OFFICE OF RESOURCE CONSERVATION

State of Illinois

Grant Segment

PROJECT NUMBER: T-51 D-1

PROJECT TITLE: Demonstrating the Benefits of In-stream Restoration to Riparian Wildlife in the Cache River Basin

PURPOSE:

The Cache River drainage is a unique, ecologically diverse watershed in southern Illinois. This region contains ecologically valuable bottomland forest and remnant cypress-tupelo swamps that are recognized as wetlands of international importance and provide critical habitat for over 100 state and federally protected species. As such, federal and state agencies, conservation organizations such as the Nature Conservancy, and private citizens have devoted tremendous effort to the protection and restoration of the Cache River's riparian wetlands over the past 3 decades, resulting in extensive, watershed-level restoration efforts. Along with efforts focused on riparian habitats, restoration efforts in the Cache basin included the installation of a series of 25 rock weirs in the channel of the upper Cache River in 2001 and 2003-2004. Along with their intended purpose of stream channel stabilization, recent studies show these structures benefit in-stream communities and may also benefit riparian predators such as birds and amphibians by enhancing emergences of adult aquatic insects. We will quantify the degree to which rock weirs increase insect emergences and insectivorous bird abundance and nesting success. Documenting far-reaching benefits of restorations such as these is critical for justifying further efforts.

NEED:

Bottomland hardwood forests are endangered systems (Noss et al. 1995). Only 20% of the original forests in the Mississippi Alluvial Valley remain (Mitsch and Gosselink 1993). Historically, large floodplain systems were among the most productive systems (Bellrose et al. 1983, Sparks 1995) and supported diverse assemblages of plants and animals (Inman et al. 2002). In the case of birds, bottomland hardwoods support greater species richness and densities than surrounding upland areas (Best et al. 1995, Inman et al. 2002); 70 species use these forests for breeding (Pashley and Barrow 1992). The state-threatened Cerulean Warbler and state-endangered Swainson's Warbler rely on these habitats, as do many waterfowl and terrestrial birds (Bellrose et al. 1983, Knutson et al. 1996) including Prothonotary Warblers, Northern Parulas, Acadian Flycatchers, and Yellow-throated Warblers.

The Cache River basin contains bottomland hardwood forest of international importance and provides critical habitat for numerous state and federally protected species. Because of their ecological significance, federal and state agencies and conservation groups have devoted tremendous resources to restoration and protection of the basin. The construction of the Post Creek cutoff in the early 1900's resulted in diversion of much of the water to the Ohio River and disrupted connection to the floodplain. Rapid flows resulting from the construction of the cutoff deepened the channel and ultimately reduced the frequency of water flow through the floodplain. During 2001 and 2003-2004, the Illinois State Water Survey installed 25 rock weirs in the channel

of the Upper Cache River, with the goal of stabilizing the channel (Fig. 1). Weirs span the width of the channel and are composed of limestone boulders (Fig. 2). Construction of the weirs addressed the stream action plan "to protect, restore, and enhance near-stream and in-stream habitats and processes," (The Illinois Wildlife Action Plan, 2005, Section III, Statewide Overview, E. Priority Conservation Actions-Stream Campaign p. 62). This study constitutes "effectiveness monitoring" of restoration efforts, which is "measuring of the effects of some conservation action, relative to effects of other actions…" as described in the Illinois Wildlife Action Plan. In this case, effectiveness monitoring will be accomplished by comparing areas where in-stream restorations have been performed (conservation action) to areas without weirs (other actions).

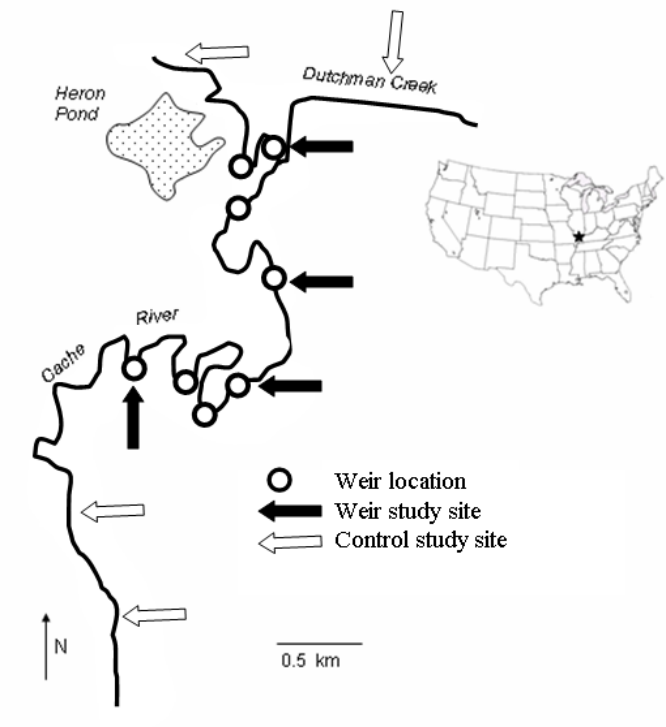

Fig. 1. Map of the Cache River basin showing weir locations and weir and control study sites.

Previous studies on biological responses to weir construction in the Cache found that, among other benefits, weirs harbored higher biomass of insects with aerial adult stages than ambient habitats, indicating they are likely "hot spots" of insect emergence production (Walther 2007, Walther & Whiles *In press*). These in-stream restorations may thus have important benefits that transcend in-stream habitats, including enhancing food for riparian predators such as insectivorous birds, bats, and amphibians. Through increasing insect emergences, weirs may also enhance biological connectivity between the river and forest. Quantifying this unforeseen benefit is critical because it will provide tangible evidence of large-scale benefits and justification for further restoration efforts in the Cache and other systems.

Figure 2. Newly constructed rock weir on the upper Cache River.

To quantitatively demonstrate the benefits of weirs on riparian insectivores, we will focus on insectivorous birds and assess avian species richness and diversity along reaches with and without weirs. We will also quantify impacts on reproduction and relative abundance of insectivorous birds. We predict weirs will significantly enhance insect food availability and that bird nesting success will be higher

at weir sites because females will be able to spend less time foraging and more time on nests (Wittenberger 1980, Rastogi et al. 2006). In many species, eggs and chicks are more vulnerable and conspicuous when parents are away from the nest (Montgomerie & Weatherhead 1988, Martin 1992), which can increase nest predation, lower hatching success, and reduce fledgling rates. This study is novel, as avian responses to in-stream restoration efforts have never been examined, although relationships between stream integrity, riparian habitat quality, and riparian bird communities have been documented in some regions (Bryce et al. 2002).

OBJECTIVES:

1- Quantify and compare differences in seasonal insect emergence production (numbers, biomass, and taxonomic composition of emerging insects) from the Cache River at 4 sites with constructed weirs (restored) and 4 unrestored sites during fall 2008- spring 2011.
2- Quantify and compare abundance, richness, and diversity of insectivorous bottomland hardwood forest birds along restored and unrestored reaches during spring 2009, 2010, and 2011 with point count surveys.
3- Quantify the degree to which reproduction (e.g., nest success, food delivery rates, clutch size, and fledging rates) in insectivorous birds is impacted by changes in insect emergence production associated with restoration efforts during spring 2009, 2010, and 2011.

EXPECTED RESULTS OR BENEFITS:

Ecological restoration efforts such as those in the Cache are expensive and labor intensive, and thus require justification and positive public relations. Demonstrating tangible, unforeseen, and wide-reaching benefits of in-stream restoration efforts in the Cache River, such as benefits to riparian predators such as insectivorous birds, will provide information critical for justifying efforts to date and further restoration activities. This information will quantitatively demonstrate that in-stream restoration efforts can enhance connectivity of the Cache River and surrounding floodplain forest, and that benefits extend well beyond the stream channel. Construction of the weirs in the Cache River addressed the stream action plan component of the Illinois Wildlife Action Plan. This study provides "effectiveness monitoring" of these restoration efforts as described in Illinois Wildlife Action Plan. As stated in the ILWAP, "traditional and emerging techniques (e.g., improved fish passage, de-channelization, wetland and floodplain restoration….) are significant investments of funding and personnel time, but seldom have been approached to rank the effectiveness of alternatives and measure cost efficiency. This study will directly address these issues by quantifying tangible benefits associated with an increasingly common restoration procedure and will do so by making comparisons to similar, unrestored sections of the same system.

APPROACH:

Meeting the objectives of this project will require 3 years of data collection and laboratory analyses. Multiple field seasons are necessary to account for annual variability associated with weather patterns, stream flows, etc. Estimating insect emergence production is time-intensive work, but results will allow for a quantitative assessment of the increase in export of insect prey to riparian habitats associated with in-stream restoration.

Objective 1. We will quantify insect emergence from 4 restored reaches with constructed weirs and 4 similar, unrestored reaches (Fig. 1) using 6 insect emergence traps (1/8 m^2 sampling area, 250 μm mesh) mounted on rebar stakes driven into the streambed or suspended directly over the water, depending on water levels and

substrate conditions at sites during sampling events. These types of emergence traps have mesh tops with collecting reservoirs to trap insects as they emerge from the water and fly upward and have been used successfully in similar systems (Stagliano et al. 1998, Whiles and Goldowitz 2001). Six traps will be placed randomly at each study reach and insects will be removed every 24-48 hr during sampling periods. Sampling will take place for 3-5 day intervals at least 5 times during March-June of each year, when stream insect emergence is generally highest and birds are nesting. To quantify annual differences in insect emergence between restored and unrestored sites, which may be of great importance to birds as well as other riparian groups such as amphibians and bats, we will also measure emergence for at least three different 3-5 day intervals during summer, fall, and winter periods of each study year. Insects collected in traps will be identified to genus, dried, weighed, and data expressed as emergence production (g dry mass/m^2/d). We predict that insect emergence production and emergent insect diversity will both be higher at restored sites because of increased availability of stable substrates and higher habitat complexity associated with rock weirs (Minshall 1984, Gurtz and Wallace 1986, Beisel et al. 2000).

Objective 2. We will assess the effect of restoration on birds by determining relative abundance, species richness, and diversity (Shannon-Weiner diversity index) along restored and unrestored reaches during spring of each study year. To accomplish this, we will conduct point count surveys at least weekly between the hours of 6:00 and 8:00 at both restored and unrestored sites. On each sampling date, we will randomly select the order in which transects are sampled and multiple investigators will assist with surveys to assure that surveys at all sites are performed as close together in time as possible. All species detected visually and aurally will be counted and recorded. We predict that insectivorous bird abundance and diversity will be higher at restored sites because of increased abundance and diversity of food (e.g., Gray 1993, Whitaker et al. 2000)

Objective 3. We will examine nest success, food delivery rates, clutch size, and fledging rates at restored and unrestored sites each spring. We will search for nests of insectivorous birds such as Prothonotary Warblers, Acadian Flycatchers, and other species encountered opportunistically using behavioral cues and systematic searches. To increase the sample size of nests, equal numbers of nest boxes will be placed in restored and unrestored sites for cavity-nesting birds. Nests will be monitored every 3-4 days to determine nest survival (Mayfield 1961, Johnson 1979). We predict higher clutch sizes at restored sites because of greater food availability for females and chicks. We predict that nest success will also be higher at restored sites because parents can spend less time searching for food and more time on nests (Wittenberger 1980); increased nest attendance generally reduces nest predation. We will determine the number of foraging trips made by the attending female and the time spent between food deliveries to the chicks by observing the nest for 1 hour in the morning on day 6 of the nestling period (or as appropriate depending on the period of highest energetic demand for each species). We predict that if food availability is higher at weir sites compared to unrestored sites, the interval between trips and the total time spent foraging will be shorter at weir sites. The rate of food delivery to chicks (as measured by the number of trips/time) is expected to increase if food abundance is appreciably greater at weir sites. Increased food delivery should also increase fledging rates of chicks (Harmeson 1974).

The end products of this effort will be a dissertation, at least four presentations by the student at regional and national meetings, and at least two peer-reviewed scientific papers. Most importantly, we will also provide a detailed final report, which, along with copies of publications, will be disseminated to any interested parties. Reports and publications will include all information generated during this study, along with interpretations and recommendations. We will also submit annual reports as required.

LOCATION:

This study will be conducted at 4 restored and 4 unrestored sites along the Upper Cache River in Johnson County, Illinois near the town of Belknap (Fig. 1 & 3). The Cache River Watershed was identified in the Illinois Comprehensive Wildlife Conservation Plan as an "especially important" area for species in greatest need of conservation (III. Statewide Overview, E. Priority Conservation Areas, p. 95). The Illinois Comprehensive Wildlife Conservation Plan also identified bottomland hardwood forest and swamp forest as priority resources.

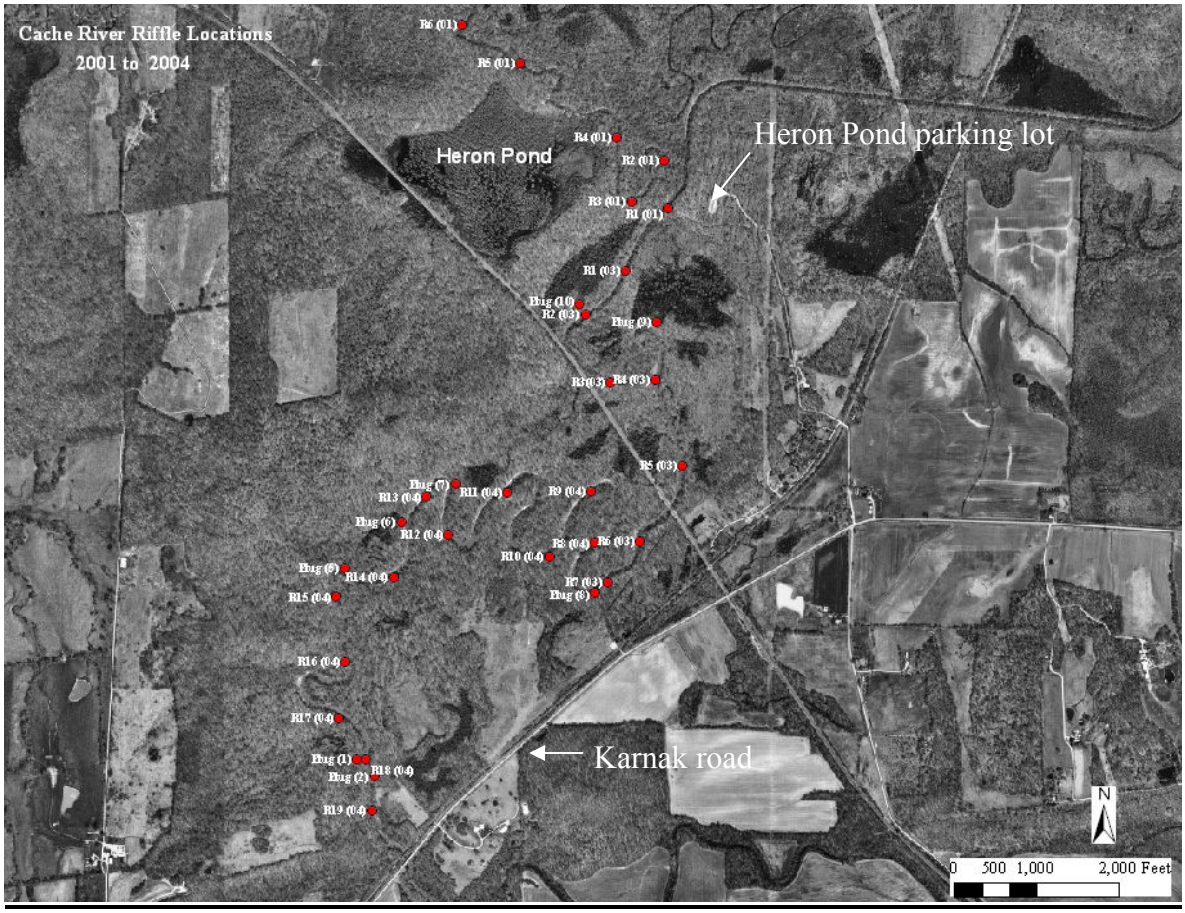

Figure 3. Location of constructed weirs on the upper Cache River in Johnson County, Illinois.

PROJECT SCHEDULE:

OBJECTIVES	Jul-Feb 08/09	Mar-Jun 09	Jul-Feb 09/10	Mar-Jun 10	Jul-Feb 10/11	Mar-Jun 11
Insect emergence	X	X	X	X	X	X
Insect sorting/analyses	X	X	X	X	X	X
Point count surveys: bird diversity		X		X		X
Nest searching for success, delivery rates, etc.		X		X		X

Annual report submission	X	X	X	
Final report & manuscript submission				X

RELATED GRANTS:

In 2002, the Cache River Watershed Partnership was awarded $320,000 from the Illinois C2000 program for installation of a series of weirs in the upper Cache River. Weirs were installed by the Illinois Water Survey, and these structures represent the basis for this study.

ESTIMATED COSTS:

Category	Federal Request	SIU match	Total
Personnel			
P.I. Whiles		$29,606	$29,606
P.I. Roy-Nielson		$16,513	$16,513
Graduate student (1)	$49,800		$49,800
Field technicians (2)	$15,600		$15,600
Undergrad student (1)	$12,000		$12,000
Fringe		$18,397	$18,397
Total Personnel & fringe	**$77,400**	**$64,516**	**$141,916**
Travel	$8,000		$8,000
Commodities	$5,500		$5,500
Contractual Services	$2,255		$2,255
Total Direct Costs	**$93,155**	**$64,516**	**$157,671**
Indirect costs	$18,631	$47,270	$66,090
Total project Costs	**$111,786**	**$111,786**	**$223,572**
Percentages	50%	50%	100%

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COMPLIANCE:

The IDNR will use its CERP (Comprehensive Environmental Review Process) as a tool to aid the Department in meeting NEPA compliance for the projects outlined under this grant proposal. It is the Department's policy to require CERP applications for all land disturbing activities unless those activities are covered by CERP exemptions (see the enclosed Comprehensive Environmental Review Process documents).

This proposal addresses NEPA via a categorical exclusion in 1.4B1 Appendix 1. Actions described in this proposal will not affect environmental quality and will not promote conflict over alternative resource uses. The USFWS categorical exclusion 1.6 allows for "nondestructive data collection, inventory, research and monitoring activities."

All planned activities will also be in compliance with the Endangered Species Act. All determinations and documentation will in accordance with the current established U. S. Fish and Wildlife Service protocols for Section 7.

All planned activities will be in compliance with the National Historic Preservation Act and the Council on Historic Preservation Act. All determinations and documentation will be in accordance with the terms of the Programmatic Agreement, as amended, effective September 23, 2002.

When applicable, those planned activities which involve a floodplain and/or jurisdiction wetlands will be done in accordance with Presidential Executive Orders 11988 and 11990.

BUDGET JUSTIFICATION:

Personnel:
Field and laboratory work associated with this project will be labor intensive. Therefore, the bulk of the requested funds and SIUC match are related to personnel. USFWS funds will be used to support a doctoral student in the Department of Zoology at SIUC. Graduate stipends at SIUC are $15,798 per year, which includes tuition waiver and health insurance, and are anticipated to increase at a rate of 5% per year. Federal

funds are also requested to pay for two student field technicians and one undergraduate laboratory technician to assist with field sampling and insect sample processing, respectively. Undergraduates will be paid at the rate of $7.50 - $8.00 per hour, depending on experience. The doctoral student will be co-advised by the two project leaders, Whiles and Roy-Nielson. As part of the SIUC match, each director will dedicate 1.5 months time during year 1, and 1.5 and 1 month per year for Whiles ($6,386 per month salary and assume 3% annual raises) and Roy-Nielson ($4,600 per month), respectively, during years 2 and 3. Fringe and benefits rates through SIUC are 12.22% for retirement and $1,595 per person month for medical and life insurance (i.e., year 1, with a total of 3 person months from the PIs = $4,785 medical and life insurance).

Equipment:
Equipment necessary for the successful completion of this project is already in place at SIUC.

Commodities:
Funds are requested to purchase supplies including new mesh for emergence traps, rebar stakes for traps, sample containers and vials, slides and mounting medium, preservatives, field notebooks, and related materials that are essential for the field and laboratory components of this project.

Travel:
Funds are requested to lease a vehicle through SIUC travel services that will be dedicated to the project for 6 months of each year, given the frequent travel that will be associated with field sampling of birds and insect emergence. Vehicle lease ($300 per month for 6 months) and fuel and maintenance costs (estimated at $75 per month for 12 months) are estimated at $8,000 for the three-year duration of the project.

Contractual:
Minimal funds are requested to cover printing, photocopying, mailing, and software upgrades during the study. We also request funds to offset costs associated with publication of the results of the study.

Indirect costs:
SIUC indirect costs are normally 44.5%. The federally-allowed 20% of total direct costs is included in the budget; remaining unrecovered indirect costs constitute the remainder of the SIUC match on this project.

Documents supporting the grant Proposal:
The following are attached in support of this grant proposal:

Application for federal assistance (form 424)
Comprehensive environmental review process
Federal aid section 7 evaluation form
Grant proposal budget
Illinois Clearinghouse response per federal executive order 12372
NEPA compliance checklist

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