Meeting Program

17th Annual Meeting of the Tennessee Bat Working Group

Virtual Meeting

Thursday, November 18th, 2021

9:00am – 1:15pm CST

Schedule

(times are CST)

8:00am- 9:00am Gather Town: Feel free to enter the virtual space and get acquainted with the app, play games, socialize, etc.

Session 1: Gather Town/ Microsoft Teams

Moderator- Dustin Thames

9:00am: Dustin Thames**–** Opening remarks and Business Meeting

9:15am: Josh Campbell– Annual White-nose syndrome statewide update

9:30am: John JaKa–Three Bat Species Status Assessment (SSA)

9:45am: Riley Bernard– Feasting, not Fasting: Winter Diets of Cave Hibernating Bats in the United States

10:00am: Break

Session 2: Gather Town/ Microsoft Teams

Moderator Daniel Istvanko

10:15am: Cory Holliday– Investigating Tennessee Migrations Local, Regional, and Global

10:30am: Dustin Thames– If you build it, they will come; Indiana bat conservation and artificial roost trees in Wilson County, Tennessee

10:45am: Nate Marshall– Effective Bat SciComm in the Age of Social Media

11:00 am: Ash Cable*– Roosting and Foraging Ecology of Female Tri-colored Bats in Tennessee, USA

11:15am Lunch/ Gather Town Social

12:00pm-1:00pm: Gather Town Poster Session

Mason Cordan*–Rock Climber Interactions with Bats in Marquee National Parks

Leah Crowley*– Microplastics Exposure in Insectivorous Bats

Ashley Epstein*– Prescribed fire impacts on winter hibernation and foraging ecology of eastern red bats (*Lasiurus borealis*)

Kelsie Eshler– Foraging and Roosting Ecology of *Lasiurus borealis*, *Nycticeius humeralis*, and *Eptesicus fuscus* on Arnold Air Force Base, Tennessee

Sarah Krueger*– Impact of white-nose syndrome and local climate on reproductive female bats in the southeastern United States.

Trevor Walker*– Effects of Aquatic Insect Abundance and Biomass on Bat Species Diversity

Sarah Zirkle*– Summer roost-site selection of a white-nose syndrome impacted bat species.

1:00 pm: Dustin Thames–Best Student Presentation Award Announcement and Closing Remarks

1:05 - ? Gather Town Social.

* student presentations.

Abstracts

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 within the state have performed over 1,000 cave surveys over the last 12 years to assess the progression of WNS across the state and its impacts to wintering bats. Since this discovery, the fungal causal pathogen, *Pseudogymnoascus destructans* has been detected in 57 of the 77 counties containing caves. WNS is now considered widespread in the state. Despite the presence of WNS within the state, observations are increasing for some species. However, several species continue to decline. Results from the 2020-2021 winter field season and impacts of WNS being observed by researchers will be presented.

Three Bat Species Status Assessment (SSA)

Johnathan Jaka[1], Jacob Burkhart[1], and Richard Geboy[1]

[1] U.S. Fish and Wildlife Service.

The U.S. Fish and Wildlife Service is currently assessing whether three bat species (northern long-eared bats, tricolored bats, and little brown bats) warrant listing as threatened or endangered under the Endangered Species Act. As part of the evaluation process, we have conducted a Species Status Assessment (SSA) for all three species. In this talk, we will provide a brief overview of the analytical framework used within the SSA and provide an update on the current timeline of forthcoming actions.

Feasting, not Fasting: Winter Diets of Cave Hibernating Bats in the United States

Riley F. Bernard[1,2,3], Emma V. Willcox[2], Reilly T. Jackson[2,4], Veronica A. Brown[5], and Gary F. McCracken[3]

1 *Department of Zoology and Physiology, University of Wyoming, Laramie, USA;* ***2*** *Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***3*** *Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, USA;* ***4*** *Department of Biological Sciences, University of Arkansas, Fayetteville, USA;* ***5*** *Division of Biology, University of Tennessee, Knoxville, USA*

Temperate bat species use extended torpor to conserve energy when ambient temperatures are low and food resources are scarce. Previous research suggests that migratory bat species and species known to roost in thermally unstable locations, such as migratory tree bats, are more likely to remain active during winter. However, hibernating colonies of cave

roosting bats in Tennessee are active throughout winter and have been documented emerging from caves when ambient temperature at dusk is at or below 0°C. Given the proclivity of bats to remain active throughout winter, we investigated the diet of bats during these bouts of winter activity. We captured 2,044 bats of 10 species that emerged from six hibernacula over the course of 5 winters (October – April 2012/13, 2013/14, 2015/16, 2016/17, and 2017/18). Using Next Generation sequencing of insect DNA from 284 fecal samples, we determined bats were consuming at least 14 Orders of insect prey while active on the landscape. Dietary composition did not vary among bat species; however, we observed variation in the dominant prey items represented in species' diets. Based on the relative read abundance, over half of the diet of *Corynorhinus rafinesquii* (72.2%) and *Lasiurus borealis* (67.4%) contained Lepidoptera. Diptera were the most consumed order for *Myotis leibii* (32.4%), *M. lucifugus* (37.4%), *M. sodalis* (35.5%) and *Perimyotis subflavus* (68.8%). The information from this study is integral to managing the landscape around bat hibernacula for insect prey, particularly in areas where hibernating bat populations are threatened by white-nose syndrome.

Investigating Tennessee Migrations Local, Regional, and Global

Cory Holliday[1], Steve Samoray[2], Joseph Wisby[1], Piper Roby[2], Dustin Thames[3], Daniel Istvanko[3]

[1]The Nature Conservancy, Nashville, TN, USA; [2]Copperhead Environmental Consulting, Inc, Paint Lick, KY, USA; [3]Tennessee Wildlife Resources Agency, Nashville, TN, USA

A foundation of wildlife conservation and research is understanding natural history to provide evidence for strategic conservation. For aerial wildlife, full life-cycle natural histories are often not known and can be challenging to research and understand. Researchers have investigated bat migration and movements for decades, but we still have insufficient data to support full life cycle conservation for many species. Tennessee bat research and conservation collaborators have worked together for over a decade to improve techniques and provide new data on bat migration and movement. The Nature Conservancy (TNC) is using that information to develop a migration and movement model for gray bats throughout their range. This model is being tested and informed by actively tracking gray bats during migration with a hypothesis that they will migrate in relatively straight lines, similar to other bat species tracked during migration. After two seasons of gray bat migration, with only 6 bats tracked, we have inconclusive results. In addition, TNC and other state partners are utilizing the Motus collaborative platform to better understand migration of all aerial species in Tennessee.

If you build it, they will come; Indiana bat conservation and artificial roost trees in Wilson County, Tennessee

Dustin Thames[1], Mallory Tate[1], Josh Campbell[1], Chris Simpson[1]

[1] Tennessee Wildlife Resources Agency, Nashville, Tennessee, USA.

Indiana bats (*Myotis sodalis*) have been listed as federally endangered under the Endangered Species Act since 1967. The species is a conservation priority for many organizations, including the Tennessee Wildlife Resources Agency (TWRA). In 2013, maternity colonies of Indiana bats were first discovered in Wilson County, Tennessee. With grant funding, TWRA has leased approximately 1,200 acres of private property for Indiana bat conservation in the county. In 2020, we installed 24 artificial roosts to augment roosting habitat and improve monitoring efforts. In an area of the leased property that was used by Indiana bats in 2013 and 2014, we implemented a research project to examine roost selection and paired 9 artificial bark roosts with 9 rocket boxes. Indiana bat maternity colonies utilized one of the artificial bark roosts in 2020 and an average of 7.7 ± 3.6 ($\bar{x}$ + SD) bats emerged from the roosts during the maternity period. In 2021, Indiana bats formed a maternity in a different artificial bark roost and an average of 17.6 ± 3.6 bats emerged from the roost during the maternity period. So far, Indiana bats have only selected the artificial bark roosts in our study area and, contrary to our initial hypothesis, have not utilized the rocket boxes. TWRA will continue installing artificial roosts, conducting research, and monitoring Indiana bat populations in Wilson County.

Effective Bat SciComm in the Age of Social Media

Nate Marshall

#givebatsabreak

From the early pioneers who put the nature documentary on the silver screen to modern productions on Netflix and TikTok, scholarship's many messengers have long sought to place their data in front of the human population's science-starved eyes. Whether in the form of Disney's *True-Life Adventures* or Nickelodeon's *Mr. Wizard's World*; *Bill Nye the Science Guy* or *Startalk*; or social media influencers like Hood Nature or Hank Green, science has found a way to express itself in relevant, engaging, yet ever-evolving modes. Bats have had their champions in the media as well, perhaps none better known than Dr. Merlin Tuttle. The platforms collectively referred to as “social media” are likely our current greatest opportunity to make bats seen, something that even Dr. Tuttle seems to understand, and those with the time and energy to commit to understanding the various platforms will find themselves communicating science directly to a never-sleeping audience. It is in this world that I now find myself after a series of tweets about bats I sent to the Pope. I will briefly tell my story, discuss the reach of early media vs modern social media, and present best practices and tools to more effectively use social media to the advantage of bats and fellow bat researchers.

Roosting and Foraging Ecology of Female Tri-colored Bats in Tennessee, USA

Ashleigh B. Cable[1] and Emma V. Willcox[1]

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

The tri-colored bat (*Perimyotis subflavus*) has been negatively affected by white-nose syndrome across the eastern portion of its range. Populations have declined both in winter hibernacula and on the summer landscape. The United States Fish and Wildlife Service has announced a formal species status review to determine if federal listing is warranted. Despite once being a common bat, studies that have assessed the summer roosting needs of the species are limited. Moreover, there are no published studies determining its foraging affinities. We conducted 63 mist-net surveys from May-August from 2019-2021 in Tennessee, USA to target female tri-colored bats. We examined 17 roost trees used by 6 female tri-colored bats. Additionally, we collected foraging data for 6 females using biangulation. The best roost models indicated that they select trees with more canopy volume in areas with higher tree species richness in the 0.1 ha surrounding plot. Bats used an average of 2.1 roosts ± 0.6 SE during the tracking period. Overall foraging areas (95% kernel) were 2580.2 ha ± 1605.3 SE and the mean maximum foraging distance was 4.3 km ± 1.7 SE. Bats foraged in areas with more water, more development (i.e., paved rural roads in this case), more forest, and less open areas than available on the landscape. Managing forests for tree species richness and retaining live trees with large canopy volumes during the maternity season might benefit female tri-colored bats. This might especially be important near water bodies, as female tri-colored bats used those areas for foraging.

Poster Presentations Abstracts

Rock Climber Interactions with Bats in Marquee National Parks

Mason A. Cordan[1], Adam S. Willcox[1], Michelle L. Verant[2]

[1]Department of Forestry, Wildlife, and Fisheries, University of Tennessee Knoxville, USA; [2]National Park Service

Bats that roost in vertical environments have been hard to study because of the extreme nature of their habitats. For this reason, the National Park Service wants to find out if rock climbers would be willing to participate in their management and conservation because of their ability to access these remote sites. To do this, we will first write a qualitative survey for NPS biologists and rock climbers alike to better understand the issues and concerns for both parties. Using the responses from this, we will write a quantitative survey to give to rock climbers in marquee National Parks

across the US. The responses from the survey will hopefully assist NPS biologists in writing more in depth management plans for bats to help conserve these keystone creatures.

Microplastics Exposure in Insectivorous Bats

Leah Crowley[1], Ashleigh Cable[1], and Emma V. Willcox[1]

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

Bats in temperate North America are experiencing precipitous population declines due to habitat loss and degradation, wind turbine mortality, and disease. Environmental contaminants may affect fitness and elevate the impacts of other stressors to bats. Microplastics are emerging environmental contaminants and might be detrimental to wildlife health. These tiny plastic particles can be transferred from aquatic to terrestrial systems via emergent aquatic insects; thus, bioaccumulation of microplastics is a concern for aerial insectivores that prey on thousands of insects a night. Our objectives are to 1) determine the extent of microplastic exposure and accumulation in insectivorous bats and 2) investigate pathways of microplastic exposure related to diet. Using bat carcasses collected from rabies monitoring programs, we will use a chemical digestion method to isolate plastic particles from tissues and a dissecting microscope to quantify and describe these particles. We will then use a spectroscopy method to characterize the chemical properties of the particles. By testing a variety of tissue types from bat carcasses, we will determine the extent of microplastic accumulation in different internal tissues. We will also investigate diet as a pathway of exposure by determining diet of bats and quantifying plastics in guano. We will use the data we collect to investigate relationships between prey consumed and attributes of plastic particles (i.e., size, shape, concentration, and chemical property). Our findings will improve understanding of bat exposure to microplastics and the potential for this contaminant to affect bat body condition, which might have implications for recovering from disease

Understanding the Winter Hibernation and Foraging Ecology of Red Bats to Inform Prescribed Fire Management

Ashley D. Epstein and Emma V. Willcox

Department of Forestry, Wildlife and Fisheries, University of Tennessee Knoxville, USA

In the Southeastern U.S., prescribed fire is a tool regularly used by land managers to achieve a variety of management objectives. Prescribed burns in this region are often conducted during winter to best achieve objectives and avoid direct mortality to wildlife. Many bat species hibernate in caves during winter, reducing their exposure to winter prescribed fire. Eastern red bats (*Lasiurus borealis*, LABO), however, roost exclusively in forests throughout the year and are still present on the landscape when these burns are conducted, making them vulnerable to prescribed fire activities. No studies have examined LABO response following disturbance by

fire with regards to roost site selection, distance traveled, or foraging activity. With this study we will capture and apply transmitters to LABO in and around stands subject to prescribed burning. Using radio telemetry, we will track bats to roost sites and identify roost characteristics at three spatial scales (i.e., roost site, forest stand, and landscape). We will use full spectrum Song Meter SM4 acoustic detectors to identify bat calls and feeding buzzes as a measure of foraging activity pre- and post-burn. Results from this study will help fill gaps in our knowledge of LABO life history, and aid managers in development of prescribed fire prescriptions that conserve this species.

Foraging and Roosting Ecology of *Lasiurus borealis, Nycticeius humeralis,* and *Eptesicus fuscus* on Arnold Air Force Base, Tennessee

Kelsie Eshler, Malachia Evans, and Steve Samoray

Copperhead Environmental Consulting, Inc., Paint Lick, KY USA

With the decline of species diversity due to white-nose syndrome, the "common" bat species on Arnold Air Force Base (AAFB) including, big brown bats (*Eptesicus fuscus*), eastern red bats (*Lasiurus borealis*), hoary bats (*L. cinereus*), and evening bats (*Nycticeius humeralis*) may be becoming more important to the local ecology. Because previous studies at AAFB have focused on federally endangered or threatened bat species, little is known about the roosting and foraging ecology of these more common bat species. To begin to answer these questions, we conducted mist-net surveys in June and July 2021 and attached radio transmitters to a total of 53 bats of three different species (27 eastern red bats, 18 evening bats, and 8 big brown bats) including both sexes and age classes. Individuals were tracked to diurnal roosts and nightly forging data were collected to determine overall home range locations and sizes. A total of 150 roosts were found and included trees, shrubs, and man-made structures. Foraging data were collected for 45 bats resulting in 1,216 individual foraging points. Home range calculations showed that all three species tracked used small areas of the base and in general did not forage far from roost trees or capture sites. This information will provide land managers at AAFB with the data necessary to make informed decisions to help protect the bats species that remain on the base and will provide baseline data needed to assess recovery efforts should these species become federally endangered or threatened in the future.

Impact of White-nose Syndrome and Local Climate on Reproduction of Female Bats in the Southeastern United States

Sarah K. Krueger[1], Trevor G. Walker[1], Sarah C. Zirkle[1], Joy M. O'Keefe[2], Gene Zirkle[3], and Catherine G. Haase[1]

1 Department of Biology, Austin Peay State University, Clarksville, USA; 2 Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, USA; 3 Environmental Division, US Army Fort Campbell, Fort Campbell, USA

Energetic trade-offs between hibernation and reproduction occur in hibernating bat species to ensure pups are born when forage availability is optimal, yet little is known about how disease is affecting the success of reproduction and microclimate influences. White-nose syndrome (WNS) is an infectious disease that disrupts hibernation, leading to premature exhaustion of fat during hibernation. There is evidence of reproductive shifts in areas where WNS has devastated bat populations; however, current research has yet to assess these changes in response to winter duration or local climate. We compiled data from four states and used mixed linear effects models to compare effects of WNS, winter duration, and local climate variables on female reproduction for two WNS-susceptible species – *Perimyotis subflavus* and *Myotis lucifugus* and two species not affected by WNS –*Eptesicus fuscus* and *Lasiurus borealis*. We incorporated the effects of WNS in two ways: presence and absence of WNS, with presence dictated by year first observed, and year since WNS was reported. We suspect that WNS susceptible species would see a decline in the number of reproductive females, with the effect exaggerated by longer winter durations and harsher climate variables. We found that both WNS-susceptible species and species not affected by WNS experienced an increase in the number of reproductive females as the previous summer climate variables increased; however, WNS-susceptible species experienced a decline with years since WNS. This overall negative trend of WNS-susceptible species may cause a shift in bat populations. This information is critical to understanding the effects of disease on population growth through impacts on reproductive behavior.

Effects of Aquatic Insect Abundance and Biomass on Bat Species Diversity

Trevor G. Walker[1], Sarah C. Zirkle[1], Sarah K. Krueger[1], Gene Zirkle[2], and Catherine G. Haase[1]

1 *Department of Biology, Austin Peay State University, Clarksville, USA;* **2** *U.S. Army Fort Campbell, Fort Campbell Fish and Wildlife, Kentucky, USA*

Due to the reliance of North American bat species on aquatic insects for forage, we suspect there should be a link between stream health and metrics of bat diversity. The relationship is especially important with the current global declines of insects and with ongoing land-use change. We assessed this hypothesis using metrics of bat diversity and various variables of aquatic insects, specifically those related to aquatic species sensitive to stream health. We captured bats via mist nets at 26 sampling locations on Fort Campbell Army Base, KY and calculated species richness and Simpson's Diversity Index. We also collected aquatic insects with Hess samplers, kick nets, dip nets, and light traps. Insects were identified down to family, dried, and weighed. We assigned each family an average of tolerance values and calculated the Family Biotic Index for each location. We also calculated percent abundance and percent biomass comprised of Ephemeroptera, Plecoptera, and Trichoptera at each location. We used a generalized linear model to relate bat diversity indices to aquatic insect metrics and included weather variables

(nightly mean temperature, total nightly precipitation) and Julian date as covariates. Preliminary results show that percent Ephemeroptera, Plecoptera, and Trichoptera abundance is the only significant variable explaining bat species evenness. However, this is an ongoing study where more data will be incorporated to better detect significant variables.

Summer Habitat Use and Roost-site Selection of a Recently Petitioned Bat Species

Sarah C. Zirkle[1], Sarah K. Krueger[1], Trevor G. Walker[1], Gene A. Zirkle[2], and Catherine G. Haase[1]

1 *Department of Biology, Austin Peay State University, Clarksville, TN, USA;* ***2*** *U.S. Army, Fort Campbell Fish and Wildlife, Kentucky, USA*

The tri-colored bat (*Perimyotis subflavus*) is a hibernating North American bat species that uses forested landscapes during summer months; however, information on the spatial ecology and summer habitat requirements of the tri-colored bat is limited. Summer habitats are critically important to population persistence as they support multiple life history requirements, including maternity colonies, nursery sites, and foraging locations. As tri-colored bats are highly susceptible to white-nose syndrome, a devastating disease that increases fat consumption over hibernation, determining the resources that are important for building up pre-hibernation fat stores is crucial. Our objective is to quantify the selected resources of tri-colored bats for roost sites during the summer. We will capture, tag, and track bats using radio-telemetry to their roost locations. At each roost, we will record roost habitat characteristics and other forest descriptions. We will repeat these measurements for three random trees to serve as the habitat available for selection. We will use a suite of mixed conditional logistic regression models with individual as a random effect to evaluate the relationships between covariates and habitat selection at the roost tree and individual level. Preliminary results from fifteen bats demonstrate roost tree selection was influenced by roost tree height, which may be linked to microclimatic factors. Future field work will increase sample size and provide a more robust analysis. There is a critical information gap for the ongoing recovery of tri-colored bats; better understanding of summer habitat and proper forest management implications is needed to better understand tri-colored bat management needs.