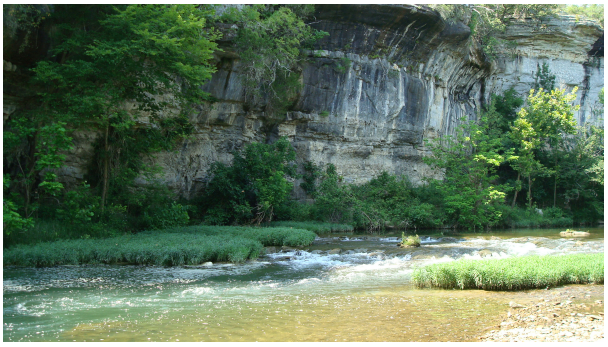
Project Title: Using Historical and Current Collections to Assess Stream Geomorphology, and Fish Assemblages in the Spring, Myatt, Eleven Point, and Current River Drainages.

Project Summary: Arkansas ranks fifth in the nation in fish biodiversity, yet the status of many Species of Greatest Conservation Need (SGCN) is often unknown or incomplete. We have previously been funded to fill data gaps in ten streams/rivers in the Ouachita and middle White drainage. Our data have provided unique insights into land use change influences on fish assemblage structure in the Ozarks and Ouachitas, and provide status and distribution data for SGCN species and others that may warrant future assessment. This project will examine fish assemblages, concentrating on SGCN species, in rivers of the middle White drainage where the updated AWAP noted high threats from increased agricultural activities coupled with priority data gaps for fishes. We will continue a unique approach, comparing our data to historical data collected 35-45 years ago, and examine potential correlations with land use/land cover in the watersheds. Additionally, we will incorporate stream geomorphology as instream changes observed in our current research warrants intensive data collection. We will repeat historical fish surveys conducted by Arkansas State University and University of Louisiana at Monroe (formerly Northeast Louisiana University) using similar techniques, revitalizing these data sets, and providing critical information on fish distribution and affects of land use. Additional sites will be included to target SGCN species based on occurrence data from state and federal agencies. This project will provide Arkansas Game and Fish Commission and Arkansas Natural Heritage Commission with critical conservation data, and establish current stream geomorphology prior to further land use alteration in these watersheds.



Project Leaders (Univ. of Central Arkansas):

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Project Partners (Arkansas Game and Fish Commission):

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Budget Summary:
Total Project Cost: $ 172,562
Total Requested from SWG: $108,814 (Year 1 - $60,506; Year 2 - $48,308)
Matching Funds from UCA: $63,748

Project Statement

Need – Our project addresses multiple needs identified by the SWG Fish Taxa team in Fall 2016, including determining current distribution and status of aquatic biota, assessing temporal variation in temperature and water levels, and surveying in-stream physical parameters prior to further land use change in the middle White River. The middle White River contains some of the highest abundance of Species of Greatest Conservation Need (SGCN) and needs critical evaluation using both historical data and repeatable methods. Ongoing land use changes from agriculture, primarily an increase in poultry production, further threaten the streams and rivers in this watershed (Figure 1).

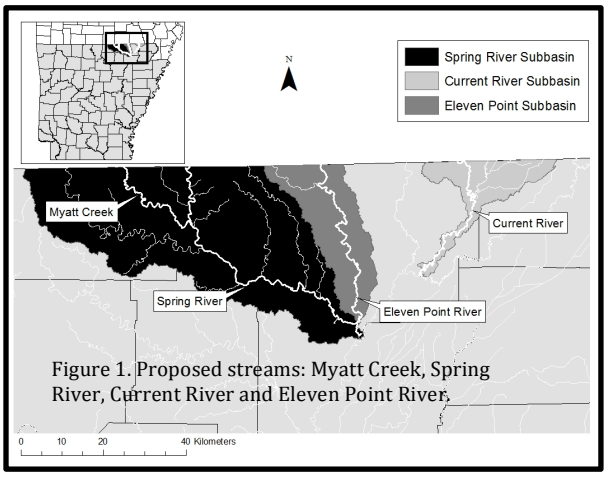

Figure 1. Proposed streams: Myatt Creek, Spring River, Current River and Eleven Point River.

Dauwalter et al. (2008) and Remshardt and Fisher (2009) identified local or reach-scale channel morphology as an influential fish species composition driver in Oklahoma Ouachita and Ozark streams. Archival records and oral histories from the Missouri Ozarks' Jacks Fork Basin also suggested changes in fish species are related to changes in stream channel morphology. More specifically, they identified increased gravel loads throughout the Ozark Region between the end of the Timber Boom period in the 1920s, and the early 1990s (Jacobson and Primm 1997). Jacobson and Gran (1999), and McKenney et al. (1995) also documented high gravel loads in the Current River. However, despite increased gravel substrate identification in northeastern Arkansas Ozark stream reaches, geomorphic studies remain sparse, and tend to focus on channel adjustments to dam closures (see Edwards et al. 2016).

Our ongoing research in the Ozarks has revealed noteworthy changes to stream morphology including a decrease in pool depth, an increase in stream width, and an increase in gravel substrate compared to historical data. Additionally, land use variables were correlated with observed in-stream data (Figure 2). Resulting impacts to fishes included an increase in distribution of tolerant pool species (mosquitofish, bluegill, spotted bass and largemouth bass) and a decrease in sensitive taxa (smallmouth bass) likely tied to pool depth. In contrast, there was a range expansion in some sensitive riffle taxa (slender madtom, greenside darter, and rainbow darter) corresponding to an increase in shallow, vegetated, riffle habitat. We also observed a downstream expansion of headwater taxa (southern redbelly dace and creek chub) that may be related to changes in flow, increased water withdrawal or climate change. Smaller catchments (<120km^2) exhibited more variation in assemblage stability and persistence compared to larger catchments. There is a pressing need to incorporate more detailed assessment of stream geomorphology prior to further land use alterations so we can use long-term data to better understand mechanisms driving assemblage change and impacts to our SGCN species.

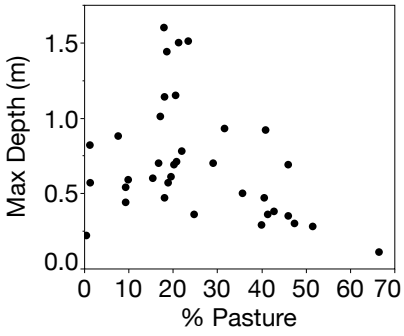

Figure 2. Pasture land use was correlated to a decrease in max pool depth.

Location –Approximately 15-20 sites will be sampled in each drainage (Spring, Myatt, Current and Eleven Point) identified by the Fish Taxa SWG team as priority drainages for status and distribution studies. The majority of sampling will occur in 1st, 2nd and 3rd order streams. All sites

are within the priority ecoregion Ozark Highlands. Historical Arkansas State University (ASU) and University of Louisiana, Monroe (ULM) data sets will be used for comparison.

Objectives – The primary objective of this research is to provide critical data on the status and distribution of SGCN species in high priority watersheds identified as "biodiversity centers" by the SWG Fish Taxa Team as well as establish baseline detailed stream geomorphological and water level assessments. We will also compare fish assemblage structures to 1970's data to determine if LULC changes and in-stream habitat have influenced fish assemblage stability. Agency records will supply additional sites as necessary. Our approach will allow us to assess temporal changes in target SGCN species, establish stream geomorphology baselines for future data comparisons, and prioritize watersheds or stream reaches needing conservation and restoration.

Expected Results and Benefits – These data will add to an ongoing project providing a multi-decade data set for northcentral Arkansas streams determined to be priority watersheds for data gaps in fishes, water quality, physical assessment and land use (Arkansas Wildlife Action Plan). To date we have sampled five systems in the Ozarks (Kings, Janes, Big, Sylamore and Piney) and are currently funded to sample the Strawberry and Fourche. If funded, this will bring the total to approximately 150 individual sites across 11 systems. This is unique given much of the existing data statewide provides strong, broad spatial coverage across watersheds but limited within system coverage (particularly for 1st and 2nd order streams). Incorporating stream geomorphology and LULC change will establish a foundation for continued long-term monitoring and research of these important understudied Arkansas watersheds. Specifically, this project will provide baseline data for fishes and in-stream habitat prior to alteration from increases in the poultry industry and other land use changes. Specific SGCN species that may be covered by this project include: least and American brook lampreys, spotfin shiner, Ozark shiner, sand shiner, silver redhorse, river redhorse, western sand darter, crystal darter, autumn darter, current darter, gilt darter, slenderhead darter, stargazing darter and saddleback darter.

Approach –Research completed at Arkansas State University and the University of Louisiana Monroe provided historical data sets. Our methods will replicate methodologies and sample locations from original studies. Although seining technique varies among investigators, we are familiar with the field approach from field work with both Dr. Matthews and Dr. Douglas. All available habitat within a 200-m reach at each site will be opportunistically sampled for fish. Seines with matching dimensions from the previous corresponding study will obtain primary fish samples, with backpack electrofishing augmentation when appropriate. Before sampling at each site, we will measure dissolved oxygen (mg/L), conductivity (uS/cm), water temperature (°C) and pH. Maximum sampling efforts will be approximately one hour per macrohabitat in accordance with Matthews (1998). In situ, we will measure and subsequently release large game species and species of conservation concern. Fishes not released will be preserved in 10% formalin (IACUC #14-005) for laboratory identification.

We will conduct geomorphic stream surveys at each study site using a 24X automatic level, a metric Stadia Rod, 100-meter reel field tapes, and a survey grade (decimeter accuracy) Global Navigation Satellite System (GNSS) receiver. Each geomorphic survey will include a longitudinal channel profile to capture the reach-scale channel gradient; multiple bank-full channel cross sections to capture hydraulic geometry and influential channel units (e.g. riffles, pools, and bars); multiple pebble counts for each cross section, and water surface elevations and water velocity measurements at multiple flow levels to develop rating curves for stream stage

measurements. We will measure stream stage with HOBO U20L stage loggers in the approximate channel thalweg of each stream reach. Velocity measurements collected at multiple stream stages will combine with direct stage measurements to estimate reach-scale discharge (Charlton 2008).

Using the GNSS receiver, we will collect spatial data points for several essential reference locations in each study site to facilitate data mapping and visualization, research replication, and long-term monitoring efforts. We will capture GNSS data for each study site's project datum (i.e. reference elevation for automatic level surveys); the Tape-Zero (0 meters on the field tape) location for each longitudinal profile and stream cross section; the local datum (instrument height calibration) for each cross section and automatic level location; and the terminus of each longitudinal profile and cross section. Longitudinal profiles will measure channel bed elevation at approximately three-meter intervals along the length of each study reach, with additional measurements added to capture unique bed forms (bars, riffles, pools, etc.) and/or rapid topographical changes as necessary. Similarly, stream cross sections will measure bank, bed, and water surface elevations at approximately one to three meter intervals, with additional measurements as necessary. We will measure cross sections every five to seven channel widths (Pavlowski 2010; Charlton, 2008; Knighton 1998) to increase the likelihood of capturing riffles and pools within study reaches. If dictated by field conditions, we will collect additional cross section measurements. Field surveys will follow standard operating procedures established by the California Department of Fish and Wildlife (Woodard 2013), and Storesund Consulting (2008). We will conduct pebble counts at one to three meter intervals along each cross section using the Wolman Method (Wolman 1954).

In addition to steam surveys, we will also analyze historical LULC changes in each study area drainage basin using GIS and the United States Geological Survey's (USGS) U.S. Coterminous Wall-to-Wall Anthropogenic Land Use Trends (NWALT) data set (Falcone 2012). We will perform post-classification change detection, and calculate percentages of prairie, forest, and urban land covers in our study drainage basins using GIS. Then, we will analyze the relationships between LULC changes and selected biological metrics (e.g. species diversity, species richness, species range, etc.).

Citations available upon request.

Budget – A majority of costs on this project are salary and travel. It will be a very field intensive project during the summer, and we will process and analyze the data during the academic year. One of the three PIs will be in the field to provide data collection continuity.

	Year 1		**Year 2**	
Item	SWG	Match UCA	SWG	Match UCA
Faculty (salary + fringe)	13,200	21,204*	13,200	21,204*
2 Graduate Student (salary + tuition)	21,046	0	21,046	0
Student worker	4,012	0	4,012	0
Travel	5,000	0	4,500	0
Supplies	4,252	0	1,500	0
Equipment	8,042	10,000	0	0
F&A	4,955	0	3,825	0
F&A unrecovered	0	5,558	0	6,688
Total	**$60,507**	**$36,762**	**$48,083**	**$27,892**

* represents cash match, otherwise in-kind

Dr. Ginny Adams, MS University of Arkansas, PhD Southern Illinois University, more than 20 years as a researcher in a variety of ecosystems. Ginny has published over 20 papers, including 13 while at the University of Central Arkansas and contributed to over 100 presentations at professional meetings. Her research has focused on the conservation of sensitive and endangered species in relation to anthropogenic disturbance. She has taught Ichthyology biannually since coming to Arkansas and has served on both the Fish Taxa Team for SWG and the Fish GAP analysis and ANHC fish ranking teams. Her responsibilities on this project will include mentoring of undergraduate and graduate students in fish collection and identification.

Dr. Reid Adams, MS University of Mississippi, PhD Southern Illinois University, greater than 20 years as a researcher of river ecosystems that includes publication of approximately 19 peer-reviewed papers, numerous presentations given at professional meetings (> 100), and mentoring of many undergraduate and graduate student projects (> 40). He has extensive experience collecting fishes in Arkansas using seines and has directed research on three other diadromous organisms in Arkansas: Striped Mullet, American Eel, and Ohio Shrimp. He has successfully completed the objectives and reporting requirements for two previously funded State Wildlife Grant proposals.

Ginny and Reid have collectively mentored over 20 graduate students since coming to Arkansas on a wide variety of projects. In addition, both PIs have worked directly in the field with Dr. Bill Matthews (principal investigator of Piney Creek and peer of previous collectors from Arkansas State) and Dr. Neil Douglas (mentor of historical surveys from University of Louisiana at Monroe).

Dr. Matthew H. Connolly, MA Geo. Texas State University, PhD Texas State University, two years conducting fluvial and coastal geomorphic field surveys with Dr. Robert T. Pavlowsky at Missouri State University's Ozark Environmental Water Resource Institute, contributed to 9 presentations at professional meetings, and delivered 7 invited talks. Matthew has published 6 peer-reviewed papers addressing human-environment interactions and water resource issues, including 2 since joining the UCA faculty in Fall 2014. His present research focuses broadly on applying GIS, Remote Sensing, GNSS, and geocomputational (i.e. "big data") methods to physical, human-environment interaction, and water resource, issues. He teaches Physical Geography, Conservation of Natural Resources, Geographic Information Analysis, Water Resources, and the Environmental Science Capstone course. Matthew will supervise the GIS, GNSS, and geomorphic stream surveys on this project.

Casey Cox, MS Biology University of Central Arkansas, more than 5 years research experience in multiple streams, rivers, and lakes in Arkansas, including extensive backpack electrofishing. Casey has published two peer reviewed scientific papers, has given greater than 20 presentations at a variety of professional and stakeholder meetings, and has three years of experience managing sportfish. His research and management background is focused on land use influence on fish and macroinvertebrates, fish movement and migration, fish community ecology, sportfish population dynamics, gear efficiency, and modeling the effects of fishing pressure and length limits on sportfish. Casey currently works for the Arkansas Game and Fish Commission as a Fisheries Biologist in northeast Arkansas. His contribution to the project will be assisting graduate students with access and sampling, as well as various other aspects of the project.