges and opportunities they face. Some places are hotspots for threatened and endangered species conservation. Others are expected to face pressures from high rates of population growth by 2025. These differences translate into differing conservation priorities and threats within individual COAs (Table 1). In general, restoring and enhancing wetlands is the top conservation priority for those working in Illinois' COAs, while invasive species and degrading habitat quality are the top two threats (Fidler, 2015).

It is rare for Conservation Opportunity Areas to embody all four of the attributes that define them. Each area within Illinois is unique, facing different conservation challenges, opportunities and levels of support. In some places, federal and state agencies are engaged in landscape-scale conservation, whereas other areas depend on citizen volunteers to plan and implement efforts. This disparity presents unique challenges when it comes to helping these areas realize their conservation potential. Further, the balance of people, resources and conservation agreement is dynamic, ever shifting.

Stakeholders within individual COAs, as expected, place differing importance and satisfaction on facets of their conservation efforts (Tables 2 and 3). For example, people working at Kankakee Sands felt the availability of core habitats and corridors for fish and wildlife populations was most important to their work, while individuals working in the Eastern Shawnee felt strong leadership from local partner organizations took priority.

A 2015 survey of stakeholders working in COAs provides a snapshot of the level of coordination, activity and conservation effort underway in Illinois' Conservation Opportunity Areas. Some key takeaways:

- Illinois' COAs need improved funding mechanisms, conservation leadership and support in combatting the spread and introduction of invasive species.
- The top factor for successful resource management is people working together, whereas lack of funding was the main impediment.
- The most important criterion for conservation projects is funding. Funding, or the lack thereof, also was the condition with which stakeholders were least satisfied.

Those interested in more detailed information on the status of individual COAs are encouraged to download the report – *Stakeholder perspectives on the status of Illinois' Conservation Opportunity Areas, a decade after their formation* (Fidler, 2015) – from the IDNR Web site.

Ways to Accomplish the Work

Conservation Opportunity Areas are, quite simply, places in Illinois 1) with significant existing or potential wildlife and habitat resources; 2) where partners are willing to plan, implement, and evaluate conservation actions; 3) where financial and human resources are available; and 4) where conservation is motivated by an agreed-upon conservation purpose and set of objectives. It is rare for Conservation Opportunity Areas to embody all four of the attributes that define them. In fact, the survey of stakeholders reveals that less than half of places embody this perfect mix of criteria; see Table 1 for the 14 COAs showing moderate, high or very high in all four criterion listed.

It is important, at this juncture, to take a moment to review the importance of the people working in these areas to accomplish conservation objectives. As you can see from this list above, the last three criteria encompass human dimensions, i.e. people work together to develop a shared conservation philosophy, while working to implement and finance conservation objectives. COAs, then, are defined by the people who work in them, whether the effort is grassroots led or part of a multi-agency collaboration. The success or failure of COAs is due, in part, to the ability of these people to coordinate conservation actions with a diverse array of people and organizations.

Despite inherent differences between COAs, there are some universal actions that individuals can take to advance conservation – locally and at the state level. These actions are designed to advance the social dimensions behind the reason for the founding of COAs within Illinois. They also were developed using a list of factors that either contribute to or reduce success of natural resource management, generated from the survey of stakeholders (Figure 2).

Each Conservation Opportunity Area is encouraged to:

1. **Form collaborative partnerships with other likeminded individuals and/or organizations working within your landscape.**

   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, as well as containing the ability to build coalitions (Dietz et al., 2003). People working to conserve Illinois would agree, ranking strong leadership right behind funding as the two most important criteria for successful conservation of our habitats and wildlife (Fidler, 2015).

2. **Connect conservation action with the species in greatest need of conservation within your COA.**

   The Illinois Wildlife Action Plan says conservationists identified COAs as having "high importance for conserving species in greatest need of conservation," (IDNR, 2005). Species in greatest need of conservation are animal species with small or declining populations or other characteristics that make them vulnerable.

   Conservation action should be focused on these species. The IDNR Web site includes a list of species in greatest need of conservation by COA.

3. **Understand how your COA intersects with statewide campaigns.**

   You will notice that each campaign chapter contains a description of the campaign, its goals, status, stresses and threats to wildlife and habitat, focal species, focal areas, conservation actions, and management resources. To help you better understand how your COA connects with campaigns, IDNR has provided a map showing the intersection between your COA and campaign focal areas. It can be found online.

4. **Develop wildlife or habitat SMART goals that can be achieved by 2025.**

SMART goals are ones that are strategic, measurable, attainable, relevant and bound by a specific timeframe. To develop these goals:

- Use the maps provided by IDNR (noted in No. 3) to understand how your COA intersects with the various campaigns.
- Review the universal and targeted actions for relevant campaigns, which are found in the campaign chapters.
- Identify which of these actions you and your fellow conservation partners intend to focus on between now and 2025.
- Connect your SMART goals directly to species in greatest need of conservation found within your region (noted in No. 2).

5. Determine funding mechanism for accomplishing work within the COA.

The biggest gaps between what Illinois conservationists *have* and what they *need* is in the realms of leadership and funding (Fidler, 2015). Be proactive and realistic in developing SMART goals, organization plans and objectives. It's important to take time to list potential funding sources for various activities.

6. Share information with IDNR.

Recognizing that COA conservation is dynamic, it's important to make information readily available to partners working in concert. Therefore, IDNR will act as clearinghouse for COA conservation information through its Web site, the Illinois Fish and Wildlife Action Team and the COA Task Force. New updates and details will be shared online.

As you work to advance COA conservation, there are some specific ways that it would be helpful to communicate with IDNR. They are:

a. If you form a collaborative partnership, a list of participating organizations and individual contacts will enable the department to communicate effectively with your group. Please provide an excel spreadsheet listing:
    i. contact first and last names;
    ii. organization or affiliation;
    iii. professional title;
    iv. email address;
    v. mailing address (street, city, state, zip code); and
    vi. telephone number.
b. A description of the conservation philosophy that brings partners together in the COA; this could be thought of as a "mission statement" for the COA.

c. Any goals and/or plans that are developed should be provided to IDNR. These documents will be shared online.
d. Progress made towards goals should also be provided.
e. Requests for modifications to COAs should be directed to the Wildlife Action Plan coordinator. In specific, there is a process for nominating new COAs and for revising COA boundaries. (Visit IDNR's Illinois Wildlife Action Plan web site for detail on these processes.)

The contact for the above requested communication is the state wildlife action plan coordinator. Contact information for the coordinator is available at IDNR's Illinois Wildlife Action Plan web site.

Figure 1. COAs currently recognized through the Illinois Wildlife Action Plan with abbreviated or alternate references for COA in parenthesis.

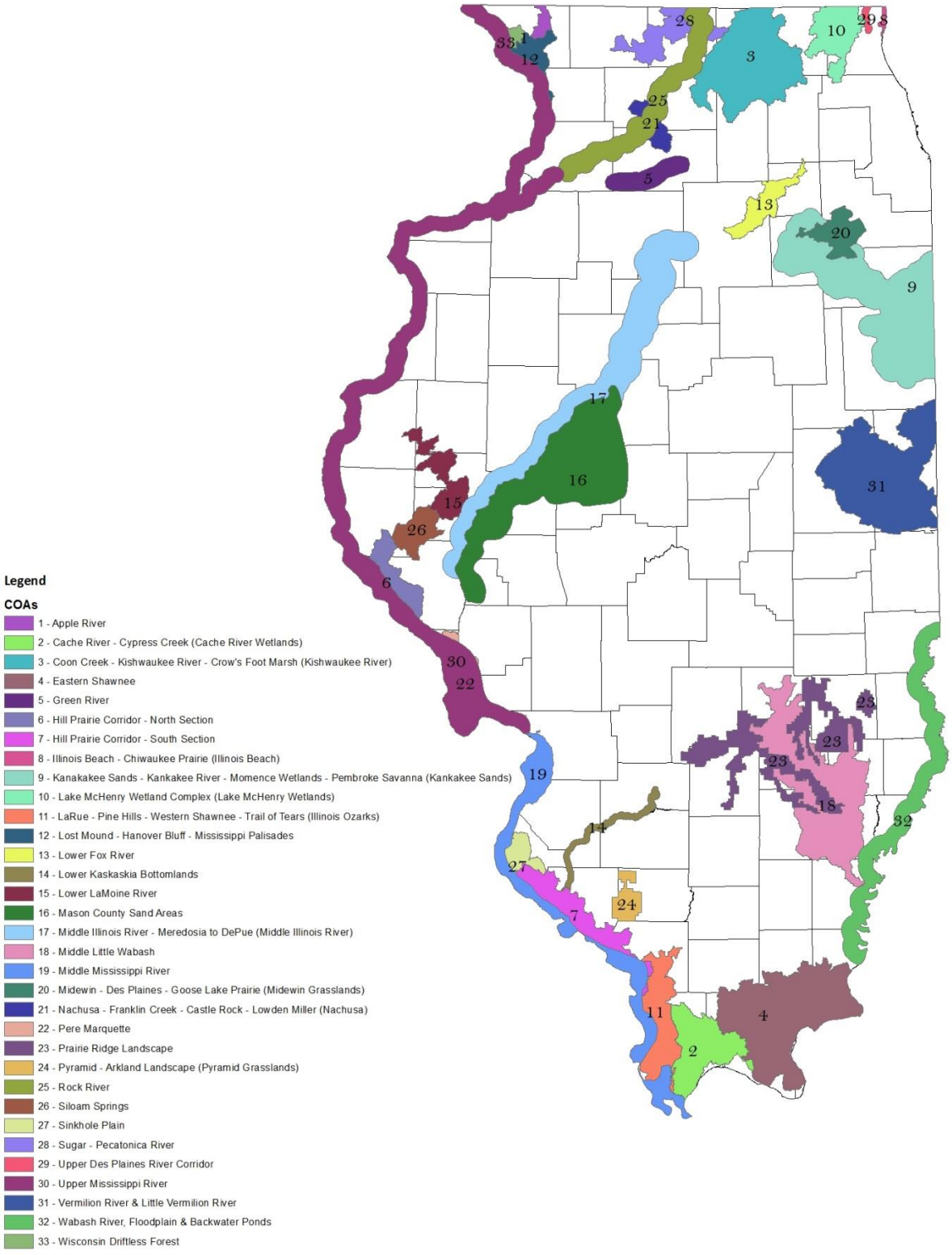


Table 1. Summary of the 2015 Status of Individual COAs[1]

COA	N[2]	RMP[3]	Conservation Priority[4]	Major Threats[5]	Campaign Connections	Criterion 1[6]	Criterion 2[7]	Criterion 3[8]	Criterion 4[9]
Apple River	8	↑	streams	invasives	Streams	↑	↔	↓	↑
Cache River Wetlands	23	↑	wetlands	hydrology	Streams, Wetlands	↑	↔	↔	↔
Eastern Shawnee	16	↔	forests & savannas	invasives	Forests and Woodlands, Streams	↑	↔	↔	↑
Green River	5	↔	wetlands	habitat quality	Farmland and Prairie, Streams, Wetlands	↓	↔	↔	↑
Illinois Beach	7	↑	wetlands & invasives	invasives	Lake Michigan, Wetlands	↑	↑↑	↔	↑↑
Illinois Ozarks	15	↑	forests & savannas	habitat quality	Forests and Woodlands, Streams, Wetlands	↑	↑	↓	↑
Kanakakee Sands	16	↑	forests & savannas	habitat loss	Farmland and Prairie, Forests and Woodlands, Streams, Wetlands	↑	↑	↓	↑
Kishwaukee River	13	↔	streams	invasives	Streams, Wetlands	↔	↑	↓	↑
Lake McHenry Wetlands	5	↓	wetlands	invasives	Farmland and Prairie, Forests and Woodlands, Streams, Wetlands	↔	↔	↓	↔
Lost Mound - Hanover Bluff - Mississippi Palisades	5	↔	forests & savannas	invasives	Farmland and Prairie, Forests and Woodlands, Wetlands	↑↑	↑	↓	↑↑
Lower Fox River	9	↑	streams & invasives	invasives	Streams	↔	↔	↓	↔
Lower Kaskaskia Bottomlands	4	↔	wetlands	hydrology, pollutants/sediment, invasives	Forests and Woodlands, Streams, Wetlands	↔	↔	↔	↔
Lower LaMoine River	6	↑	invasives	invasives	Forests and Woodlands	↔	↔	↓	↔
Mason County Sand Areas	16	↑	forests & savannas	invasives	Farmland and Prairie, Forests and Woodlands, Wetlands	↔	↔	↔	↔
Middle Illinois River	23	↑	wetlands	habitat quality	Farmland and Prairie, Streams, Wetlands	↔	↔	↔	↔
Middle Little Wabash	9	↔	wetlands	habitat quality, invasives	Wetlands	↔	↓	↓	↔
Middle Mississippi River	7	↑	wetlands	habitat quality	Forests and Woodlands, Wetlands	↑	↔	↓	↑
Midewin Grasslands	9	↑	wetlands	habitat loss	Farmland and Prairie	↑	↑	↑	↔
Nachusa	5	↑	forests & savannas, grassland & shrub	habitat loss	Farmland and Prairie, Forests and Woodlands, Streams	↔	↑	↔	↔
Northern Hill Prairie Corridor	1	↑	grassland & shrub	habitat quality, invasives	Farmland and Prairie, Forests and Woodlands	↔	↑↑	↑	↑
Pere Marquette	6	↔	forests & savannas	invasives	Forests and Woodlands, Streams	↑	↔	↓	↔
Prairie Ridge Landscape	6	↑	invasives	invasives	Farmland and Prairie, Wetlands	↔	↔	↓	↑
Pyramid Grasslands	4	↑↑	invasives	-	Farmland and Prairie, Wetlands	-	-	-	-
Rock River	7	↔	forests & savannas	invasives		↔	↔	↔	↔
Siloam Springs	7	↑	forests & savannas	habitat quality	Forests and Woodlands	↑	↔	↔	↔
Sinkhole Plain	4	↔	invasives	climate, invasives	Streams	↑↑	↔	↑	↑
Southern Hill Prairie Corridor	5	↔	invasives	invasives	Farmland and Prairie, Forests and Woodlands	↔	↔	↓	↔
Sugar and Pecatonica rivers	7	↔	wetlands	habitat quality, invasives	Streams, Wetlands	↔	↔	↓	↑
Upper Des Plaines River	3	↑	forests & savannas, invasives	invasives	Forests and Woodlands, Streams, Wetlands	↑	↑	↓	↑
Upper Mississippi River	17	↑	streams	habitat quality, pollutants/sediment	Streams, Wetlands	↑	↔	↓	↑
Vermilion River & Little Vermilion River	28	↑	streams	habitat loss	Forests and Woodlands, Streams	↔	↔	↔	↔
Wabash River	10	↔	wetlands	habitat quality	Streams, Wetlands	↑	↑	↔	↔
Wisconsin Driftless Forest	5	↑	forests & savannas	habitat quality, invasives	Forests and Woodlands	↑	↑	↑	↑

[1] Arrows indicate mean score from stakeholders on a scale of very low (1=↓↓), low (2=↓), moderate (3=↔), high 4=(↑) and very high (5=↑↑) [2] Number of stakeholders completing survey for each COA. [3] Average of the mean scores from questions 8 and 9, then rounded to nearest whole number, the effectiveness of the resource management plan in managing/protecting fish/wildlife/important habitats [4] Conservation priorities receiving highest score. [5] Conservation threats receiving highest score. [6] Criterion 1: Existing or potential wildlife and habitat resources. Average of the mean scores, then rounded to nearest whole number, for availability of core habitats and public lands. [7] Criterion 2: Partners willing to plan, implement and evaluate conservation actions. Average of the mean scores, then rounded to nearest whole number, for strong leadership from agencies and partner organizations. [8] Criterion 3: Financial and human resources available. Mean score, then rounded to nearest whole number, for funding. [9] Criterion 4: Conservation motivated by agreed-upon conservation purpose. Mean score, then rounded to nearest whole number, partners with a shared vision and participating in conservation actions. (Source: Fidler, 2015)

Table 2. Importance of conditions for planning and implementation within COAs[1]

Conditions[2]	Availability of data		Partners		Agency leadership		Partner leadership		Habitat		Project funding		Resource sharing		Outreach		Monitoring		Availability of public lands	
COAs	N[3]	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
Apple River	4	5	4	5	4	4.5	4	4.25	4	4.75	4	4.75	4	3.5	4	4	4	4.25	4	4
Cache River Wetlands	14	4.43	14	4.86	13	4.85	13	4.69	14	4.5	14	4.93	14	4.14	13	4.85	14	4.21	14	4.5
Eastern Shawnee	11	4.18	11	4.73	11	4.73	11	4.91	10	4.3	11	4.64	11	3.82	11	4.45	11	4	11	4.45
Green River	5	4.2	5	4.8	5	4.2	5	3.8	4	4	5	4.8	5	4.6	4	3.75	5	4.6	5	4.4
Illinois Beach	4	4	4	4.75	4	3.75	4	4.25	4	4.25	4	4	4	3	4	4.5	4	4.5	4	3.75
Illinois Ozarks	11	4.45	12	4	12	4.08	12	3.75	12	3.92	12	4.17	12	3.92	12	4.33	12	4	11	4
Kanakakee Sands	9	4.33	9	4.44	9	4.22	8	4.25	9	4.89	8	4.75	9	3.89	9	4.44	9	4.33	9	4.33
Kishwaukee River	10	4.9	10	4.5	10	4.2	10	4.4	10	4.6	10	4.9	9	4.11	10	4.4	10	4.3	9	4.22
Lake McHenry Wetlands	2	4.5	2	5	2	5	2	5	2	5	2	4.5	2	4	2	5	2	4.5	2	2.5
Lost Mound - Hanover Bluff - Mississippi Palisades	2	5	2	4.5	2	5	2	4.5	2	5	2	5	2	4	2	4	2	4.5	2	5
Lower Fox River	7	4.43	7	4.29	7	4.43	6	4.17	7	4.29	7	4.43	7	4	6	4	7	4.29	7	3.86
Lower Kaskaskia Bottomlands	2	5	2	4.5	2	5	2	4.5	2	4.5	2	4.5	2	4.5	2	4.5	2	4.5	2	4
Lower LaMoine River	3	4	4	3.75	4	5	4	4.75	3	5	4	4.25	3	4.33	2	4.5	3	4.67	4	3.5
Mason County Sand Areas	12	4.75	12	4.5	11	4.73	10	4.6	11	4.64	11	4.82	10	3.3	11	4.18	12	4.75	11	4
Middle Illinois River	16	4.19	16	4.31	16	3.88	16	4.31	16	4.06	16	4.06	14	3.71	16	4	16	3.5	16	3.94
Middle Little Wabash	6	4.33	6	4.33	6	5	6	4.67	6	4.67	6	4.5	6	3.83	6	4.67	6	4.17	6	3.83
Middle Mississippi River	7	4.43	7	4.71	7	4.29	7	4.57	7	4.43	7	5	5	4.6	7	4.43	7	4.86	7	4.29
Midewin Grasslands	4	4.25	4	4.25	4	4.5	4	4	3	5	4	4.75	4	3.75	4	4.5	4	4.25	3	5
Nachusa	3	4.33	3	4.33	3	4	3	4.67	3	4.67	3	4.67	3	4	3	4	3	4.33	3	4.33
Northern Hill Prairie Corridor	1	4	1	4	1	5	1	4	1	5	1	5	1	4	1	4	1	4	1	4
Pere Marquette	4	4.5	4	4.5	4	5	4	3.75	4	4	4	4.5	4	3.5	4	4	4	4.5	4	4
Prairie Ridge Landscape	5	4.6	5	4.6	5	5	5	4.6	5	4.2	5	5	5	3.2	5	4.8	5	4.8	5	4.2
Pyramid Grasslands	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	1	-	0	-
Rock River	6	4.33	6	3.83	6	4	6	3.33	6	4.5	6	4.17	5	3.4	5	3.8	5	4.4	6	3.67
Siloam Springs	5	4.8	5	4.2	5	4.6	5	4.4	5	5	5	4.8	4	4.25	5	4.2	5	4.8	5	4.2
Sinkhole Plain	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	4
Southern Hill Prairie Corridor	3	4.67	3	5	3	4.67	3	5	3	4.67	3	4.67	3	4	3	5	3	4.33	3	2.67
Sugar and Pecatonica rivers	5	4	5	4.4	5	4.6	5	4.4	5	4.6	5	4.4	5	3.8	4	4.5	5	4.6	5	3
Upper Des Plaines River	2	4.5	2	5	1	5	1	5	2	5	2	4	1	3	1	5	2	5	2	4
Upper Mississippi River	9	4.67	9	4.67	9	5	9	4.56	9	4.78	7	5	9	4	8	4.63	9	4.67	9	4.44
Vermilion River & Little Vermilion River	15	4.67	14	4.86	15	4.73	15	4.8	15	4.73	15	4.47	14	3.71	15	4.47	15	4.33	15	4.33
Wabash River	8	4.63	8	4.38	8	4.63	8	3.88	8	4.38	7	4.71	8	3.63	8	4.38	8	4.75	7	4.29
Wisconsin Driftless Forest	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	5	1	5	1	5

[1] Importance rated on a scale 1 to 5, with 1 being “extremely unimportant” and 5 being “extremely important”

[2] Conditions taken from survey question.

[3] Number of stakeholder responses.

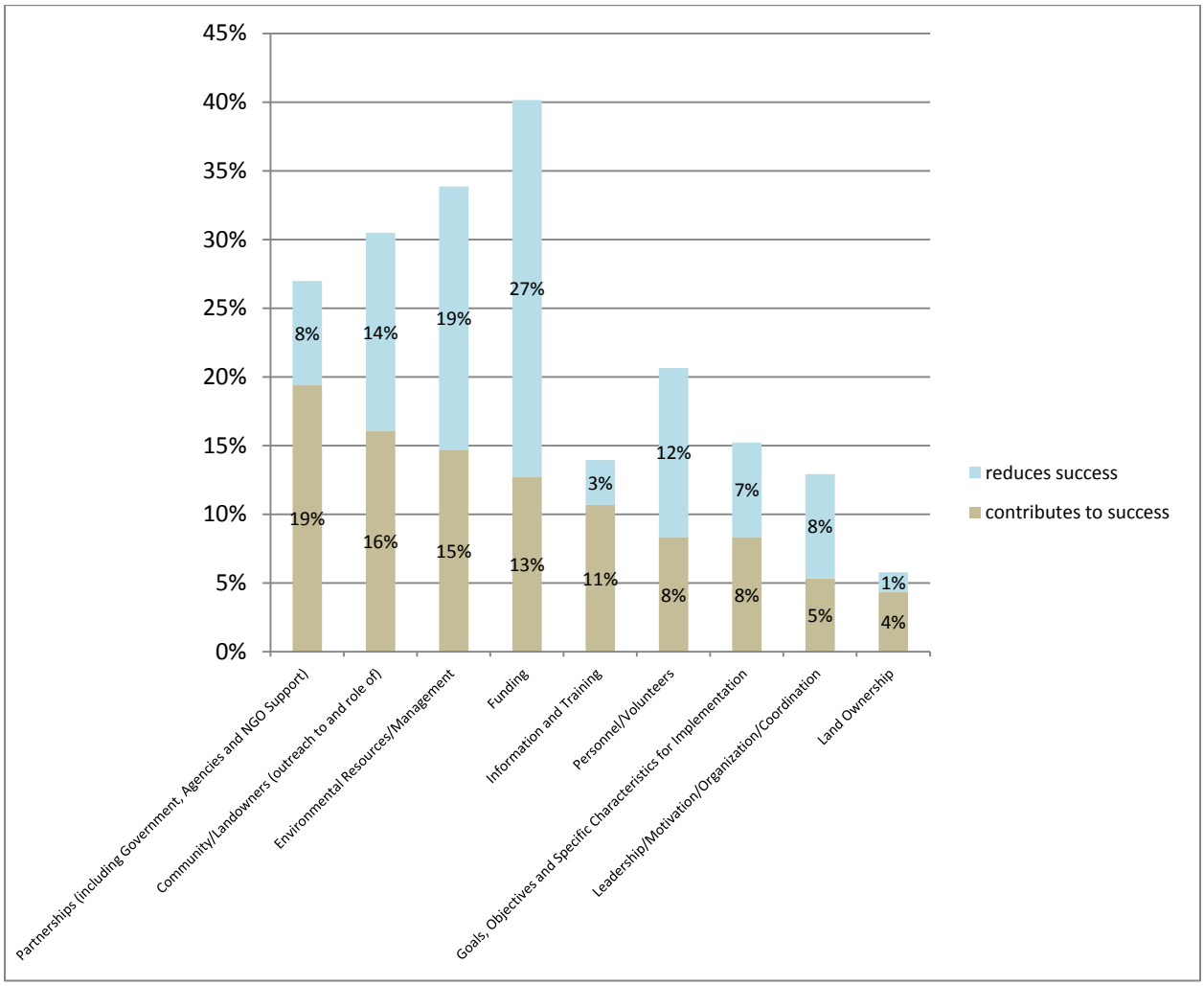
(Source: Fidler, 2015)

Table 3. Satisfaction of conditions for planning and implementation within COAs[1, 2]

Conditions[3]	Availability of data		Partners		Agency leadership		Partner leadership		Habitat		Project funding		Resource sharing		Outreach		Monitoring		Availability of public lands		AVG
COAs	N[4]	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	Mean
Sinkhole Plain	1	4.00	1	4.00	1	2.00	1	4.00	1	5.00	1	4.00	1	5.00	1	4.00	1	4.00	1	4.00	4.00
Lost Mound - Hanover Bluff - Mississippi Palisades	2	4.00	2	4.50	2	3.50	2	4.50	2	4.50	2	2.00	1	5.00	2	2.50	2	3.50	2	5.00	3.90
Upper Des Plaines River	2	4.50	1	4.00	1	4.00	2	4.50	2	3.50	1	2.00	1	4.00	1	4.00	2	3.50	2	4.50	3.85
Illinois Beach	4	3.25	4	4.50	4	4.50	4	4.50	4	3.75	4	2.75	4	4.00	4	3.75	4	3.00	4	4.25	3.83
Wisconsin Driftless Forest	1	4.00	1	4.00	1	4.00	1	4.00	1	2.00	1	4.00	1	3.00	1	5.00	1	3.00	1	5.00	3.80
Illinois Ozarks	10	3.50	11	3.73	11	3.82	11	3.64	9	4.22	11	2.36	8	3.13	10	3.80	9	3.44	10	4.20	3.58
Midewin Grasslands	2	3.50	4	3.25	3	3.00	3	4.00	3	4.00	2	4.00	2	3.50	3	3.33	2	3.50	3	3.67	3.58
Northern Hill Prairie Corridor	1	2.00	1	4.00	1	5.00	1	4.00	1	2.00	1	4.00	1	4.00	1	4.00	1	3.00	1	3.00	3.50
Kanakakee Sands	9	3.56	9	4.11	9	3.44	8	3.88	9	3.56	9	2.22	8	4.13	9	2.56	9	3.56	9	3.44	3.45
Middle Mississippi River	6	3.67	7	4.00	7	3.00	7	3.71	7	3.57	7	2.43	6	3.17	7	3.57	6	3.17	7	4.14	3.44
Upper Mississippi River	8	3.63	7	3.71	7	2.71	6	4.17	8	3.50	5	2.20	5	3.40	6	3.83	7	3.57	7	3.71	3.44
Cache River Wetlands	14	3.79	14	3.14	14	2.93	13	2.92	14	3.86	14	2.57	13	3.69	13	3.54	14	3.36	14	4.29	3.41
Eastern Shawnee	11	3.64	11	3.55	11	3.27	11	3.00	10	3.40	11	3.00	11	3.45	11	2.64	11	3.09	11	4.64	3.37
Wabash River	7	3.14	7	3.14	7	3.57	7	3.57	7	3.43	6	3.00	7	3.57	7	2.86	7	3.14	6	3.83	3.33
Kishwaukee River	9	3.00	9	4.00	8	3.00	9	4.11	8	3.38	9	1.89	7	3.86	8	2.75	8	2.75	8	3.50	3.22
Siloam Springs	4	3.50	3	2.67	3	3.33	3	2.67	4	3.25	3	2.67	2	3.00	3	2.67	4	3.25	5	4.40	3.14
Vermilion River & Little Vermilion River	11	3.55	12	3.25	13	2.85	13	3.15	13	2.69	13	2.62	9	3.00	13	3.00	12	3.50	13	3.54	3.12
Mason County Sand Areas	10	3.30	10	3.30	11	3.45	8	3.00	8	3.00	10	2.70	8	3.25	9	3.22	10	3.10	9	2.78	3.11
Lower Kaskaskia Bottomlands	2	3.50	2	3.00	2	3.00	2	3.00	2	2.00	2	2.50	2	3.50	2	4.00	2	3.50	2	3.00	3.10
Nachusa	3	3.00	3	3.33	3	3.00	3	4.00	3	3.00	3	2.67	3	3.33	3	2.67	3	3.33	3	2.67	3.10
Rock River	6	3.00	6	3.33	6	3.17	6	3.50	6	2.83	6	2.50	5	3.80	5	3.00	5	2.40	6	3.33	3.09
Apple River	4	3.50	4	3.75	4	2.25	4	3.50	4	3.50	4	2.25	4	3.00	3	2.67	3	2.67	4	3.75	3.08
Pere Marquette	4	3.00	4	3.25	4	2.75	4	2.75	4	3.75	3	2.33	3	3.00	3	3.00	4	3.50	4	3.50	3.08
Southern Hill Prairie Corridor	3	3.33	3	3.33	3	2.33	3	3.00	3	3.33	3	1.67	3	3.67	3	2.67	3	3.67	2	3.50	3.05
Green River	4	3.00	5	4.00	5	2.80	5	3.40	3	1.33	3	3.33	4	4.00	4	2.50	5	2.60	5	3.40	3.04
Middle Illinois River	16	3.69	16	2.81	16	2.50	14	3.21	16	3.00	16	2.56	14	3.00	16	2.69	16	3.63	15	3.20	3.03
Lake McHenry Wetlands	2	3.50	2	3.00	2	3.50	2	3.00	2	2.50	2	2.00	2	4.00	2	3.00	2	2.00	2	3.00	2.95
Lower Fox River	7	2.86	6	3.17	7	3.29	6	3.17	7	2.71	7	1.71	7	3.00	6	3.00	7	3.00	7	2.71	2.86
Prairie Ridge Landscape	5	2.20	5	3.60	5	2.60	5	3.00	5	2.60	5	1.80	4	2.50	5	3.00	4	3.25	5	3.20	2.78
Lower LaMoine River	2	1.50	3	3.33	3	3.00	3	3.33	3	3.00	3	2.00	2	4.00	2	2.00	3	3.00	2	2.50	2.77
Sugar and Pecatonica rivers	4	2.25	4	3.50	4	2.25	3	3.33	3	3.00	4	1.50	3	3.33	4	2.50	4	2.50	3	2.33	2.65
Middle Little Wabash	6	2.83	6	2.50	6	2.33	6	2.17	6	2.83	6	1.83	6	2.67	6	1.83	6	2.50	6	2.33	2.38
Pyramid Grasslands	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	1	-	0	-	-

[1] Satisfaction rated on a scale from 1 to 5, with 1 being “extremely unsatisfied” and 5 being “extremely satisfied.”
[2] COAs ranked according to average mean responses to all questions.
[3] Conditions taken from survey question.
[4] Number of stakeholder responses.
(Source: Fidler, 2015)

Figure 2. Factors that contribute or reduce success of natural resource management



(Source: Fidler, 2015)

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Midewin - Des Plaines - Goose Lake Prairie Macrosite

(also known as the *Midewin Grasslands*)

Implementation Guide

The implementation guide (2015) is organized around campaigns. This COA is mentioned in three campaigns: Farmland and Prairie, Green Cities and Streams.

Farmland and Prairie

Within the Midewin - Des Plaines - Goose Lake Prairie Macrosite, the campaign lists Midewin Area as one its highest priority conservation sites.

Specific actions

- Acquisition of grasslands should follow a Landscape Scale Approach (when possible) to maximize the benefits to grassland birds.
- Inter-agency cooperation and coordination to ensure agricultural programs do not have conflicting objectives.
- At local, county and regional scales, involve stakeholders in discussions of long-term land use planning to meet agricultural, conservation, economic, residential and recreational needs.

Green Cities

Portions of this COA are contained in the Chicago Metropolitan Area, which is a focus area for this campaign.

Actions listed for grasslands

- Protection of large parcels of non-linear grasslands.
- Identification of areas on urbanizing edge where large grassland tracts can be established,
- Removal of woody incursions such as tree lines, brush mowing, and herbaceous weed mowing.
- Restoration of hydrology.
- Establishment of a fire regime.

Actions listed for Blue spotted Salamander

- Restoration and maintenance of vernal pool systems.
- Invasive species removal.
- Restoration of hydrology.
- Implement actions to encourage oak regeneration.
- Assembling large 1000 acre woodlands/forested complexes.
- Linking protected oak complexes to existing urban oak canopies.
- Educating the public on the value of oak woodlands.

Streams Campaign

The Des Plaines River is identified as an important place for the Streams Campaign's focal species, the Iowa Darter, and as a Priority Watershed for Point Sources.

Actions for the Iowa Darter

- Improve water quality and clarity by reducing the amount of pollutants and particulates that enter the stream. Clearer and cleaner water will facilitate growth of native aquatic vegetation.
- Use native riparian vegetation buffers help prevent erosion and overland transport of sediments into streams.
- Enhance the effectiveness and capacity of wastewater treatment facilities (e.g., reduced phosphorus loads).
- Protect and buffer headwater wetlands and wetlands adjacent to streams to filter water before it enters the main stream channel, these areas may provide additional habitat for Iowa darters.
- Increase stream habitat heterogeneity by creating meanders and leaving woody debris, natural stones, etc. in the stream channel to facilitate the formation of pools, riffles, side channels, backwaters, etc. The resulting variety of depths, current velocities, and bottom substrate types will provide the basis for habitat heterogeneity.
- Decrease flashiness of streams by allowing more rainwater to enter the ground (e.g., permeable pavement, plantings of native trees, shrubs, grasses, etc.).
- Install non-point source infiltration practices to mitigate discharge from wastewater treatment facilities after extreme storm events to reduce or eliminate the occurrences of Combined Sewer Overflows.
- Create natural floodplains adjacent to streams.

Universal actions

- Continue statewide comprehensive monitoring & assessment programs focused on the conservation status of aquatic SGCN.
- Initiate a sentinel monitoring program for a broad range of habitat conditions & taxa to improve trend analysis and assessment
- Encourage or require implementation and effectiveness monitoring in work plans on Public Lands or within projects supported by State funds.
- Evaluate the success of, and potential barriers to, recruitment (reproduction) of SGCN. (1,2,5)
- Identify and prioritize areas associated with SGCN for protection, enhancement, and restoration.
- Develop and begin implementation of recovery plans for state-listed aquatic species.
- Assist with implementation of the Illinois Nutrient Loss Reduction Strategy
- Explore efforts to develop environmental flows for Illinois waterbodies
- Assess, grow, and increase the impact of buffer easement programs
- Improve the compatibility of implementation of drainage law and other statutes with the needs of SGCN and their habitats including those of Endangered & Threatened Species.

- Identify and quantify the principle stressors for SGCN in aquatic systems associated with flow modifications, water chemistry, and physical "habitat" quality and availability.

Illinois Wildlife Action Plan

For each Conservation Opportunity Area, the Wildlife Action Plan (2005) identifies protected lands, conservation philosophy, objectives and priority actions.

Protected lands

Located in Will county, Midewin is the first tallgrass prairie to be established under federal control. Encompassing over 19,000 acres, it is the largest tallgrass prairie complex in the state, and is second only to Prairie Ridge State Natural Area in the number of nesting area-sensitive grassland bird species. Goose Lake Prairie is the largest native tallgrass prairie remnant in Illinois. Des Plaines Conservation Area provides 2,000 acres of additional grassland habitat.

Conservation philosophy

(none listed)

Priority Resources

(none listed)

Objectives

(none listed)

Priority actions

Restoration and management of tallgrass prairie vegetation are on-going; unnecessary legacy infrastructure (Midewin) and invasive woody vegetation are being removed. The surrounding landscape is vulnerable to exurban and suburban development because of its proximity to Chicago. Preserving open space would help ease the impact of land lost to development and increase an already ecologically important grassland ecosystem.

Natural Divisions

Conservation Opportunity Areas are part of broader landscapes in Illinois. These landscapes are divided into natural divisions. For each natural division, the Wildlife Action Plan (2005) identifies 1) major habitats and challenges, 2) conservation opportunities, 3) management guidelines, 4) recreation opportunities, 5) education and interpretative resources and 6) natural resource commodities. The Midewin - Des Plaines - Goose Lake Prairie Macrosite is in the The Grand Prairie Natural Division. For planning purposes, excerpted below are major habitats, critical species and management guidelines.

Grand Prairie Natural Division

Major Habitats

Forests, open woodland/savanna, wetlands, streams, lakes/ponds

Critical Species

Mussels snuffbox, sheepnose, salamander mussel, slippershell mussel, purple wartyback, spike, black sandshell, kidneyshell, elktoe

Insects regal fritillary, northern sedge grasshopper, Indian skipper, Catocala amestris, C. praeclara, Gabara subnivosella, Oligia obtusa, Hyparpax aurora, Paraphlepsius electus, P. carolinus, P maculosus, Scaphytopius abbreviatus, bracken borer moth

Fishes American eel, brown bullhead, western sand darter, eastern sand darter, largescale stoneroller, highfin carpsucker, brook stickleback, gravel chub, lake chubsucker, northern pike, bluntnose darter, harlequin darter, banded killifish, starhead topminnow, bigeye chub, northern brook lamprey, silver lamprey, American brook lamprey, redspotted sunfish, ribbon shiner, smallmouth bass, spotted bass, river redhorse, black redhorse, greater redhorse, bigeye shiner, ironcolor shiner, blacknose shiner, rosyface shiner, silverband shiner, weed shiner, slender madtom, pugnose minnow, yellow perch, trout-perch, southern redbelly dace, blacknose dace, sauger, central mudminnow

Amphibians four-toed salamander, Illinois chorus frog

Reptiles Blandings turtle, ornate box turtle, eastern massasauga, Kirtland's snake, western hognose snake, smooth green snake, lined snake

Birds northern harrier, short eared owl, Henslow's sparrow, grasshopper sparrow, bobolink, LeConte's sparrow, Nelsons's sharp-tailed sparrow, stilt sandpiper, piping plover, black tern, marsh wren, yellow rail, prairie warbler, willow flycatcher, loggerhead shrike, black rail, American woodcock, short-billed dowitcher, red-headed woodpecker, savannah sparrow, dickcissel, field sparrow, greater yellowlegs, buff-breasted sandpiper, upland sandpiper, American bittern, Wilson's phalarope, king rail, red-shouldered hawk, brown creeper, least bittern, northern bobwhite, American golden plover, Smith's longspur

Mammals American badger, gray bat, Indiana bat, Rafinesque's big-eared bat, red squirrel, Franklin's ground-squirrel

Management guidelines

Grasslands Grassland landscapes larger than 20,000 acres in the Grand Prairie Division should contain at least 60% grassland cover (over 90% in patches larger than 200 acres), less than 10% fescue and no more than 2% combined wooded and urban land covers. By 2025, restore and manage an additional 400,000 acres of grassland, with emphasis on focal areas

with >1,000 acres of mosaic and contiguous grasslands; convert >4,000 acres of fescue dominated roadsides to quality grassland habitat; improve the quality of Conservation Reserve Program grasslands on >4,000 acres. A system to estimate avian use of Pheasant Habitat Areas is needed, and long-term evaluation of the Conservation Reserve Program must be refined.

Wetlands Wetlands currently in agriculture should be buffered with upland habitat equal or greater than the wetland area. Bottomland wetland complexes should be buffered with bottomland habitat equal or greater than the wetland area; corridors connecting wetland complexes should be at least 50 m wide. Restored wetlands should be concentrated within focal areas. A net increase of at least 5,000 acres is needed to begin meeting wildlife objectives.

Streams Restore 1,000 acres of backwater habitat. Buffer >1,000 miles of stream bank with no less than 50 m of habitat.

Lakes & Ponds Establish aquatic vegetation on 10-20% of the littoral zone on all impoundments.

Open Woodland/Savanna Managed savannas should contain at least 95% native species. An increase of 45,000 acres is needed to begin meeting wildlife objectives.

Forest Upland forests will have a basal area of >35% for oak and hickory species combined, a basal area of <20% sugar maple, and fewer than 200 stems/ha of invasive shrubs. Bottomland forests should have a basal area of >20% early successional hard mast producing tree species and fewer than 200 stems/ha of invasive shrubs. Strive to reduce fragmentation. A net increase of 54,000 acres is needed to begin meeting wildlife objectives.

LaRue - Pine Hills - Western Shawnee - Trail of Tears

(also known as the *Illinois Ozarks*)

Implementation Guide

The implementation guide (2015) is organized around campaigns. This COA is mentioned in three campaigns: Forest and Woodlands, Green Cities, Streams and Wetlands.

Forest and Woodlands

Trail of Tears State Forest is a primary site for this campaign. Additionally, it states Trail of Tears will be used as demonstration site to inform, educate and train those interested in forest management, including conservation practitioners, land managers and the general public.

Universal actions

- Maintain and enhance the composition of Illinois' forested habitats.
- Promote prescribed fire.
- Direct the expected expansion of statewide forest acreage (the continuation of an 80-year trend).
- Develop and expand programs to assist private forest owners in managing forest resources and employing sustainable forestry practices.
- Fill information gaps and develop conservation actions to address stresses.
- Restore and manage high-quality examples of all forest, savanna and barrens communities, including all Grade A and B Illinois Natural Areas Inventory sites, in all natural divisions within which they occur.
- Develop zoning criteria and local greenway plans that protect important habitats and ensure "smart growth."

Green Cities

This COA is not a priority for the Green Cities campaign, but it is located in the Cape Girardeau, MO-IL and Carbondale-Marion, IL statistical areas.

Universal actions

- Increase high quality habitat for SGCN in Metropolitan Areas;
- Restore and manage Metropolitan waters that support SGCN
- Increase habitat connectivity to reduce fragmentation in urban land and water habitats at all scales and facilitate wildlife movement. Use Green Infrastructure principles (Core and Hub) to establish habitat corridors to large open space.
- Investigate causes of initial decline and feasibility of reintroduction success. Species reintroductions may be appropriate where species have been extirpated, where suitable habitat has been reestablished, and where fragmentation prevents re-colonization.
- Expand research on the value of Metropolitan Areas for neotropical migrants and other migratory species.

- Establish and support large scale monitoring programs (e.g. Bird Conservation Network)
- Recognize and manage specific (niche) habitats in Metropolitan Areas that provide for SGCN not found in the rest of the State such as cave amphipods in karst region, Blue-spotted Salamander in northern flatwoods, and Blanding's Turtle.
- Address wildlife species/human interaction with appropriate education and training for mutually beneficial interaction including large carnivore, deer populations and other urban wildlife.
- Study urban areas for their importance or role in maintaining Illinois species of SGCN.
- Establish long term monitoring of SGCN and the species they depend on. Provide data to State and local agencies to inform management decisions. Expand and refine existing data sharing networks for transfer of information.
- Utilize and train volunteers as stewards and citizen scientists to expand habitat restoration capabilities across the state and to expand collected data.

Streams

The LaRue - Pine Hills - Western Shawnee - Trail of Tears COA includes a Biologically Significant Stream Reach and portions of the Big Muddy River Watershed (a Nutrient Management Priority Area) and part of the Cache River Basin, making it a focal area of the Streams Campaign.

Universal actions

- Continue statewide comprehensive monitoring & assessment programs focused on the conservation status of aquatic SGCN.
- Initiate a sentinel monitoring program for a broad range of habitat conditions & taxa to improve trend analysis and assessment
- Encourage or require implementation and effectiveness monitoring in work plans on Public Lands or within projects supported by State funds.
- Evaluate the success of, and potential barriers to, recruitment (reproduction) of SGCN. (1,2,5)
- Identify and prioritize areas associated with SGCN for protection, enhancement, and restoration.
- Develop and begin implementation of recovery plans for state-listed aquatic species.
- Assist with implementation of the Illinois Nutrient Loss Reduction Strategy
- Explore efforts to develop environmental flows for Illinois waterbodies
- Assess, grow, and increase the impact of buffer easement programs
- Improve the compatibility of implementation of drainage law and other statutes with the needs of SGCN and their habitats including those of Endangered & Threatened Species.

- Identify and quantify the principle stressors for SGCN in aquatic systems associated with flow modifications, water chemistry, and physical "habitat" quality and availability.

Wetlands

The Wetlands Campaign lists wetlands in the Lower Mississippi River Bottomlands Natural Division as a high priority. Further, within that natural division, it lists several sites within this COA for highest conservation priority, including Oakwood Bottoms (Shawnee National Forest) and Big Muddy Bottoms (Shawnee National Forest).

Targeted actions

- Acquire and protect existing wetlands or restorable wetlands.
- Enhance habitat quality of existing wetlands.
- Restore shallow wetlands.
- Manage existing wetlands to maximize wildlife benefits.
- Restore historic hydrology to wetlands associated with large rivers.
- Support state and national wetland conservation legislation.
- Adopt/support agricultural practices which are less detrimental to wetlands and wildlife.
- Adopt/support economic and social development planning and strategies which are less detrimental to wetlands and wildlife.
- Facilitate interagency communication to provide consistent messaging and information about wetlands and other wildlife habitats.
- Conduct research to gain a greater understanding of wetland ecology, wetland wildlife and the relationship between wildlife and wetlands in Illinois.

Illinois Wildlife Action Plan

For each Conservation Opportunity Area, the Wildlife Action Plan (2005) identifies protected lands, conservation philosophy, objectives and priority actions.

Protected lands

Pine Hills Ecological Area/Research Natural Area, LaRue Ecological Area/Research Natural Area, Ozark Hills Nature Preserve, Shawnee National Forest (including Oakwood Bottoms), Trail of Tears State Forest

Conservation philosophy

Maintain connectivity among Ozark, Shawnee Hills and Lower Mississippi River Bottomlands Natural Divisions with riverine, swamp, bottomland forest, bluff, and upland forest, glade and barrens communities; protect and proactively manage for the unique flora and fauna native to these ecosystems; use sound management decisions guided by historical conditions

Priority Resources

high-quality streams, glades, barrens, large oak-hickory forest tracts, Neotropical migratory birds, swamp, sloughs of the Big Muddy River, high diversity of reptiles and amphibians

Objectives

- Restoration and management of a forest >50,000 acres.
- Enroll unprotected critical habitats for endangered/threatened species into long term protection plans.
- Proactively manage natural communities; enroll unprotected critical habitats for endangered/threatened species into long term protection plans.
- Generate funding to increase biologist positions to help with personnel needed to proactively manage these communities.

Priority actions

use prescribed fire to manage fire climax communities of glades, barrens, and upland forests; permanent protection of high quality community types; reforestation to create larger patches

Natural Divisions

Conservation Opportunity Areas are part of broader landscapes in Illinois. These landscapes are divided into natural divisions. For each natural division, the Wildlife Action Plan (2005) identifies 1) major habitats and challenges, 2) conservation opportunities, 3) management guidelines, 4) recreation opportunities, 5) education and interpretative resources and 6) natural resource commodities. The LaRue - Pine Hills - Western Shawnee - Trail of Tears Conservation Opportunity Area spans three natural divisions. For planning purposes, excerpted below are major habitats, critical species and management guidelines.

Lower Mississippi River Bottomlands Natural Division

Major Habitats

Forests, Grasslands, Wetlands, Streams

Critical Species

Spring cavefish, bantam sunfish, Alabama shad, plains minnow, sturgeon chub, flathead chub, sicklefin chub, banded pygmy sunfish, Illinois chorus frog, eastern narrowmouth toad, bird-voiced treefrog, green treefrog, mole salamander, alligator snapping turtle, mud snake, western cottonmouth, Mississippi green water snake, timber rattlesnake, eastern massasauga, least bittern, pied-billed grebe, Mississippi kite, least tern, red-shouldered hawk, bald eagle, common moorhen, migratory shorebirds, eastern wood rat, Indiana bat, river bulrush, cattail, lotus, pickerelweed

Management guidelines

Forests Increase forest cover by at least 10,800 acres. Inventory forested blocks at least 500 acres, and prioritize for addition on linkage with other

blocks. Encourage sound management practices to promote healthy floodplain forests through landowner education and assistance, timber stand improvements, and exotics control (mechanical, chemical and fire). Controlling deer herds in bottomland forests needs to be addressed.

Grasslands Increase grassland by at least 10,400 acres. In all remnant wet-mesic prairies, encourage sound management practices to maintain and increase their extent through prescribed burning, restoration with native cordgrass and stable water levels. Education of the public to the importance of wet prairies is necessary to gain support.

Wetlands Increase wetlands by at least 4,000 acres. Recreating the historic meander scars and oxbow slough depressions may begin to restore wetlands on floodplain soils. Existing open wetlands need to be monitored and managed to prevent the encroachment of woody species such as willow. Establish buffer between wetlands and adjacent agricultural land to prevent herbicide runoff and sedimentation. Establishment of deeper and shallow wetlands is needed to increase amphibian breeding habitat, and help reduce harmful parasitic insect populations.

Streams Encourage sound management practices to maintain and upgrade the quality of streams through landowner education and assistance, adjacent buffer and riparian corridors to filter herbicide runoff and avoid degradation by siltation and development, and discouraging destructive alteration by illegal off-road vehicle and all-terrain vehicle use.

Natural Communities Floodplain forest, wet and mesic prairie, cypress-tupelo swamps, geological areas

Ozark Natural Division

Major Habitats

Forests, Open woodlands/savannas/barrens, grasslands, lakes and ponds, streams, caves, primary communities (cliffs, bluffs, glades)

Critical Species

Illinois cave amphipod, plains scorpion, spring cavefish, northern blacktail shiner, eastern narrowmouth toad, eastern coachwhip, Great Plains rat snake, flathead snake, scarlet snake, timber rattlesnake, hooded warbler, ovenbird, worm-eating warbler, and Indiana bat. Distinctive plant species include reticulate-seeded spurge, stiff bedstraw, Missouri black-eyed susan, small heliotrope, Harvey's buttercup, large-flowered rock-pink, Bradley's spleenwort fern, black spleenwort, shortleaf pine, azalea, and big-leaf snowbell-bush.

Management guidelines

Forests Increase forest cover by at least 10,800 acres. Forested blocks of at least 500 acres should be inventoried and prioritized for addition or

linking to other forests blocks. Encourage sound management practices to promote healthy upland forests through landowner education/assistance, prescribed burning, timber stand improvements, and exotics control (mechanical, chemical, or fire). Controlling deer herds in upland forests is an issue to address.

Open Woodland/Savanna/Barrens Increase open woodland, savanna, & barrens by at least 7,500 acres. Pro-actively manage existing habitat that is not already in a management agreement or long term protection program – several blufftop glades and barrens could be targeted. Encourage sound management practices to maintain and increase the extent of natural savannas and barrens through landowner education and assistance, prescribed burning, selective woody encroachment removal and exotics control (mechanical, chemical, or fire). Law enforcement assistance should be given to landowners who wish to curb illegal allterrain/off-road vehicle use in these shallow soil areas.

Grasslands Encourage sound management practices to maintain and increase the extent of hill prairies to historic boundaries through landowner education and assistance, prescribed burning, selective woody encroachment removal and exotics control (mechanical, chemical, or fire). As with savannas and barrens, illegal all-terrain/off-road vehicle use in these shallow soil, steep aspect areas should be discouraged, and law enforcement assistance given
to landowners who wish to have it.

Lakes & Ponds Pro-actively manage sinkhole ponds exists that are not already in a management agreement or long term protection program. Encourage sound management sinkhole practices with landowners thorough education and assistance, creating buffer areas around the edge of sinkhole ponds with respect to herbicide application and soil disturbance, and discouraging trash dumping in these ponds. Restore amphibian breeding ponds in these sinkholes to reduce harmful parasitic insect populations.

Streams Encourage sound management practices to maintain and upgrade the quality of streams through landowner education and assistance, adjacent buffer and riparian corridors to filter herbicide runoff, correcting degradation caused by sedimentation, development, and illegal off-road/all-terrain vehicles.

Caves Encourage sound management practices to maintain and reduce degradation of cave systems through landowner education and incentives, promotion of cave gates with enrollment into a long term protection program to minimize disturbance to these fragile ecosystems – while also protecting sensitive cave fauna and reducing vandalism to subterranean cave features. Create mapping efforts with local speleological societies for unmapped caves. Work with quarrying

companies to enroll their property in long term protection plans and publicly promote their stewardship efforts. Protect recharge areas for caves that provide habitat for Illinois cave amphipod and other listed troglobytic species.

Primary Communities Encourage sound management practices to maintain these extremely sensitive natural areas through landowner education and assistance, enrollment of qualifying properties into long term protection plans, prescribed burning, selective woody encroachment removal and exotics control (mechanical, chemical, or fire). As with savannas, barrens, grasslands, and streams, illegal all-terrain/off-road vehicle use in these shallow soil, steep aspect areas should be discouraged and law enforcement assistance given to landowners who wish to have it. Equestrian use of these areas should also be discouraged to avoid more erosion. As with caves, work with quarrying companies to enroll their property in long term protection plans and publicly promote their stewardship efforts.

Shawnee Hills Natural Division

Major Habitats

Forests, open woodland/savanna/barrens, grasslands, lakes and ponds, streams, caves, primary communities

Critical Species

Alligator snapping turtle, timber rattlesnake, ruffed grouse, Bachman's sparrow, Henslow's sparrow, hooded warbler, ovenbird, worm-eating warbler, southeastern myotis, gray myotis, Indiana bat, Rafinesque's big-eared bat

Management guidelines

Forest Promote the use of forest stand improvement, prescribed burning and sound harvesting practices to increase oak regeneration and native plant diversity in upland oakhickory forests. Increase cooperation and coordination of management activities across ownership boundaries to facilitate landscape level management. Increase forest cover by at least 22,000 acres. Forested blocks of at least 500 acres should be inventoried and prioritized for addition or linkage to other forest blocks. Restore and manage two contiguous forest blocks of greater than 50,000 acres each. Forest landscapes larger than 50,000 acres should contain at least 80% forest land cover and less than 5% cropland cover. Forests should grade into open woodland habitats on adjacent uplands.

Open Woodland/Savanna/Barren Encourage management practices such as prescribed fire to maintain open woodlands, savannas and barrens. Set a goal for a net increase of 11,000 acres of this habitat type.

Grassland Improve by encouraging conversion from fescue to warm season grasses, discouraging overgrazing and providing education and assistance for landowners.

Wetlands Construct 2-3 ephemeral wetlands on public sites each year. Inventory croplands on state sites to identify lands marginal for cultivation and begin by converting these first. Begin a program to encourage landowners to construct and maintain "fishless" impoundments to benefit amphibians and dragonflies. Set a goal for 15-25 new impoundments per year on private lands.

Lakes & Ponds Promote sound management of water, by producing educational materials for landowners which would cover runoff, pollution and siltation threats to impoundments.

Streams Increase education efforts in areas of high development or karst topography. Widen and protect riparian areas along high quality streams. Begin restoration efforts on the Saline River and its tributaries.

Caves Work with landowners and local volunteer groups (grotto's, etc.) to locate and map all caves and sinkholes in the division. Provide technical support and incentives for protection at biologically significant caves. Protect all significant bat hibernacula with preservation agreements and/or gating projects. Maintain 30 m vegetated buffer around caves, sinkholes, and springs. Gate appropriate bat hibernacula (caves, mine entrances), and create Indiana bat winter hibernacula in southern Illinois by opening abandoned/sealed mines.

Primary Communities Complete inventory of cliff and shelter bluff/overhang habitats and take steps to protect these habitats on public lands and educate private landowners to the uniqueness of these rare habitats. Restoration and management of glades on public and private lands should become a priority. Efforts to work with private landowners to prevent destruction of glade habitat should be increased along with education. Elimination or relocation of recreational activities such as equestrian trails traversing glades should be a top priority.

Barrens, Woodlands and Glades

Take a trip to your local forest, and you likely will see just that: a forest. People who restore and study these areas, though, see a mosaic of different natural community types.

Eastern box turtle and pipevine swallowtail © Chris Benda

Southern Illinois forests are composed of glades, barrens, open oak woodlands, closed oak woodlands, upland forests, bottomland forests, swamps and more. The differences between each community type are subtle – and can seem academic to the average forest lover. For example, in a closed oak woodland, the tree canopy covers between 50 and 80 percent of the sky, while an open oak woodland canopy spans between 20 and 50 percent. Where you find a specific community depends largely on the underlying geology, the kind of soil, topography of the land, the amount of moisture present and disturbance history.

Without fire, Illinois' oak dominated natural communities — barrens, woodlands and forests — are becoming denser, with shade-loving trees increasing most in numbers. Once these trees get a foothold, they make the forest moister and cooler, essentially changing the climate of the forest. Leaves and wood on the forest floor begin retaining more moisture, which further limits fire on the landscape. Over time, a self-perpetuating cycle is created where these shade-loving trees gradually change the forest to suit them — not oaks, the keystone species in Southern Illinois forests, or the other plants that thrived in this fire-dependent environment. Academics coined a term for this cycle — mesophication, which they are seeing in many eastern U.S. forests.

Ecological History

Trail of Tears State Forest

People have been shaping Trail of Tears State Forest for thousands of years. Native Americans lit it, European settlers cleared its trees and grazed animals on it, others reforested it and sought to suppress its wildfires. (See table below for a timeline of key events.) Natural resource professionals refer to these points in time as disturbance regimes, in that each era indicated a different connection between people and the forest. Understanding how people have shaped — and continue to shape — the forest helps us better understand today's forest and how our actions may impact it. Our role as the shaper of natural communities is so profound that scientists consider us a "keystone species."

Generally, scientists recognize three distinct periods of time when talking about disturbance regimes: prior to European settlement, during early European settlement and the modern era. The first disturbance regime, prior to European settlement, is when Native Americans lived on the land. Many believe that Native Americans lived in harmony with nature, having only a benign influence on it. William M. Denevan, however, was among the first scientists to debunk this idea, which he calls the Pristine Myth. "Where

Date	Land use practice	Forest impact
Before 1800	Native American hunting grounds	Hunting pressure and understory burning
After 1803	European-American settlement	Timber cut to build homes, roads, and towns
1811-1812	New Madrid earthquakes	Downed timber and oak regeneration
1830-1930	Grazing of domestic livestock	Soil compaction and understory damage
1838-1839	Trail of Tears-exiled Cherokee Indians	Cherokee hunted and made make-shift camps
1840-1930	Sawmill towns	Timber cut for barrels and lumber industry
1850-1880	Railroads	Timber cut for railroad ties and routes
1913	Ice storm	Trees damaged
1929	Purchased by the Department of Conservation	Much of TTSF has been selectively logged
1934-1937	Civilian Conservation Corps	Fire trails on ridgetops, pine planted, and tree nursery
1938	State inaugurated fire protection program	Suppression of forest fires that were historically common on the landscape

Ecological History

Trail of Tears State Forest

people occur, they change their environment by necessity in order to live on and from the land," he writes. Since his initial publication on this subject in 1992, new research has helped us better understand precisely how Native Americans used the landscape, specifically their use of fire as a game and land management tool. At Trail of Tears, we know they hunted, collected firewood and burned the forest to drive game.

The second disturbance regime is when European settlers arrived. Illinois forests spanned 13.8 million acres on their arrival. By the 1920s, however, the forest had declined to a mere 3 million acres. Telford, in a 1926 forest survey, says the forests of the Illinois Ozarks spanned a mere 23.8 percent of its original lands. At Trail of Tears State Forest, early settlers grazed its lands and harvested some trees. Between 1850 and 1880, the Illinois Central Railroad extensively cleared the forest for road ties and locomotive fuel.

Beginning the 1930s, people started talking about conserving America's great forests. We invested in protecting these lands. During this era – our third disturbance regime – we reforested lands and instituted fire protection measures. In comparison to the previous regimes, it "serves as a reference to demonstrate the effect of absence of disturbance" (Fralish and McArdle, 2009). Nowacki and Abrams (2008) describe how the lack of disturbance affected the forest: "A cascade of compositional and structural changes took place whereby open lands (grasslands, savannas, and woodlands) succeeded to closed-canopy forests, followed by the eventual replacement of fire-dependent plants by shade-tolerant, fire-sensitive vegetation. This trend continues today with on-going fire suppression." Efforts to suppress fire got underway at Trail of Tears in 1938, when the state of Illinois launched a new program. From 1938 to 2013, fire was suppressed, though a few small wildfires occurred. Also, from 1950 to 1989, there was some small-scale harvesting of mature trees in an attempt to encourage oak regeneration.

blue racer, blue-stemmed goldenrod, goldenseal, pipevine swallowtail, star tickseed © Chris Benda

Looking ahead, one might consider Trail of Tears State Forest management as constituting a new disturbance regime, where a diverse, resilient and productive forest is restored and maintained.

Restoring Giant City's *Forests and Woodlands*

Example of a Southern Illinois woodland © Tracy Fidler

Fire once played an important role in maintaining Illinois' forests and woodlands. That's why natural resource managers use prescribed fire to manage these communities today. At Giant City, fire is being used to improve the health of the ecosystem. Prescribed fire is planned and overseen by professionals. These planned fires only happen when specific conditions of temperature, humidity and wind occur. It also requires trained staff to complete the burn.

Eastern box turtle and pipevine swallowtail © Chris Benda

Forest Restoration Goals

- Let more light into the forest for oaks – the dominant tree in our forests and food for about 100 different animals.
- Restore the park's wildflowers, grasses and shrubs. Bees, butterflies and other pollinators feast on these flowers.
- Improve habitat for wildlife, such as birds that prefer grassy openings for nesting and foraging.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Southern Illinois' Birds

Trail of Tears State Forest

Every bird needs something different. Kentucky warblers, for example, love dense ground cover, often choosing to build nests there. Indigo buntings forage in open areas, eating everything from seeds and berries to delectable spiders. Cerulean warblers nest high up in the canopy of trees, picking insects off leaves. And, the nocturnal Eastern Whip-poor-will swoops through open forests to hunt insects. Because of this, scientists who study birds often group them together based on the kinds of habitat they prefer. For Southern Illinois to be a home to each of these birds, then, it needs a diversity of forest habitats.

Managing forests for bird requires a careful review of the scientific literature, as information and knowledge about the needs of birds has expanded a lot in the last decade. We know, for example, that birds prefer large, unbroken blocks of forest. The more expansive the forest, the less parasitism there is from cowbirds. And, for a long time, scientists thought this meant that our forests should be undisturbed. It wasn't until

> Oak forests support more birds that those dominated by maple trees.

Southern Illinois' Birds

Trail of Tears State Forest

bird surveys revealed that birds that depend on more open habitat were on the decline that scientists looked more closely at what was causing it and what could be done.

Scientists now know that birds require a diverse mix of forest communities to thrive. Introducing disturbance into the forest – through prescribed fire or tree removal – are two ways land managers can do that. And, the good news is that removing trees inside a forest block does not create forest edges that could be exploited by cowbirds. Research at Trail of Tears State Forest, after a tree harvest in the 1980s, showed birds that depend on forest gaps increased. Further, birds that depended on forest blocks did not change. The researchers suggested the reason was a "greater structural complexity of vegetation created by selective logging" (Robinson and Robinson, 2001).

New thinking about forest management for birds suggests "the management of disturbance through some combination of flooding, application of fire, or the expression of wildfire, and use of certain types of silviculture have the potential to diversify avian habitats at the local, landscape, and regional scale" (Brawn et. al., 2001).

(Table shows a select listing of birds by group, often called a guild.)

Canopy-nesting guild
Eastern wood-pewee
Yellow-throated vireo
Blue-gray gnatcatcher
Cerulean warbler
Scarlet tanager
Midstory-nesting guild
Acadian flycatcher
Red-eyed vireo
Wood thrush
American redstart
Shrub-nesting guild
Carolina wren
Kentucky warbler
Hooded warbler
Prairie warbler
Eastern towhee
Indigo bunting
Ground-nesting guild
Black-and-white warbler
Worm-eating warbler
Ovenbird
Cavity-nesting guild
Red-bellied woodpecker
Eastern tufted titmouse
White-breasted nuthatch
Avian predators and nest parasites
Blue jay
American crow
Brown-headed cowbird

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The Voice for Illinois Forests

Acting on issues that impact rural and community forests and promoting forestry in Illinois

Inside this Issue

IFA Website
www.ilforestry.org

Message from the President

By Mike McMahan

What a difference a year can make! Last year at this time I was writing to you as the new President of the IFA. Looking back at my column I talked about how our situation reminded me of some good advice my mom gave me about dealing with too many irons in the fire. It seemed there was so much that we wanted and needed to do - and so little time.

Fast forward a year later, and I find myself humbled and honored to be re-elected to serve as President for a second year. I'm thankful to have earned the confidence of those who nominated and voted for me, and pledge to continue an approach that I think has helped the IFA turn a corner toward a brighter future.

There may always be too many things that we want and need to do, but this past year we made deliberate progress by carefully selecting which "irons" would help us the most. We started with a plan that was flexible enough to allow board members to choose what role fits them the best. If we can get a volunteer to take just one iron out of the fire, that's progress.

This year we saw what kind of difference an active committee can make, and having an Executive Director to help facilitate committees and do the kind of day-to-day work that propels us forward on each of our five goals has been a game changer for the IFA. Stephanie Brown is capable of handling just about every iron in that fire, but there is only so much time in the day. She has been especially good at focusing attention on what needs to happen sooner than later in order to position the IFA for long term success. Our investment in her services has been a wise one.

We started the year with a deficit budget. Instead of artificially padding the income line with dues and other income that was not assured, we consciously chose to invest in our game-changing strategy and put everyone's feet to the fire to close the gap. Thanks to a lot of determination and hard work, some well-placed partnerships, and responsive members like you, we were able to push the car up over the crest of the hill. We're ending 2015 with a very encouraging increase in member numbers and a modest budget surplus that we can continue to invest for success. We will remember our 10th year as a turning point for the IFA.

There are still 49 irons in the fire, but we're getting better at seeing which ones need the most attention so that we can get more members and volunteers engaged and committed to working alongside us to promote forest management in Illinois, to show people what forestry is and why it's important, and to be a collective voice that influences programs and policies that help landowners grow healthy and productive forests. I'd like to think Mom would be proud.

Merry Christmas from our family to yours. See you in 2016!

Mike McMahan

Illinois Bats Face Perilous Hibernation this Winter

By Tracy Boutelle Fidler

Biologists inspect bats for White Nose Syndrome
Photo by Steve Taylor, Illinois Natural History Survey

Researchers fear that thousands of bats in Illinois face a perilous hibernation this winter after the recent discovery that additional counties are home to the fungus that causes white-nose syndrome.

"We are definitely seeing die offs similar to some of the places out east," says Steve Taylor who leads bat surveys for the Illinois Natural History Survey at the University of Illinois. "The populations are really decimated."

Once infected, a colony of bats can be completely wiped out in two years, according to U.S. Fish & Wildlife Service's national plan to manage this threat to America's bats. That's what happened in Albany, New York, where the disease was first discovered. In nearby Indiana, which documented its first occurrence in 2011, the state's Department of Natural Resources reports bat numbers are down between 27 and 90 percent, depending on the species.

White-nose syndrome was first discovered in Illinois in 2013. It is found in Adams, Carroll, Hardin, Jackson, Pike, LaSalle, Monroe, Pope, Saline and Union counties.

The disease has killed about 6 million bats and spread to 26 U.S. states and five Canadian provinces, according to WhiteNoseSyndrome.org, the website used by the Service and other agencies to jointly share information about the disease.

"There is no method for stopping the spread," says Tim Carter, a bat scientist at Ball State (and Southern Illinois University alum) whose research is at the forefront of efforts to save bats. "This disease is going to spread slowly but surely. We can only hope to slow it down enough to find a cure."
Taylor, however, is less than optimistic.

"We haven't solved breast cancer or even athlete's foot, which is still around, so how are we going to deal with white nose?" he asks.

From Europe to America

Pseudogymnoascus destructans, the fungus that causes white-nose syndrome, is believed to have originated in Europe. The culprit for its movement here? Us, according to scientists working at London's Royal Veterinary College who examined the fungus' molecular structure to ascertain its origin.

The disease takes its name from the physical appearance of infected bats: They have white noses. The white fungus is capable of breaking down collagen, the glue that holds tissue together. It first forms as lesions, then spreads throughout a bat's body, eventually resulting in its death. Since the fungus predominately is found in caves, the disease affects bats that hibernate, including the federally-endangered Indiana bat.

Why care about bats?

Bats are gluttons when it comes to insects. Consider, a single colony of 150 brown bats can eat a whopping 1.3 million insects in one year alone.

"Bats are saving us big bucks by gobbling up insects that eat or damage our crops," says Paul Cryan, a scientist with the U.S. Geological Survey. His research with Southern Illinois University wildlife ecologist Justin Boyles ranks bats' economic value to agriculture at between $3.7 billion and $53 billion a year.

About 1 million bats have died from white-nose syndrome so far, meaning we now have 1,455 tons of insects not being eaten every year. That's enough insects to fill 161 dump trucks.

Managing Forests for Bats

Forest landowners and managers can support bat and wildlife conservation by leaving alone standing dead trees, often called snag habitat by natural resource professionals. Many different kinds of bats like to roost during the summer months in dead trees. U.S. Fish & Wildlife Service's "Forest Management Practices for Conserving Indiana Bats" offers these additional tips for bat conservation:

- Maintain at least 60 percent canopy closure after timber harvest within forested stands.
- Retain standing snags, except where they pose a human safety hazard.
- Do not harvest shagbark hickory trees (Carya ovata) unless the density of shagbark hickory exceeds 16 trees per acre.
- Maintain high value roost trees and at least three trees per acre greater than 20" dbh.
- Do not cut trees or use prescribed fire between April 1 and November 15.

Continued on the next page...

Search for a cure

There have been some great strides towards a cure, just this year. University of California, Santa Cruz researchers reported in April they discovered a bacterium, which occurs naturally on some bats, slowed the fungi's spread on fruit in the lab. Now, they are testing the bacteria on bats with white-nose syndrome to see whether it helps them.

And in May, a different bacterium, this one found in soil and used as a flavoring in food, cured some bats. U.S. Forest Service and Georgia State University researchers released those bats back into the wild. They are tracking the bats to see how they respond to treatment.

Scientists have learned a lot in the last nine years about this disease. When white nose first appeared, natural resource professionals were baffled about what was causing bats to die. Theories abounded. Knowing what causes the disease and how it affects bats has allowed the scientific community to hone its research.

Ball State scientist Tim Carter is testing a treatment this fall in Wisconsin. Still, he cautions scientists are a long way from having a way to treat millions of bats who are spread across the eastern United States. That's because of the challenges in developing and testing a cure, which he likens to efforts to finding a cure for cancer because of the difficulty of taking a technique from the lab into the real world.

"It's really complex to wrap your head around," agreed Rich Geboy, who helps U.S. Fish & Wildlife Service coordinate its white-nose syndrome efforts. Geboy says bats can move the fungus, but so can people. And, even if you cure a bat, the fungus will persist in the caves, which are super delicate systems, he said.

If scientists find a cure, they're not sure what to do about the fungi, which can persist in caves even without bats presence. This depressing finding was uncovered by Daniel Raudabaugh, a graduate student at University of Illinois working with Andrew Miller.

Even if cured, bats could be re-infected with this fungi every winter. Raudabaugh says a treatment "buys time, but how much is it going to cost every fall? Treat every bat, every year for, what, ever?"

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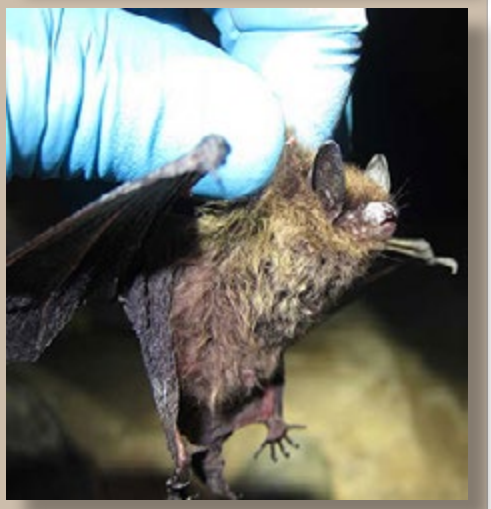

Photos by Steve Taylor, University of Illinois, Illinois Natural History Survey