

2018 (Arkansas) State Wildlife Grant Proposal

**TITLE: ESTABLISHING BASELINE ECOLOGICAL CONDITIONS FOR THREE ECOLOGICALLY SENSITIVE WATERSHEDS IN NORTHEASTERN ARKANSAS**

**PROJECT SUMMARY:** As a means of protecting water quality and ecological integrity of receiving streams Arkansas designates high-quality waterbodies constituting outstanding state or national resources as Extraordinary Resource Waters (ERW) and Ecologically Sensitive Waters (ESW). Nine of 11 stream segments identified in the Ozarks as ERW segments are located in the Eleven Point, Spring, and Strawberry river watersheds in Northeastern Arkansas (Arkansas Pollution Control and Ecology Commission, 2015). Associated with a high degree of water quality, some of the highest levels of aquatic biodiversity in the state are found in these three watersheds, including many aquatic species of state and federal interest. Declining ecological integrity is anticipated in these three ecologically sensitive rivers because of changes in land use that will occur as poultry production expands eastward across the Ozark ecoregion. Baseline ecological data and spatial comparisons of those data are needed in order that aquatic conditions in these watersheds can be adequately monitored, so that when and where necessary, management practices can be implemented in a timely manner. The two primary study objectives will be: (1) to compare ecological conditions across the land use gradient now present in the three watersheds (i.e. a spatial comparison), and (2) to make baseline data available in order that pre- and post-ecological conditions can be compared at a later date (i.e. for a temporal comparison).

**PROJECT LEAD:** Jennifer L. Bouldin, PhD, Arkansas State University ERF, State University, AR 72467; PHONE: 870-972-2570; EMAIL: [jbouldin@astate.edu](mailto:jbouldin@astate.edu);

**PROJECT PARTNERS**

Billy Justus, Aquatic Research Biologist, USGS, Lower Mississippi-Gulf Water Science Center, Little Rock, 501-228-3626; [bjustus@usgs.gov](mailto:bjustus@usgs.gov);

Nathan Wentz, Aquatic Ecologist Coordinator, Office of Water Quality, Arkansas Department of Environmental Quality, North Little Rock, AR; 501-682-0661; [WENTZ@adeq.state.ar.us](mailto:WENTZ@adeq.state.ar.us)

Allison Asher, Fisheries Management Biologist, Arkansas Game and Fish Commission, Little Rock, AR; 870-972-5438; [Allison.Asher@agfc.ar.gov](mailto:Allison.Asher@agfc.ar.gov)

A.J. Pratt, Ozark Fisheries Regional Supervisor, Missouri Department of Conservation, West Plains, MO.

**PROJECT BUDGET:**

SWG amount requested - \$162,410

Match amount provided - \$87,582

Total project amount - \$249,991

## PROJECT STATEMENT

*Need:* Arkansas designates high-quality waterbodies constituting outstanding state or national resources as Extraordinary Resource Waters (ERW) and Ecologically Sensitive Waters (ESW). Eleven stream segments in the Ozark Highland (Ozarks) are designated as ERW (and ESW) and, of those, 9 segments are located in the Eleven Point, Spring, and Strawberry river watersheds in Northeastern Arkansas (Arkansas Pollution Control and Ecology Commission, 2015). Arkansas specifically created the ERW and ESW designations to protect water quality, natural flow regimes, and instream habitat of watersheds. Even though the State encourages protective land management practices, other incentives and priorities make protection of what are often impoverished rural watersheds that are comprised of large numbers of private holdings, increasingly difficult.

Dramatic changes in land use that are occurring in northeastern Arkansas as poultry production expands eastward across the Ozark ecoregion are anticipated to result in declining water quality. As part of the poultry expansion into northeastern Arkansas, an estimated 800 poultry houses are currently under, or are planned for, construction in the watersheds of these three streams. To accommodate new poultry producers in the area, one large poultry processing facility was recently constructed in Pocahontas and another facility in Batesville has been upgraded.

Broiler houses in Arkansas produce an average of 154.2 tons of litter (Arkansas Natural Resource Commission, 2015), and in parts of western Arkansas, “nutrient surplus areas” have been established to limit the amount and timing of litter applications. Further, because of the increased grass and hay production resulting from the availability of litter for pasture fertilizer, cattle density also will likely increase in newly established poultry production areas. This is concerning to water quality managers, given the wide recognition that deforestation alone (i.e. without the addition of manure sources) can result in increased nutrient and sediment runoff into streams, inevitably resulting in declining aquatic ecological conditions.

Associated to their high degree of water quality, these three watersheds have very diverse aquatic ecosystems. Many aquatic species of state and federal interest occur there, including federally threatened or endangered species and State Species of Greatest Conservation Need (e.g. Ozark Hellbenders, Curtis Pearly and Rabbitsfoot mussels, Strawberry River Darter). Significant data gaps exist for some crayfish, fish, and mussels and their exact status is unknown or incomplete (Arkansas Wildlife Action Plan, 2015).

All three rivers are regionally important sport fishery resources. Some segments in all three rivers have excellent smallmouth bass fisheries, and some segments of the Eleven Point and Spring rivers have excellent walleye fisheries. Canoe outfitters serve the public on Arkansas and Missouri sections of the Eleven Point River, as well as on the Spring and Strawberry rivers in Arkansas.

The biological and chemical data necessary to provide a thorough baseline ecological evaluation of these streams is incomplete. Further, for the Eleven Point watershed in particular, relatively little is known about the current status of the overall aquatic biological communities (Nathan Wentz, ADEQ, pers. comm.). Given the ecological, aesthetic, and economic significance of these watersheds, an ecological study is needed to (1) establish a baseline data set, (2) document the relation between ecological characteristics and the present-day land use gradient, and (3) for comparisons with historical data when available.

### *Purpose and Objectives*

Although many biological, chemical, and physical factors define the overall ecological stream condition, aquatic species or groups of species are frequently used as biological endpoints that can be used to identify ecological thresholds and for assessing aquatic conditions (Karr, 1991). Establishing relations between biological metrics (measures of the condition of algal, macroinvertebrate, and fish assemblages) and nutrient and sediment related water-quality constituents prior to drastic changes in land use intensity will facilitate the capability to determine the extent of ecological change over time. The two primary study objectives will be: (1) to compare ecological conditions across the land use gradient now present in the three watersheds (i.e. a spatial comparison), and (2) to make baseline data available in order that pre- and post-ecological conditions can be compared at a later date (i.e. for a temporal comparison).

### *Location*

Ecological conditions will change more dramatically and rapidly in small streams; thus, 18 Wadeable Stream sites are targeted for sampling. Sampling sites will be divided across the watersheds based on the number of streams in each watershed, ERW designations, and the availability of historical data.

### *Approach*

We anticipate that poultry production will increase first in areas having the most pasture. Geographic information system analysis will be used to select the 18 Wadeable Stream sites proposed for study along a forest/pasture gradient. Field reconnaissance will be conducted at Wadeable Stream reaches prior to selecting sampling sites.

Four water-quality samples will be collected during base-flow conditions prior to biological sampling—in the spring, summer, and winter of year one, and again in the spring of year two. Nutrients, total suspended solids, and turbidity analysis will be collected and processed according to USEPA or USGS protocols, and analyses will be conducted at the Ecotoxicology Research Facility (ERF, an EPA-certified laboratory). Field parameters (e.g. pH, dissolved oxygen) will be measured *in situ* at the time of site reconnaissance, and on all sampling occasions. Habitat characteristics associated with hydrology and geomorphology will be recorded following standard USGS protocols. At the same time of habitat measurements, macroalgae cover will be visually estimated at each of 5-1 m<sup>2</sup> quadrats (two edges of water and three locations spaced at equal intervals across each of the 11 transects). Discharge data at seven USGS stream gages will indicate antecedent flow conditions.

Macroinvertebrates, periphyton and fish will be collected and processed in the spring of year two using USGS protocols (Moulton et al., 2002) that have been used previously for biological assessments in Ozark streams (Justus et al., 2010). In addition to a sample for species identification, one aliquot of the periphyton sample will be filtered for chlorophyll *a* analysis (at ERF). Taxonomy for the periphyton and macroinvertebrate samples will be conducted at the ERF laboratory. Following appropriate quality assurance procedures, sample sorting and taxonomic proficiency will be determined for a subset of samples sent to outside laboratories. Fish will be collected primarily with a backpack electrofishing unit but a barge unit may be used in the largest streams sampled. Most fishes will be identified to species in the field and will be released at the point of capture; however, taxonomically challenging species and specimens

retained as voucher records will be verified in the lab and will be stored in the fish collection maintained at the Arkansas State Museum of Zoology.

*Expected Results and Benefits*

As the human population increases, animal production will continue to expand into remote areas where a majority of the Nation’s reference quality streams are located. Without adequate information, economic benefits will invariably outweigh ecological concerns associated with these expansions, especially if those concerns are based solely on assumptions and perceptions that can be perceived as lacking foundation. Ecological data such as those described above are an important component that must be available before the public and resource managers can be adequately informed in order that important aquatic resources can be protected.

In addition to gaining field and lab experience, graduate students will write two theses or dissertations. Subsequently, the PIs will summarize data and publish results as peer-reviewed journal articles. Professional presentations will be given at state, regional, national and international meetings. Both students and collaborators will participate in public speaking venues. The PIs also will cooperate with Dr. Karl VanDevender, (nutrient management specialist with the UofA Cooperative Extension Service) to educate producers in the area regarding best management practices. Relatedly, the USDA NRCS has provided written support regarding the potential of the project for educational outreach to poultry producers in the study area.

This project is significant at a state, interstate, and national scale. USGS data indicate that manure sources of total nitrogen and total phosphorus are increasing in Arkansas and Missouri streams in the Ozarks (Rebich and Demcheck, 2007), and USGS models indicate that manure may be a larger source of phosphorus to the Gulf of Mexico than row-crop sources (Alexander et al., 2008).

Literature cited above is available upon request.

	Request	Match
Salaries & Benefits		
PI Salary (Jennifer Bouldin)		\$17,964
Graduate Student	\$14,000	\$3,650
AGFC biologist		\$2,160
Fringe	\$28	\$3,772
Travel*		\$6,750
Equipment/supplies (shocker maintenance, WQ monitors)		\$2,300
Supplies (preservative, lab/sampling supplies)		\$700
Sample analysis	\$7,000	\$13,800
<b>Subtotal A-State</b>	<b>\$21,028</b>	<b>\$51,096</b>
Subaward - USGS	\$40,000	
<b>Project Cost</b>	<b>\$99,279</b>	
IDC (10%, 29.73% match)	\$2,103	\$6,252
IDC on Match Amount		\$20,301
IDC on Subaward (39.73% of first \$25,000)		\$9,933
<b>Total Request/Match</b>	<b>\$162,410</b>	<b>\$87,582</b>
*Lodging (\$75/night inkind use of cabin 6 people)		

## QUALIFICATIONS:

Dr. Jennifer Bouldin received her PhD in Environmental Sciences from Arkansas State University and is a Professor of Environmental Biology at A-State. She has been the Director of the Ecotoxicology Research Facility (ERF) since 2006. She maintains USEPA certification and requires an annual inservice for Good Laboratory Practice for all researchers, technicians and students at the ERF. She and her students have published on water, soil and sediment toxicology, and long-term watershed studies including the Spring, Strawberry, Cache, Buffalo, and L'Anguille rivers. The ERF is a multidisciplinary research facility utilizing whole organism bioassays, organism collection and identification, and analytical analyses with the GCMS, AA, and Skalar SAN nutrient analyzer.

Billy Justus has a Bachelor of Science in wildlife management (1987) and a Master of Science in Biology (1990), both of which he acquired from A-State. From 1989 until 1995, he was employed as an aquatic biologist with the Mississippi Department of Environmental Quality but has worked at USGS since 1995. As a research aquatic biologist for USGS, most of Billy's projects are multidisciplinary ecological studies that investigate interactions between aquatic biota and multiple types of environmental stressors. Some of his most recent publications have identified biological thresholds for various constituents (i.e. dissolved oxygen and nutrients). He has been an electrofishing field trainer for USGS and has led fish sampling crews and served as field taxonomist in 18 states.

Tate Wentz is the Aquatic Ecologist Coordinator for Arkansas Department of Environmental Quality. He has a B.S. in Fisheries and Wildlife Biology from Arkansas Tech University and M.S. in Biology from Arkansas State University. Tate has worked at ADEQ for nine years as an aquatic ecologist and researched a variety of topics from efficacy of habitat restoration to the long-term effects of nutrients and major ions in wadeable streams.

Allison Asher is a Fisheries Management Biologist for Arkansas Game and Fish Commission. She assists in managing waterbodies in northeast Arkansas, including the Eleven Point, Spring, and Strawberry Rivers. Allison received a B.S. in Zoology (2006) and an M.S. in Environmental Sciences (2009) from Arkansas State University. Allison has been working in the aquatic sciences for over 10 years in capacities ranging from graduate researcher, college instructor, fisheries technician, aquatic outreach educator, and now as a biologist.

A.J. Pratt is the Ozark Fisheries Regional Supervisor for the Missouri Department of Conservation. His office is in West Plains, MO. He supervises fishery biologists in southeast Missouri, including those for the Eleven Point and Current Rivers.