13th Annual Meeting of the

Tennessee Bat Working Group

Montgomery Bell State Park
Burns, Tennessee
November 17, 2016

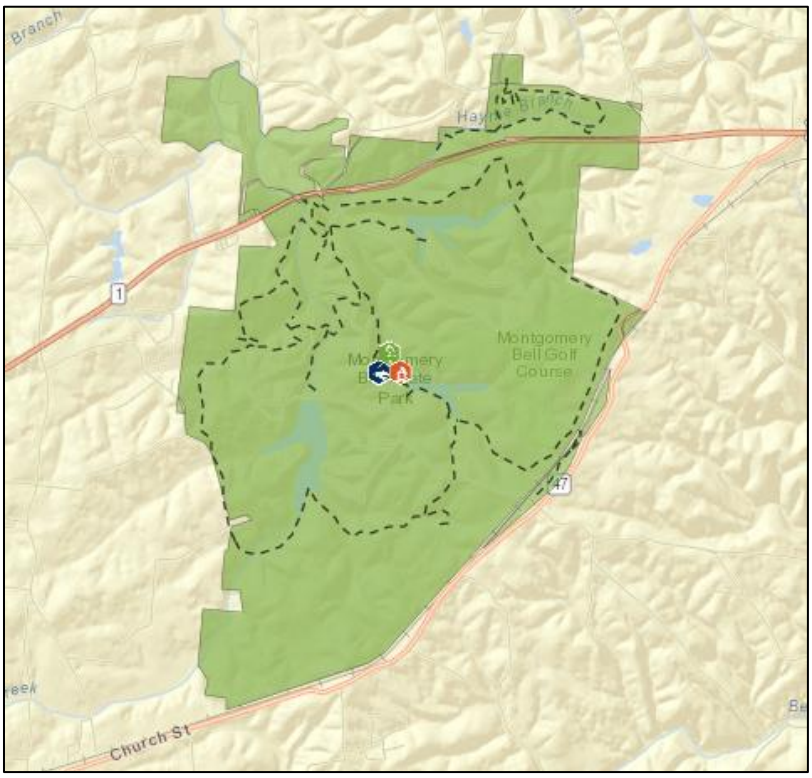
Montgomery Bell State Park

Located in Burns, Tennessee, Montgomery Bell State Park encompasses 3,782 acres of dissected wooded terrain representative of the Nashville Basin. The state park is located in an area that was once the center of the iron industry of middle Tennessee. There were numerous iron furnaces located within this region during this time, and Laurel Furnace was the main furnace located within what is now Montgomery Bell State Park. Much of the iron produced by the Laurel Furnace was shipped to Turnbull Forge in Cheatham County where it was worked into higher quality iron. The namesake of the park was Montgomery Bell, a manufacturing entrepreneur who was known as the "Iron Master of the Harpeth" or "Iron Master of Middle Tennessee."

The Cumberland Presbyterian Church was founded in 1810 in the log cabin home of Reverend Samuel McAdow within what is now Montgomery Bell State Park. A replica of both the church and log cabin are located within the park.

Montgomery Bell State Park is open for year-round recreation. The main recreational opportunities within the park are hiking, biking, golf and fishing. There are 19 miles of trails throughout the park, a par 72, 18 hole golf course and three lakes opened to fishing.

For more information regarding Montgomery Bell State Park, please visit: http://tnstateparks.com/parks/about/montgomery-bell.



Agenda

Conference Room B	
9:00	Welcome/Opening Remarks
	Montgomery Bell State Park Staff
9:10	Business Meeting
Conference Room B	
Session I - Disease	*Moderator* - Cory Holliday
9:50	**Annual White-nose syndrome statewide update** Josh Campbell
10:05	**White-Nose Syndrome Extirpated One-Quarter of the Bat Species in Great Smoky Mountains National Park** Dr. Joy O'Keefe
10:20	**Bat Capture Trends at Arnold Air Force Base, TN** John Lamb
10:20 - 11:00	**Poster Session I** **Break:** *Refreshments provided by the Tennessee Valley Authority*
Session II - Disease	*Moderator* - Steve Samoray
11:00	**Transmission risks of *Pseudogymnoascus destructans* by bats and human activity during summer** Dr. Anne Ballmann
11:20	**Understanding the Vulnerability of Tricolored Bats to White-Nose Syndrome in the South: Torpor Patterns and Hibernacula Conditions** Pallavi Sirajuddin
11:40	**North American Bats as Reservoir Hosts of Human Bacterial Pathogen, *Bartonella mayotimonensis*** Dr. Emma Willcox
12:00 - 1:00	**Lunch**
Conference Room B	
Session III - Genetics, Management and Policy	*Moderator* - Chris Simpson
1:00	**Range-wide population genetic structure of Rafinesque's Big-eared Bat, *Corynorhinus rafinesquii*, and Southeastern Myotis, *Myotis austroriparius*.** Jessi West
1:20	**Utilizing spatial analysis for quantifying impacts, protecting bat habitat, and implementing a State Wildlife Action Plan** Pete Pattavina
1:40	**Timing and Emergence of Bats on the Landscape: Using Acoustics to Inform Land Management Decisions** Dr. Riley Bernard
2:00	**Using False-Positive Occupancy Models to Estimate Probability of Presence for *Myotis septentrionalis*** Vanessa Rojas
2:20 - 3:00	**Poster Session II** **Break:** *Refreshments provided by the Tennessee Wildlife Resources Agency*

Session IV - Management and Energy Development *Moderator* - Liz Hamrick	
3:00	**Influence of Prescribed Fire on Endangered Bats in the Southern Appalachians** Kaitlyn Rountree
3:20	**Roost Selection by Synanthropic Bats in Buildings of Great Smoky Mountains National Park** Kirstin E. Fagan
3:40	**Status and Roost Selection of Male Tri-colored Bats in the Great Smoky Mountains National Park** Grace M. Carpenter
4:00	**Foraging ecology of the tri-colored bat, *Perimyotis subflavus* , in middle Tennessee** Dustin Thames
4:20	**Mexican free-tailed bat activity in an area of high wind energy development pressure** Jessica Dreyer
4:40	**Closing Remarks**

Business Meeting Items

1. Elections:
    a. Nominations:
        i. Call for additional nominations
        ii. Chair:
            1. Josh Campbell
            2. Dr. Brian Carver

        iii. Board Member A, Board Member B, Board Member E (if necessary):
            1. Daniel Istvanko
            2. Jessi West
            3. Theresa Wetzel
            4. Dustin Thames

2. Updates (Business from 2015 Meeting):
    a. Citizen Scientist Program
    b. Education Boxes
    c. Google Analytics
    d. Silent Auction

3. New Business:
    a. Best Student Presentation Award
    b. TNBWG Supporting the listing review for *Perimyotis subflavus*
    c. Changing how TNBWG conducts its business

Proposed Position Statement Regarding a Status Review of the Tricolored Bat (*Perimyotis subflavus*) as Threatened or Endangered

As stated in its charter, the Tennessee Bat Working Group's (TNBWG) goal is to conserve bats and their habitats in the southeastern United States through collaborative research, education, and management. Two of the several objectives that support this goal are:

- Develop technical reviews, position statements, and other materials regarding bats and their habitats in Tennessee.
- Make recommendations to government agencies and private organizations for specific actions regarding bats and their habitats.

Originally formed in 2004, the TNBWG has grown to include 177 members. In the 12 years since formation, the membership has only issued one position statement. That position was to support the United States Fish and Wildlife Service (USFWS) efforts to down list the gray bat (*Myotis grisescens*) from Endangered to Threatened. However, with the continued spread and devastation of white-nose syndrome (WNS), the membership feels strongly that the time has come to issue another. Unfortunately, this position statement stands in stark contrast to the last.

Based on the best available scientific data, the Tennessee Bat Working Group is issuing this position statement to urge the USFWS to commence a status review to evaluate the listing of the tricolored bat (*Perimyotis subflavus*) as Threatened or Endangered. Available data in Tennessee supporting this position include cave surveys and both summer and winter mist netting surveys, thereby covering the two major annual life history periods for this species. Cave surveys indicate tricolored bats have declined between 90-98% since monitoring began in 2009 (Campbell 2016). There are three summer mist netting data sets available in Tennessee that cover the post-WNS time period and were conducted at the same locations every year. The first two are in the Great Smoky Mountains National Park where an estimated 78 - 87% decline in capture rates has been documented since 2009 (Carpenter et. al. pers. comm., O'Keefe pers. comm. respectively). The third data set is from Arnold Air Force Base. At this site capture rates were stable for the ten years prior to WNS, however, an 83% decline has occurred since 2010 (Lamb pers. comm.) with a statistically significant downward trend in capture rates ($p = 0.008$). Finally, Bernard (pers. comm.) noted a 63% decline in the capture rates of tricolored bats over the course of two winter seasons (2012 – 2013 and 2013 – 2014) when netting outside cave hibernacula.

This position statement represents the majority of the voting membership in attendance at the 2016 annual meeting of the TNBWG and, therefore, the official position of the TNBWG. It does not represent the organizations for which members individually work either directly or under contract.

Abstracts
Presentations

Annual White-nose syndrome statewide update

Josh Campbell
Tennessee Wildlife Resources Agency, Nashville, TN, USA

White-nose syndrome (WNS) was first discovered in Tennessee in 2010 in upper east Tennessee. Biologists and researchers have performed over 470 cave surveys over the last 6 years to assess the progression of WNS across the state and its impacts to wintering bats in the state. Since this discovery, the fungal causal pathogen, *Pseudogymnoascus destructans* has been detected in 52 of the 78 counties containing caves. WNS is now considered widespread in the state. Results from the 2016 winter field season and impacts of WNS being observed by researchers will be presented.

White-Nose Syndrome Extirpated One-Quarter of the Bat Species in Great Smoky Mountains National Park

Joy M. O'Keefe[1], Joseph L. Pettit[2] and Susan C. Loeb[3]
[1] Center for Bat Research, Outreach, and Conservation, Indiana State University, Terre Haute, USA; [2] College of Natural Resources, Utah State University, Logan, USA; [3] USDA Forest Service, Southern Research Station, Clemson University, Clemson, USA

White-nose syndrome (WNS) is an emerging infectious disease that has killed over 6 million bats in North America since its discovery in New York in 2006. Population declines have been described for winter hibernacula, but there is less information on changes in bat communities during the active season (April–September). We aimed to measure the impacts of WNS in Great Smoky Mountains National Park (GRSM), an ecologically rich protected area that hosts 12 bat species, by comparing bat abundance pre-WNS and 2–4 years after WNS was first confirmed in GRSM hibernacula. We compared captures per unit effort (net area*hr) for surveys at long-term summer monitoring sites in 2009–2012 (10–15 nights/year) and 2014–2016 (21–40 nights/year). By 2016, we could no longer capture *Myotis septentrionalis* and *M. lucifugus*, once two of the most commonly captured species in GRSM. We also detected substantial declines for *M. sodalis* (-97%), *Perimyotis subflavus* (-87%), and *Corynorhinus rafinesquii* (-52%). Interestingly, we captured *Eptesicus fuscus* and *M. leibii* at higher rates in 2016 than pre-WNS. This epidemic disease has essentially extirpated 4 (25%) of the bat species in this biologically important natural area. With such a large proportion of species declining, we expect a significant change in insect populations and, subsequently, forest health in GRSM and surrounding areas. In areas presumed to be WNS-free, we recommend gathering baseline data on bat abundance via mist netting surveys or acoustic monitoring to facilitate future assessments of the impacts of this devastating disease on bat populations.

Bat Capture Trends at Arnold Air Force Base, TN

John W. Lamb
Arnold AFB, Manchester, TN, USA

Arnold AFB is located in Coffee and Franklin counties in Middle Tennessee. The Base occupies 39,081 acres including the 3,632-acre Woods Reservoir. Nine species of bats have been captured including Indiana bat (*Myotis sodalis*), gray bat (*M. grisescens*), and Northern long-eared bat (*Myotis septentrionalis*). Bat work at the Base has been ongoing since 1998 and has included harp trapping at caves, mist netting at a bridge, standard mist netting, acoustic monitoring, and telemetry. Results from standard mist netting protocols were examined as number of captures per night for the period before WNS was documented in Tennessee (1998 – 2008) and years following confirmation of WNS (2010 – 2016). Data includes in-house efforts combined with that from a contracted studies and, in 2016, two nights of netting on-Base done by Tennessee Wildlife Resources Agency personnel. Simple linear regression was used to detect any trends in species for which sufficient individuals have been captured. Trends were considered significant at $p = 0.05$. Significant negative trends were identified for the post WNS period in Northern long-eared and tricolored bats. However, significant positive trends were documented for red bats prior to WNS which leveled post WNS, but has not declined. The same trend was also true for evening bats. No significant trends were observed for gray bats in either pre or post WNS years when examined separately. However, when examined as one period (1998 – 2016) there was a significant upward trend. It is hoped that this relatively long term data set can be used to supplement information from winter cave surveys initiated with the arrival of white nose syndrome in North America.

Transmission risks of *Pseudogymnoascus destructans* by bats and human activity during summer

Anne Ballmann, Miranda Torkelson, Elizabeth Bohuski, Robin Russell, and David Blehert
USGS-National Wildlife Health Center, Madison, WI, USA

Pseudogymnoascus destructans (Pd), the causative agent of white-nose syndrome (WNS), persists in contaminated hibernacula and presents a previously unknown risk for bats occupying contaminated sites during the summer. Viable fungal spores picked up from the environment could be carried on the surface of the bat and serve as a source of transmission to other bats as they disperse from these contaminated sites and come into contact with naïve bats from other locations during fall swarm interactions or trapping activities. This study, conducted at eight hibernacula within the Ohio Valley region during Summer 2012, investigated: 1) the potential for late summer bat occupants of contaminated hibernacula to harbor viable Pd; 2) differences in environmental levels of Pd contamination among sites with reduced winter bat populations compared to sites with stable winter bat population sizes; and 3) the proportion of bats harboring Pd among sites suspected to have higher levels of environmental contamination. Findings demonstrated important surveillance considerations for identifying Pd exposure during summer months, provided valuable ecological insights regarding summer bat use of known winter hibernacula, and improved our knowledge of the timing of Pd infection among bats. Furthermore, evidence of potential anthropogenic pathogen transmission through trapping and

caving activities was demonstrated even during summer months when disease prevalence is historically low.

Understanding the Vulnerability of Tricolored Bats to White-Nose Syndrome in the South: Torpor Patterns and Hibernacula Conditions

Pallavi Sirajuddin[1], Susan C. Loeb[2], Eric R. Britzke[3], and David S. Jachowski[1]
[1] Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA; [2] USDA Forest Service, Southern Research Station, Clemson, USA; [3] US Army Engineer Research and Development Center, Vicksburg, MS, USA

Recent data from the southeastern U.S. suggest tricolored bat (*Perimyotis subflavus*) populations have experienced > 80% declines due to white-nose syndrome (WNS) despite milder and shorter winters in the south. Most behavioral and physiological studies on responses of bats to WNS have been on northern populations of little brown bats (*Myotis lucifugus*) and as a result, data are lacking on responses of *P. subflavus*, the most common bat in southern hibernacula. We initiated a study to determine the torpor patterns of *P. subflavus* in a WNS positive site in northwestern South Carolina in January 2016. We used temperature sensitive radio transmitters and Lotek data loggers to record *P. subflavus* skin temperature (Tsk), and HOBO data loggers and iButtons to record hibernacula temperature and relative humidity. We collected data on seven *P. subflavus* (five males, two females). Minimum torpor Tsk was 4.20C and average torpor Tsk was 15.60C. The longest torpor bout was 10 days and the shortest was 2 days. Torpor duration tended to decrease as hibernaculum temperature increased. Mean arousal frequency was 4.2 times during the tracking period (mean tracking period = 17.1+ 3.9 days) and arousal length ranged from 31 minutes to 170 minutes. Our preliminary results suggest that *P. subflavus* Tsk during torpor is within the optimal temperature range for *Pseudogymnoascus destructans* growth. There was no evidence that bats left the hibernaculum to forage during warm nights. We will continue to collect data on bats in Stumphouse Tunnel as well as from WNS negative sites in Mississippi and Florida in 2016-17, which will allow us to evaluate the effect of WNS on *P. subflavus* torpor patterns.

North American Bats as Reservoir Hosts of Human Bacterial Pathogen, *Bartonella mayotimonensis*

Emma V. Willcox[1], Riley F. Bernard[1], Cali A. Wilson[2], Thomas M. Lilley[2], Kenneth A. Field[2], DeeAnn M. Reeder[2], Allen Kurta[3], and Arto T. Pulliainen[4]
[1]Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN, USA; [2]Biology Department, Bucknell University, Lewisburg, PA, USA; [3]Department of Biology, Eastern Michigan University, Ypsilanti, MI, USA; [4]Institute of Biomedicine, University of Turku, Turku, FIN

Candidatus *Bartonella mayotimonensis* was detected in 2010 from an aortic valve sample of an endocarditis patient from Iowa, USA. Environmental source of the novel endocarditis-causing Bartonella remained elusive. We set out to study the prevalence and diversity of bat-associated Bartonella in North America. During 2015, mist nets and harp traps were used to capture 92 bats belonging to two species little brown myotis (*M. lucifugus* Le Conte 1831, n = 73) and the gray myotis (*M. grisescens* A.H. Howell 1909, n = 19) in Kentucky, Michigan, Pennsylvania, and

Tennessee. DNA preparations of bat peripheral blood samples were subjected to a 3-marker (gltA, rpoB and ISR) multilocus sequence analysis. Sequence-verified gltA-positive PCR amplicons were obtained from 9 samples. Three sequences were 99.7 % – 100 % identical with the gltA sequence of the Iowa endocarditis patient strain. Analysis of rpoB and ISR sequences demonstrated that one little brown myotis sample from Upper Peninsula of Michigan contained Bartonella DNA with 100 % sequence identity with the Iowa endocarditis patient strain DNA. It appears possible that the Iowa endocarditis patient got infected via contact with bats. Bats should be considered in the etiology of endocarditis.

Range-wide population genetic structure of Rafinesque's Big-eared Bat, *Corynorhinus rafinesquii*, and Southeastern Myotis, *Myotis austroriparius*.

Jessi West
Tennessee Technological University, Cookeville, TN, USA

Population genetic structure can provide pertinent and essential information for the conservation and management of rare species. *Corynorhinus rafinesquii*, or Rafinesque's Big-eared Bat, and *Myotis austroriparius*, or Southeastern Myotis, are two rare bat species with overlapping ranges across much of the southeastern United States. Both species can be found in bottomland hardwood forests, but the decline of these forested habitats has had a negative impact on their persistence. At the state level, both species are regarded as threatened, endangered, or of greatest conservation need across nearly all of their range. As urbanization, fragmentation, and habitat loss continue, it is of the utmost importance to understand the population genetic structure of these two species in order to properly manage and conserve their populations. Tissue samples will be collected from bats in various states across the southeastern United States from the Gulf Coastal Plain, the Mississippi Alluvial Plain, the Atlantic Coastal Plain, and the Appalachian Plateau. The tissue will be used to extract DNA for analysis through genotyping-by-sequencing (GBS). Very few questions have been answered on the population genetic characteristics and gene flow in *C. rafinesquii* and *M. austroriparius*, yet this information is crucial for proper management and protection of these species of concern. The overall objective of this study will be to understand the population genetic structure of *C. rafinesquii* and *M. austroriparius* to determine population connectivity and determine if there is sufficient gene flow to maintain a high level of genetic diversity among populations. It may be beneficial to create wildlife corridors to reconnect these populations for proper mixing of the gene pool and for maintaining genetic diversity, while lessening the impacts of genetic drift and the risk of a population bottleneck. Each state will be able to use the gathered information to infer management protocols and conservation actions specific to their state.

Utilizing spatial analysis for quantifying impacts, protecting bat habitat, and implementing a State Wildlife Action Plan

Pete Pattavina
Southeast White-nose Syndrome Coordinator
U.S. Fish and Wildlife Service, Athens, GA, USA

Understanding where myotis bats may occur and how habitat usage is partitioned across landscape presents difficulties to land managers, conservationists, and Endangered Species Act practitioners because of seeming wide environmental disparities that exist over species' ranges and other factors that may confound analyses, such as: (1) poorly understood behavioral traits; (2) unknown hibernacula; (3) absence of summer capture records or roost information; (4) unknown behavioral and social factors; and (5) data sets largely composed of non-random, unstratified survey points. Spatial analyses and modeling may offer valuable insight not only for future data needs but also may provide habitat classification screening that can assist both forecasting landscape-level changes to habitat, prioritization of survey efforts, and the development of land conservation strategies. Case studies presented from Georgia will focus on where in-lieu fee mitigation programs are utilizing spatial analysis for quantifying impacts, protecting bat habitat, and implementing the State Wildlife Action Plan.

Timing and Emergence of Bats on the Landscape: Using Acoustics to Inform Land Management Decisions

Dr. Riley F. Bernard[1,2,] Emma V. Willcox[1], John M. Zobel[1] and William H. Stiver[2]
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Regional United States Fish and Wildlife Service (USFWS) offices and state resource agencies have put forth restrictions on when many land management activities, such as hazard tree removal and prescribed fire, are allowed to occur. In the Southeast, spring restrictions range from April 1st (Tennessee), April 15th (Kentucky and North Carolina) to May 1st (Alabama and Georgia). Although these dates have been set to protect bats while they prepare for spring migration, we have found no evidence to suggest these dates are based on data and limit the amount of habitat management that can be conducted prior to the May 15th – August 15th maternity season for Threatened and Endangered bat species. Recent studies have shown that regular prescribed fires have many long-term benefits for bats and other wildlife. We examined acoustic data collected year round at six cave hibernacula and seven landscape sites to try and identify a range of dates for when bats are most likely to be emerging from and returning to cave hibernacula. Data were collected continuously from January 2011 to May 2016 in middle and eastern Tennessee, USA. We recorded over 43,000 hours of bat activity, which equated to 1,071,000 bat calls. Bats were most active at caves during spring emergence (March through May) and fall swarming (October). The peak in activity at our study sites occurred at the beginning of May, suggesting the current restrictions imposed by USFWS may be overly conservative, leading to a decrease in habitat management activities.

Using False-Positive Occupancy Models to Estimate Probability of Presence for *Myotis septentrionalis*

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Although *M. septentrionalis* once comprised the bulk of mist-net captures in North Cherokee National Forest (CNF), populations are now in steep decline due to white-nose syndrome. Traditionally, mist-netting surveys were used to assess presence/probable absence, but mist-net surveys may not adequately represent dispersed, low-density bat populations. Acoustic surveys aid in detecting rare bats, but we risk false-positives. From May to August 2013–2015, we surveyed 34 road corridor sites on the North CNF for *M. septentrionalis*, using both mist-net and acoustic (Anabat SD2s; analyzed using Bat Call ID v2.7c) methods. *Myotis septentrionalis* were captured at 12 sites and represented <5% of acoustic files each year. We aimed to identify environmental and geographic factors that predict probability of occupancy for *M. septentrionalis*. To account for both non-detections and misidentifications, we compared 16 multi-season false-positive occupancy models (Presence v11.5) with 1–4 variables each. We chose sites with similar structure and vegetation and, thus, assumed sites had similar detection probabilities; hence, we included only weather-related detection factors in our models. Our results indicated that sites with higher forest density at lower elevations and further from karst had a greater probability of presence for *M. septentrionalis*. False-positive model results provided more rigorous site-specific occupancy estimates ranging from 0.01–1.00 per site, whereas estimates were 0.45–1.00 with standard occupancy models. False-positive models provided the most plausible explanation for our data. With decreasing populations and capture likelihoods, false-positive models may lead to more reliable distribution models and management plans.

Influence of Prescribed Fire on Endangered Bats in the Southern Appalachians

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[1] Department of Biology, University of West Georgia, Carrollton, USA; [2] Department of Biological Sciences, Ohio University, Athens, USA; [3] Shoal Creek Ranger District, Talladega National Forest, U.S. Forest Service, Heflin, USA

Longleaf pines (*Pinus palustris*) ecosystems of the southeastern U.S. require low-intensity fire to maintain their open-canopy forest structure. Efforts to restore this once widespread ecosystem are being implemented by use of prescribed fire and forest thinning. These restoration efforts may, however, have negative impacts on the threatened northern myotis (*Myotis septentrionalis*) and the endangered Indiana myotis (*Myotis sodalis*), which are declining due to white-nose syndrome. Our objective is to examine roost site selection and foraging patterns of northern myotis and Indiana myotis across prescribed fire regimes. The study area is located in the Shoal Creek Ranger District of the Talladega National Forest in northeastern Alabama. We mist netted for and radio tagged northern myotis and Indiana myotis during the summer of 2016. We tracked each tagged individual daily to find day roosts, and we obtained foraging points nightly. We

obtained roost characteristics for each day roost found. Our preliminary results suggest that northern myotis and Indiana myotis had a higher proportional home range use in high fire frequency areas. Indiana myotis used pine snags with high DBH for roosts, whereas northern myotis used a variety of living and dead pine and hardwood trees with a lower DBH for roosting. These early results suggest that extensive prescribed fire management associated with longleaf pine ecosystem restoration is compatible with the habitat needs of the northern myotis and Indiana myotis. This research will be continued in the summer of 2017 to obtain more data on roost selection and foraging behavior of Indiana myotis and northern myotis on the Shoal Creek Ranger District.

Roost Selection by Synanthropic Bats in Buildings of Great Smoky Mountains National Park

Kirstin E. Fagan[1], Emma V. Willcox[1], Riley F. Bernard[1, 2,] and William H. Stiver[2]
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Bats are regularly reported roosting in buildings during summer at Great Smoky Mountains National Park (GRSM), resulting in concerns for public health, historic building preservation, and bat conservation. GRSM managers want to make decisions regarding timing and duration of building maintenance and visitor access that minimize impacts on bats, but lack information on synanthropic species in the region. We assessed bat presence, based on observation of bats or guano, and site attributes at 143 buildings in GRSM during summer 2015, and compared the characteristics of buildings used and unused by bats with a series of G-tests. Roosts were found more frequently in buildings older, wooden buildings with interior and exterior structural complexity, access points to the interior, as well as an attic, porch, and chimney, all $p<0.01$, suggesting that these features may be important roosts selection criterion. Microclimate, spatial, and bat presence data from summer 2016 will be incorporated in a multi-level model to examine interacting factors that affect roost selection by synanthropic species in GRSM.

Status and Roost Selection of Male Tri-colored Bats in the Great Smoky Mountains National Park

Grace M. Carpenter[1], Emma V. Willcox[1], Riley F. Bernard[1] and William H. Stiver[2]
[1] Department of Forestry Wildlife and Fisheries, University of Tennessee, Knoxville, USA; [2] National Parks Service, Great Smoky Mountains National Park, Gatlinburg, USA

The tricolored bat was once common across the eastern U.S. However, populations have been severely impacted by white-nose syndrome (WNS) and the species has been petitioned for federal listing. During the summers of 2015 and 2016, we determined the status of tri-colored bats in Great Smoky Mountains National Park (GRSM), and examined summer roost tree use and selection by the species to better inform management strategies and aid in species recovery. We captured bats at 24 locations across GRSM over 68 net-nights. We compared our data with results from a study conducted at the same sites during the summers of 2000-2004, prior to the WNS outbreak. Pre-WNS, 10 bat species were captured, while, post WNS, we captured 12 bat species. From 2004 to 2016 total bat captures declined by 65%. Over the same time period,

capture rates of tri-colored bats declined by 78%, suggesting populations of the species have declined dramatically since the arrival of the disease. To investigate roost site selection, we used radio telemetry to locate day roosts used by individual bats. To date, we have tracked 15 male bats (no females have been captured) to 35 roost trees. Of the roost trees used, 42.9% were oaks (Quercus spp.), 28.6% were maples (Acer spp.), and 28.6% were other hardwood species. We are in the process of conducting analyses to characterize roost tree selection.

Foraging ecology of the tri-colored bat, *Perimyotis subflavus*, in middle Tennessee

Dustin Thames[1,2], Josh Campbell[1], Emma Willcox[2]
[1] Tennessee Wildlife Resources Agency, Nashville, USA; [2] Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA

Tri-colored bats are declining in Tennessee and throughout the temperate portions of their range, primarily, but not exclusively, from the impacts of white-nose syndrome. With regulatory decisions imminent, research is needed on the foraging ecology of the species to better inform regulatory decision making and to help land managers access the impacts of habitat management on the species. During the summer of 2016, we captured and radio tagged 1 female and 2 male tri-colored bats. With the use of telemetry equipment, foraging locations were biangulated and land cover compositional analysis was conducted at two spatial scales. First, the proportion of land cover types in a 95% minimum convex polygon (MCP) foraging range for each bat was compared with the proportions of land cover in a 24.4 km buffer around the center of each bats roost trees. Next, the proportion of foraging locations in each land cover category was compared with the proportion of land cover types in the MCP foraging range. Preliminary analysis at both spatial scales suggests tri-colored bats prefer to forage over open water. The two male tri-colored bats flew a longer maximum distance (mean 17.95 km, range: 11.5- 24.4 km) from their roost trees to forage over open water than the female (3.2 km). Next summer, we will work to increase our sample size and use additional methodologies to estimate tri-colored bat foraging ranges.

Mexican free-tailed bat activity in an area of high wind energy development pressure

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[1] Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN, USA;

Central Texas, known as the Hill Country, is a high-interest region for the development of wind energy. This region is also home to one of the largest concentrations of Mexican free-tailed bats (*Tadarida brasiliensis*). Recent evidence has revealed the negative impacts of wind turbines on aerial species, but the importance of bat populations and habitat is not typically incorporated into siting evaluations. Quantifying bat activity at potential development sites as well as in the landscape around major maternity roosts is critical for encouraging responsible siting decisions. We monitored bat activity over 4 weeks using ultrasound detectors along a transect from Eckert James River Bat Cave to a proposed wind energy development site in Mason County, Texas. These data are one critical piece of evidence within a strong multifaceted case against wind energy development in this area. This case study provides a positive example of responsible

siting decisions and the power and efficacy of conservation organizations partnering with citizen groups to achieve a common conservation goal.

POSTERS

Spatial and Temporal Variation in Bat Activity in Great Smoky Mountains National Park

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White-nose syndrome (WNS) is an emerging disease which has caused unprecedented mortalities in several bat species in Great Smoky Mountains National Park. Acoustic surveys allow for the examination of points inaccessible for mist-netting surveys, thus allowing for a more complete view of bat communities in a WNS-affected landscape. We conducted a large-scale acoustic survey with Pettersson D500X detectors from May to late August 2016 to assess spatial and temporal variation in bat activity rates. We surveyed 42 points, stratified by 4 major vegetative groups (early successional-ES, conifer & mixed hardwoods-CM, northern hardwoods-NH, and spruce-fir forests-SF) and proximity to water—near (≤ 50 m away) or far (≥ 200 m)—for a total of 204 detector-nights. Preliminary data, analyzed using Bat Call ID v2.7c, indicated bat activity was highest at ES sites, followed by CM, NH, and SF. Overall bat activity was 15 times higher at points near streams in CM sites vs. sites far from streams. In contrast, at high-elevation NH and SF sites, activity was 2−4 times greater at points far from streams. Overall activity was highest for bats in the Low phonic group, followed by the Myotis group, and then the Mid phonic group. Myotis activity was highest at NH sites, with >38 calls/deployment at 4 sites. Overall activity peaked in July, with similar activity levels in August and June, and very little activity in May. Incorporating the results of large-scale acoustic surveys with those of mist-net surveys allow for a more comprehensive assessment of bat activity that better informs management decisions for bats of conservation concern.

Database for Identifying Guano to Bat Species in the Southeastern United States

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As white-nose syndrome (WNS) spreads throughout North America, altering the species composition of bat communities, wildlife managers increasingly need to identify the species of bats present in an area. Guano is often the only indication to the presence of bats. During the first year of a multi-year survey in the Great Smoky Mountains National Park in Tennessee and North Carolina, where the bat fauna has changed dramatically since WNS was confirmed in the park in 2010, we created a sequence database for 16 bat species found throughout the southeastern United States. We first extracted and sequenced DNA from tissue of opportunistically collected bats. From those samples, we were able to distinguish all 16 species using a single set of primers that were previously published to create a similar database for bats

in the Northwest. We then confirmed that the primers work on fecal samples using guano collected from known species of bats. This database has broader use outside this project and outside the southeastern US as more land managers need to identify bat species based solely on the guano.

Utilizing BrandenBark™ as a Mitigation/Habitat Enhancement Tool in Tennessee and Alabama

Copperhead Environmental Consulting, Tennessee Valley Authority, The Nature Conservancy, and Tennessee Wildlife Resources Agency

With white-nose syndrome decimating bat populations in hibernacula, the preservation and enhancement of summer habitat has become increasingly important to the survival of many of the bat species in the United States. One way method to combat the loss of summer roosting habitat is by installing artificial bat roosts. However many of the early artificial roost designs have had limited success in attracting Indiana bat maternity colonies. Copperhead Environmental Consulting developed BrandenBarkTM specifically for Indiana bats. To date, 30 structures have been installed in Tennessee and Alabama. Twenty-five by the Tennessee Valley Authority (TVA) in Benton and Union Counties TN and Limestone and Marshall Counties AL, two by The Nature Conservancy (TNC) in Montgomery County TN, and three by the Tennessee Wildlife Resources Agency (TWRA) in Van Buren County TN. Guano has been found at the base of several of the structures located on TVA sites and acoustic surveys of the site indicated eight species, including gray bats, northern long-eared bats, Indiana bats, and tri-colored bats, were likely present in the area. There have been no signs of use at the TNC or TWRA trees; however, those trees were installed late in the summer.

Corridor Use by Neoptropical Bats in the Chiquibul Forest Reserve, Belize

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The Chiquibul Forest Reserve in the Cayo District of Belize is home to one of the largest selective logging concessions in the country. Since 2006, when they were issued their logging permit, the concessionaire has constructed multiple roads, trails, and tracks through the reserve to facilitate timber extraction. This has created numerous open corridors through the otherwise thick tropical evergreen seasonal broadleaf forest. In the summer of 2016, we devised a pilot study to understand the role corridor structure may play in determining use by neotropical bats. We deployed mist nets to capture bats and measured corridor structure characteristics (corridor height, corridor width, ground cover, canopy cover, etc.) at 11 corridor locations. We captured 24 species of bats from 4 families (Phyllostomidae, Mormoopidae, Vespertilionidae, and Emballonuridae) using corridors. Of the 44 recorded extant species found in the Chiquibul, we captured 52%. In addition, we captured a species not previously reported for the area. We will present the results of initial analyses examining how species richness and relative abundance of captured bats were affected by corridor structure characteristics.

Extra Limit Maternity Colony of Southeastern Myotis in Northeastern Alabama

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Southeastern myotis (*Myotis austroriparius*) is an insectivorous bat that occurs in bottomland hardwood forest along the coastal plain and Mississippi River from southern Illinois to Florida. Female southeastern myotis form large maternity roosts containing several hundred to 90,000 individuals during the spring and summer months. These maternity roosts are primarily located in caves, but have also been found in tree cavities. In Alabama, only two known maternity roosts for southeastern myotis exist and both are located in caves along the coastal plain. Southeastern myotis are considered a species of highest conservation concern in Alabama and little is known about their distribution and natural history in the state. We discovered a maternity colony of southeastern myotis in the southern Appalachians of northeastern Alabama over a hundred miles outside the known range of this species. The maternity roost was located in a basal cavity of a large tulip popular (*Liriodendron tulipifera*) in upland riparian forest habitat. Over two years, we misted netted for bats at the maternity roost and in the surrounding riparian habitat. A total of 37 adult and juvenile southeastern myotis were captured over two years at the study site. Emergence observations at the maternity roost revealed that several hundred bats were using the roost during the breeding season. In 2016, we radio tagged two pregnant females and an adult male southeastern myotis and tracked their day roost usage. The two females exclusively used the basal hollow maternity roost, whereas the male used small, cavity roost sites. Due to the lack of ecological knowledge of this species, we cannot conclude if the range of southeastern myotis has extended or has previously been undetected in the area. Further research will provide a more conclusive outcome.

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Tennessee Bat Working Group

Tri-colored Bat (*Perimyotis subflavus*)

The tri-colored bat is one of the smallest bats in Tennessee. Its name is derived from its tri-colored fur, the hairs of which are dark at the bases, lighter, almost yellow, in the middle, and the tips are slightly darker. The tri-colored fur, its pink forearms and black wing membranes make it easily distinguishable from other bats in Tennessee.

Dustin Thames

General physical characteristics include:

- Weighs between 5 - 8 grams
- Forearms range from 30 - 35 mm
- A wingspan of 21 - 26 cm

Feeding

Tri-colored bats often forage over waterways and forest edges feeding on a variety of insects that include moths, beetles, mosquitoes, midges, bugs, ants, and other insects.

Reproduction

Mating occurs in autumn, sperm are stored during winter, and fertilization takes place in early spring. These bats usually bear twins in late spring or early summer.

Winter Roosting Sites

Tri-colored bats are typically solitary roosters and have a preference for humid sites during the winter that include caves, mines and rock crevices.

John Lamb

Summer Roosting Sites

After emerging from winter sites, female tri-colored bats will roost alone or form small maternity colonies along forested edges and open habitats. Male tri-colored bats roost solitary in clumps of dead foliage.

- Foliage of Trees
- Buildings (rare)
- Caves.

Dustin Thames

Threats

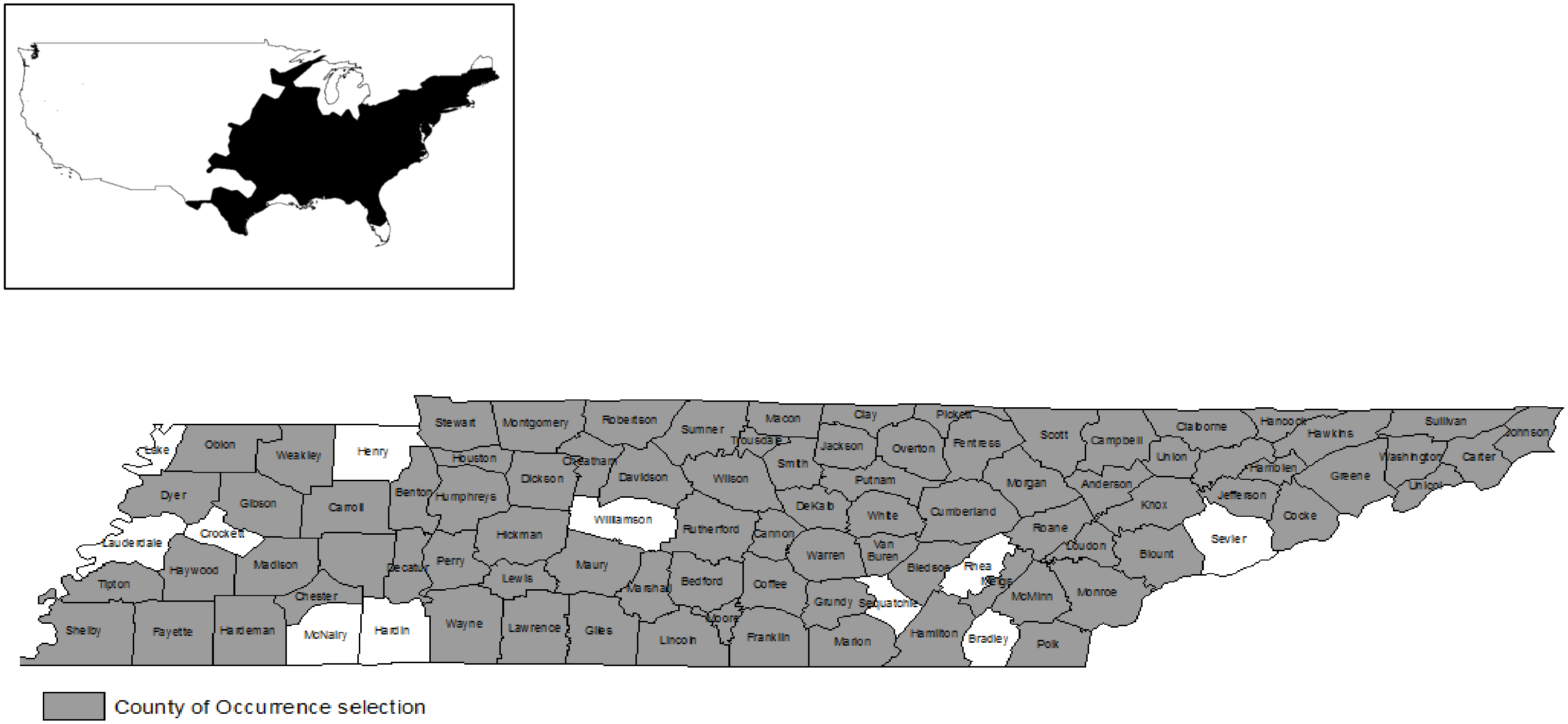
- White-nose Syndrome
- Disturbances at winter sites
- Habitat loss

Status:

Federal: Petitioned for Listing

Tennessee: Proposed Threatened

Tri-colored bat county of occurrence in Tennessee.



Range Map Data Sources

National bat ranges - Layer downloaded from nationalatlas.gov. The data were compiled by Bat Conservation International using data from state natural heritage programs, published literature, unpublished reports, museum collections, and personal communications from university, Federal, State, and local biologists.

TN county occurrence data - TWRA Scientific Collection Permit data compiled from 2000-2013, TWRA Wildlife Diversity database, Annual WNS Reports for Tennessee, published literature [Graves and Harvey 1974. (Journal of the Tennessee Academy of Sciences 49:106-109)], personal communications from university, Federal, State, local biologists, and TNBWG members.

John Lamb