Summary. A survey of a unique assemblage of Interior Highland beetle species is proposed. These species are endemic to particular ecoregions, have very small known distributions and biogeographic affinities with southern Appalachian species. The study will provide up-to-date, georeferenced distribution and ecology data about these species. It will guide efforts to monitor their responses to environmental change, and help justify protection and proactive management of areas of insect endemism in Arkansas. We also expect to discover new species with similar ecological significance.

Christopher E. Carlton, Ph.D.
Professor of Entomology
Director, Louisiana State Arthropod Museum (LSAM)
Louisiana State University Agricultural Center
E-mail: ccarl@lsu.edu

Mailing address: Dept. of Entomology
400 Life Science Building
Baton Rouge, LA 70803

Telephone: 225-578-0425
Fax: 225-578-1643

Amount requested from sponsor: $37,400

Amount and source of matching funds/inkind services: $39,008

Proposed Project

Funding priorities, justification, and ecoregions. This preproposal directly addresses terrestrial habitat, forest conservation management for ecologically sensitive species. The species proposed for study are unique in having extremely restricted distributions, many known from single localities, and most from very few specimens. Multiple species tend to have overlapping ranges and these areas of endemism can be circumscribed through systematic survey work. Many of these species have relatives in the southern Appalachian Mountains, usually species in the same genus. Thus, these species comprise a significant biogeographic faunal association. They represent a unique, environmentally sensitive insect fauna endemic to Arkansas that has long been recognized but typically underrepresented in habitat management decision making and conservation priority assessment.

Most species in the targeted assemblage are small (typically 1–3 mm in size), and require specialized methods to collect and a high level of technical expertise to identify. Our study will provide up-to-date distributional data about these species. By doing so, we will identify with precision forested areas that should be considered for special management due to the extreme sensitivity of these species to changes in forest cover and fragmentation of habitat. Small size, limited ranges, and, usually, limited dispersal capabilities (i.e., many are blind and wingless) make populations of these organisms extremely susceptible to extinction. Even relatively small scale human activity may potentially divide or degrade populations (see comments under individual species below). Knowing the extent of these populations and, potentially, identifying additional species that share this susceptibility to habitat modification, can inform decisions about land purchases or conservation easements to conserve populations of single species or species assemblages. Relatively minor changes in the placement of roads, trails and campgrounds can have major impacts on the long-term viability of these populations, particularly in State Parks, urban fringes, and other publicly accessible areas. This survey will provide data for proactive management of these interesting, scientifically important components of Arkansas’ non-game animal fauna.

This study will be performed in four Arkansas Interior Highland ecoregions. The largest number of species under consideration are known from the Ouachita Mountain Ecoregion. A significant subset of these species are also known from, and a few are restricted to, the isolated plateaus (e.g., Mt. Magazine) located along the southern boundary of the Arkansas Valley Ecoregion. Relatively few are known from the Boston Mountain and Ozark Ecoregions, but these include some of the least known. Additional species will likely be discovered when these areas are surveyed more completely.

Goals, objectives and taxa targeted for study. The overall goal of this project is to establish a baseline of information about endemic or disjunct forest litter beetles in the Interior Highlands of Arkansas. By the end of the project period we will provide a single source reference for all known species and any additional species that come to light during the study. Though much information was compiled in Robison and Allen’s *Only in Arkansas* (1995) book on endemic species of Arkansas, most of the data was based on dated information without precise locality information, and several recently described species were not included. We will provide a technical analysis of distributions using modern georeferencing tools, a relational database, and species webpages. The information will be packaged and delivered to the sponsor in a format that can be optimized for future management and monitoring purposes.

Specific objectives towards this goal include:

1. Conducting distributional surveys of the following species (broken down by taxonomy with species of high conservation concern in bold):
   - Family Carabidae; Subfamily Carabinae
     - *Scaphinotus infletus* Allen and Carlton (1988), a snail eating ground beetle. This and the following species stand in contrast to other species on the list in being rather large insects (~10mm, 35mm, respectively). This species is known from three specimens collected at Lost Valley State Park, Newton Co.
     - *Scaphinotus parisiana* Allen and Carlton (1988), a snail eating ground beetle. This species is known from only three specimens from two localities, Mt. Magazine, Logan Co. and near Fayetteville, Washington Co. Dr. Kipling Will at the University of California, Berkeley reportedly has additional specimens and data that are available for study.
Subfamily Trechinae

*Anillinus magazinensis* Sokolov and Carlton (2004), a minute ground beetle. Members of this ground beetle genus are all less than 2mm in length, blind, wingless, and prone to extreme endemism. This species is known from good series collected on Mt. Magazine.

*Anillinus robisoni* Sokolov and Carlton (2004), a minute ground beetle. This species is known from good series collected at several localities in Montgomery and Polk Counties.

*Anillinus tishechkini* Sokolov and Carlton (2004), a minute ground beetle. This species is known from five specimens from a single litter sample taken on a rocky ridge crest in Perry Co.

Family Staphylinidae; Subfamily Tachyporinae

*Derops divalis* (Sanderson, 1947) (often listed as *Rimulincola divalis*), a rove beetle. An inhabitat of deep litter associated with caves and crevices from numerous localities in all four ecoregions under consideration. Considered rare.

Subfamily Pselaphinae

*Arianops copelandi* Carlton (1990), a short-winged mold beetle. This species is known from five specimens collected from ~100 m² area on the northeast face of Pinnacle Mountain, just west of Little Rock. A critical need for this species is knowledge of whether populations occur outside Pinnacle Mountain State Park and what steps can be taken to protect them in the face of urban expansion of the Little Rock metropolitan area.

*Ouachitychus parvoculus* Chandler (1988), a short-winged mold beetle. This species is known from good series from numerous localities in the Ouachita Mountains, in addition to the type locality on Mt. Magazine.

*Pseudactium magazinensis* Carlton and Chandler (1994), a short-winged mold beetle. This species is known from three specimens collected at two localities, Mt. Magazine and Bard Springs Recreation Area in Polk Co.

*Pseudactium ursum* Carlton (1995), a short-winged mold beetle. This species is known from three specimens collected in Buffalo National River near Erbie Campground, Newton Co.

2. **Confirming and describing the following putative new species** (= “new to science”) through morphological and molecular analysis, and collection of additional specimens:

Family Carabidae; Subfamily Trechinae

*Anillinus* new species 1, a minute ground beetle. We have one female specimen of this possible new species from Queen Wilhemina State Park in Polk Co. We need males for confirmation.

*Anillinus* new species 2, a minute ground beetle. We have one specimen in poor condition of this possible new species from Dutch Creek Mountain in Scott Co. We need additional specimens for confirmation.

*Anillinus* new species 3, a minute ground beetle. We have one female specimen of this possible new species from Garland Co. We need males for confirmation.

Family Staphylinidae

Subfamily Pselaphinae

*Actium* new species, a short-winged mold beetle. We have a single specimen from Buffalo National River near Erbie Campground, but need additional specimens for description.

**Methods.** Three primary methods have proven effective for various species targeted, Berlese extraction of forest litter samples, flight intercept trapping, and hand collecting. Berlese extraction is the most widely used method for sampling forest litter arthropods. It entails collecting moist forest litter samples that are usually sifted though quarter-inch mesh screen and driving the organisms out using heat and drying from incandescent lights in a device called a Berlese funnel. Flight intercept traps use ground-based trays filled with preservative and vertical barriers to collect insects. A fine mesh screen is used as the barrier and a plastic rain cover is usually employed to keep the trays from flooding. Hand collecting in the context of the current study usually involves turning rocks or sifting litter onto a white surface then picking target organisms up using forceps or an aspirator.
Permits will be obtained for State Parks where collections are required. District Rangers will be notified in National Forests and any requisite paperwork done. Applications will be submitted for collections in National Rivers and Parks via the automated online NPS permitting system.

In addition to the described fieldwork, we will visit collections housing relevant specimens and compile data on them. The University of Arkansas Arthropod Museum in Fayetteville is the main institutional collection, but smaller college and university collections will also be visited.

**Products and outcomes.**
1. Relational database of all specimen records from survey results, previously published data and museum specimens, including precise georeference and habitat association data and distribution maps. The database will be adapted for export to a database platform of sponsor’s choice.
2. Species webpages (HTML) containing images of species, habitats, etc., distribution maps, and diagnostic descriptions. These will be posted on project website at [http://entomology.lsu.edu/lsam/](http://entomology.lsu.edu/lsam/) and made available for posting on sponsor’s website if desired.
3. Publications in scientific journals of new species descriptions resulting from project.
4. Recommendations and content for promoting conservation and public awareness of these and other obscure but important insect species endemic to Arkansas. Recommendations for immediate action to protect populations judged to be under imminent threat.

**Resources available for the project.** The Louisiana State Arthropod Museum (LSAM) totals 4125 sq. ft. including 2200 sq. ft. for collections, and the remaining 1925 sq. ft. as a processing/sorting laboratory, student and staff offices, including a visiting specialist’s office, and a library/reading room.

A complete Syncroscopy Automontage photomicroscopy system was recently purchased and comes complete with Z16 MacroScope, dedicated computer, Automontage Explorer software, and large format printer. Six research grade microscopes are available for the project, including an Olympus B-Max brightfield/phase/DIC compound microscope with drawing attachment and phototube, and one Olympus SZH-10 stereomicroscope with drawing attachment and phototube. Scanning electron microscopes and molecular sequencing and analyzing equipment are available in shared labs nearby.

The project will benefit from an existing major initiative by our lab group to survey all beetles in Great Smoky Mountains National Park as part of the All Taxa Biodiversity Inventory being conducted there. Many of the procedures, products, and databasing standards proposed here were developed and improved as a result of our involvement with that project.

**Budget.**

<table>
<thead>
<tr>
<th></th>
<th>Requested from sponsor.</th>
<th>Matching funds.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yr 1</td>
<td>Yr. 2</td>
</tr>
<tr>
<td>Salaries/benefit</td>
<td>$9000&lt;sup&gt;1&lt;/sup&gt;</td>
<td>9000</td>
</tr>
<tr>
<td>Operating Expenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td>$5000</td>
<td>3000</td>
</tr>
<tr>
<td>Supplies</td>
<td>$4000</td>
<td>2000</td>
</tr>
<tr>
<td>Publications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect Costs (10% of direct)</td>
<td>$1800</td>
<td>1600</td>
</tr>
<tr>
<td>Annual totals</td>
<td>$19,800</td>
<td>17,600</td>
</tr>
<tr>
<td>Grand total</td>
<td>$37,400</td>
<td>39,008</td>
</tr>
<tr>
<td>Total project cost</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> 50% of graduate half-time assistantship to support 25% graduate student commitment to project

<sup>2</sup> 15% during year 1, 12% during year 2 of P.I.’s salary and fringe (fringe is 30% of salary) commitment to project.

<sup>3</sup> 37% of direct cost; difference between AgCenter’s normal rate (47%) and sponsor’s allowed rate (10%) as in-kind contribution for staff time (e.g., curatorial work and databasing), use of facilities and equipment, and administrative costs.
Qualifications and Experience of Personnel

Christopher E. Carlton, Principal Investigator

Education:
Hendrix College (Conway, Arkansas), B.S. in Biology, June 1977
University of Arkansas (Fayetteville, Arkansas), M.S. in Entomology, May 1980
University of Arkansas (Fayetteville, Arkansas), Ph.D. in Entomology, May 1989

Appointments and Professional Experience:
Professor (2005-present), Associate Professor (2000-2005), Assistant Professor (1995-2000), Department of Entomology, Louisiana State University and AgCenter (Baton Rouge, Louisiana)
Editor, Coleopterists Bulletin (1999-2005)
Director, Louisiana State Arthropod Museum (1995-present) (LSAM) (Baton Rouge, Louisiana).
Research Associate (1989-1995), Department of Entomology, University of Arkansas (Fayetteville, Arkansas)
Research Assistant (1982-1989), Department of Entomology, University of Arkansas

Publications Relevant to the Proposed Research:

Additional Personnel:
Victoria Bayless, the full time Curator of the Louisiana State Arthropod Museum will be responsible for data management and specimen archiving. Two Ph.D graduate students, Matt Gimmel and Mike Ferro, will participate in fieldwork, taxonomic research and publication writing. Postdoctoral Associate Igor Sokolov took the lead role in describing three recently published species of ground beetles from Arkansas and two from nearby eastern Oklahoma. He will participate in fieldwork and continue his research on the ground beetle fauna of Arkansas. The P.I. has a long-term collaborative relationship with Dr. H. W. Robison, of Southern Arkansas University, and he has agreed to assist with logistics and fieldwork in Arkansas.