

2016 State Wildlife Grant pre-proposal

PROJECT TITLE

Surveys, modeling, and prioritization for dragonfly species of concern across the Ozark-Ouachita region

PROJECT SUMMARY

We propose a rigorous distribution and prioritization assessment of four regional endemic dragonflies designated as SGCN in Arkansas and several neighbor states. This will be done using a combination of habitat-directed surveys, niche modeling to predict and map potential distributions (both current and projected under climate change), and ranking each species based on range-wide vulnerability and relative endemism across Arkansas, Kansas, Missouri, and Oklahoma.

PROJECT LEADERS

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PROJECT PARTNERS

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PROJECT BUDGET

SWG Amount Requested: \$72,352

Match (35%): \$25,323

Total: \$97,675

Project Need: This project will address the ‘Dragonfly species of concern’ funding priority in Table 1 of the SWG 2016 RFP, and the associated action to ‘Obtain baseline distribution status for multiple species.’ Two dragonfly species (*Gomphus ozarkensis* Ozark Clubtail, *Ophiogomphus westfalli* Ozark Snaketail) were included as SGCN in the original Arkansas WAP completed in 2005. Two more species (*Cordulegaster talaria* Ouachita Spiketail, *Somatochlora ozarkensis* Ozark Emerald) were added in the 2015 revision, as motivated by Bried and Mazzacano (2010). All four species are regional endemics breeding in or near highland lotic systems, and one or more have been labeled SGCN in neighboring Kansas, Missouri, and Oklahoma. Many sources have recognized the range restriction, lack of knowledge, and conservation concern for these species (e.g. Bick 2003, Paulson 2011, Patten & Smith-Patten 2013).

All four species are understudied and under-surveyed, especially *C. talaria* on account of being recently described (Tennesen 2004). Presumably the distributions of these species are limited mainly by natural environmental and climatic constraints and perhaps by emerging threats to aquatic systems (e.g. natural gas extraction and fracking), but there has been a lack of habitat-directed baseline surveys. Even with targeted searches these species are difficult to find and observations may remain sparse, so we recommend niche modeling to (1) suggest the best places to look and (2) refine our understanding of species-specific environmental and climatic preferences (Collins & McIntyre 2015, Guillera-Aroita et al. 2015). A climate forecasting approach would allow us to predict future distributions and population security, as suggested in the revised AWAP (Section 7, pgs. 1639–1656).

Species of concern are unlikely to have equal conservation need, and limited human resources must be allocated based on priority. Importantly, the AWAP includes a Species Priority Score for each SGCN. These scores are a weighted index combining the NatureServe G rank, Arkansas S rank, and best-guess population trend (increasing vs. decreasing). The current dragonfly priority scores range from relatively low (*G. ozarkensis*) to relatively high (*C. talaria*). Here we propose comparing these scores with a comprehensive regional triage (see ‘Approach’) to better prioritize future planning and action for these species.

Purpose and Objectives: The purpose of this project is to improve knowledge of the distribution and priority status of *G. ozarkensis*, *O. westfalli*, *C. talaria*, and *S. ozarkensis*. We have three objectives:

- 1) Conduct baseline surveys across the Ozarks, Ouachitas, and Flint/Osage Hills
- 2) Generate maps of potential distribution, both current and projected under climate change
- 3) Regional (range-wide) prioritization of the four species

Location: Ozark-Ouachita region (ca. 160,000 km²), which stretches from St. Louis to southeastern Oklahoma, covering the Ozark, Boston, and Ouachita mountain ecoregions of Arkansas-Missouri-Oklahoma, and the Flint/Osage Hills of Kansas/Oklahoma. The effort in Arkansas will focus on the Red, White, and Ouachita River ecobasins. Target habitats, based on current information (e.g. Paulson 2011), will include rivers, streams, and seepages. We will focus on medium to large rivers with gravelly bottoms for *G. ozarkensis* and *O. westfalli*, small rocky forest streams (and nearby open areas) for *S. ozarkensis*, and woodland seepages/tiny streams for *C. talaria*.

Approach: For the baseline surveys (objective 1), we will compile and map vetted point records for each species. We will extract records from museum collections and the online OdonataCentral database, and consult with other odonate biologists who have experience in the region. The plan in the first year is to concentrate searches near existing record localities and to target sample other locations. To narrow down “other” locations, we will grid the study region into 5-km² cells using the Geospatial Modelling Environment. We will select 300 grid cells (~1% of study region) with a 2× oversample for backup, using generalized random tessellation stratified sampling to maintain spatial balance (Stevens & Olsen 2004). Recent orthoimagery and hydrographic data layers will be viewed throughout each selected cell to find water courses and potential breeding sites; cells lacking these features will be replaced from the oversample.

Following the first year surveys, we will use niche modeling to relate presence/absence records with environmental and climatic predictors to estimate relative likelihoods of occurrence throughout the study region. The resulting site ranking maps will be used to guide search efforts in the second year. We will also project the climatic niche of each species to future periods (e.g. 2050s, 2080s) under IPCC greenhouse gas emissions scenarios (e.g. best-case and worst-case). This forecast could help determine potential refugia and vulnerable locations for these species, especially if we can estimate occurrence probabilities by accounting for pseudo-absences in the collected data (Guillera-Arroita et al. 2015).

To prioritize these species for conservation, we will implement a novel analysis framework supported by State Wildlife Grant funding awarded through the Northeast Regional Conservation Needs Program (<http://rcngrants.org/>). This framework was recently tested on all 228 dragonfly and damselfly species across the northeastern U.S. (White et al. 2015). The analysis will rank the four species based on regional vulnerability and state-level responsibility. Specifically, we will assign a vulnerability rank that reflects each species’ relative extinction risk based on range extent and area of occupancy, habitat specificity and vulnerability, and estimated sensitivity to human disturbance. This rank will be combined with relative endemism (% of range) among Arkansas, Kansas, Missouri, and Oklahoma as a proxy for state management “responsibility” (see White et al. 2015). Our approach recognizes that prioritization must follow species’ ranges and not state lines to ultimately achieve conservation.

Timeline:

Fall 2016	planning work, recruit MS student
Jan 2017	MS student starts
Jan – Apr 2017	determine survey locations (records, consultation, grid analysis)
Apr – Sept 2017	field surveys (primarily MS student with assistant)
Sept 2017 – Apr 2018	niche modeling, prioritization analysis, report writing
Apr – Sept 2018	additional surveys guided by the modeling results
Fall 2018	finalize analysis and products

Expected Results and Benefits: This project will provide a rigorous distribution and prioritization assessment of regional endemic dragonflies designated as SGCN in Arkansas and several neighbor states. Furthermore, this effort will provide the requisite baseline for using these species as ecological indicators of regional environmental and climatic change.

Literature cited:

Bick, G. H. 2003. At-risk Odonata of conterminous United States. *Bulletin of American Odonatology* 7:41-56.

Bried, J. T., and C. A. Mazzacano. 2010. National review of state wildlife action plans for Odonata species of greatest conservation need. *Insect Conservation and Diversity* 3:61-71.

Collins, S. D., and N. E. McIntyre. 2015. Modeling the distribution of odonates: a review. *Freshwater Science* 34:1144-1158.

Guillera-Aroita, G., et al. 2015. Is my species distribution model fit for purpose? Matching data and models to applications. *Global Ecology and Biogeography* 24:276-292.

Patten, M. A., and B. D. Smith-Patten. 2013. Odonata species of special concern for Oklahoma, USA. *International Journal of Odonatology* 16:327-350.

Paulson, D. 2011. *Dragonflies and Damselflies of the East*. Princeton University Press, NJ, USA.

Stevens, D. L., Jr., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. *Journal of the American Statistical Association* 99:262-278.

Tennessee, K. J. 2004. *Cordulegaster talaria*, n. sp. (Odonata: Cordulegastridae) from west-central Arkansas. *Proceedings of the Entomological Society of Washington* 106:830-839.

White, E. L., P. D. Hunt, M. D. Schlesinger, J. D. Corser, and P. G. deMaynadier. 2015. Prioritizing Odonata for conservation action in the northeastern USA. *Freshwater Science* 34:1079-1093.

Budget:

Cost category	Amount
1. Salaries, wages, tuition	\$50,924
2. Fringe benefits	\$1,790
3. Supplies/equipment	\$2,500
4. Travel	\$11,500
5. Total direct costs	\$66,714
6. Indirect costs (Fed request)	\$5,638
7. Indirect costs (Non-Fed match)	\$25,323
8. Total estimated costs	\$97,675

Budget Justification:

Salaries, wages, tuition – Master’s student at \$1,444 per month (current rate for a 9-mo MS assistantship in the U. Ark. biology department) and 700-hr (~2-mo per year) field assistant (enrolled student) at \$10 hourly, each getting a 3% increase in the second year; also includes GRA tuition for 24 credit hours at \$420 per hour, with tuition increased 5% per year

Fringe – determined at the institutional rate (6.68%) for a GRA

Supplies/equipment – close-focus binoculars (x2), GPS unit, miscellaneous smaller expenses

Travel – includes mileage, lodging, and meal per diem for an estimated 100 total days in the field (~50 days per spring/summer), at \$0.42/mile (state rate) over 4,500 miles total, \$89/night lodging for 50 nights (supplemented with camping and some day trips from Fayetteville), and \$51/day per diem (lodging and per diem assume the current FY federal rates for AR)

Indirect – Fed request assumes 10% AGFC rate; match includes \$21,143 unrecovered F & A cost (U. Ark. Rate = 37.5%) and the remainder (\$4,180) from in-kind services and faculty salary, totaling to 35% of the \$72,352 SWG request

Jason Bried, PhD has studied and surveyed dragonflies for nearly 15 years. He has 20 scientific papers on dragonflies (out of 40 total), has led several collaborative projects in dragonfly conservation and survey methodology, and served on advisory committees for the New York Dragonfly & Damselfly Survey and the regional prioritization framework mentioned in this proposal. As project leader Jason will provide general coordination and technical assistance while working closely with the MS student.

Adam Siepielski, PhD is a population and community ecologist whose work focuses on understanding spatial variation in the determinants of aquatic insect community structure at local and regional scales. He has more than 15 years of experience in ecological studies and has published more than 30 peer reviewed scientific publications. As project co-leader Adam will assist with coordination and serve as faculty advisor to the MS student.

Brenda Smith-Patten has worked with Odonata for 18 years in the United States and Central America. She is the co-PI for the Odonata of Oklahoma Project and for a SWG investigating three odonate species of conservation concern in Oklahoma. She is also the odonate conservation specialist for the Oklahoma Natural Heritage Inventory and a record vetter for iNaturalist and Odonata Central (<http://www.odonatacentral.org/>). She will contribute expert knowledge on the target species, help in procuring database and museum records, help with GIS/analysis tasks, and assist with field surveys.

Michael Patten, PhD has published extensively (nearly 200 publications) on conservation biology, evolutionary ecology, and biogeography. Although much of his research has been on birds, he has focused increasingly on dragonflies and damselflies over the past decade. He and Brenda Smith-Patten have conducted intensive field surveys for odonates across Oklahoma, amassing over 30,000 records for nearly 150 species. He will contribute expert knowledge on the target species, help with GIS/analysis tasks, and assist with field surveys.

Monica Papeş, PhD is a macroecologist involved in the baseline development of niche modeling applications in biodiversity since 2001. She has 40 peer-reviewed publications in diverse areas of geographic biodiversity analysis and conservation planning. Papeş will contribute expertise on ecological niche modeling and forecasting under future climate scenarios, and provide GIS and remote sensing support.

Erin White is a Zoologist at New York Natural Heritage Program with expertise in Odonata. She coordinated a statewide atlas effort, the New York Dragonfly and Damselfly Survey, led a conservation status assessment of Odonata in the Northeast region (2012-2014), and serves as co-curator of the Odonata collection at the New York State Museum. She will contribute to the prioritization analysis.

Bruce Henry is a Natural History Biologist for the Missouri Department of Conservation. He is the Missouri state recovery leader for the federally endangered Hine's emerald dragonfly, focusing on field surveys, mark-recapture studies, threats assessment, and habitat restoration efforts. He is also the project leader for an extensive field survey for *Somatochlora ozarkensis* in the southeast Missouri Ozarks. He will contribute expert knowledge on the target species and assist with field surveys.