Aquatic invertebrate surveys of springs in the Buffalo National River watershed

Aquatic invertebrate surveys of spring systems (i.e. small springs, spring runs, and spring-fed headwater streams) located in the Buffalo National River watershed will be conducted to address priority species data gaps, determine additional target species, and initiate comprehensive biodiversity inventories for these special habitats. Determining watershed, local habitat and water quality conditions associated with the invertebrate communities of spring habitats will support evaluations of potential problems and threats while working to conserve the unique biodiversity of the Ozarks.

A pre-proposal submitted to the Arkansas Game and Fish Commission – State Wildlife Grant Program
(2008 – 2010)

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Total project cost: $150,756

State Wildlife Grant Request: $75,378

Matching Funds and In-Kind Services: $75,378

Project overview

Small mountain streams in the Ozarks are shaped by karst landscape features where groundwater can reach the surface to create a variety of spring types (e.g., springs, spring runs, and spring-fed headwater streams). These systems are typically characterized as having temporal persistence of water, low range of water temperatures, potentially good water quality, high microhabitat diversity, and relatively undisturbed surrounding landscapes when compared to larger aquatic systems. These unique characteristics and the antiquity of the Ozark Mountains has provided a unique habitat template for the speciation of aquatic invertebrates, with regional speciation highlighted by the recorded fauna from cave and small headwater stream systems in the Ozark Highlands and Boston Mountain ecoregions.

The aquatic invertebrate fauna inhabiting springs in the Ozark Mountains has been sparsely investigated, and therefore potential undescribed or unrecorded species may exist in these unique habitats. Furthermore, the unique physical characteristics among particular spring types and the lack of interconnectivity across mountain headwater systems may provide key habitats for disjunct or relic populations. These habitats should be thoroughly investigated to develop accurate element occurrence data while supporting biological survey and species monitoring needs of the Arkansas Wildlife Action Plan (AWAP).

Within the Buffalo River National Park (BRNP), we have recently recorded the occurrence of the Arkansas-endemic, Sulphur Springs Diving Beetle, *Heterosternuta sulphurius*, and several other species of predaceous water beetles. The proposed project involves a two-year, invertebrate and water quality survey of spring systems in the Buffalo National River watershed to further address element occurrence data gaps across all spring-inhabiting invertebrate species. The main focus of the study is to determine these elemental occurrences of species of greatest conservation need (SGCN) and other potential target species while evaluating any influential problems and threats. In addition, we will evaluate the usefulness of spring-inhabiting invertebrate assemblages as surrogate, ecological indicators for assessing the overall health and integrity of Ozark ecosystems.

Funding priorities addressed

1. Integrate Arkansas Wildlife Action Plan priorities with other land-use or natural resource efforts at the local, state, or federal level.

This two-year project will initiate a comprehensive bioinventory of springs for the Ozark region. Plans are currently underway to conduct an All Taxa Biodiversity Inventory for the Ozark region, with efforts initially focusing on the BRNP. Biological surveys funded by the State Wildlife Grant would integrate conservation priority initiatives of the AWAP such as filling element occurrence data gaps with similar conservation and biodiversity initiatives for the BRNP. Concurrent BRNP programs underway that fully complement AWAP priorities include Discovering Life and Managing Biodiversity in the Ozark Ecoregion (http://pick5.pick.uga.edu/pa/or/polistes/pr/2007nps/ozarks.html) and community-based biodiversity assessments focused on our U.S. National Parks (http://www.discoverlife.org/pa/or/polistes/pr/2007nps/).

2. Address the needs of Species of Greatest Conservation Need while benefiting other fish and wildlife.

Approximately 13 aquatic invertebrate SGCN reported in the AWAP could be affected by this project. Most of those species require a need to "survey areas near known occurrences to locate additional populations." One SGCN, *Heterosternuta (Hydroporus) sulphurius*, currently has status G1? and S1? and is endemic to Arkansas and we have recently collected 28 individuals from two spring-fed streams in the Buffalo River watershed. Additionally, a current survey of one headwater, spring-fed stream has revealed a diverse invertebrate community including four species of predaceous water beetles. Based on these recent findings, we feel that a concentrated sampling effort at these spring habitats may lead to a multitude of new element occurrence data associated with this unique biodiversity. Finally, highlighting headwater stream biodiversity will ultimately contribute to a holistic conservation approach for sustaining aquatic life use in the entire watershed; Biodiversity surveys from upland spring habitats throughout the watershed will contribute to the downstream conservation of the 74 species of fish in the Buffalo River and thus provide *ecological system targets* for long-term conservation monitoring.

3. Projects that publicize and raise the profile of the Arkansas Wildlife Action Plan with elected officials, decision and policy makers, interested parties (e.g., land trusts), and the general public.

Bioinventories of spring habitats would facilitate mutual efforts of AWAP and BRNP biodiversity assessment and conservation programs. This project will increase the awareness of the AWAP through concurrent BRNP programs that will highlight natural resources conservation throughout the U.S. (i.e., 2016 National Park Centennial, Community-Based Science and Bioinventories, Discovering Life and Managing Biodiversity in the Ozark Ecoregion). Furthermore, information developed by these programs will eliminate redundant biodiversity assessments of these unique spring habitats within the Ozark region.

Geographic area of study

The geographic area of study is the Buffalo River National Park (Ozark Highlands and Boston Mountain Ecoregions). Based on results from initial spring surveys, springs outside the park boundaries but within these two ecoregions could be visited if specific spring types are found to contain particular SGCN or potential target species.

Methods

A GIS database of ≈ 300 spring locations developed by Buffalo National River Park personnel will be used to select springs for the proposed surveys. We will focus the initial selection of spring sites on perennial, spring fed, headwater streams with steep gradients and high microhabitat diversity due to our recent success in recording elemental occurrences for *Heterosternuta sulphurius* and other unique species from this type of habitat. We will attempt to select springs across from a number of HUC8 watersheds in order to evaluate element occurrences across subwatersheds. It is important to note that these surveys will be focus on surface water habitats, probably downstream from spring sources and the local surface-groundwater interface, and therefore not inclusive of the karst habitat classification in the AWAP (i.e., karst, cave, and mine habitats). However, some cave adapted SGCN may be collect from our selected clear, cold perennial spring-fed streams and information from this propose project could potentially provide important biological information to improve our understanding of these connected aquatic systems. Species preference for functional habitat associations will be evaluated (e.g., obligate spring branch and headwater stream) and finer-scale descriptions of our subset of springs will be evaluated with biotic classifications and descriptive environmental measurements to further evaluate spring classification strategies.

Our project is budgeted to survey at least 40 springs during the two year time period (2008 – 2010). This number is based on funding and time spent on the project; approximately 50 work days will be spent in the field to conduct biological surveys (including sample sorting and preservation in the field), habitat assessments including physico-chemical measurements, and water quality sampling from at least one spring per field-day. Laboratory sample processing, species identifications, literature searches, correspondence with taxonomic experts, data preparation and analysis, museum curatorial tasks, and report generation will require an additional 150 days.

A variety of physical habitat and hydrological measurements will be recorded for each spring system including discharge, elevation, aspect, streambank and riparian conditions, and microhabitat characterization including substrate. In addition, large spatial scale characteristics (e.g., dominant geology) will be recorded for each spring location. Water samples from each site will be collected and analyzed using standard analysis techniques for nitrogen, phosphorus, carbon, chloride and many other soluble trace elements. Analyses will be conducted using a Skalar San Plus Wet Chemistry Autoanalyzer and a Spectro Inductively Couple Plasma Optical Emission Spectroscopy (ICP-OES), and a Varian Bio-50 UV-Visible Spectrophotometer. Field equipment (YSI85 probes) will be used to measure physico-chemical parameters including pH, dissolved oxygen, conductivity and temperature.

A qualitative sampling method will be used to record the occurrence of invertebrates from spring habitats and to avoid destructive sampling of potentially small and disjunct populations. Various sampling devices (e.g., D-frame kicknet, minnow nets, and small seine-type nets) may be used depending on the type of habitat, and then a representative group of specimens will be picked from nets and preserved for each site. Species identifications will be made using the most current taxonomic keys for the regional fauna. All specimens will be deposited in the Department of Entomology Arthropod Museum at the University of

Arkansas and labeled as the representative collection of the proposed State Wildlife Grant project. The collection from our proposed surveys will also supplement the final aquatic invertebrate collection of the Buffalo National River All Taxa Biodiversity Project.

Measurable products and outcomes

This project will produce taxonomic lists of aquatic invertebrates for selected springs in the Buffalo River National Park. Biological and physical habitat information for SGCN and other target species will be added to the CWCS database. Scientific quality photographs will be produced for all SGCN and other target species and maps will be produced using geographic coordinates to display element occurrence data.

Partnerships and existing resources

The University of Arkansas will partner with the Buffalo River National Park for this project. Existing resources of the BRNP include the developed GIS database of spring locations and park housing during field work. Existing resources of the University of Arkansas include the water quality analysis laboratory, a microscope and literature for species identifications, community analysis software, and field equipment for invertebrate sampling and environmental measurements.

Long-term project maintenance

With this project, we will develop the framework and conduct two years of field sampling, species identifications, and data analysis to supplement a potential, multi-year, comprehensive biological survey of springs in the BRNP and the entire Ozark region as part of the All Taxa Biodiversity Inventories. Following the completion of these biodiversity inventories, a monitoring framework will allow us to evaluate SGCN and other species distributions over time and investigate influential environmental conditions to work towards the common goal of sustaining Arkansas' wildlife.

Budget

The following proposed budget includes salaries and benefits of one post-doctoral research associate (S. Longing) and one full-time field technician (@ 500 hours). Travel is estimated at 11, four-day field events at 500 miles roundtrip per event (0.43 per mile). Water quality samples are estimated at 20.00 per sample, which is considerably less than normal costs. Materials will consist of ethanol for sample preservation, glass vials, community analysis software, and species identification literature for developing a comprehensive library. All other materials are existing resources maintained by the PIs. BRNP will provide housing during field work.

Table 1. Proposed budget.

	SWG YEAR 1	SWG YEAR 2	TOTAL SWG
Salary/Benefits	28,973.00	28,973.00	57,946.00
Operating Expenses			
domestic travel	2,400.00	2,400.00	4,000.00
materials and supplies	1,000.00	1,000.00	2,000.00
Capital Expenses			
water quality sample analysis	400.00	400.00	800.00
Total Direct Costs	32,773.00	32,773.00	66,746.00
Total Indirect Costs (15%)*	4,916.00	4,916.00	9,831.00
Total amount requested	37,689.00	37,689.00	75,378.00

*current percentage agreement between UA and AGFC

Qualifications

Scott Longing is an aquatic entomologist and post-doctoral research associate at the University of Arkansas. Past research involved ecological studies of benthic invertebrates in Chattahoochee National Forest headwater mountain streams affected by sedimentation, a study in cooperation with the U.S. Forest Service Southern Coldwater Fisheries Research Unit and Chattooga River Large-Scale Watershed Restoration Project. Currently, research involves developing a multi-state database of nutrient and water quality parameters for the Red River basin, conducting field surveys for the occurrence of *Heterosternuta sulphurius* (Sulphur Springs Diving Beetle) in the Buffalo River watershed and in northwest Arkansas. Other activities include developing and conducting seasonal and annual invertebrate biomonitoring sampling procedures for the future Watershed Research and Education Center stream system located at Arkansas Agricultural Experiment Station in Fayetteville.

Dr. Haggard's primary area of research is the effect of land use on stream sediment and water chemistry; his sediment and water quality laboratory at the University of Arkansas has the ability to analyze water and sediment samples as required for nitrogen, phosphorus, carbon, chloride and many other soluble trace elements. The equipment available in this laboratory includes a Skalar San Plus Wet Chemistry Autoanalyzer for nitrogen, phosphorus, carbon and chloride, a Spectro Inductively Couple Plasma Optical Emission Spectroscopy (ICP-OES), and a Varian Bio-50 UV-Visible Spectrophotometer. This laboratory has field equipment available to measure physico-chemical parameters on site at stream monitoring stations, including pH, dissolved oxygen, conductivity and temperature.