SURVEY OF BUILDINGS USED AS SUMMER ROOSTS BY BATS IN ARKANSAS

PROJECT SUMMARY:

At least seven of the bat species found in Arkansas will roost in buildings during the summer months. These include the little brown bat (*Myotis lucifugus*; MYLU), big brown bat (*Eptesicus fuscus*; EPFU), and Brazilian free-tailed bat (*Tadarida brasiliensis*; TABR). Arkansas Game and Fish Commission (AGFC) has an interest in obtaining baseline population data on these currently common species because of the threat they face from White-Nose Syndrome (WNS) and the potential listing by the State of at least one, MYLU, as a species of greatest conservation need (SGCN). These data will be more easily collected by surveying buildings than by searching on the landscape. The goals of our project are to assess the use and selection of buildings in Arkansas as summer roosts by MYLU, EPFU, and TABR and to collect baseline population data (i.e., relative abundance estimates) for these species that can be used for population monitoring. From January 2016−August 2017, we will work intensively to identify buildings potentially used by bats for summer roosting. We will extensively survey identified buildings for bats from May−August 2016 and 2017 using a combination of techniques that includes visual searches, acoustic monitoring, emergence counts, and bat capture. In order to describe the microhabitat and landscape characteristics of buildings used as roosts by bats during summer and determine factors influencing selection, we will categorize all surveyed structures using a variety of variables (e.g., age, use, level of human activity, volume, construction, temperature, distance to habitat features). To determine the characteristics of buildings that best predict bat presence and relative abundance we will use an information theoretic approach and Akiake's Information Criterion. We will use a Fisher's exact or Chi-square test (depending on sample size) to examine selection of buildings for roosting by individual bat species and all species combined. We will produce a variety of project deliverables including annual and final reports; a spreadsheet containing baseline data; a workshop for AGFC employees and other interested parties on surveying buildings for; and an M.S. thesis, journal manuscripts, and conference presentations.

PROJECT LEADER:
Emma V. Willcox: Assistant Professor; Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37996; Phone 865-310-1165; Email: ewillcox@utk.edu

PROJECT PARTNER:
Riley Bernard: PhD Candidate; Department of Ecology and Evolutionary Biology, 569 Dabney Hall, University of Tennessee, Knoxville, TN 37996; Phone (865) 974-3969; Email: rbernar3@utk.edu

PROJECT PERIOD:
January 1, 2016 – May 31, 2018

PROJECT BUDGET:

	Year 1	**Year 2**	**Year 2**	**Total**
SWG Request	$73,212	$59,689	$14,798	$147,699
Match	$25,666	$21,283	$6,508	$53,457
Project Total	$98,878	$80,972	$21,306	$201,156

PROJECT STATEMENT

NEED:
At least seven of the bat species found in Arkansas will roost in buildings during the summer months. These include the little brown bat (*Myotis lucifugus*; MYLU), big brown bat (*Eptesicus fuscus*; EPFU), and Brazilian free-tailed bat (*Tadarida brasiliensis*; TABR). Arkansas Game and Fish Commission (AGFC) has an interest in obtaining baseline population data on these currently common species because of the threat they face from White-Nose Syndrome (WNS) and the potential listing by the State of at least one, MYLU, as a species of greatest conservation need (SGCN). These data, which will be more easily obtained by surveying buildings than by searching on the landscape, will allow AGFC to monitor bat populations for potential declines as a result of WNS and improve management and conservation efforts for three species they consider at risk from the disease.

PURPOSE AND OBJECTIVES:
The goals of our project are to assess the use and selection of buildings in Arkansas as summer roosts by MYLU, EPFU, and TABR and to collect baseline population data (i.e., relative abundance estimates) for these species that can be used in future population monitoring efforts. To realize our goals, our project objectives are to 1) identify buildings used as summer roosts by bats in Arkansas; 2) intensively survey identified buildings for bats; 3) when bats are found, determine species, relative abundance, sex of individuals, status of roost (e.g., maternity), and roost fidelity; 4) describe the microhabitat and landscape characteristics of buildings used as summer roosts by bats and determine factors influencing roost selection; 5) use the information gathered under 1) & 2) to provide baseline information for future bat population monitoring; 6) use information gathered under 2) & 3) to provide managers with a means of identifying and prioritizing buildings in Arkansas for future summer bat roost surveys.

LOCATION:
This study will be conducted throughout Arkansas, wherever buildings used as summer roosts by MYLU, EPFU, and TABR are located. Initial efforts to locate buildings will focus on areas in close proximity to winter hibernacula of MYLU and EPFU. However, ultimately, we will attempt to collect data across the state.

APPROACH:
Identification of Buildings Used by Bats
From January 2016−August 2017, we will work intensively to identify buildings potentially used by bats for summer roosting. To identify buildings, we will use a variety of approaches, including consultation with AGFC, other state and federal agency personnel, and wildlife control companies regarding previous locations of bats in buildings. Additionally, we will examine Arkansas Department of Health bat rabies records to determine locations where bats have been reported coming in contact with humans. We will also implement outreach activities designed to encourage the public to report bats in buildings by phone or the Internet.

Building Surveys
We will extensively survey identified buildings for bats from May−August 2016 and 2017. We will use a combination of techniques to determine if bats are present in identified buildings and

to establish species, sex, relative abundance, and roost status. These techniques are similar to those we are using for an ongoing study examining bat use of buildings in The Great Smoky Mountains National Park, Tennessee, and include:

- *Visual searches*- We will perform visual searches during the day with flashlights. All accessible areas of buildings will be examined thoroughly for bats or signs of bat presence, such as guano and staining. During visual searches, we will also use a handheld ultrasonic acoustic bat detector (Echometer EM3+, Wildlife Acoustics, Maynard, MA) to listen for bat "chatter" and determine bat presence. If bats are found and can be accessed, we will count the number of individuals present; record their location; identify to species; determine age, sex, and reproductive condition of individuals; and assess roost status. We will also tag individuals with an aluminum-lipped wing bands to permit future identification of roosting individuals and initial assessment of roost site fidelity.
- *Ultrasonic Acoustic Sampling*- We will use a stationary ultrasonic acoustic bat detector (Song Meter SM3Bat, Wildlife Acoustics) to record calls of bats at emergence for a minimum of one night. We will analyze recorded calls using automated call recognition software (Sonobat, Arcata, CA) to identify species and obtain an estimate of bat activity and relative abundance.
- *Emergence Counts*- We will conduct emergence counts in the evenings. If bats are observed, we will determine the location of exit points and count the number of individuals emerging to obtain an estimate of relative abundance.
- *Bat Capture-* We will use double/triple-high mist nets, raised harp traps, or elevated hand nets, as appropriate, to capture bats as they emerge from buildings. For captured individuals, we will identify to species; determine age, sex, and reproductive condition; assess roost status (e.g. maternity); and apply a wing band.

Description of Buildings
In order to describe the microhabitat and landscape characteristics of buildings used as roosts by bats during summer and determine factors influencing selection, we will categorize all surveyed structures by age, use, level of human activity, number of rooms, volume, construction, temperature, illumination, airiness, presence of predators, distance to habitat features (e.g., water, forest edge, road) and a variety of other characteristics.

Data Analysis
To determine the characteristics of buildings (e.g., type, size, human activity, temperature etc.), that best predict dependent variables (e.g., bat presence, relative abundance) we will use an information theoretic approach and Akiake's Information Criterion. We will use a Fisher's exact or Chi-square test (depending on sample size) to examine selection of buildings for roosting by individual bat species and all species combined.

Timeline
The duration of our project is 2.5 years, January 2016−May 2018. We will conduct fieldwork for 2 summers (May−August 2016 and 2017). In addition to surveying new buildings, this will give us the chance to resurvey buildings where bats are found during the first year of the project and allow us to begin assessing roost fidelity and changes in relative abundance.

2016 and 2017												
Task	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Recruit MS student and field technicians	▓	▓	▓	▓								
Identify buildings for survey	▓	▓	▓	▓	▓	▓	▓	▓				
Field work- conduct building surveys					▓	▓	▓	▓				
Data analysis									▓	▓		
Annual report preparation												▓
2018												
Deliverable production (see below)	▓	▓	▓	▓	▓							
Final report preparation					▓							

EXPECTED RESULTS AND BENEFITS:

This project will provide baseline data on summer populations of MYLU, EPFU, and TABR in buildings across Arkansas and allow AGFC to monitor for potential population declines as a result of WNS. This information will be needed by AGFC when devising bat management and conservation strategies and considering species for listing. In addition, the project will provide knowledge that will help AGFC prioritize buildings for future survey.

We will produce a variety of project deliverables including annual and final reports detailing project progress and outcomes; a data spreadsheet containing results of all visual searches, emergence counts, acoustic monitoring, and mist netting that will serve as a baseline for future data collection; a workshop for AGFC employees and other interested parties detailing methods for building survey and data collection; and an M.S. thesis, peer-reviewed journal manuscripts, and conference presentations related to the project.

BUDGET:

	Year 1	Year 2	Year 3	Total
SWG Request				
Salary and Wages- GRA and Field Technicians	$23,889	$23,889	$6,250	$54,028
Benefits- GRA and Field Technicians	$2,283	$2,283	$655	$5,221
Transportation- Vehicles and Gasoline	$7,920	$7,920	$0	$15,840
Rentals- Field Accommodations	$4,500	$4,500	$0	$9,000
Materials and Supplies	$14,605	$1,110	$0	$15,715
Other- GRA Tuition	$13,359	$14,561	$6,548	$34,468
Direct Total	**$66,556**	**$54,263**	**$13,453**	**$134,272**
F&A	**$6,656**	**$5,426**	**$1,345**	**$13,427**
Total Costs	**$73,212**	**$59,689**	**$14,798**	**$147,699**
UT Match Budget				
Salary and Wages- PI Emma Willcox (6.5%)	$5,443	$5,606	$2,406	$13,455
Benefits- PI Emma Willcox (39% of salary)	$2,123	$2,186	$938	$5,247
Direct Total	**$7,566**	**$7,792**	**$3,344**	**$18,702**
F&A on UT Direct Costs	**$3,329**	**$3,428**	**$1,471**	**$8,228**
F&A on Sponsor Budget (Unrecovered)	**$14,771**	**$10,063**	**$1,693**	**$26,527**
Total Costs	**$25,666**	**$21,283**	**$6,508**	**$53,457**

QUALIFICATIONS:
Emma Willcox (Project Leader)
E. Willcox is an Assistant Professor in the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee (UT), Knoxville. Her research interests are focused on improving understanding of the ecology and management of imperiled bat species. Many of her projects involve her working closely with state and federal agencies, including Tennessee Wildlife Resources Agency and the National Park Service to collect data applicable to bat management and conservation. She will be responsible for overall project administration and management. In addition, she will advise the project MS student, conduct data analyses, and ensure delivery of project deliverables. Her current related projects include:

- Management of anthropogenic structures used as summer roosts by WNS affected bats in Great Smoky Mountains National Park.
- Tricolored bat cave hibernacula and roost tree selection in Tennessee.
- Enhancing monitoring of imperiled bat species on DoD installations using aerial acoustic technology.
- Epidemiology of *Pseudogymnoascus destructans*: Changes in fungal load on active bats throughout winter in the Southeast,
- Understanding lower *Pseudogymnoascus destructans* loads and susceptibility to WNS in gray bats (*Myotis grisescens)*.
- Roost trees used by female Indiana bats in Tennessee during the transitional pre-maternity period.
- Bat response to prescribed fire and canopy reduction within hardwood forests of the Southeastern U.S.

Riley Bernard (Project Partner)
R. Bernard is a PhD candidate working under Dr. Gary McCracken in the Department of Ecology and Evolutionary Biology at UT. She has extensive experience working with and conducting research on bats. Her MS project examined potential competitive dietary overlap between the invasive coqui frog (*Eleutherodactylus coqui*) and the endemic Hawaiian hoary bat (*Lasiurus cinereus semotus*) on the Island of Hawaii Hilo. Through her PhD research she is examining the behavior of bats in association with WNS at southern latitudes. In addition, she is currently a collaborator or Co-PI on many of the projects listed above. R. Bernard will coordinate the field crew (MS student and field technicians) associated with this project and assist with project management, data analyses, and preparation of project deliverables.

MS Student and Field Technicians
The MS student will invest considerable time during the first and second year of this project consulting AGFC, other state agency, and wildlife control company personnel; reviewing Arkansas Department of health rabies records; and designing and distributing outreach materials to the public in order to identify buildings potentially used by bats for summer roosting. Along with the field technicains, the MS student will also be responisble for surveying all identified buildings for bats. Finally, the MS student will particiapte in the preparation of all project deliverables.