

**PROJECT TITLE:** Development of a Statewide Freshwater Mussel Monitoring Program in Arkansas

**PROJECT SUMMARY:** A large data set exists for Arkansas' large river mussel fauna that is maintained in the Arkansas Game and Fish Commission mussel database. In general, most Arkansas rivers have historically diverse mussel populations with relatively large assemblages (beds) dispersed along their length. Due to a variety of environmental changes and stressors, it is important to periodically assess the health and well-being of aquatic habitats and mussel communities. A program is needed to monitor SGCN mussels in Arkansas rivers, and it should be developed utilizing existing mussel assemblage (bed), mussel distribution, and mussel population data. Stream segments to be monitored will be selected from the lower White River (Batesville to mouth), Ouachita River, Black River, Little River, St. Francis River, Cache River, Spring River, Strawberry River, Little Missouri River, Saline River, and potentially other rivers or streams for which data exist. The objective of this study is to examine the longitudinal distribution of freshwater mussels in Arkansas streams, statistically define unique community types along the continuum for selected streams, and recommend specific sites for long-term community monitoring.

**PROJECT LEADER**

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**PROJECT BUDGET:**

**SWG AMOUNT REQUESTED - \$16,715**  
**MATCH AMOUNT (36%) - \$9,461**  
**TOTAL AMOUNT - \$26,176**

## **PROJECT STATEMENT:**

Need: Freshwater mussels represent some of the most imperiled species in North America. Locating individuals and populations is a necessary first step in any conservation effort (Harris *et al.* 2010). Since the mid-1980s, systematic inventory of freshwater mussels has been undertaken in drainages throughout AR by a large number of researchers (Harris and Gordon 1988, Ahlstedt and Jenkinson 1991, Rust 1993, Christian 1995, Davidson 1997, Davidson, *et al.* 1997, Harris 1997, Posey 1997, Davidson, *et al.* 2000, Stoeckel and Davidson. 2000, Davidson and Clem 2002, 2004, Christian and Harris 2004, Christian *et al.* 2005, Harris *et al.* 2007, Trauth *et al.* 2007, Brooks *et al.* 2008, Martin *et al.* 2010, Matthews *et al.* 2010, Wentz *et al.* 2010, Bouldin *et al.* 2013a, 2013b; Bouldin *et al.* 2015). Many of the mussel surveys have been conducted by researchers associated with or graduates of Arkansas State University. Data from mussel studies have been incorporated into the Arkansas Game and Fish Commission maintained mussel database that includes information for 25,812 species occurrences from 3,441 individual site locations (Harris and Posey 2015).

In order to manage freshwater mussel resources, it is imperative to sample populations over time to evaluate assemblage health and to assess population status of species of greatest conservation need (SGCN). Therefore, it is necessary to develop and implement a statewide monitoring network for mussel communities in AR. This proposal directly addresses the need to develop a statewide large river monitoring program protocol which is listed under mussels as Priority # 1 in the 2017 AR SWG RFP.

Purpose and Objectives: The purpose of this project is to analyze existing data for freshwater mussel species and construct a statewide mussel monitoring program for Arkansas. The objectives of the study are as follows: (1) examine the longitudinal distribution of freshwater mussels in Arkansas streams; (2) statistically define unique community types along the longitudinal continuum for selected streams; and (3) recommend specific sites for long-term community monitoring.

Location: The proposed project is located in every ecoregion throughout Arkansas (Fig. 1). Proposed streams to be analyzed by river basin include:

Arkansas River Basin: Arkansas River, Big Piney Creek, Cadron Creek, Illinois Bayou, Illinois River

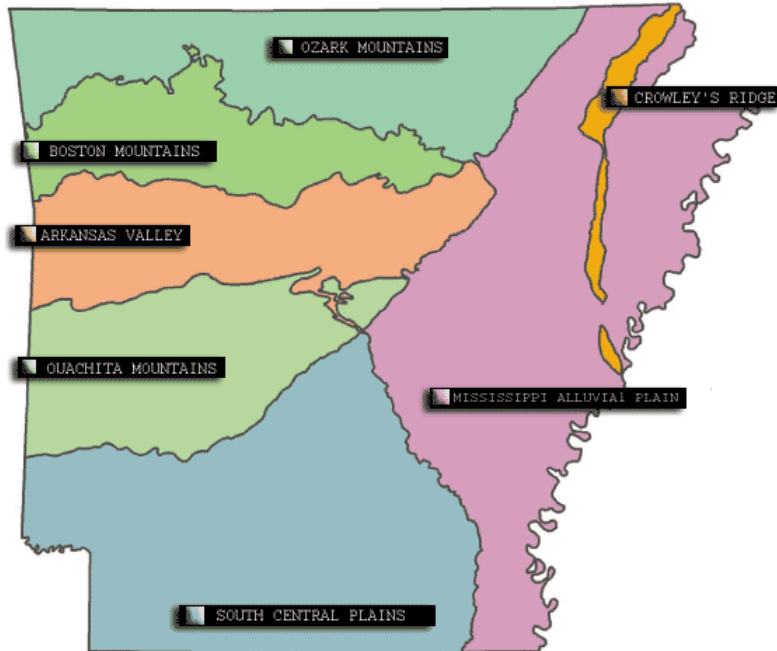
Ouachita River Basin: Bayou Bartholomew, Little Missouri River, Ouachita River, Saline River

Red River Basin: Cossatot River, Little River, Saline River

St. Francis River Basin: St. Francis River, Tyronza River

White River Basin: Black River, Buffalo River, Cache River, Little Red River, Strawberry River, Spring River, South Fork Spring River, White River

Approach: We will first acquire GIS layers or paper maps from the U.S. Army Corps of Engineers for river mile (kilometer) locations in AR rivers and streams. For streams to be analyzed that do not have established river miles, we will use GIS to establish stream mile locations beginning at the stream mouth and extending upstream to the known limit of mussel occurrence. We will utilize the most current version of the AGFC mussel database to acquire/assign unique sample sites, assign a stream mile (km), and convert mussel sample data for each species to percent composition by site and sample date. We will compare mussel species



**Figure 1.** Proposed project is located over the entire state of Arkansas.

in the database with the original source reports and QA/QC species identifications and taxonomy to conform to current usage.

The presence and abundance of species are distributed in a non-random way (Dray *et al.* 2012). Therefore, searching for spatial structures at multiple scales is necessary to determine areas of biological relevance for appropriate monitoring. Dray *et al.* (2012) recommend combining multivariate analyses and more recent methods of spatial pattern analysis. We will utilize the complete data set to analyze the spatial variation of community composition at multiple scales

based on both presence-absence and abundance data. First, we will use a Moran's I correlogram to identify the scale(s) of spatial structure if spatial autocorrelation is present (Dorman *et al.* 2007). Second, we will use a multivariate analysis such as redundancy analysis (RDA; Finn and Poff 2005) and/or detrended correspondence analysis (DCA; Matthews, *et al.* 2010) to identify the main spatial patterns, after using a chi-square transformation to put emphasis on rare species (Dray *et al.* 2012). Finally, the asymmetric eigenvector maps (AEM) technique (Blanchet *et al.* 2008) has been developed for cases of directional spatial patterns such as river reaches, but other methods such as principal coordinates of neighbor matrices (PCNM, Borcard *et al.* 2004) or multivariate regression tree models (Chambers and Woolnaugh 2016) may be used. Methods like AEM and PCNM allow analyzing temporal trends or the effect of environmental factors on beta diversity while explicitly accounting for identified spatial patterns (Dray *et al.* 2012). Together, these methods will help identify if mussel species assemblages are clustered, distributed along a gradient, or intermediate with transition zones. They will further help us identify sites of sampling from each community type within each river for future long-term monitoring.

Expected Results and Benefits: The proposed project will provide a framework for establishing a long-term freshwater mussel monitoring program for Arkansas. The long-term monitoring program will provide a mechanism to evaluate assemblage health and to assess population status of species of greatest conservation need (SGCN).

**Proposed start date: October 1, 2017**

**Completion date: September 30, 2019**

References: References cited in this proposal can be provided upon request.

Budget:

	Budget Justification	SWG Year 1	Match Year 1	SWG Year 2	Match Year 2	SWG Total	Match Total
<b>PERSONNEL</b>							
Virginie Rolland (PI)	0.25 month summer salary, each year	\$1,645		\$1,645		\$3,290	
Technician	\$1,300/month, 3 months each year	\$3,900		\$3,900		\$7,800	
Virginie Rolland (PI)	0.2 month time during academic year				\$1,316		\$1,316
Brook Fluker (Co-PI)	0.2 month time during academic year		\$1,307				\$1,307
<b>FRINGE BENEFITS</b>							
Virginie Rolland (PI)	17.84% of salary base	\$294		\$294		\$588	
Technician	7.84% of salary base	\$306		\$306		\$612	
Virginie Rolland (PI)	34.82% of matched salary				\$459		\$459
Brook Fluker (Co-PI)	34.82% of matched salary		\$456				\$456
<b>SUBTOTAL PERSONNEL &amp; FRINGE</b>		<b>\$6,145</b>	<b>\$1,763</b>	<b>\$6,145</b>	<b>\$1,775</b>	<b>\$12,290</b>	<b>\$3,538</b>
<b>TRAVEL</b>							
Harris travel to A-State Campus	4 round trips (1096 total miles) @ \$0.42/mile	\$231		\$231		\$462	
Harris Lodging, Jonesboro, AR	16 nights @ \$89/night	\$712		\$712		\$1,424	
Harris Per Diem	20 days @ \$51	\$510		\$510		\$1,020	
<b>TRAVEL SUBTOTAL</b>		<b>\$1,453</b>		<b>\$1,453</b>		<b>\$2,906</b>	
<b>TOTAL DIRECT COSTS</b>		<b>\$7,598</b>	<b>\$1,763</b>	<b>\$7,598</b>	<b>\$1,775</b>	<b>\$15,196</b>	<b>\$3,538</b>
<b>INDIRECT COSTS (10% restricted)</b>		<b>\$760</b>		<b>\$760</b>		<b>\$1,520</b>	
	Waived Indirect costs (29.73% [ASU rate is 39.73%])		\$2,259		\$2,259		\$4,518
	39.73% of matched salary and fringe waived		\$700		\$705		\$1,406
<b>Totals</b>		<b>\$8,358</b>	<b>\$4,722</b>	<b>\$8,358</b>	<b>\$4,739</b>	<b>\$16,715</b>	<b>\$9,461</b>

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**Principal Investigator:** Dr. Virginie Rolland

**QUALIFICATIONS:**

Virginie Rolland: Received Ph.D. in Population Ecology from the University of Pierre and Marie Curie, Paris, France in 2008, with an emphasis on quantitative analyses of a large 40-year albatross dataset. Has 12 years of experience manipulating and analyzing datasets from various taxa (birds, bats, small mammals, turtles), resulting in 15 publications and 30+ presentations at local to international conferences. Has graduated 3 MS students, is supervising 2 MS and 1 PhD students, and has served on 23 graduate student committees.

Brook L. Fluker: Received Ph.D. in Biology from the University of Alabama in 2011 with an emphasis in phylogenetics, population genetics, and conservation of freshwater fishes. Has 13 years of experience sampling, handling, and collecting tissues from freshwater fishes in North America, including experience assisting with surveys of freshwater mussels and snails and seasonal abundance surveys for several federally protected fishes. This work has resulted in six publications, 10 technical reports, and 40+ presentations at professional conferences and meetings.

John L. Harris: Received Ph.D. in Zoology from University of Tennessee in 1986 with emphasis in taxonomy and systematics of aquatic fauna concentrating on fish and mussels. Has 30+ years experience in performing mussel surveys and impact analyses resulting in numerous peer-reviewed publications and/or agency reports. Has co-directed or been a committee member for 15 graduate students researching distribution and/or life history aspects of freshwater mussels in Arkansas.