A. Title: Evaluating the benefits and use of restored grasslands for loggerhead shrikes across their full-life cycle

B. Project summary: The loggerhead shrike is a grassland-associated avian species and one of the fastest declining passerines in both North America and Arkansas. To improve our ability to manage and conserve this species, we propose to evaluate both the benefits and use of restored grasslands for breeding and non-breeding loggerhead shrikes in Arkansas. We will survey and capture shrikes occupying restored grasslands and agricultural areas and compare overwinter survival, non-breeding body condition and stress of adults, density and success of nests, body condition of fledglings, and food habits of individuals between these two habitats. We will also use radio telemetry to determine relative use of specific habitat types and features by individuals within both habitat types.

C. Project Leaders:

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D. Project Partners:

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E. Requested Federal (SWG) Funds: Non-breeding: $86,844
Breeding: $47,193
Combined Seasons: $134,037

Amount and Source of Cooperator Match:
Arkansas State University will provide $41,630 in salaries, fringe benefits, and IDC as matching funds. Arkansas Tech will provide $24,412 in salaries, fringe benefits, and tuition as matching funds. Arkansas Game and Fish will provide $5,939 in salary and fringe benefits. Total match is 35.3% of total project budget.

Total Project Budget: Non-breeding: $128,474
Breeding: $72,605
Combined Seasons: $207,018

Project Statement

A. Need

Our proposal specifically addresses the need to evaluate habitat restoration and management of grasslands for the benefit of loggerhead shrikes (*Lanius ludovicianus*), as specified in the Arkansas Wildlife Action Plan for 2014 and Table 1 in the RFP. Like many other grassland-associated species, loggerhead shrike populations have undergone a fairly consistent decline over the past 50 years throughout North America (-3.0%/yr; Ziolkowski et al. 2010). The population of the eastern migrant subspecies of the shrike (*L. l. migrans*), which can putatively be found in Arkansas year-round (Vallianatos et al. 2002), has declined at an even more severe rate (-3.7%/yr; Cade and Woods 1997, Sauer et al. 2012). The underlying cause of the shrike's decline is very broadly attributed to habitat degradation and/or loss (Yosef 1996, USFWS 2000), but the specific mechanisms for the observed population decline is unclear and could involve reduced food availability, pesticides, increased predation, and associated limiting demographic factors such as low winter survival rates and/or low reproductive productivity.

Loggerhead shrikes have similar habitat requirements during the breeding and non-breeding season making populations potentially vulnerable to risks such as habitat loss and degradation throughout their annual life cycle. Year-round, loggerhead shrikes use open habitat characterized by grasses and forbs interspersed with bare ground, shrubs, and small trees (Dechant et al. 2002, Norris 2003); these habitat requirements are rather different when compared to typical obligate grassland species. In Arkansas, loggerhead shrike habitat includes margins of pasturelands and row crop fields, as well as restored grasslands that have at least some woody component. Despite the assumption that restored grasslands provide appropriate habitat for shrikes, it is currently unclear which of these different habitat types is most beneficial to shrikes or how these different habitats impact survival or reproduction. Although shrikes have been studied in restored grasslands elsewhere in North America (e.g., Fornes 2004, Shen et al. 2013), we are not aware of any extensive investigations of shrikes in restored grasslands within Arkansas, particularly during the non-breeding season, a period when their ecology is poorly understood (USFWS 2000). Consequently, we do not know the role that restored grasslands play in maintaining breeding and overwintering shrike populations in Arkansas or what factors may be strongly contributing to the species decline.

B. Purpose and Objectives

Our overriding goal is to determine the role restored grasslands play in maintaining shrike populations in Arkansas. In support of that goal we have three objectives for this project: 1) assess the relative quality of restored grasslands and agricultural habitat for shrikes during the non-breeding and breeding seasons in Arkansas, 2) compare used and unused habitat structure by shrikes within native grasslands and agricultural habitats, and 3) evaluate potential limiting factor(s) that may be contributing to the decline of the loggerhead shrike population (e.g., food availability, demographic factors including overwinter survival and breeding productivity).

C. Location of Work

We will work in the following restored/managed grassland areas in eastern Arkansas: Stuttgart Airport Prairie, Downs Prairie, Konecny Prairie, Mike Freeze Wattensaw WMA, Railroad Prairie (Prairie County), Roth Prairie (Arkansas County), Prairie Bayou WMA (Lonoke County), and Steve N. Wilson Raft Creek Bottoms WMA (White County; Fig. 1), Dave Donaldson Black

River WMA (Clay County), and William E. Brewer Scatter Creek WMA (Greene County; Fig. 2). We will also work on the edges of agricultural areas surrounding these grasslands. This will range from croplands adjacent to the grasslands (to examine shrikes that may use both habitats) to croplands >1 km from these areas (to examine shrikes that use agricultural areas exclusively). The first eight study areas lie within the Mississippi Alluvial Plain ecoregion. The last two are within the Crowley's Ridge ecoregion.

D. Approach

Non-breeding season: Between October and March (2014 and 2015), we will conduct surveys for shrikes occupying: 1) agricultural lands and 2) restored grasslands in eastern Arkansas. Although these surveys will provide us with some short-term occupancy data for shrikes in different habitat types, occupancy information can be very misleading, particularly in the long-term (e.g. ecological traps; Battin 2004). Thus, to accurately evaluate the impact of restored grasslands on the species, detailed demographic, physiological, and/or habitat use data are necessary. To gather this information, we will use traps baited with mice to capture shrikes (e.g., Potter, modified Tordoff; Collister 1995). We will age individuals, collect blood for sex and subspecies confirmation (*l. l. migrans* or not), collect one rectrix (to induce feather growth), and measure condition (by using fat indices, mass, and linear measurements). We will mark each bird with unique color leg-bands and a silver USGS aluminum band and will return to monitor survival of marked birds throughout the non-breeding season. For individuals that survive until February/March, we will attempt to re-capture them to re-assess condition, and collect the re-grown rectrix (to measure stress hormone concentration in feathers and tail growth bars, both of which are potential measures of food availability/habitat quality; Yosef and Grubb 1992, Bortolotti et al. 2008). We will then statistically compare survival, condition, food availability and stress, and age structure of shrikes that used the two habitat types to evaluate potential benefits of grassland restoration.

A subset of adults (~10 in each habitat/yr) will be fitted with radio transmitters. These birds will be followed throughout both seasons in order to further evaluate survival as well as habitat selection and use of features in native grasslands and agricultural lands. We will pay special attention to use relative to the openness of the habitat as well as the distribution of shrubs, trees, and fence lines since those features are easily managed and likely important components of shrike habitat. From these data, we will evaluate habitat within home ranges as a basis for comparison with unused habitat (which may suggest selection and/or preference). We expect some shrikes to use both agricultural lands and native grasslands because shrikes perch on fence lines, trees and shrubs which are common at the edges of, and often separate, agricultural fields from grasslands. For these individuals, comparing the area of native grassland and agricultural land used and the time spent in each would indicate a preference (since both habitats would be available). We will evaluate habitat use and the potential impact of habitat on condition and survival at both the microhabitat scale (within home range) and at broader landscape scales (within 2-km radius of home range/territory).

Breeding: Between April and July (2015 and 2016) we will locate nests by systematically searching areas used by shrikes. Each nest will be checked every 3 to 5 days to monitor its fate. We will attempt to capture juvenile shrikes within 24 hours of fledging. Norris (2003) often used a butterfly net to capture juveniles while they were still in the nest tree and we will attempt to follow that method. Each juvenile's condition will be assessed as in the non-breeding season.

In order to evaluate food availability we will monitor shrike larders. We will be able to catalogue prey items in those larders. We will also monitor the frequency with which items are not removed from the larders. Presumably, that would be an index of prey availability and consequently, any differences in food use from larders would indicate a difference in prey availability between habitats. As an additional measure of relative prey availability, we will compare, between habitats, the frequency of attacks made by foraging shrikes as well as prey delivery rates to nestlings.

As in the non-breeding season, we will fit transmitters to approximately 10 individuals/habitat each year. Similar methods (as in non-breeding season) will be used for radio telemetry work for those individuals. However, in addition to the spatial habitat analyses that were proposed for non-breeding birds, we will use an adjusted transformed soil-adjusted vegetation index (ATSAVI) on Landsat 8 imagery as an assessment of openness within each home range (see Shen et al. 2013). We will also randomly sample areas outside of each home range and determine the ATSAVI for those areas as a basis of comparison.

E. Expected Results and Benefits

Loggerhead shrikes, and particularly the eastern subspecies, are experiencing long-term population declines within Arkansas and North America. Habitat loss due to agricultural intensification is commonly proposed as the underlying cause of these declines, however little is known about how grassland restoration benefits shrikes in particular, because they have slightly different habitat requirements from many other grassland species (e.g., more woody vegetation). Thus, the main benefits of this research will be to evaluate: 1) whether, and how, native grasslands are more beneficial for shrikes than agricultural lands, 2) what features of grasslands and agricultural lands in Arkansas we can manage to attract, and provide maximum benefit for, shrikes, and 3) which potential limiting factors (in both non-breeding and breeding seasons) appear to contribute most to shrike decline.

Data collected will include adult body condition, over-winter survival rates, stress and feather growth rate, and breeding productivity and fledgling condition of shrikes. In addition, we will be able to refine grassland management recommendations by evaluating what habitat features are of greatest importance to shrikes in both the breeding and non-breeding seasons.

Although this proposed research provides benefit specifically for loggerhead shrikes, our results could have implications for other SGCN that use similar habitats (i.e., grass/farmlands with some bare ground and sparse woody/shrub components). These species include Bell's vireo (*Vireo bellii*), lark sparrow (*Chondestes grammacus*), willow flycatcher (*Empidonax traillii*), Bachman's sparrow (*Peucaea aestivalis*), and painted bunting (*Passerina ciris*).

F. Budget

Requested Funding:	ASU (Non-breeding)	ATech (Breeding)	Total	
PI Salary	$6,111	$0	$6,111	
Graduate Project Manager Salaries	$38,000	$26,000	$64,000	
Field Assistant Salaries	$9,600	$7,040	$16,640	
PI Fringe Benefits	$1,094	$0	$1,094	
GPM Fringe Benefits	$380	$350	$730	
Field Assistant Fringe Benefits	$764	$549	$1,313	
Travel and Lodging	$11,000	$6,260	$18,260	
Supplies	$7,000	$3,600	$9,600	
Equipment	$5,000	$0	$5,000	
TDC	$78,949	$43,799	$122,748	
IDC (≤10%)	$7,895	$3,394	$11,289	
TOTAL REQUESTED	**$86,844**	**$47,193**	**$134,037**	
Match	**ASU**	**ATech**	**AGFC**	**Total**
Salary	$16,044	$13,000	$4,640	$33,684
Fringe Benefits	$4,903	$0	$1,299	$6,202
Tuition	$0	$7,650	$0	$7,650
IDC Difference (Fed-Request)	$20,683	$4,762	$0	$25,445
Total Match	**$41,630**	**$25,412**	**$5,939**	**$72,981**
Total Project Costs	**$128,474**	**$72,605**	**$5,939**	**$207,018**

Qualifications of Key Personnel:

Dr. Than J. Boves is an ornithologist and ecologist with a Ph.D. from the University of Tennessee. He is an assistant professor of avian ecology at Arkansas State University and will act as co-manager of the overall project, perform field activities, and work closely with graduate students and field technicians in all aspects of the project. Than will help: develop field data collection protocols, collect data, design and conduct appropriate analyses, interpret results, and write reports and manuscripts. Than Boves has been involved in biological field research for the past 16 years, with a strong emphasis on habitat management, avian ecology, and conservation. His previous research has included investigations related to: the potential for various forest management techniques to improve habitat for the songbirds in the Appalachian Mountains (particularly Cerulean Warblers), the impact of selective logging on avian species in Belize, roadway mortality of Barn Owls (*Tyto alba*) in Idaho, the use of cowbird management to enhance reproduction for the endangered Black-capped Vireo (*Vireo atricapilla*), the effect of weather and global climate cycles on nest survival of endangered bird species in Texas, the influence of temperature and food availability on susceptibility of amphibians to chytrid fungus, and impact of anthropogenic activity on avian color signaling systems. Than has published 18 peer-reviewed papers, provided contributions to 2 books, written 7 technical reports or management guidelines, and helped complete 7 funded projects.

Dr. Chris Kellner is a professor of wildlife science at Arkansas Tech University. He has spent the past 20 years evaluating avian species response to management. For example, he has examined response of Bell's vireo to early successional bottomland hardwood restoration, northern bobwhites response to habitat restoration, and response of cerulean warblers to group-

selection timber harvest and controlled burning. He has also studied overwintering and breeding shrikes in Arkansas during which he captured and determined the condition of several dozen shrikes in Arkansas. He also has experience fitting transmitters to American Kestrels and loggerhead shrikes during both winter and breeding seasons.

Dr. Kellner has also used Landsat imagery to model avian habitat and he is familiar with the techniques required to evaluate vegetation within home ranges. He will use his expertise in combination with Dr. Boves to direct the research of a graduate student.

Karen Rowe is the Nongame Migratory Bird Program Coordinator for the Arkansas Game and Fish Commission. For the past three decades, Ms. Rowe, a certified wildlife biologist, has been responsible for developing and implementing conservation programs for priority non-game birds in Arkansas. She has also assisted with the implementation and monitoring of several grassland restoration projects including the AWAP funded Stuttgart Airport Prairie Restoration effort.

Fig. 1. Map of eight restored/managed grasslands where proposed research would occur. County borders and names are marked.

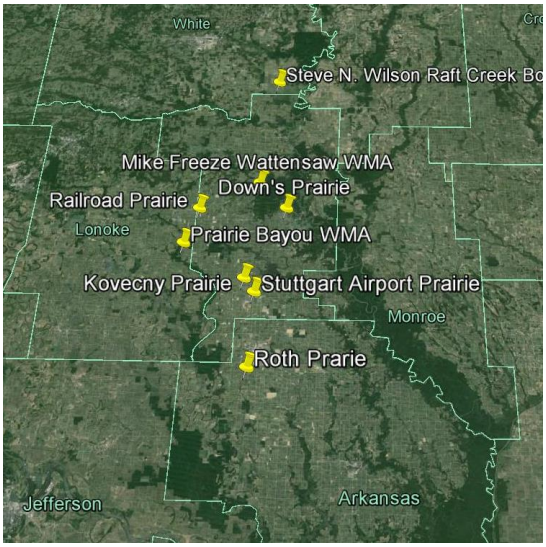

Fig. 2. Map of two additional sites with restored/managed grasslands where proposed research would occur. County borders and names are marked.