

## **Climate change and management impacts on prairie biota of Arkansas**

The proposed project focuses on the diversity and species' composition of vertebrate and invertebrate species on natural and restored prairies of Arkansas. We will examine the influence of management methodologies on prairie communities across temperature and humidity gradients.

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Total Project Costs: \$87,878

Total SWG Funds Requested: \$57,044

Total Matching Funds/In-kind Services: \$30,834

## Climate change and management impacts on prairie biota of Arkansas

Climate change is occurring across the globe potentially altering the distribution and abundance of the world's biota. The ongoing and potential impact of climate change in Arkansas and the South Central US is relatively unknown as few long-term data sets are available. Mathematical models are being used to predict changes in species' ranges under different climate predictions based upon physiological tolerances. These envelope models have many limitations due to uncertainties in physiological tolerances, behavioral adaptations related to thermal regulation, and in the influence of heterogeneity in climate effects.

Climate change can also impact species' ranges indirectly by altering disturbance patterns such as drought, fire, and flood events. Fire, forest thinning, and mowing (in prairies) are central components of restoration of habitat in Arkansas. Studies have shown that prairies and glades have responded strongly to restoration in Arkansas, however, little is known regarding invertebrate taxa and many small vertebrate taxa. Previous studies have shown strong correlation of invertebrate taxa with fire frequency (Bellanceau and Huxel in prep). Many small mammals such as shrews also respond to fire which can increase the availability of small seeded plants and increased invertebrate diversity and densities. Ornate box turtles are mainly grassland species that have been species of concern mostly likely due to the loss of grassland/prairie habitat throughout most of its range. Restoration of prairie habitat has focused on the use of fire and some mowing to maintain diverse prairie habitat.

The family Carabidae in the order Coleoptera is one of if not the largest family of organisms with about 22,000 species globally. Little is known of the distribution of carabids which are diverse taxa in Arkansas prairies and forests (Huxel unpublished data). Collections by the PI suggest that other important coleopteran families in prairies include Tenebrionidae, Scarabaeidae, and Histeridae (Huxel unpublished data). Again, little is known how these taxa respond to different prairie restoration methods, singularly or in combination (e.g., burning only versus mowing and burning). Furthermore, no studies in Arkansas have linked climate and species' distributions of coleopterans.

The federally endangered American burying beetle (ABB; *Nicrophorus americanus*) is currently found on Fort Chaffee Wildlife Management Area. Several restored prairies are located within 10-20 km of Fort Chaffee WMA and may be possible habitat for this endangered species. Congeners of the ABB have been collected in unbaited traps at Cherokee Prairie (Huxel, unpublished data). Increased burning may result in greater densities of species that the ABB feeds upon as carcasses such as quail and uses for egg laying. Increases in densities at Fort Chaffee may result in spill over into Cherokee Prairie (if the ABB is not already using that habitat). The impact of burning and mowing at Cherokee Prairie on prey availability and directly on the ABB is unknown.

There are two congeneric species of box turtle in Arkansas, *Terrapene carolina triunguis*, the common three-toed box turtle (TBT) and *Terrapene ornate ornate*, the ornate box turtle (OBT), a species of special concern. These two species differ in diet and habitat preference. The TBT likes more mesic forested habitat, while the OBT is a prairie species. However, TBT will utilize prairie habitat and is common on several restored prairies in Arkansas (Huxel unpublished data). Both species are thought to be in decline due mostly to habitat loss, but also it is thought that collection for commercial trade is an important factor. As the landscape changes over the next few generations, several factors may play a role in whether box turtles remain in decline or perhaps are able to stabilize or increase their populations. Included in these factors are hybridization between the two species, physiological adaptation in the light of global biological change, and landscape patterns.

Another diverse taxonomic group in the prairies are spiders, which are important predators in the system. Ground spiders, web builders, funnel spiders, and jumping spiders are all represented in the communities. Preliminary sampling suggests that spider community diversity and composition is related to management methods and that thatch is an important habitat component for spiders (Huxel unpublished data). Again, little is known regarding how these species respond to prairie restoration methods and climate change. Other important taxa in the system are birds and burrowing crayfish.

We propose to perform broad surveys of vertebrate and invertebrate taxa on prairies over a latitudinal (and therefore temperature and humidity) gradients. Our primary sites will include Arkansas Natural Heritage Commission sites in the Grand Prairie, the Arkansas River Valley and Northwest Arkansas. We will sample sites monthly as temporal species' activity varies greatly over the course of a year. We will use a combination of pitfall traps and sweep nets for invertebrates, and observational sampling for vertebrates and small mammal traps for rodents.

This is especially important in light of climate change occurring in the region. Using data from the International Panel on Climate Change, the EPA (2009) predicts that Arkansas winter and summer temperatures could increase by 2°F and spring and fall temperatures could increase by 3°F. Additionally summer droughts are predicted to be stronger will fewer, stronger storm events. The U.S. Global Change Research Program suggests that many ecological systems are potentially facing sharp transitions in their composition due to increased temperatures and drought. Drought will significantly impact prairies by increasing the burn frequency and intensity of these habitats. Thus, greater knowledge of the influence of various management methodologies of prairie habitats is necessary as climate and land use/cover changes accelerate given climate model projections over the next fifty years.

Budget for two years:			
CATEGORY	SWG	MATCH	TOTAL
Travel: Gas/Mileage	\$4,128	\$0	\$4,128
Miscellaneous Supplies	\$500	\$0	\$500
Software licenses	\$0	\$1,500	\$1,500
Salary/Benefits	\$38,367	\$14,715	\$53,082
Total Direct Cost	\$52,745	\$16,215	\$68,690
Tuition	\$9,750	\$0	\$9,750
Indirect Costs	\$4,300	\$14,618	\$18,918
Total	\$57,044	\$30,833	\$97,877

## **Budget Justification**

### **AGFC (SWG) REQUEST**

**Travel, Gas/Mileage:** AGFC (\$4,128), 400 miles per month for 24 months at \$0.43/mile. The average distance to field sites is 200 miles, allowing 2 trips per month for 2 years.

**Miscellaneous Supplies (\$500):** AGFC will cover the price of sample collection material including vials, bags, ethanol, and other disposables at \$500.

#### **Salary/benefits:**

Graduate Student: 12 months @ \$1,500/month in Year 1 and assumes a 3% increase in Year 2.

Fringe Benefits: salary x 5%

**Graduate Tuition:** 1 Graduate Student, 15 credit hours @ \$325/credit hour for each of two years.

### **UNIVERSITY OF ARKANSAS MATCH**

University of Arkansas match is ~35% of the total cost of this phase of the overall project.

**Software (\$1,500):** Site licenses for GIS and statistical software.

#### **Salary/Fringe Benefits**

Dr. Gary Huxel: 1 month summer salary based on his 9-month appointment and assumes a 3% increase in Year 2.

Fringe Benefits: salary x 16.5%

#### **Facilities and Administrative Costs (formerly Indirect Costs):**

AGFC: F&A @ 10% ( $\$52,745 - \$9,750 = \$42,995$ .  $\$42,995 \times 10\% = \$4,300$ .)

UA unrecovered F&A:  $34\% \times 16,215 = \$14,618$

UA negotiated federal rate agreement: 44.0% of MTDC in accordance with F&A Rate Agreement, DHHS, 07/01/09 - 06/30/13.

### Qualifications of Project Participants

Dr. Gary Huxel: Dr. Huxel is a tenure-track faculty member of the Department of Biological Sciences with a specialty in Ecology. Dr. Huxel has worked in a variety of systems from freshwater to marine to terrestrial. He has worked with reptiles in Arkansas including box turtles. His current work focuses on prairie and stream community dynamics and ecosystem processes.

Douglas Leasure, PhD student. Mr. Leasure has worked on projects involving prairie dynamics at Fort Chaffee WMA including a focal study on the endangered American Burying Beetle. He has co-authored two reports/articles on the ABB. He has also worked on the impact of the invasive birds on cliff swallows in Arkansas. He is currently a PhD student at the University of Arkansas.

Both participants are employed at the University of Arkansas a Research I institution with lab, office, and analytical resources available.