A. **Using Geographic Information Systems (GIS) to identify populations of the Comanche Harvester Ant *(Pogonomyrmex comanche)* a species of concern in xeric sandhill habitats of southwestern Arkansas**.

B. Project Summary:

This proposal will use habitat modeling and GIS to locate new populations of the rare Comanche harvester ant *(Pogonomyrmex comanche)* [GNR/S1] a species of concern in xeric sandhill habitats of southwestern Arkansas. Habitat variables like open pine woodlands on deep sandy soil are linked to a currently known population at Arkansas Oak Natural Area.

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H. Project Partners:
Arkansas Forestry Commission
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I. Total project cost**: $71,703**

J. Total SWG requested: **$35,770**

K. Matching funds amount and source: **$35,993**, University of Arkansas Agricultural Experiment Station

A. Funding priorities this preproposal addresses.

This preproposal addresses a species of concern, the Comanche Harvester Ant (*Pogonomyrmex comanche*) [GNR/S1] that is thought to be very rare in Arkansas. However, a research project on native ants conducted by the School of Forest Resources at UAM discovered a large population in 2008 at the Arkansas Oak Natural Area southwest of the Poison Springs State Forest. Perhaps 400 colonies were found in a recently purchased open pine plantation there. After observing this population during the summer of 2008 we believe that the ant is locally common because its primary food is abundant, the rare plant Georgia frostweed (or Georgia rockrose; *Helianthemum georgianum*; family Cistaceae). This ant evidently consumes the seeds of this plant with vigor since piles of castoff seed pods litter the edges of a colony. The distribution of Georgia frostweed includes only 3 counties in Arkansas--Ouachita, Nevada and Miller--and we believe that the distribution of the Comanche harvester ant follows this same pattern. Both the ant and its food evidently prefer arid open sandy sites. In his book "The world of the harvester ant" Stephen Taber (1998) notes that little is known about this ant but that in Texas it likes open forests of oak and pine on sandy soils. The published distribution range is from southern Kansas to southern Texas and east into western Louisiana and southwestern Arkansas.

B. Ecoregion/ecobasin/hatitat/area where project will be conducted.

Oak sandhill woodlands in the South Central Plains of Arkansas, especially Miller, Ouachita, and Nevada Counties, and perhaps other locations revealed by the research.

C. Methods.

We have what we believe to be is a large established population of the Comanche harvester ant at the Arkansas Oak Natural Area in Nevada County (owned and maintained by the Arkansas Natural Heritage Commission). This population provides us the opportunity to study the ant's habitat likes and dislikes. The meager literature suggests the ant likes open woodlands on sandy soils, so we have two environmental variables as starters. Because the population is locally restricted, we also know that other factors are limiting. The following list includes habitat variables that we believe may be important, since they are conspicuous at the Arkansas Oak Natural Area.

Deep sandy soils – The existing population is on Darden loamy fine sand, a soil that extends more than 80 inches deep (NRCS soil information). The ants are not on the adjacent Rosalie and Briley loamy fine sands, perhaps because the soil texture changes to sandy clay loams at about 30 inches depth. These differences may be important because the ants nest very deep in the soil and small changes in soil texture may limit colony growth and dynamics in essential ways.

Former clearcut - open pine plantation, perhaps 10-years old. Harvester ants of most species are associated with open sites; with harvesting often the agent that opens up woodlands for colonization.

Abundant Georgia frostweed – although this species is the dominant seed in ant refuse piles (or middens) at the perimeter of colonies, it may not be the preferred food. However, studies have shown that the contents of middens are a good approximation of harvester ant food preferences.

To learn more about selection of colony location, we will sample the population by setting out a 20x20 meter grid and locating, marking, and GPSing each colony. Then, at one randomly selected colony within each grid we will take the range and bearing to the nearest tree (woody stem taller than 1.5 meters) and recording species, diameter, and height (estimated to be about 200 colonies based on area occupied by colonies). At 20% of these randomly selected colonies (about 40) we will also sample the plants and substrate and their area coverage enveloping this colony using a 2-meter square quadrat centered on it.

To quantify the spatial relationships of the colonies, all colonies will be GPSed and their

locations set on a 6-inch resolution normal color aerial photo taken in the spring (obtained from Kingwood Forestry Services). The relationship of colonies to planted pines on the site will be assessed using a similar resolution photo taken in the winter. If other locations are discovered that include a viable population of harvester ants, additional photos will be taken of these sites to document the spatial relationships of colonies to trees and soil variables.

To better understand the spatial distribution of colonies on the ground relative to each other and the surrounding vegetation at the micro-habitat scale, we will take a digital photo of the 40 randomly selected colonies discussed earlier with the 2-meter square quadrat centered on the colony and at 40 randomly selected sites with no colony present. The camera will be oriented and fixed so that it is parallel to the ground to provide a spatially accurate representation of the colony and surrounding area (i.e. minimize any directional 'tapering' of the image). We will use the quadrat to delineate and therefore standardize the effective extent of each image. These images will be georectified in ArcGIS, and using the spatial statistics program Fragstats, we will develop a suite of metrics describing the spatial characteristics of the ant colonies, vegetation, and soil patches in these images (e.g. shape and size of vegetation patches, distance from colony to nearest vegetation patch). We will compare the metrics from images with colonies to those without colonies using 2-sample t-tests to assess the differences in spatial patterns among patches of vegetation, bare ground, and ant colonies.

Based on the data collected on the colonies present at the Arkansas Oak Natural Area, we will attempt to develop a model for predicting the occurrence and/or density of ant colonies in other counties in the region. The habitat data and spatial analyses described above provide detailed and multiscale baseline information regarding the preferred habitat characteristics for the ants in this portion of their range and facilitate identification of critical habitat components that are easily characterized with remotely sensed data for inclusion as potential habitat variables in the model. Likely predictors include soil type, aspect, slope, forest cover, and occurrence of recent harvests (digitized from DOQQs or other recent aerial imagery); we will develop a suite of landscape level habitat variables in ArcGIS. Using the locations of known colony sites, and a number of random sites, we will build a set of potential models using logistic or linear regression containing independent variables describing preferred habitat and choose the best model using Akaike's Information Criterion (AIC). We will use the final selected model to create a map of our study region identifying potential new locations. As sites are identified using the model we will visit them to locate the ants and also to compare them to the "preferred" habitat the model is based on. If ants are present, the extent of the population will be assessed, GPSed, documented, and photographed. If ants are absent, an assessment of what conditions might be missing will be made.

D. Measureable products/outcomes to be produced.

1. A report describing the process of obtaining useable data, managing it, filtering it, and using it to find unknown populations of this ant. **2.** A state map and many county and site maps showing all ant populations revealed by the research. **3.** Manuscripts eventually to be published in refereed science journals. (One on the research process, another on the ant and its new locations, and maybe another on the ant-food plant relationship.)

E. Extent this project will use existing resources (like funding, teams, conservation areas, partnerships).

This project will use an existing team of ant and GIS experts within the Arkansas Forest Resources Center at the University of Arkansas - Monticello. The research team includes two ant specialists, Dr. Lynne Thompson and Mr. Dave General (also a GIS specialist), one Landscape Ecologist, Dr. Todd Fearer, one graduate student, and one student field worker. The team is employed by the Arkansas Agricultural Experiment Station and has access to dedicated vehicles, computers, GIS software,

field equipment, and office and lab space for this project. Dr. Thompson will seek permission to use Arkansas Oak Natural Area as a study site to assess the ecological advantages it provides to this ant (and its primary food Georgia frostweed). The team will also partner with the Arkansas Forestry Commission (AFC Dictrict 4) who will assist the ant team in locating additional populations. Mr. Bill Sprinkle, with the AFC, supervises Foresters and Rangers within 7 counties in southwestern Arkansas.

F. Proposed budget.

The project is scheduled to run 2 years. The principal cost is a grad student to do much of the GIS and photo interpretation work, the salary is to be split between SWG and UAM. Included in the grad student costs to the SWG are Tuition and Fees (a requirement for grad student employment) for both years. The GIS and photo interpretation work will be supervised by Dr. Fearer and Mr. General. Field work will be done by Dr. Thompson, Mr. General, a student worker, and the grad student. Operating costs include transportation to and from the research site and travel to potential new habitats identified by the research process or located by the ant team or is partners. Our team has all the equipment needed for the study, but supplies like pin flags, flagging, vials, and alcohol are needed. High resolution aerial photography of the Arkansas Oak NA site and other locations identified by the study will be contracted through Kingwood Forestry Services in Monticello. Finally, the Arkansas Agricultural Experiment Station requires that external grants charge 42% overhead, so 10% is being charged and 32% is being included in the matching funds.

SWG

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Salary/benefits	
Grad student (year #1, $15,000/yr)	15,000
Tuition & fees (for 2 yrs; $187/cr-hr x 30 hrs)	5,610
Student help (42 days x $64/day)	2,688
Benefits (1.07% for grads & 7.8% for students)	370
Operating expenses	
Travel: Ant survey (400 mi RT x $0.45/mi x 10 trips)	1,800
Ark Oak NA plot research (200 mi RT x 20 trips)	1,800
Professional meetings ($500 ea x 4)	2,000
Supplies:	750
Aerial photos: ($250 ea x 10, high resolution natural color)	2,500
Capital expenses	0
Overhead (10%)	3,252
SUB TOTAL	**35,770**

AFRC

Salary/benefits	
Grad student (year #2, $15,000/yr)	15.000
Program Technician (25%)	7,402
Benefits (26% for PT + 1.07% for grad)	2,085
Operating expenses	0
Capital expenses	0
Overhead (32% of SWG sub total)	11,446
SUB TOTAL	**35,933**
GRAND TOTAL	**71,703**

Qualifications of individuals and organizations.

Research Team

Dr. Lynne C. Thompson, Professor of Forest Protection, School of Forest Resources, UAM;

Lynne has been studying ants since 1993 when he started research on the chemical control of Red Imported Fire Ants. Research on this species eventually expanded into biological control efforts and assessments of economic damage in the state. Since 2005 Lynne has teamed up with Dave General to do research on native ants. They have generated 1 Masters thesis, 5 published manuscripts, and made at least 3 ant presentations per year over the past 2 years. This collaboration continued in 2008 when they collected ants at five Arkansas Natural Heritage Commission Natural Areas and two Arkansas Game and Fish Commission Wildlife Management Areas. This study demonstrated that fire ants dominate the ant community in open areas like prairies, and that burned areas have as many fire ants as unburned areas. In 2009 Thompson and General will sample ants in prairie remnants in Prairie and Ashley Counties.

Dr. Todd Fearer, Assistant Professor of Landscape Ecology, School of Forest Resources, UAM

Todd's research interests include wildlife-habitat relationships at the landscape scale, the conservation of oak forest ecosystems, landscape ecology, and GIS. His research to date has focused on integrating data from different sources (e.g. BBS, FIA, NOAA Climate Data) to model wildlife-habitat relationships (with a focus on forest song and game birds). A secondary focus has been modeling spatial patterns of acorn production relative to physiography and climatic factors. His current research is focused on assessing the impacts of natural and anthropogenic disturbance events on forest-bird communities.

Mr. David M. General, Program Technician, School of Forest Resources, UAM

Dave is a Filipino ant researcher who has been collaborating with ant specialists in the Museum of Comparative Zoology at Harvard University since 2003. He is also a "remote curator" of Philippine ants for the Antweb project of the California Academy of Sciences. He has recently been appointed as a Research Associate of the National Museum of the Philippines and as a Contributing Scientist of the Museum of Natural History of the University of the Philippines at Los Baños. His master's thesis dealt with the ants of Arkansas Post National Memorial, in the course of which he established several new distributional records of species and genera in the state of Arkansas. Dave specializes in computer spatial information systems and ant ID and he works with Drs. Thompson and Fearer.

Partner

Mr. William Sprinkle, Arkansas Forestry Commission, District 4, Stamps, AR

Bill supervises foresters and rangers within 7 counties in southwestern Arkansas. These employees spend lots of time in the woods and know their counties very well. We have already scheduled an April 21 presentation in Camden to describe the ant and its ecology to them and to visit a site so they will know what Comanche harvester ants and colonies look like and what might be suitable habitat.