2023 Tennessee Bat Working Group

19th Annual Meeting

November 16th, 2023

Ijams Nature Center

2915 Island Home Ave., Knoxville, TN 37920

AGENDA (Times are eastern standard):

8:30 Registration

9:30 Sara Samoray – Welcome, Opening Remarks, Bat Blitz Results

9:40 Business Meeting, Nominations from the floor

9:50 Dustin Thames – **Annual Update on White-nose Syndrome in Tennessee**

10:10 Joe Hoyt (Virtual) – **Mechanisms of Persistence in the Tricolored Bat**

10:30 Break/Posters

11:00 Mallory Tate Cogburn – **Indiana Bat Use of Artificial Roost Structures in Wilson County, TN**

11:20 Cory Holliday and Steve Samoray- **Gray Bat Movements and Use of Caves in Tennessee: the More We Know, the More We Don't**

11:40 Mallory Tate Cogburn – **Fall Swarming and Spring Staging Timing for Imperiled Bat Species in Tennessee**

12:00 Lunch

1:30 Brandon Gully*– **Impacts of Perceived Predation on Foraging Behavior**

1:50 Ash Cable*– **Mercury in Bats of Tennessee and Kentucky and Implications for Species Affected by White-Nose Syndrome**

2:10 Ashley Epstein* – **Investigating the Winter Roost Selection of Eastern Red Bats in East Tennessee**

2:30 Break/Posters

2:50 Megan Wallrichs – **Home Range and Habitat of Northern Long-eared and Tri-colored Bats during Fall Swarm**

3:10 Chris Ogle – **Newly Discovered Virginia Big-Eared Bats in Tennessee**

3:20 USFWS – **An Update to the Status of the Tricolored Bat**

3:30 Closing remarks, Election results

*Student Presenter

ABSTRACTS (in order of presentations)

Mechanisms of Persistence in the Tricolored Bat

Joseph Hoyt
Biological Sciences, Virginia Tech, Blacksburg, VA, USA.

White-nose syndrome (WNS) has caused severe mortality in populations of multiple bat species across the eastern United States. *P. subflavus* have suffered >95% declines across much of its range. However, initial declines in the southern part of the range have been much more variable and mechanisms that are allowing populations to stabilize and even increase in some instances remain largely unexplored. Our results suggest that the fraction of *P. subflavus* that become infected is decreasing over time and a combination of reduced environmental transmission and pathogen avoidance could be contributing to the survival of this species.

Annual update on white-nose syndrome in Tennessee

Dustin Thames
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White-nose syndrome (WNS) was first documented in Tennessee during the winter of 2009/10. Following the discovery, biologists from a variety of state and federal agencies, non-profit organizations, and universities joined together to create and implement a response plan. A major element of the response is annual monitoring of bat hibernacula to determine the scope of the disease across the state and the severity of the disease on bat populations in Tennessee. Since 2010, members of Tennessee's WNS Response Team have conducted approximately 1,263 surveys at approximately 546 sites across Tennessee. White-nose syndrome has either been confirmed or is considered suspect (i.e., field signs observed) in 61 of the 77 (79%) counties in Tennessee with caves. The disease is now endemic in the state and population declines have been documented in several species of cave hibernating bats including northern long-eared bats, Indiana bats, little brown bats, and tri-colored bats. During the winter of 2022/23, 129 surveys were conducted in bat hibernacula across the state at 113 sites. White-nose syndrome was not documented in any previously undocumented counties during winter colony counts in 2022/23. Results of these surveys and bat population trends in winter hibernacula will be presented.

Indiana Bat Use of Artificial Roost Structures in Wilson County, TN

Mallory Tate Cogburn[1], Dustin Thames[1]
[1]*Tennessee Wildlife Resources Agency, 5107 Edmondson Drive, Nashville, Tennessee 37220.*

For decades, bats have faced a large number of stressors including habitat degradation, critical levels of disturbance, and disease. In the late 1960s, the Indiana bat (*Myotis sodalis*) was listed as federally endangered due to extremely high levels of disturbance within their cave roosts during the winter hibernation period, resulting in energetic loss. Within the implementation of cave gates and seasonal restrictions, karst managers have been able to sustain populations of this endangered bat species. When White Nose Syndrome was introduced to the United States in 2006, these already imperiled bats faced further declines. Due to this added stressor during the winter hibernation period, the energetic opportunities on the landscape and in the seasons surrounding this critical time are even more important. We investigate the use of specifically designed artificial roosts and the potential to deploy these structures for immediate, longer lasting habitat during the migration maternity seasons for Indiana bats. We discuss the use of these tools as a management strategy for private and public land managers.

Gray Bat Movements and Use of Caves in Tennessee: The More We Know, the More We Don't

Cory Holliday[1], Stephen Samoray[2]
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Gray bats (*Myotis grisescens*) have been on the endangered species list since 1976 and have come a long way in recovery. Commercial wind energy development is an emerging threat throughout their range that requires new approaches to conservation compared to the site-based protection that has led the way for gray bat conservation for decades. A better understanding of the full breadth of landscape use by gray bats is needed to inform future conservation efforts.

In 2018 we began developing models of gray bat movements and possible migration pathways. Simultaneously, we collected movement data on individual gray bats during summer foraging and spring migration using aerial telemetry and the Motus Wildlife Tracking System (Motus). The telemetry data suggested we have a lot to learn about landscape and cave use by gray bats in Tennessee. Summer foraging tracking revealed gray bats can travel 48 miles in a night and may roost shift for several nights. Our gray bat migration data show that gray bats often move between caves and other roosts throughout the migration season making it challenging to determine when a migration is complete. This, coupled with the large nightly movements during the summer, suggests that gray bats are using large areas of Tennessee throughout the spring, summer, and fall. Continued protection and conservation of roost sites is critical to gray bat recovery efforts, but we have much to learn about how this species uses other habitats in Tennessee and where conservation focus would be most beneficial..

Fall Swarming and Spring Staging Timing for Imperiled Bat Species in Tennessee

Mallory Tate Cogburn
Tennessee Wildlife Resources Agency, 5107 Edmondson Drive, Nashville, Tennessee 37220

Since the introduction of White Nose Syndrome, researchers have heavily studied two critical time periods for imperiled bat species: the winter hibernation period and summer maternity period. To further understand the full life cycle needs and provide for better protection and management of habitat for bats in Tennessee, we must also investigate the times surrounding hibernation and maternity seasons. Fall swarming is a time of high bat activity where individuals mate and gorge themselves on insects in preparation for hibernation periods. Spring staging refers to the period immediately after winter hibernation, as bats emerge from torpor and prepare for migration to summer sites. In our study, we use Passive Integrated Transponder technology and change point analysis to further understand these time periods by determining bat arrival to hibernacula, peak swarming activity, and emergence from hibernation. We investigate these critical time periods for 4 Tennessee bat species: the Indiana bat (*Myotis sodalis*), the tricolored bat (*Perimyotis subflavus*), the little brown bat (*Myotis lucifugus*), and the eastern small-footed bat (*Myotis leibii*).

Impacts of Perceived Predation on Foraging Behavior

*Brandon R. Gulley[1], Dakota J. Van Parys[1] and Catherine G. Haase[1]
[1]*Department of Biology, Austin Peay State University, Clarksville, USA.*

Predators can affect organisms both directly, through predation, and indirectly, through the perception of predator presence. Prey animals often sacrifice foraging potential to mitigate predation risk which can result in nutritional deficits. Bats are known to be difficult prey due to their agility in flight and nocturnal behavior, leaving few predators capable of hunting them, and the effects of predator presence on foraging behavior are largely unexplored. This study attempts to determine temporal and spatial changes in foraging behavior exhibited by insectivorous bats of the Southeastern United States. We monitored the presence of bats at known foraging sites located at Fort Campbell, Kentucky and Clarksville, Tennessee for a period of four months using acoustic detectors. Each site was monitored for two weeks, with the first week acting as the control with treatments implemented in the second week. Treatments consisted of automated sound boxes which broadcasted predator calls and distressed bat calls. Decoys of owls and hawks were placed as visual cues at certain plots. Additionally, variables include moon phase, and microclimate data. We predict a reduction in total foraging activity, abandonment of foraging grounds, and changes in foraging times or intervals given perceived predator presence. Understanding changes in foraging behavior by different external stressors such as predation will aid wildlife managers in future conservation efforts for organisms whose status is becoming increasingly threatened.

You Are What You Eat: How Insects Effect Bat Populations and Diversity – CANCELED

*Carmen Black[1], Jerome Grant[1], Rebecca Trout-Fryxell[1], Ernest Bernard[1], Joy O'Keefe[2], and Elizabeth Beilke[2]
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[2]*Natural Resources and Environmental Sciences, University of Illinois Urbana-Champaign, Urbana, USA*

As white nose syndrome (WNS) causes devastating impacts to bat species, it becomes integral to understand the availability of prey. Bat diet studies PCR test guano samples, providing identification of organisms in the sample. Data from PCR studies are unable to provide frequency of these organisms, nutritional value, or definitive species due to false positives. The overall goal of this research is to assess the relationship between habitat, prey density, prey diversity, and bat abundance. Abundance of arthropods and bats will be determined at sites at Arnold Air Force Base (middle Tennessee) using light traps, carbon dioxide traps, and mist-nets. Acoustic data from 4 sites will be supplemented for mist-net data in off season. Summer and year-round samples were collected from May 2022 to August 2023. Insect samples will be sorted to family. Trends suggest insects peak in mid-summer, declining into fall. Mist-net and acoustic data will be used to evaluate bat activity in relationship to insects, habitat, and season using mixed linear models. Habitat is more influential on bat activity overall, followed by insect availability. Frequency of prey alludes to relative nutritional availability for bats foraging before and in hibernation periods that are disturbed by WNS. This research aims to address the problems in bat diet work and recognize important factors in bat foraging strategies. This research may inform management decisions about how to increase high nutritional diets for bats and mitigate mortality rates associated with WNS.

Mercury in Bats of Tennessee and Kentucky and Implications for Species Affected by White-Nose Syndrome

*Ashleigh Cable[1], Emma Willcox[1], James Kiser[2], Peijia Ku[3], and Theresa Matthews[3]
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Mercury is among the many contaminants with known negative impacts to wildlife. Mercury exposure has been studied in North American bat species more than any other contaminant. Despite this, there are many knowledge and geographic gaps that limit researchers' ability to make species-level inferences. Herein, we quantify mercury exposure in bats in Tennessee and Kentucky to fill a large geographic data gap. Moreover, we compare exposure across species groups with varying susceptibility to white-nose syndrome (no WNS vulnerability: *Lasiurus borealis*; low WNS vulnerability: *Eptesicus fuscus*, *Myotis grisescens*; high WNS vulnerability: *Myotis sodalis*, *Myotis lucifugus*, *Perimyotis subflavus*). Data suggest that concentrations in the temperate regions of the Southeast USA are not as large as those previously documented in the Northeast USA, with many falling below the threshold known to cause neurological issues in other wildlife species. However, exposure does vary among WNS vulnerability groups, with the bats most vulnerable to the disease having higher fur tissue concentrations of mercury than those with lower vulnerability. This could have implications for bats experiencing compounding stressors of disease and contaminants.

Investigating the Winter Roost Selection of Eastern Red Bats in East Tennessee

Ashley D. Epstein and Emma V. Willcox
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The eastern red bat (*Lsiurus borealis;* LABO) is a solitary, foliage roosting bat that is commonly found throughout much of the southeastern United States, including across the state of Tennessee. In warmer months, this species can be found roosting in large, canopy trees in the forest, often hanging on the edges of branches or near clusters of leaves. The winter roosting behavior of LABO appears to be thermally dependent, and when temperatures become colder, they have been observed abandoning tree roosts in favor of leaf litter which provides a more stable microclimate. For this study we captured red bats using mist nets and applied VHF radio transmitters, after which we tracked each bat to its day roost. We identified each roost used and collected data at the roost, patch, and landscape level to determine which site characteristics red bats were selecting for when choosing a winter roost. Unlike in the summer when LABO are selecting large, canopy trees, our results show that in winter bats are selecting for smaller, mid- or understory trees in dense patches of forest. Our results also show that roost switching occurs less frequently in winter. Understanding winter roosting behavior of this species will help us fill knowledge gaps on LABO roosting ecology, and allow us to make informed management decisions that help to conserve the species.

Home Range and Habitat of Northern Long-eared and Tri-colored Bats during Fall Swarm

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Fall swarm is an essential period in the annual life-cycle of bats. Foraging during this period is under-studied in comparison to the summer maternity season. We completed a study to describe landscape-use during fall swarm and create a resource for managers tasked with decisions about the future viability of northern long-eared (*Myotis septentrionalis*) and tri-colored (*Perimytois subflavus*) bats on their conservation or management lands. In 2018, we conducted a ground-based foraging study during autumn on these two species in the Boston Mountain ecoregion of northeastern Oklahoma. Four northern long-eared and 13 tri-colored bats were radio tagged and synchronized azimuths were gathered from five stations for five nights. Mean home range of northern long-eared bats was 196.0 ± 83.7 ha, and mean location distance (n=84) from the swarm site was 1,337.8 ± 192.3 m. Mean home range for the tri-colored bat was 91.6 ± 11.8 ha, and mean location distance (n=103) from the swarm site was 609.0 ± 76.6 m. Field surveys provided finer-scale habitat data than available from the National Land Cover Dataset'; compositional analysis and linear regression showed that both species use breaks in the forested landscape, such as trails, to a greater degree than those habitats are available on the landscape. Both species used second-order and larger streams more than first-order streams, wetlands, ponds, or lakes.

New Species of Bat Found for the First Time Hibernating in the State

Chris S. Ogle and Scott Dykes
Tennessee Wildlife Resources Agency

Virginia big-eared bats (*Corynorhinus townsendii virginianus*) have only ever been documented in Tennessee by radio tracking from North Carolina. These occurrences in 2013 and 2014, were in the Springtime. Biologists from the Tennessee Wildlife Resources Agency (TWRA) surveyed a cave in Carter County in 2023 and documented three individuals of this species hibernating in that cave. Identification was confirmed with multiple other bat biologists via pictures. Hair samples were also taken and confirmed to be Virginia big-eared bats by the Genomics Lab at the University of Tennessee, Knoxville.

POSTERS

Table for Four: Eating Habits of Four Sympatric Bats

Elizabeth A. Beilke[1] and Joy M. O'Keefe[1]
[1]*Natural Resources and Environmental Sciences, University of Illinois Urbana-Champaign, Urbana, USA*

Dietary partitioning may contribute to the structure and composition of ecological communities, and individuals may adapt their foraging strategies in response to competition and resource abundance (e.g., through specialization or generalization). However, the degree to which bats specialize or generalize is debated, as is the degree to which they are influenced by competition. Using molecular techniques, we examined the diets of four sympatric species (*Myotis grisescens, Nycticeius humeralis, Lasiurus borealis, and Eptesicus fuscus)* to explain the degree to which species partition dietary resources and how competition and resource availability influence niche breadth. We captured bats at Arnold Air Force Base, Tennessee in 2022 and 2023, collected guano samples, and characterized site-specific resource availability (dry biomass of potential prey items) and competition (intraspecific bat captures, interspecific bat captures, and bat diversity). We detected fewer unique amplicon sequence variants in the diet of *Lasiurus borealis* than other bats. In general, we observed more intraspecific variation in the diets of *Eptesicus fuscus* and *Myotis grisescens,* which together covered a broad and divergent niche-space. In contrast, *Lasiurus borealis* and *Nycticeius humeralis* occupied narrow niches that overlapped. We also report a negative relationship between dietary diversity and prey availability; bats had more generalist diets when prey availability was low. Competition did not predict niche breadth. These preliminary results suggest these four bats may be fairly generalist in their foraging strategies, and that bat diets may be more affected by prey than competition.

Fungal Disease Evasion in Aboveground Non-traditional Hibernacula

*Leah N. Crowley, Nathan Fuller, and Catherine Haase
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While *Perimyotis subflavus* are severely impacted by white-nose syndrome (WNS) throughout their range, there are populations in east Texas using non-traditional hibernacula (highway culverts) that evade the disease even though *Pseudogymnoascus destructans* (*Pd*) has been observed in their hibernacula. The mechanism in which these populations are able to persist with no disease pathology has yet to be understood. We aim to quantify one hypothesis that may allow WNS evasion. The microclimate hypothesis suggests that culvert microclimates are not conducive to persistent fungal growth adequate to cause WNS morbidity and mortality. The objectives of this study are 1) to summarize the potential for *Pd* growth among sites and determine the impact of microclimate variables on the potential, 2) to determine potential impacts of site variables (latitude, type [culvert, mine, tunnel, cave], presence of water, microclimate) on the presence and absence of *Pd* and WNS (when *Pd*-positive), and 3) to predict the potential for *Pd* growth over winter given microclimate variability. We gathered microclimate data over winter months from multiple hibernacula in Texas, Oklahoma, and South Carolina. Initial analyses determined the impact of the amount of time spent within the fungal growth range of *Pd* and its impact on WNS status in these hibernacula. Finally, we predicted *Pd* growth rate over hibernation for each site and assessed the impact of site characteristics on growth rate. We present the preliminary results and future plans for this project.

Factors Affecting the Longevity of Tree Roosts Used by Imperiled Bats

* Josie Hoppenworth, Reed Crawford, & Joy O'Keefe
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Cavities, exfoliating bark, and other features present on trees create habitats bats can use as roosts. Trees with these characteristics are scarce and ephemeral on forest landscapes. With tree maturation taking decades to centuries, tree roosting habitat develops slowly especially for live trees and is often only present after tree death. The persistence of tree roosts is therefore dependent on a variety of temporal, spatial, and individual specific factors. Since 2012, federally endangered northern long-eared bats and Indiana bats have been found roosting in ~270 trees throughout Morgan-Monroe and Yellowwood State Forest in southern Indiana. During the summers of 2022 and 2023, we attempted to locate 260 historical bat tree roosts (162 were dead and 98 were living) to assess the factors affecting their longevity and suitability for roosting. For each historical tree roost located, we recorded whether it was living and if it was still standing. Along with this, we collected information on each tree's height, diameter, and decay stage. We successfully located 52.3% of the historical tree roosts. We found 70.4% of historical live trees and only 41.6% of historical dead trees. Most trees were still usable; however, 21.3% of located tree roosts had fallen and were no longer viable bat roosts. With so many unlocated dead historical tree roosts, we assume most of the historical roosts are no longer usable by bats. To sustain populations of tree-roosting bats, land managers should adopt methods to create and sustain populations of trees with characteristics desirable to bats.

Evaluating Tricolored Bat Foraging Activity: A Comparison of Activity in Open Field Areas Along Forest Edges Versus Riparian Sites in Relation to Food Availability

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Tricolored bats (*Perimyotis subflavus*) are insectivores that tend to forage along forest edges, in open fields, and within riparian zones. Some literature on tricolored bat foraging activity suggests they favor foraging over water and in riparian zones, due in part to their consumption of aquatic insects. However, the presence of these aquatic insects tends to fluctuate in availability as the summer progresses, due to changes in temperature and other factors. With this research we hope to better understand if tricolored bat foraging activity in riparian areas and forest openings is driven by prey availability. We hypothesize that tricolored bat foraging activity in field or riparian sites increases with prey availability. We deployed 8 acoustic recorders at 4 sites within Chuck Swan Wildlife Management Area and Loyston Recreation Area to obtain data on species presence and nightly activity of bats. Four were placed at lake edges and 4 were placed in open areas along forest edges. Insect traps were then deployed at sites 1 (riparian site) and 2 (open site) at a minimum of 100 ft from the recorders. We measured prey availability by identifying species to Order and measuring insect biomass from 17 successful deployments (n=8 riparian, n=9 open). Preliminary data show trends in insect biomass throughout the summer and changes in availability by Order. The next step is to investigate the relationship between prey availability and tricolored bat activity in field and riparian zones.