2023 Abstract Book

28th Annual Meeting of the Southeastern Bat Diversity Network

33rd Annual Colloquium on the Conservation of Mammals in the Southeastern U.S.

Oral Presentations

Listed alphabetically by first author

OFFSHORE WIND TURBINES MAY ATTRACT BATS: EVIDENCE FROM ACOUSTIC AND THERMOGRAPHIC OFFSHORE MONITORING (ATOM)

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Transitioning away from fossil fuels to renewable energy sources is one of the greatest and most urgent challenges of our time. A key component in the renewable energy sources mosaic is wind, with an increasing number of wind energy facilities being developed globally on land, and increasingly, offshore. However, no development comes without environmental cost, and wind turbines are no exception. Mortality due to collisions with turbines is a major concern for many bird and bat species, leading many regulatory authorities to require ecological surveys that will assess impact on susceptible species prior to granting approvals for development.

However, since animals interact with their environment, even the most diligent pre-development survey cannot predict changes to animal behavior once the facility is operational. More and more evidence suggests that bats may be attracted to land-based wind turbines in some cases. Here, we present evidence that this may be the case with offshore turbines as well.

Using an integrated system of Acoustic and Thermographic Offshore Monitoring (ATOM), we have recorded a significant amount of presence and activity of multiple bat species on and around turbines located 24 nautical miles offshore Virginia. Bat presence and activity at the turbines was significantly higher than recorded at surface buoys in a similar geographic location but closer to shore, suggesting the turbine structure creates an attraction for bats (and birds).

Our results highlight the importance of post-construction monitoring, development of integrated data-collection methods, and real-time mitigation tools to complement policies based on pre-construction surveys.

COMPARING EFFECTIVENESS OF AHDRIFT SYSTEMS AND SHERMAN TRAPS FOR SMALL MAMMAL SURVEYS – ALSO WEASELS

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Traditional small mammal survey methods (e.g., Sherman traps) are beneficial in certain conditions but tend to require substantial effort and can introduce individual/species biases. The recently described AHDriFT Camera Trap System (i.e., camera traps combined with drift fences) effectively surveys small terrestrial vertebrates without requiring much time in the field. Our objective was to compare the efficiency and effectiveness of AHDriFT systems and traditional Sherman traps for surveying small mammal communities. AHDriFT system and Sherman trap surveys were conducted in four sites of varying habitat types at the Eagle Marsh Nature Preserve (Fort Wayne, IN, USA) from February to July in 2020 and May to August in 2021. We conducted 640 trap nights (one trap set on one calendar night) of Sherman trap surveys and 551 trap nights of AHDriFT system surveys. We captured 192 small mammals of three distinct species with Sherman traps and obtained 532 images of unique small mammal individuals of seven distinct species with AHDriFT systems. AHDriFT systems resulted in two times greater species richness ($Z = -6.21$, $P < 0.01$), 16 times greater species evenness ($Z = -4.83$, $P < 0.01$), and 23 times greater Shannon's diversity values ($Z = -4.87$, $P < 0.01$) than Sherman traps. AHDriFT systems also documented the presence of four species that the Sherman traps did not (e.g., *Blarina brevicauda, Neogale frenata, Sorex cinereus, Tamia striatus*). AHDriFT system surveys provided five times more observations per dollar spent and required 90% less time in the field than Sherman trap surveys. These results suggest that AHDriFT systems may be a more efficient and effective method of surveying small mammal communities. However, without further development, AHDriFT systems are less functional in studies requiring the identification of individuals and collection of biological samples.

RANGE EXPANSION OF THE GRAY MYOTIS IN INDIANA

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Species often exist across a broad landscape where they are irregularly distributed; range maps and descriptions often fail to capture precise range boundaries or elements of seasonality, abundance, or reproduction and ranges expand or contract across time. The range of the gray myotis (*Myotis grisescens*) is typically described as cave regions of the southeastern United States, Missouri to Alabama, while caves farther north are not used. Thus, although this bat is common in parts of Kentucky, it has historically been absent from Indiana. However, during recent years the gray myotis has become increasingly common in the state. Populations of gray myotis were documented in three karst areas across southern Indiana, all separated by > 50 kms. Populations were documented (capture, observation and/or acoustic) simultaneously during all seasons. After 3 years of surveys and year-round monitoring, summer populations appear to be increasing at two locations (at least), with reproduction confirmed at one location and likely at another. Winter populations have increased over 1,800% since 2017, when only 368 gray myotis were located. In total, five caves and 1 mine are confirmed to be used by gray myotis during at least one season. Interestingly, strong spring and autumn activity was documented at three caves and 1 mine, two of which are the furthest north of any gray myotis population in Indiana and range-wide. These data indicate that a range expansion is in progress and help inform conservation and management decisions, including potential conflicts with other protected species.

PUBLIC PERCEPTIONS OF BATS AND THEIR MANAGEMENT AT A RECREATION SITE IN THE SOUTHEASTERN UNITED STATES

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High bat mortality from white-nose syndrome (WNS) has increased the need to manage hibernation sites (e.g., caves, tunnels, and mines) that are also recreation sites. Conservation of recovering bat populations may require restricting public access to these sites, making it essential to understand public perception and the factors that predict attitudes towards bats and lead to support for management actions (e.g., closures). We used Stumphouse Tunnel, a recreation site and *Perimyotis subflavus* bat hibernaculum located in northwestern South Carolina, as a case study to assess public knowledge of and attitudes towards bats and to measure support for site management actions. We conducted surveys of tunnel visitors, local homeowners, and members of local recreation and conservation groups (n=1,281). Despite informational signage at the tunnel, 62% of respondents had not heard of WNS. A positive attitude towards bats was related to higher knowledge about bats, positive experiences with bats, and biophilia-related beliefs about wildlife (R2=0.49). Support for bat management at Stumphouse Tunnel was associated with higher perceived levels of responsibility of the self and other residents and state and federal government to conserve bats, support for restricting access at recreation sites, biophilia-related beliefs about wildlife, awareness of WNS, attitude towards bats, and higher education level (R2=0.40). However, as an individual's visitation to the site increased, their support for bat management decreased. Beliefs prioritizing humans over wildlife were negatively associated with attitude toward bats and support for bat management. Respondents familiar with WNS were more likely to strongly support closure of the tunnel during hibernation (P<0.0001). Our results suggest that outreach aimed at providing positive bat experiences could lead to more positive attitudes towards bats, and increased education about WNS and other threats bats face internationally may increase support for management that may result in restricting access to recreation sites.

SUMMER HABITAT FOR THE FEMALE TRI-COLORED BAT IN TENNESSEE

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We conducted a mist-net and telemetry study from May-August of 2019-2022 to determine roost selection and foraging area use of female tri-colored bats (Perimyotis subflavus; PESU) in Tennessee. Female PESU comprised only 3% of all bat captures. We captured and tracked 8 bats at 4 study locations, located 19 roosts, and collected foraging data for 5 bats. Local roost selection was influenced by proportion of subcanopy trees to canopy trees (+), basal area (+), tree height (+), canopy closure (+), distance to nearest canopy tree (-), number of snags (-), and understory clutter (-). Roost use probability increased when there were more tree species, more oaks (Quercus spp.), and more hickories (Carya spp.) in the plot. Bats avoided plots with more tulip poplar (Liriodendron tulipifera). Landscape-level roost selection was influenced by deciduous forest in a 300 m radius (+), forest connectivity (+), water in a 300 m radius (-), developed area in a 300 m radius (-), shrub area in a 300 m radius (-), and evergreen forest in a 300 m radius (-). Bats traveled an average maximum distance of 3,449 m (range 809-9,055 m) from roost to forage area. Minimum convex polygons averaged 662 ha (range 185-1,994 ha). Core foraging areas (50% kernel distributions) were comprised of 53% forest, 39% open area, 7% water, and <1% developed area. Management and conservation efforts for this species should consider forest structure (i.e., retaining trees in both the canopy and subcanopy level to provide cover), composition (i.e., retaining live oaks and hickory trees), and access to water, forest, and open/edge cover types for foraging opportunities.

BAT RESPONSES TO CHANGES IN STAND STRUCTURE AND INSECT COMPOSITION IN WINTER: A STRUCTURAL EQUATION MODELING APPROACH

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In the southeastern U.S. Coastal Plain, many bats are year-round residents and remain active during winter or are winter migrants from colder areas seeking milder temperatures. In addition to being the winter destination for migratory species, southeastern Coastal Plain forests may represent important areas for remnant populations of species affected by white-nose syndrome. Working forests represent a large proportion of southeastern Coastal Plain forests, yet responses in bat activity with respect to insect composition and vegetation structure complexity during winter remain understudied. Therefore, we used structural equation modeling (SEM) to evaluate relationships between bat activity, aspects of the insect community (i.e., captures, diversity, and adult size), vegetation structure, and environmental conditions (i.e., temperature) in forest stands representing a range of conditions within working pine (Pinus spp.) forests. From January to March 2021-2022, we deployed Anabat Swift acoustic detectors, collected insects using light traps, and measured site covariates at randomly selected points across working pine forests in Florida, Mississippi, and North Carolina, South Carolina, (n = 35 per state). Our preliminary results indicate that winter bat activity is best explained by combining vegetation characteristics and insect attributes. We observed higher activity related to one or more insect metrics, depending on bat species, and lower activity in most species in areas with higher levels of vegetation structure. Not surprisingly, temperature had a statistically significant negative effect on bat activity. Our results add to the limited information on winter bat communities and foraging habitat associations to inform managers of forest features important to wintering bats, thus increasing conservation opportunities within working forests.

UTILIZATION OF ACOUSTIC DETECTORS, EDNA, AND CLIFFLINE SURVEYS TO LOCATE UNKNOWN MATERNITY ROOSTS FOR VIRGINIA BIG EARED BATS (*CORYNORHINUS TOWNSENDII VIRGINIANUS*) IN KENTUCKY

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Virginia big-eared bats (*Corynorhinus townsendii virginianus*) inhabit limestone caves and sandstone rock shelters in a portion of Eastern Kentucky. Based on winter censuses of known hibernacula in the state, around 30% of the population of Virginia big-eared bats could be accounted for in known maternity sites. We used a combination of data collection methods, including eDNA and guano collection, acoustic monitoring, and cliff line surveys to locate unknown maternity sites throughout the species' range in Kentucky. To date, 183 surveys of caves and rock shelters have been completed. As a result, two new Virginia big-eared bat maternity sites have been confirmed, with three suspected maternity sites awaiting confirmation in the summer of 2023. Handheld macro-enabled digital cameras have aided field identification of guano based on prey remains, allowing for accurate sample collection from the target species. Additionally, genetic analysis of guano has streamlined field verification efforts at likely Virginia big-eared bat maternity sites. Utilization of on foot cliff line surveys, coupled with eDNA and guano collection and analysis, have yielded valuable information that will continue to assist resource agencies as they manage this species into the future. Due to implementation of these field techniques, a newly-discovered maternity site found during this project has been protected via gating.

INTENSIVE CAMERA TRAP SURVEY FOR THE PLAINS SPOTTED SKUNK (*SPILOGALE INTERRUPTA*) IN KANSAS

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The plains spotted skunk (*Spilogale interrupta*) once commonly occurred across the Great Plains, but has suffered severe declines across its historical range since the 1940s. Population declines in Kansas prompted the closure of the trapping season in the 1970s. Declines have continued to present day with the last confirmed sighting of the species occurring in 2020 in western Kansas. In order to determine the current abundance and distribution of the plains spotted skunk, we are conducting a camera trap study at 600 locations across 18 counties in Kansas. As of February 2022, we have sampled approximately 450 camera locations and have yet to detect a spotted skunk. However, we successfully detected three mammal species of conservation concern listed under the Kansas State Wildlife Action Plan (SWAP): gray fox (*Urocyon cinereoargenteus*), swift fox (*Vulpes velox*), and the Southern flying squirrel (*Glaucomys volans*). We will continue to sample this winter season until March, with camera trapping efforts continuing this summer 2023.

COLONIZATION AND USE OF ARTIFICIAL ROOSTS BY INDIANA BATS IN THE INNER BLUEGRASS OF KENTUCKY

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In addition to using natural roosts, Indiana bats (*Myotis sodalis*) form maternity colonies in artificial roosts such as rocket boxes and bark-mimic structures. However, few Indiana bat study systems contain multiple artificial roost types alongside natural roosting options. We have monitored use of rocket boxes by Indiana bats since 2019 at Veterans Memorial Wildlife Management Area (VMWMA) in Scott County, Kentucky. Considering emergence count data over the years, Indiana bats generally use rocket boxes in an interior forest habitat earlier in the maternity season before shifting to use of rocket boxes along forest edges for the remainder of the season. From April through September 2021, we radio-tagged and tracked 12 female Indiana bats to day roosts. Concurrently, we assessed natural roost availability across VMWMA. Despite our documenting of a wide range of natural options, bats roosted in 10 unique rocket boxes, 14 unique bark-mimic roosts, and only 3 unique natural roosts. Artificial roosts were used on 96% of bat days. Potential roost trees are abundant at VMWMA, but most are relatively small. Neither the abundance of snags, shagbark hickories, or ideal roost trees, nor canopy closure varied across slope position; however, the distribution of suitable roosts varied across the ownership. Results indicate the forest at this study system is young, but still contains natural roosting options for Indiana bats (which will presumably increase as the forest ages). Nevertheless, maternal Indiana bats at VMWMA prefer artificial roosts over natural roosts. Our data underscores a continued need for research on artificial roosts, and for bat conservation efforts to focus on holistic habitat management (as opposed to limited roost creation).

LANDSCAPE AND CULVERT STRUCTURAL INFLUENCES ON TRICOLORED BAT ABUNDANCE IN GEORGIA, U.S.A.

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White-nose syndrome, caused by the fungal pathogen *Pseudogymnoascus destructans*, has led to the death of millions of cave-dwelling bats by prompting them to lose vital fat reserves from repeated arousals during winter hibernation. The tricolored bat (*Perimyotis subflavus*) was once a common cave-dwelling species in the eastern U.S. but has suffered high mortality from white-nose syndrome in the core of its range where it primarily hibernates in caves. In areas without caves, tricolored bats are known to hibernate in culverts. White-nose syndrome was documented in culvert hibernacula in Georgia and Mississippi in 2022. Our objective was to determine if landscape characteristics or culvert structure influenced tricolored bat abundance at culvert hibernacula in the southern extent of their range. From November to March, 2017-2022, we surveyed culverts throughout Georgia, USA, during winter to determine tricolored bat abundance and measure culvert structural components. We obtained spatial data layers and quantified landscape composition and configuration metrics surrounding culvert hibernacula. We used generalized linear mixed models to estimate characteristics of the landscape and culverts that influenced bat abundance. Our results indicated that tricolored bat abundance was negatively related to latitude and positively related to distance to karst, a one-kilometer buffer area of forest, and culvert length. Increased forest area near culverts may provide opportunities for bats to forage to replenish fat stores lost during hibernation, and culverts further from karst can provide refugia that may offer climatic conditions suitable for hibernation. These findings can be used to focus tricolored bat survey efforts and white-nose syndrome monitoring on culverts in areas where the abundance is likely to be the greatest, or alternatively, identify where abundance is lowest to determine if those sites could be modified to increase abundance.

BAT OCCUPANCY ESTIMATES OF BUFFALO NATIONAL RIVER USING A FALSE-POSITIVE OCCUPANCY MODEL

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The importance of proper management for bats has become paramount in recent years because of the introduction and spread of white-nose syndrome throughout the United States and Canada. Occupancy modeling is one research/management tool that is widely used among biologists, and being based on the presence/absence of a species, makes it a natural fit for presence/absence data produced from acoustic recordings. However, disagreement among automated bat identification programs can make accurate occupancy estimates based upon acoustic recordings difficult to achieve. We analyzed data collected from acoustic bat surveys performed at 113 sites throughout the Buffalo National River in 2014-2016, using two USFWS-approved auto-i.d. programs (BCID and Kaleidoscope) to independently identify the calls. We then estimated occupancy using a false-positive occupancy model in which call sequences identified as the target species by both auto-i.d. programs are considered “certain detections”, and call sequences identified as the target species by one program are considered “uncertain detection”. We also calculated occupancy estimates using a simple, single season model which uses only “detection” and “non-detection”, and compared the models using AIC. In our study, the simple, single season model fits the data better than does the false-positive model, however occupancy estimates derived from the two models were comparable. As auto-i.d. programs continue to improve, a false-positive occupancy model may be the best way to mitigate for their inaccuracies.

IMMEDIATE RESPONSE OF BATS TO PRESCRIBED FIRE

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Prescribed fire is a frequently used management technique in southeastern US forests. Fire can change vertical structure, diversity of vegetation, and insect abundance. To inform this management practice, it is important to understand its impact on important and at risk species, such as bats. The goal of this study was to determine if prescribed fire has a positive, neutral, or negative effect on bat behavior immediately following prescribed fire. If there was an effect, we also wanted to determine what factors contribute to bats' response and if their response changed over time. We recorded bat activity after fires conducted between February and March 2022 in northwestern South Carolina using Anabat Express ultrasonic detectors. We randomly selected treatment sites in hardwood and pine stands of burn units and control sites at least 500 m outside of burn boundaries. We also collected data on insect abundance, percent canopy cover, basal area, and understory density at each study site. We recorded 867 passes during our 45-day study period with 264 passes identified to species. We recorded 587 passes on burn sites and 280 passes on control sites. Total bat activity was significantly influenced by stand type and treatment. Big brown/silver-haired bats and red bats/Seminole bats were both significantly influenced by the interaction of stand type and treatment and these groups' activity decreased significantly as canopy cover increased. The Myotis/tricolored bat species group was not significantly impacted by burns or any factor that we measured. There was no significant variation in total or species group activity as time increased post burn. Our findings suggest that not only are bats not negatively impacted by prescribed burns, but some species may benefit from the disturbance and its ability to create more open foraging habitat.

SUMMER ROOST SELECTION BY SEMINOLE BATS IN COASTAL SOUTH CAROLINA

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The Seminole bat (*Lasiurus seminolus*) is a common yet understudied species in the southeastern United States. There is little information about the habitat characteristics at their summer day roosts which are in the foliage of trees. To get a better understanding of summer day-roost selection, we observed roosting habits of Seminole bats at Palmetto Bluff in Bluffton, South Carolina. We radiotracked four adult male and four adult female Seminole bats to their roost trees from mid-June to mid-August 2021 and one adult male and five adult females from mid-June to early-September 2022. We documented a total of 22 male and 45 female roosts. We measured characteristics of the roost tree as well as a 10m radius plot around the roost and repeated these measurements at two random trees for every roost tree. We compared characteristics of roost trees and plots between males and females to determine whether there were sex-specific differences in selection of day roosts. We also compared the selected day roosts and surrounding plots to random trees and plots. Seminole bats roosted in the foliage of loblolly pine (*Pinus taeda*), slash pine (*Pinus elliottii*), live oak (*Quercus virginiana*), water oak (*Quercus nigra*), and hickory (*Carya sp.*) trees. Male and female roost trees were taller than random trees. Female roost trees had wider canopies, more clutter, and larger DBH than males. At the plot level, males used areas that had taller, skinnier trees, and females used areas with taller trees, larger canopies, and fewer trees than random plots. Our results suggest that females are selecting roosts with more cover than males, and areas with taller trees on the landscape may be important roosting habitat for Seminole bats.

MULTI-SCALE NATURAL ROOST SELECTION BY AN ELUSIVE AND ENDANGERED SPECIES

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Understanding roost selection is fundamental for successful bat conservation but is often challenging for rare and high-flying species. At the time of listing, nothing was known about the factors influencing roost selection for the federally endangered Florida bonneted bat (*Eumops floridanus*). Between 2015 and 2022, we used various passive and active strategies (acoustic lures, PIT tags, break-away collars, aerial radio-telemetry) to locate and characterize roosting habitat of *E. floridanus* across their range, conducting vegetation surveys at roost site plots and random plots. In total, we located 36 roost trees throughout pine flatwood and freshwater forested habitats, 75% of which were snags. We used generalized linear mixed models and multinomial regressions to test predictors influencing roost selection at multiple scales. At the plot-level, roost plots had greater subcanopy airspace and lower canopy depth than random plots. At the tree-level, roost trees were taller above the canopy, had greater diameter at breast height (DBH) and had a larger number of cavities than random trees. At the roost-level, occupied cavities had greater entrance sizes and heights above the ground than unoccupied cavities. Together this indicates that *E. floridanus* selects for fatter, taller cavity trees with more open space around the tree for easier access or greater solar radiation, and prefers larger cavity entrances situated high on trees. Moreover, nearly all of the roosts (97%) were located within cavities, and only 2.5% of over 6000 total trees measured had cavities, suggesting that cavities are a very limited and highly coveted resource for this species. Documented roost losses and abandonment following natural disasters and management activities indicate that *E. floridanus* faces ongoing threats to its roosting habitat and long-term recovery. These findings will be incorporated into management and policy guidelines to protect and promote suitable roosting habitat for this endangered species.

ROOST SELECTION BY SYNANTHROPIC BATS IN RURAL KENYA AND IMPLICATIONS FOR HUMAN-WILDLIFE CONFLICT

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Many wildlife species are synanthropic, often using structures built by humans. This creates a high-risk interface for human-wildlife conflict and zoonotic pathogen spillover. However, studies that investigate microclimate and structural attributes of buildings that make them appealing to wildlife and create that interface with humans are currently lacking. We surveyed 85 buildings used by bats and 172 neighboring buildings unused by bats (controls) in southeastern Kenya during 2021 and 2022. We evaluated the role of microclimate and structural attributes in building selection by using structural equation models to assess both direct and indirect effects of features on bat roost selection. We identified eight bat species roosting inside surveyed buildings, with over 25% of building roosts used concurrently by multiple bat species. We demonstrate that bats selected older and taller buildings with higher relative humidity and lower presence of permanent human occupants. When broken down by the most commonly observed species, Molossid bats (*Mops condylurus* and *M. pumilus*) selected buildings with these same attributes, except building age was no longer important. Conversely, the megadermatid, *Cardioderma cor*, selected only older buildings with lower presence of permanent human occupants, regardless of height or humidity. Our results show that different synanthropic wildlife species select building roosts based on different characteristics, and roost selection is predictable based on microclimate and structural attributes of buildings. These results can be used to identify hotspots of human-wildlife interactions within the urban-wildlife interface and mitigate human-wildlife contact in African hotspots for emerging infectious diseases, ultimately promoting wildlife and human health.

A BENEFICIAL PARTNERSHIP BETWEEN THE UNITED STATES AIR FORCE AND FISH & WILDLIFE SERVICE IN FLORIDA FOR FLORIDA BONNETED BAT AND TRICOLORED BAT CONSERVATION

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The US Fish and Wildlife Service and US Air Force work together in a Partnership to conserve and manage threatened and endangered species on military installations. In Florida, the Partnership facilitates projects focusing on tricolored bats (*Perimyotis subflavus*, proposed for endangered status), and the Florida bonneted bat (*Eumops floridanus*, listed endangered). Past projects include landscape-level bat acoustic monitoring, trapping and tagging bats to locate roosts, winter roosting emergence counts, monthly emergence counts, and monitoring ahead of land management activities. Installations with bat species are focusing on accomplishing the military mission while conserving natural resources and restoring at-risk and protected species. In the future, we hope to foster strong partnerships to facilitate collaboration in better understanding bat species distributions and how land management activities on military lands can encourage species recovery. We welcome discussions post-presentation with audience members to discuss opportunities for collaboration and conservation.

THE MISSISSIPPI BATS AND BRIDGES INITIATIVE

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The Mississippi Bats and Bridges Initiative was developed and implemented in April 2021 and involves bat surveys at bridges and culverts throughout the state with an emphasis on the northern long-eared bat (*Myotis septentrionalis*), Indiana bat (*M. sodalis*) and gray bat (*M. grisescens*). Mississippi is on the edge of the range for all three of these federally listed species and few records exist for each in the state. Presently, 261 bridges and 161 culverts in 33 counties have been surveyed. A total of 4,252 bats representing seven species have been observed under 49 bridges and in 33 culverts (19% and 21% of total surveyed respectively) in 17 counties since 2021. Brazilian free-tailed bats (*Tadarida brasiliensis*) had the highest number of individuals observed representing 51% of the total observed (under eight bridges), followed by the southeastern myotis (*M. austroriparius*) (32% under eight bridges and in 21 culverts), big brown bat (*Eptesicus fuscus*) (10% under 22 bridges and in 9 culverts), tri-color bat (*Perimyotis subflavus*) (4% under two bridges and in 17 culverts) Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) (2% under 14 bridges and in 3 culverts), Indiana bat (0.7% under 1 bridge) and gray bat (0.3% under 1 bridge).

Two gray bats and 12 Indiana bats were observed utilizing the same bridge located in Tishomingo County in the northeast corner of the state on different dates. This is only the third location record for Indiana bats and the fourth location record for gray bats in Mississippi. It is the first bridge roost documented in the state for both of these species. The bridge is 450 feet long and 35 feet wide and is surrounded by a tupelo brake on the north side and mixed hardwoods on the south side. An intensive survey effort will begin at the site starting in April 2023.

FORAGING ECOLOGY OF AN OZARK BIG-EARED BAT MATERNITY COMPLEX IN WESTERN ARKANSAS

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The Ozark big-eared bat (*Corynorhinus townsendii ingens*) is a federally endangered subspecies restricted to north-central/western Arkansas and northeast Oklahoma. Although the population is estimated at less than 2,000 individuals, few studies evaluate important ecological characteristics of the species, including nightly movements or habitat preferences. A two-year foraging study was conducted at a maternity complex in the Ozark-St. Francis National Forest, Franklin County, Arkansas to assess the colony's foraging ecology in response to past timber management activities. Twenty-seven Ozark big-eared bats were radio-tagged in 2021 and 2022 during two trapping events in each year, including 24 females and three males. The four cohorts were tracked for seven nights, each, using synchronized azimuths from at least five telemetry stations, generating a total of 779 locations. Colony home range size was estimated at 2,461 ha and mean core-foraging areas was approximately 224 ha using uniform-density kernel estimates (n = 779). Home ranges for females (1,412.8±313.7 ha) were significantly larger than males (722.8±159.8 ha; Welch's t17 = 2.3, p = 0.04) and females also traveled significantly farther than males (Welch's t188.1 = -3.3, p = 0.001). Binomial linear mixed effects models were used to assess the role of landscape features and forest treatments in describing probability of species presence during foraging. Landscape features included DEM, slope, aspect, water distance, road distance, (USFS) incorporation age. Forest treatments included chemical, cutting, fire, and mechanical activities conducted 2004 to 2022. The full model with all landscape and treatment variables explained significantly more variation in foraging use than random (X243 = 7,616.7, p <2.2e-16), indicating the importance of controlling for landscape variability and the effects of forest treatments. All forest treatments had significant effects on likelihood of Ozark big-eared bat presence: areas were used significantly more following prescribed fire, and were used significantly less following other treatments.

HIBERNACULA RECOVERIES REVEAL MIGRATION HABITS AND MANAGEMENT GAPS FOR VIRGINIA BIG-EARED BATS IN KENTUCKY

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Virginia big-eared bats (*Corynorhinus townsendii virginianus*) occur in karst-heavy eastern Kentucky in isolated caves and rock shelters. Most of the state's known population overwinters in a single limestone cave. Approximately 30% of the species' overwintering population has historically been accounted for during summer maternity site surveys. Assuming existence of undetected critical maternal habitat for the species, we applied multi-colored anodized bands during harp trap surveys at known summer sites to determine recovery rates in primary hibernacula. We collected reproductive and morphometric data across eleven harp trapping events at six sites through the 2021 and 2022 maternity seasons. These data indicate 79% of adult female Virginia big-eared bat captures exhibited signs of reproduction (pregnant, lactating, or post-lactating). Bands were applied to 417 Virginia big-eared bats, and 26% have been recovered in hibernacula to date. Banding effort results lead us to hypothesize the existence of two subpopulations of Virginia big-eared bats in Kentucky with limited interchange. Band recoveries at the primary northern hibernaculum yielded a 65% return rate from maternity sites associated with the northern subpopulation, whereas maternity sites associated with the southern subpopulation yielded a 15% return rate at this cave. Additionally, bands from the primary southern maternity site were discovered across multiple shelters during hibernacula surveys. Management in areas surrounding known southern hibernacula poses challenges due to more extensive karst topography and a higher concentration of private land ownership. Further banding and recovery search efforts will aid in continued assessment of these management challenges for Virginia big-eared bats in Kentucky.

TRICOLORED BAT FORAGING SITE USE AND SELECTION DURING SPRING AND FALL IN NORTHWESTERN SOUTH CAROLINA

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Tricolored bats (*Perimyotis subflavus*) have experienced some of the largest population declines due to WNS. Recent studies focusing on factors affecting bat survival and population recovery from WNS suggest the importance of fat reserves pre- and post-hibernation (i.e., spring and fall). Our goal was to determine suitable foraging habitat for tricolored bats in northwestern South Carolina during spring (March-May) and fall (September-November). We determined occupancy at 138 sites during spring and fall 2021 and 2022 using acoustic detectors, and related tricolored bat occupancy to forest management, forest structure, forest composition, and landscape features. We stratified stands on the Andrew Pickens Ranger District of the Sumter National Forest using forest type and past forest management, and selected sites using the spatially balanced Generalized Random Tessellation Stratified sampling design. We placed acoustic detectors at selected sites for three nights and recorded vegetation structure and landscape data for each site. We identified bat calls using Kaleidoscope Pro software, and calls identified as tricolored bats were manually vetted. We ran single season occupancy models to assess habitat use. Across both years we detected tricolored bats at 40 sites in spring and 34 sites in fall. During spring, probability of occupancy declined as percent canopy cover increased. During fall, probability of occupancy increased at sites with past forest management; sites that had previously been burned, harvested, or thinned had greater occupancy than control sites. Our results suggest the importance of forest openings or reduced understory clutter for suitable foraging sites pre- and post- hibernation in northwestern South Carolina. Forest management that increases open habitat may provide tricolored bats greater chances of survival and recovery from WNS because access to open habitat likely minimizes energy expenditure and therefore enhances energy acquisition.

THE RESPONSE OF BATS AND THEIR INSECT PREY TO DIFFERENT COASTAL UPLAND HABITAT MANAGEMENT TECHNIQUES

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Grand Bay National Estuarine Research Reserve

Coastal upland forests in Mississippi are home to a variety of flora and fauna, including the unconsidered forest-dwelling bats. Bats play a crucial role within forested ecosystems as the primary predators of night flying insects, but national declines in some bat populations have reduced many of the ecological and economic services bats provide. As threats increase, coastal forests have the potential of being a vital refugia for its residential and migrating bats. Many forested areas are managed in efforts to improve overall forest habitat quality and increase biodiversity. Understanding how bats respond to land management induced changes within Mississippi coastal forested habitat is necessary for the conservation of these species. Leveraging off the large-scale land management projects at the Grand Bay National Estuarine Research Reserve (GNDNERR) in Jackson County, Mississippi, this project will determine if the activity and diversity of bats and their insect prey is affected by different coastal upland land habitat management techniques, such as prescribed fire and mechanical clearing. Analysis of bat species presence and activity was assessed using acoustic surveys. Passive insect traps were used to trap flying insects for analysis of abundance and diversity relationships among potential bat prey between the land management techniques. Findings from this study could be used to inform land managers of the potential benefits and impacts of land management practices on forest bats and their insect prey.

BALANCING NATURAL AND CULTURAL RESOURCES: A RAFINIESQUE'S BIG-EARED BAT COLONY AND A NATIONAL HISTORIC SITE

Stacy Scherman, Jennifer Kindel
SC State Parks

The South Carolina State Park Service (SCSPS) is responsible for the conservation, protection and interpretation of the diverse natural and cultural resources entrusted to it. One SCSPS property is Hampton Plantation State Historic Site (HPSHS), in Georgetown SC, which has been listed on the National Historic Register since 1970. There are two historic structures remaining on the site, a Mansion house and a kitchen building. While public tours of the mansion house occur twice daily year-round, the kitchen building has been closed to the public for over 30 years due to a colony of state endangered Rafinesque's big-eared bats (*Corynorhinus rafinesquii*; CORA) that reside in the attic, the largest known colony in the state. Working with South Carolina Department of Natural Resources (SCDNR) to determine if public access to the building could be safely improved during non-sensitive seasons, cameras were set up in the attic to monitor CORA reactions to test tours. These test tours consisted of 2 – 4 park staff standing in the first-floor kitchen area while having a 15-minute conversation. A SCDNR or SCSPS staff member recorded observations made using a nearby monitor to view CORA reactions. Test tours were conducted in non-sensitive seasons, spring (February 16 – March 31) and fall (August 16 – November 14). The colony would be considered disturbed if multiple CORA exhibited sustained flight or left the space during a test tour. Our observations did not find that test tours in the fall disturbed the colony. Using this evidence, SCDNR approved twice daily 15-minute tours of the kitchen building during the fall non-sensitive season. In the short-term, further test tours are planned for the spring non-sensitive season. In the long-term, a newly built bat tower will be monitored for use while SCSPS and SCDNR explore maternity season and winter season test tours.

WORKING WITH A DETECTION DOG: LESSONS FROM THE FIELD

Lisa Smith, Kendyl Hassler
Florida Fish and Wildlife Conservation Commission

Detection dogs have been used extensively in wildlife to directly, and indirectly, detect a variety of mammals, birds, reptiles, and even insects. Detection dogs are advantageous for locating cryptic species that have large home ranges and occur in low densities and have been proven to be more effective in detecting rare mammals than camera traps or hair snares. Additionally, the collection of scat can have multiple advantages when coupled with laboratory analysis, including the ability to identify species, individuals, density, habitat use, diet, and hormone levels. Each scat produces a scent cone, where the strongest concentration of vapor molecules exists closer to the target and disperses out in lower concentrations until the scent is undetectable. The probability of detection, and thus the detection distance, can be affected by weather and habitat conditions. Despite extensive survey efforts, both the Everglades mink (*Neovison vison evergladensis*) and long-tailed weasel (*Mustela frenata*) have proven difficult to detect using traditional survey methods and therefore we acquired a detection dog. To determine how far away scat could be reliably detected during surveys (effective sweep width) and to evaluate the impact of weather and habitat on detection, we conducted controlled field trials where the dog searched for mink scat along transects in four different vegetation classes (open, dense understory, dense overstory, and trail). We used the program jagsUI in program R, using Bayesian Markov chain Monte Carlo methods to evaluate the impact of corresponding covariates. We determined our detection dog had an effective sweep width of 50 m, surprisingly with no significant impact of weather or vegetation covariates. Additionally, when deciding to use a detection dog or planning a study, we recommend several considerations related to the biology of the target species and the environment to be surveyed to determine practicality and increase the probability of success.

MICROBIAL COMMENSALS OF TRI-COLORED BATS IN GEORGIA AND THEIR RELATIONSHIP TO WNS SUSCEPTIBILITY

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Pseudogymnoascus destructans (Pd) is a fungal pathogen that has been circulating in North American bats since its initial discovery in 2006. Pd is the causative agent of white-nose syndrome (WNS), a disease leading to as much as a 90% decrease in some eastern United States bat populations. To date, there is no effective treatment for WNS, but microbiomes have come under investigation in other disease systems for their perceived connection with pathogen colonization and disease severity across taxa. To this end, our research will focus on characterizing the microbiome of tri-colored bats (*Perimyotis subflavus*) across transportation-based (i.e.: manmade bridges and culverts) and subterranean hibernacula. Tri-colored bats have been documented living in anthropogenic structures which maintain temperatures consistent with Pd growth requirements, yet have not been classified as having WNS. Because built environments are correlated with altered host microbiomes, I aim to differentiate tri-colored bat microbiomes across these anthropogenic, transportation-based hibernacula and more traditional, subterranean hibernacula. By characterizing these microbiomes, I will identify microbes displaying anti-fungal properties, which will then be tested in vitro for anti-Pd activity. We will fill a gap in the knowledge of how bat microbiomes impact host survival while identifying microbial candidates for possible probiotic treatments.

Poster Presentations

Listed alphabetically by first author

BAT HOUSE TEMPERATURE MANAGEMENT USING A WAX MOTOR

Larry Alvord
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Installation of bat houses is a common strategy to address habitat loss and fragmentation. Bats can occupy these houses from spring through fall. However, bat house designs with fixed features may under perform during temperature extremes. Internal temperatures can potentially reach levels that stress or harm resident bats. This work demonstrates the concept of using a wax motor to repeatably open and close an auxiliary vent in response to the internal temperature of a bat house without the need for external power or control. An off-the-shelf wax motor thermostat with a melt point of ~44ºC was connected to an auxiliary vent in the peak of a single chamber bat house mock-up. Solar heating was simulated using a variable DC power supply connected to thin film heater elements distributed within the mock-up. The temperatures near the top, middle, and lower regions of the mock-up were recorded. The thermostat opened the vent after the temperature reached ~50ºC. The temperature in the peak did not significantly change after opening. However, the temperature in the mid section dropped from ~50ºC to ~42ºC and the lower section dropped from ~40ºC to ~30ºC. The thermostat closed the vent after the power was reduced. The internal temperatures then stabilized between ~34ºC to 45ºC depending on location and applied power. Opening the vent produced a physiologically significant amount of cooling within the roost chamber. Closing the vent retained heat in the conventional manner. This functionality may enable improvements in artificial roost temperature management. Optimization of the wax formulation and vent mechanism could enable a wax motor to maintain more ideal internal temperatures within a bat house.

VARIATION IN MOVEMENT PATTERNS AND WINTER ROOST USE OF TRICOLORED BATS (*PERIMYOTIS SUBFLAVUS*) IN NORTH FLORIDA

Daniel Batie, Scout Hogan, Mike Gilikin, Terry Doonan, Lisa Smith
Florida Fish and Wildlife Conservation Commission
U.S. Fish and Wildlife Service

Tricolored bats (*Perimyotis subflavus*) are known to use caves, bridges, and roadway culverts as hibernacula in northern Florida. However, we know very little about their movement between these hibernacula or their use of other winter roosts. Movements of bats among culverts could act as a *Pseudogymnoascus destructans* transmission corridor between white-nose syndrome (WNS) positive and WNS negative regions. To better understand tricolored bat winter movements and roost use, we attached 0.27 g radio transmitters to bats (n = 20) roosting within culverts in North Central Florida in winter 2021-2022 (December to March) and on bats in culverts or caves in Northwest Florida in winter 2022-2023 (n = 10). We tracked bats to their roost by using directional antennas to follow transmitter signal to the culvert, tree, or cave roost site or by triangulating to an approximate area when we could not gain access to the site. We found that bats tagged in North Central Florida stayed in their initial culvert (50 total days between all bats), moved to trees or areas with trees (n = 27; 111 total days tracked between all bats), or moved to a nearby culvert (n = 1). We observed 5 of those bats switching between culverts and trees multiple times over the duration of the tracking period, while 7 bats roosted only in trees after tagging. In contrast, most of the radio tagged bats in Northwest Florida (n = 9) stayed in their original roost for the duration of the life of the transmitter. One bat moved from the original cave to a nearby cave, where it remained until the transmitter was recovered after 17 days. Our findings indicate that tricolored bat winter roosting behavior is more complex than we initially thought and might vary greatly depending on geographical location and the regional climate.

ACTIVITY PATTERNS OF ALLEGHENY WOODRATS (*NEOTOMA MAGISTER*) AND CO-OCCURRING RODENTS IN EASTERN KENTUCKY

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Allegheny Woodrats (*Neotoma magister*) are rodents affiliated with high elevations, rocky outcrops, and cave systems. Allegheny Woodrats have experienced population declines since the early 1900's; interspecific competition for this species merits investigation given declines of primary food resources such as American Chestnuts (*Castanea dentata*), and various oaks (*Quercus sp.*) on the landscape. Specifically, understanding variation in seasonal and daily activity patterns of Allegheny Woodrats alongside more common rodents such as Peromyscus sp. of mice and eastern chipmunks (*Tamias striatus*) will help elucidate potential competitors' impacts on Allegheny Woodrat activity. We deployed 41 camera traps baited with molasses-covered goat feed across three state nature preserves located on Pine Mountain in Letcher and Harlan counties, Kentucky. Sampling spanned April-August 2022, yielding a total of 1341 trap nights. Allegheny woodrats were detected across all nature preserves and were active across the full field season; our study provides valuable occurrence records for this understudied species in Kentucky. In total, *Peromyscus sp.*, Allegheny Woodrats, and eastern chipmunks were documented at 76%, 68% and 39% of camera locations, respectively. Unsurprisingly, Allegheny Woodrats were active during nocturnal periods. Regarding potential competitors, *Peromyscus sp.* were active during similar (but broader) nocturnal time periods, whereas eastern chipmunks were active during diurnal periods. Most camera locations (n = 24) yielded observations of both Allegheny Woodrats and Peromyscus sp., albeit never in the same camera frame. Our data suggest Allegheny Woodrats and Peromyscus sp. are in competition for food resources given overlap in peak activity periods at the same camera locations.

EXAMINATION OF PLAINS SPOTTED SKUNK (*SPILOGALE INTERRUPTA*) BURROW SYSTEMS

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The Plains Spotted Skunk, *Spilogale interrupta*, and other *Spilogale spp.* have often been documented as using burrows for cover; however, the schematics of a burrow that Spilogale spp. use had only been documented once. During the recovery of two GPS radio transmitters in the Katy Prairie region of Southeast Texas, we excavated two active *S. interrupta* burrows. Herein, we report the schematics of one system that was likely initially created by a *Geomys breviceps*. Additionally, we provide casual information on a second excavated burrow system frequently used by a *S. interrupta*. Our observations further confirm the three requirements for diurnal rest site usage of *S. interrupta*: protection from predation, thermoregulatory benefits, and protection from inclement weather, while providing additional insight into the intricacies of the burrow system itself. Future research into the structure of Spilogale burrows is needed for improving future conservation and management efforts of the genus.

WHEN ART MEETS SCIENCE: DESCRIPTION OF A NEW SPECIES OF *STEATONYSSUS* MITE ASSOCIATED WITH SOUTHEASTERN MYOTIS (*MYOTIS AUSTRORIPARIUS*)

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When art meets science, new discoveries and ideas move past tables of data and turn into a visual language that can be effectively communicated to everyone. Scientific illustrations work in tandem with academic progress in cementing new ideas and acting as a launch point for new discoveries. In this study, describe the research and collaboration to illustrate a new bat mite of the genus Steatonyssus (Family Macronyssidae) found on Southeastern Myotis (*Myotis austroriparius*) captured in working pine forest lands of the southeastern U.S. Coastal Plain during winter. In the description, we highlight differences observed such as the shape of the shields or the number of setae in both males and females with respect to individuals of other species of the genus Steatonyssus. With this research, we highlight how art should work in unison with science to make the identification of similar species clear and easily accessible.

FACTORS AFFECTING ENDANGERED BEACH MOUSE POPULATIONS AT ISOLATED COASTAL STATE PARKS

Terry Doonan, Zachary Butler, Emily Evans, Jeffery Gore
Florida Fish and Wildlife Conservation Commission

The Choctawhatchee beach mouse (CBM; *Peromyscus polionotus allophrys*) is a federally endangered subspecies that is endemic to coastal dune habitat in Walton and Bay counties of the Florida Panhandle. In Walton County, beach mice have historically occupied the conservation areas of Topsail Hill Preserve (THPSP), Grayton Beach (GBSP), and Deer Lake (DLSP) state parks. The primary factors influencing these isolated populations are believed to be habitat size and connectivity, degradation of habitat from major storms, predation pressure, and genetic bottlenecks. The Florida Fish and Wildlife Conservation Commission staff has used track tubes to passively monitor CBM in these state parks since 2008. Using these data, we compared changes in CBM presence within and across these parks from 2008 through 2022. Our results showed that CBM detections are generally high and stable over time at THPSP, the largest park and the park where habitat is least degraded by impacts from tropical storms. CBM detections were generally lower and varied a great deal over time at both DLSP and GBSP. CBM were extirpated from DLSP in 2018 and in one unit of GBSP in 2022. Storms and predation may have had significant negative impact on CBM populations at those two sites. Historically, CBM populations at both GBSP and DLSP have been supplemented by translocations and our results indicate future translocations to these parks may be needed. Furthermore, THPSP serves as an important long-term reference site and the CBM population there is key both for resilience of the CBM species and as a source for future CBM translocation and conservation efforts. Our results suggest that small populations of beach mice may not be self-sustaining long-term without continued translocations to augment numbers, as well as appropriate, ongoing predation monitoring and management.

AVAILABILITY OF LARGE SNAGS AND FOREST CLUTTER DIFFERENTIATES A LONG-TERM INDIANA BAT ROOSTING AREA FROM ITS SURROUNDING LANDSCAPE

Matt Dunn, Scott Bergeson
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Bat colonies are often faithful to traditional roosting areas, colonies continuously residing or annually returning to an area post-hibernation. A colony of the endangered Indiana bat (*Myotis sodalis*) near the Indianapolis International Airport (IN) has been faithful to a roosting area for over 25 years, despite expanding urbanization and loss of known maternity roosts. To understand why the colony has remained, we investigated the differences in potential roost availability between the roosting area and the surrounding landscape. We surveyed approximately 30 transects (40x100m) of both type and collected data on all live trees and snags > 10cm in diameter at breast height (DBH). We ranked, using Akaike's Information Criteria, eight logistic regression models based on a priori hypotheses concerning roost selection of the species. Models that best differentiated transect type involved forest structure, forest composition, and the availability of potential roosts. On average, transects in the surrounding landscape had greater live tree DBH (landscape: 23.49 ± 0.90 cm, roosting area: 22.64 ± 0.83 cm), a greater number of snags (landscape: 13.38 ± 1.6 snags, roosting area: 8.73 ± 1.31 snags), and a greater number of snags over 20 cm DBH (5.25 ± 0.80 snags, roosting area: 3.58 ± 0.50 snags) when compared to the roosting area. However, roosting area transects contained larger diameter snags (landscape: 20.24 ± 0.91 cm, roosting area: 24.94 ± 2.09 cm) and a higher percentage of snags over 20 cm DBH (landscape: 41.13 ± 4.57 %, roosting area: 38.87 ± 4.40 %). Our results suggest that this colony may be faithful to their roosting area due to the relatively high proportion of large snags and the reduced size of live trees in the area; characteristics that would increase the number of potential solar exposed roosts and decrease the amount of clutter surrounding roosts.

REDISCOVERED STUDENT DATA LEAD TO TRICOLORED BAT MATERNITY AND WINTER ROOST FINDINGS IN NORTH CAROLINA COASTAL PLAIN BRIDGES

Katherine Etchison, Joey Weber
NC Wildlife Resources Commission

Tricolored bat (*Perimyotis subflavus*) use of bridges on the North Carolina Coastal Plain was documented during roost surveys conducted from 1997 to 2003 by JoEllen McDonnell and Joseph Felts of North Carolina State University and the University of North Carolina Wilmington, respectively. McDonnell's summer roost surveys showed a strong correlation between bat presence and bridge type with tricolored bats found under channel beam bridges more than other bridge types. Felts monitored bridges from July to February and documented tricolored bat use at bridges across seasons.

These historic data were recently rediscovered and are especially valuable considering the proposed listing of the tricolored bat under the Endangered Species Act, leading the North Carolina Wildlife Resources Commission to repeat daytime spotlight surveys at bridges that previously had presence of bats or guano. We surveyed three bridges in Bertie County in May 2022 and found a tricolored bat roosting with three pups under a channel beam bridge. In January 2023 in Duplin, Jones, Onslow, and Sampson Counties, we surveyed 21 bridges and found 9 bridges being used by tricolored bats. Counts of tricolored bats ranged from 1 to 9 bats under 3 bridge types: channel beam (n=5), cored slab (n=3), and I-beam (n=1). Six bridges built in 1967-1975 with tricolored bat presence have not been replaced since the historic survey and three bridges were replaced in 2012-2014. Since these recent surveys led to findings of tricolored bat maternity and winter roosts, we will continue surveys of historic bridges in 2023 and 2024. Our objectives are to better understand tricolored bat occurrence in bridges on the Coastal Plain, particularly in reference to bridge type, seasonality, and maternity use.

USE OF MAMMALIAN MUSEUM SPECIMENS TO TEST HYPOTHESES ABOUT THE GEOGRAPHIC EXPANSION OF LYME DISEASE IN THE SOUTHEASTERN UNITED STATES

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NC Museum of Natural Sciences
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Virginia Museum of Natural History

Lyme disease (caused by *Borrelia burgdorferi*) is the most frequently reported vector-borne disease in North America, and its geographic extent is increasing in all directions from foci in the northeastern and north-central United States. Several southeastern states, including Virginia and North Carolina, have experienced large increases in incidence in the past two decades, with the biggest changes in incidence occurring in the western portion of each state. We tested the hypothesis that *B. burgdorferi* was present in western Virginia and North Carolina *Peromyscus leucopus* populations prior to the recent emergence of Lyme disease. Specifically, we examined archived *P. leucopus* museum specimens for *B. burgdorferi* DNA. After confirming viability of DNA extracted from ear-punch biopsies from *P. leucopus* study skins collected between 1945 and 2000 in 19 Virginia counties and 17 North Carolina counties, we used qPCR of two species-specific loci to test for the presence of *B. burgdorferi* DNA. Ten mice, all collected from the Eastern Shore of Virginia in 1989, tested positive for presence of B. burgdorferi; all the remaining 344 specimens were B. burgdorferi-negative. Our results suggest that B. burgdorferi was not common in western Virginia or North Carolina prior to the emergence of Lyme disease cases in the past two decades. Rather, the emergence of Lyme disease in this region has likely been driven by the relatively recent expansion of *B. burgdorferi* in ticks and reservoir hosts in the mountainous counties of these two states.

ASSESSING THE POTENTIAL EFFECTS OF HIGHWAY REPAIR CONSTRUCTION ON CAVERNICOLOUS BAT SPECIES AT EDGEMON CAVE IN NEWTON COUNTY, ARKANSAS.

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The Arkansas Department of Transportation (ARDOT) and Environmental Solutions and Innovations, Inc. developed a pilot approach to assess the potential impacts of drilling noise and vibration associated with slide repair activities along Arkansas Highway 21 on cavernicolous bat species at Edgemon Cave in Newton County, Arkansas. The study was conducted from 21 May 2021 - 1 July 2021 during which four slide repairs were undergoing construction. The three study methods used to collect data included seismic monitoring, ultrasonic acoustic monitoring, and audible acoustic monitoring. Two Instatel Microclimate Seismographs outfitted with external acoustic microphones were placed within the cave to record sound levels during seismic events. THOR (Stanley Black and Decker, Inc.) software was used to analyze time and intensity of seismic events related to the slide repair construction. Three Wildlife Acoustics ultrasonic detectors were placed in and around the cave to determine if bat activity changed during construction activities. Call files were analyzed through Kaleidoscope Pro (Kpro) automated ID software. All bat species were visually vetted by an expert bat acoustic identification specialist. Three Wildlife Acoustic audible detectors were placed both inside and outside of the cave. The recorded sound files were processed through Kpro using a cluster analysis to determine if the sounds were caused by anthropogenic (e.g., construction, vehicles) or natural (birds, insects, bats, water) sources. Data from the three data collection methods were time-stamped and compared with construction activity logs. No behavioral changes of bats were identified during construction activities, likely due to cave depth coupled with the vibration-dampening effect of multiple geologic layers. The methods employed in this study were used to develop a technique for monitoring potential impacts of drilling and blasting on cavernicolous bat species for future studies.

ASSESSING VARIATION IN SEASONAL BAT ACTIVITY PATTERNS IN NORTH FLORIDA

Scout Hogan, Michael Gillikin, Terry Doonan, Maria Monarchino, Lisa Smith
Florida Fish and Wildlife Conservation Commission
U.S. Fish and Wildlife Service

Bat species that are morphologically similar, may partition resources in time or space, or by prey size. We examined temporal overlap among species and used acoustic monitoring data to examine variation in nightly activity patterns between seasons. We conducted acoustic surveys across 69 sites in north Florida during winter and summer during 2020 and 2021. We auto-identified bat calls using Kaleidoscope Pro and grouped species based on similarities in call frequencies and structures. Within groups, we expected to see differences in nightly activity patterns among species if they were utilizing similar foraging habitat. Nine bat species were classified into three groups: 1) *Eptesicus fuscus, Tadarida brasiliensis, and Lasiurus intermedius*, 2) *Lasiurus borealis, Lasiurus seminolus, and Nycticeius humeralis*, and 3) *Myotis austroriparius, Myotis grisescens, and Perimyotis subflavus*. There were 80,697 acoustic calls collected in winter and 178,775 calls collected in summer. We used the overlap package in R to create a kernel density plot and calculate a delta value to determine the amount of overlap of activity among species groups and among species in both seasons. There was a high degree of overlap among species within each of the groups for both seasons. There was also a high degree of overlap among species groups within each season. Even with the high degree of overlap, species had different peaks in activity within seasons, and for most species their activity peaks differed between seasons. During winter some species saw a slight increase in activity prior to sunrise, potentially increasing foraging productivity as temperatures increased. The overlap in both winter and summer activity may indicate that there is no shortage of prey items during these seasons in Florida's subtropical climate, or bats are partitioning activity in space across different habitats.

DETERMINING RELATIONSHIPS BETWEEN BAT ACTIVITY AND WOODY VEGETATION IN NATURAL AND CONSTRUCTED WETLANDS ON THE DANIEL BOONE NATIONAL FOREST

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Wetlands provide habitat and critical ecosystem services for a wide range of organisms, including bats. However, much about bats and wetlands is still unknown. This study examined bat activity in Myotis and non-Myotis bat species and woody vegetation in both natural and constructed upland-embedded wetlands on the Daniel Boone National Forest. To test this relationship, we surveyed bat activity and woody vegetative structure at three wetland pairs (three natural and three constructed wetlands) during two data collection periods. We used SM3 bat acoustic detectors and identified bat calls using Kaleidoscope Pro software. The data relationships between basal area, woody vegetation density and dominance, and Myotis and Non-Myotis species activity were analyzed using R studio. The results show Non-Myotis species were more active at constructed wetland sites, and their activity decreased in wetlands with higher tree density and greater basal area. Myotis species were more active at natural wetland sites, and while their activity increased as basal area increased, activity was relatively consistent across tree densities. These findings suggest natural wetlands may provide important habitat for Myotis species, which is useful information for improving management practices as bat populations continue to decline due to white-nose syndrome.

COMPARATIVE EMBRYOLOGY OF THE SPECIALIZED NASAL TURBINALS OF *DESMODUS ROTUNDUS* AND *GLOSSOPHAGA SORICINA*

Alexa Kane, Alisa Hutagalung, Laurel Yohe
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Neotropical leaf-nosed bats (Phyllostomidae) demonstrate a diversity of different feeding strategies and are known to use olfaction to locate their food sources. *Desmodus rotundus* is one of the few mammal species that feed exclusively on blood, therefore they have specialized senses to optimize hunting capabilities, including olfaction. In contrast, *Glossophaga soricina* is a nectarivorous bat with an elongated palate and sticky tongue. By using diffusible iodine-based contrast-enhancing computed tomography (dice-CT) scanning, we obtained 3-dimensional digital models of the olfactory structures of *D. rotundus* and *G. soricina* throughout different stages of ontogeny. These models have allowed for more accurate measurements of the surface area of the olfactory epithelium of the different nasal turbinals. Segmenting the nasal turbinals throughout the embryonic stages across different species gives a better understanding of how each turbinal forms and then subsequently specializes, especially when compared to other species with different diets. Ongoing investigation can provide morphological and genetic evidence for the evolution of highly specialized traits observed in both species.

TRICOLORED BATS OVERWINTER IN CULVERTS IN CAVELESS SOUTHERN ARKANSAS

Anneka Lamb, Virginie Rolland, Roger Perry
Arkansas State University

Tricolored bats (*Perimyotis subflavus*; PESU) are proposed for listing under the Endangered Species Act and are already considered a Species of Greatest Conservation Need (SGCN) in Arkansas. In southern Arkansas, records of PESU captures exist for summer but not for winter because this region lacks caves where winter surveys for PESU are typically conducted. However, PESU may overwinter in culverts as reported in neighboring states. Therefore, our objective was to determine which (if any) culverts in this region are used as winter roosts by PESU and other bat SGCN. We began winter surveys of road culverts in three southern Arkansas counties in November 2020, but expanded the study area to include culverts throughout the South Central Plains Ecoregion. Survey approaches included a two-person team in November and December, and a three-day culvert blitz in January (n = 193 in 2022 and 331 in 2023). In 2020-21, we found nine culverts being used by 1–2 Rafinesque's big-eared bats (*Corynorhinus rafinesquii*; CORA) and one culvert with one PESU. In 2021-23, we found 1–2 PESU in the culvert identified the first winter, 12 additional culverts being used by PESU, and 30 additional culverts with CORA. Between 1–16 PESU and 1–6 CORA roosted in a given culvert. In total, we recorded over 500 bats, including not only 46 PESU and 47 CORA, but also 4 evening bats (*Nycticeius humeralis*), 20 big brown bats (Eptesicus fuscus), and over 450 southeastern myotis (*Myotis austroriparius*). Preliminary findings indicate that PESU remain present in the winter in southern Arkansas and use the same sites across years. We monitored identified culverts used by PESU and CORA in winters (Jan–Mar) 2022 and 2023 along with unoccupied culverts to determine characteristics that make a culvert suitable winter habitat for these SGCN in southern Arkansas.

EFFECT OF HABITAT AND SEASON ON THE ACTIVITY OF TRICOLORED BATS IN FLORIDA

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Florida Fish and Wildlife Conservation Commission

The tricolored bat (*Perimyotis subflavus*) ranges across the eastern US and throughout Florida. Although white-nose syndrome has yet to be detected in Florida, recent monitoring data suggest the tricolored bat population is declining. With the proposed listing of the tricolored bat as endangered and limited information on their habitat use in Florida, more research is needed to determine whether habitat type or seasonality significantly affect tricolored bat activity. Based on data from other parts of the southeast, we expected bats to be less active during colder months and occur more frequently in forested riparian zones due to increased prey and water availability. As part of Florida Fish and Wildlife Conservation Commission's statewide Long-term Bat Monitoring Program, we recorded stationary acoustic data seasonally, up to 4 times per year from January 2021 − December 2022 at 81 sites. We created linear mixed effect models based on a priori hypotheses and ranked model best fit using AIC. We found that tricolored bats were active all year but had higher activity in the spring and summer months. In spring and summer, tricolored bats were detected more frequently in freshwater non-forested wetlands and open habitats, and in fall and winter bats were detected more frequently in urban areas. Pooling all seasons, tricolored bats were recorded most frequently in freshwater non-forested wetlands, open areas such as improved pastures, high pine and scrub areas, and urban areas. We found that tricolored bats in Florida are active throughout the year, but both activity and habitat use varies seasonally. Continued investigations of tricolored bat habitat use across different seasons are imperative to better inform management and support the long-term conservation of this species.

USE OF ULTRASOUND FOR BAT PREGNANCY DIAGNOSIS IN FIELD SETTINGS

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Accurately documenting the reproductive status of species of interest is paramount to achieving conservation goals. This is especially important when the species under study are in population declines, such as many species of bat in the United States. Unfortunately, the accepted methods for determining reproductive status of North American bats are subjective and accuracy is influenced by experience of the handler. Ultrasound may provide a reliable method for determining pregnancy in small mammals. Our goal was to determine the efficacy of using ultrasound to image bats in the field to accurately assess reproductive status. Our first field season produced inconclusive but promising results.

TERRESTRIAL MAMMAL COMMUNITY RESPONSE TO EVERGLADES HYDROLOGICAL RESTORATION

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Habitat loss is a key driver of biodiversity loss worldwide. Wetlands in particular support high species diversity but are one of the world's most threatened ecosystems. In response, restoration efforts have increased, and effects have been studied for many species, but it is less known how communities respond to hydrologic restorations, especially terrestrial mammals. South Florida has experienced extensive development in areas now slated for hydrologic restoration as part of the Comprehensive Everglades Restoration Plan (CERP), the largest hydrologic restoration project in the United States. Our study focused on the first major component of CERP: a large-scale, ongoing hydrologic restoration affecting over 22,000 hectares in southwest Florida. We deployed 84 camera trap sites throughout the restoration and reference areas over 2 years (46 in 2020 & 38 in 2021), limiting the data analyzed to April-August, which spanned both the dry and wet seasons. We processed images in digiKam and summarized data in camtrapR using 30-minute intervals between photos to establish independence. We detected 15 mammal species, including Everglades mink, spotted skunks, Big Cypress fox squirrels, bears, bobcats, and panthers. We used generalized linear mixed models and species accumulation curves to test how hydrology (hydroperiod and water depth) and vegetation structure influenced the mammal community (species richness, diversity, and relative abundance). Preliminary analyses found that the percentage of open water within 150 m of a site was the best predictor of species richness. We also found that mammal species responded differently to hydrology depending on their habitat associations and degree of specialization. Given this, long-term effects of restoration are likely to differ within mammal communities, but species richness may increase with increasing water on the landscape, as expected with hydrologic restoration. This research will aid managers and policymakers in managing for diverse ecological communities during current and future restoration efforts.

POPULATION CHANGES IN A WNS WORLD. EIGHT YEARS OF BAT POPULATION MONITORING AT A CAVE ON THE OZARK PLATEAU NWR IN E. OKLAHOMA

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Bat population monitoring at the Duncan Field Cave system was initially designed to estimate the number of hibernating northern long-eared bats (*Myotis septentrionalis*, MYSE), beginning in 2015. However, with the onset of White-nose Syndrome (WNS) in 2016 at this location, the focus changed to monitoring population changes in all cave obligate bat species. These included two endangered, one threatened, and one species being considered for listing. Harp trapping and mist net activities (seven fall swarming and five spring emergence periods) yielded capture of 3,177 bats including 982 MYSE, 987 tricolored (*Perimyotis subflavus*, PESU), 1,043 gray (*Myotis grisescens*, MYGR), 103 Ozark big-eared (Corynorhinus townsendii ingens, COTO), 24 big brown (*Eptesicus fuscus*), 32 eastern red (*Lasiurus borealis*), 4 evening (*Nycticeius humeralis*), 1 silver-haired (*Lasionycteris noctivagans*), and 1 eastern small-footed (*Myotis leibii*) bat. Captures and visual estimates indicated > 3000 MYSE and >2000 PESU were present at the cave in fall 2015, and no MYSE and fewer than 20 PESU were present since fall 2017. Mass was significantly higher in fall for MYSE, PESU, and MYGR but not for COTO. Sex ratios were balanced in the fall for MYSE and COTO but skewed toward males in spring for MYSE and in both seasons for PESU, and MYGR. It is likely that MYSE are no longer present; PESU numbers are greatly reduced, but hopefully holding on, and the other species do not seem to be negatively affected.

BAT USE OF UPLAND EMBEDDED WETLANDS ON THE DANIEL BOONE NATIONAL FOREST

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Wetlands provide varied important ecosystem services, and are important habitats for bats and insects. Within the Daniel Boone National Forest (DBNF) in Kentucky, over 800 upland-embedded wetlands (UEWs) have been constructed in past decades to provide wildlife habitat. Our research focuses on identifying differences in bat activity across natural and constructed wetlands, and investigating what environmental variables contribute to differences in use of these wetlands. We deployed SM3 acoustic detectors at 9 natural and 31 constructed wetlands across the Cumberland Ranger District of the DBNF. Each wetland was surveyed across 3 intervals from May – August 2022, and each recording session spanned >3 consecutive nights, yielding a total of 413 detector nights. We used the package unmarked in Program R to evaluate the influence of environmental covariates on species-specific detection probability and site-occupancy of 12 bat species identified at wetlands. We found influential variables differed across respective bat species. Our results indicate that while wetland type (constructed vs. natural) is not a strong predictor of occupancy, other wetland parameters do influence bat occupancy. As we finalize our analysis, our study will provide resource managers with insight as to what UEW conditions are most important for bat communities in the Appalachian region.

THE GROWTH AND SUCCESSES OF THE NORTH AMERICAN BAT MONITORING PROGRAM

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The North American Bat Monitoring Program was established in 2015 in response to the need to address the historic lack of information on bat species status and trends. Since the program was established there has been tremendous growth in engagement, resources to support partners collecting and contributing data, and collated data. This has led to the delivery of analyses and information products that support management of bat populations in the face of multiple threats. Here we share metrics and information illustrating program growth and successes to date.

HABITAT ASSOCIATIONS OF THE PLAINS SPOTTED SKUNK (*SPILOGALE INTERRUPTA*) IN THE PLAINS ECOREGION

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The Eastern Spotted Skunk (*Spilogale putorius*) is in decline range-wide and numerous efforts have been made to model the species' distribution and to identify areas where they are likely to occur. However, the vast majority of these efforts have focused on Spotted Skunks occurring in forested habitats, and very little has focused on the Plains Spotted Skunk (*S. putorius interrupta*: likely a subspecies of the Eastern Spotted Skunk) occurring across the Great Plains and associated non-forested areas. To address this gap and to better understand the landscape correlates for the rapidly declining and poorly understood Plains Spotted Skunk, we developed a presence-only species distribution model using only occurrence records from Great Plains and adjacent prairie ecoregions. We accumulated over 300 occurrence records from 1984 to the present through public data repositories (e.g., iNaturalist and GBIF), 9 state agency databases, public outreach, and researchers in the field. Around each occurrence record, we used a GIS to calculate a suite of landscape variables (e.g., agricultural cover, grassland cover, habitat heterogeneity, etc) to predict skunk presence and evaluated their importance. Here, we will present on the results of the species distribution model and identify areas of the Great Plains predicted to have suitable landcover conditions for Plains Spotted Skunks.

THE TRICOLORED BAT (*PERIMYOTIS SUBFLAVUS*) IS A SPECIES HEAVILY AFFECTED BY WHITE-NOSE SYNDROME

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The tricolored bat (*Perimyotis subflavus*) is a species heavily affected by white-nose syndrome. Significant population declines have occurred in the Appalachian Mountain and Cumberland Plateau regions, yet little is known about tri-colored bat populations in the Coastal Plain region of the southeastern U.S. Bats in this region have been documented inhabiting transportation structures in addition to tree roosts, caves, and mines. The size and distribution of these culvert-dwelling populations are currently unknown but could represent a significant remnant population. The objective of this study was to determine the genetic connectivity of tricolored bat populations roosting and/or hibernating in transportation structures. It will also delve into how the Georgia Coastal Plain bats relate to the heavily-impacted tricolored bat populations in the Appalachian Mountains. To this end, we collected buccal swabs and hair samples of tricolored bats living in culverts. We applied 6 microsatellite markers to sequence the non-coding HV1 region of the mitochondrial genome. Our population genetic analyses revealed that high dispersal patterns among sampled sites (gene flow) exists and detected population genetic structure, but that structure was not associated with roosting locations (sampled sites). Sampled sites contained a mixture of putative populations, therefore factors other than roosting or hibernacula sites may be structuring populations. We will combine these data with geospatial distribution data and *P. destructans* presence/absence data to understand factors associated with disease spread and susceptibility to white-nose syndrome.

SEASONAL USE OF CULVERTS BY TRI-COLOR BATS (PERIMYOTIS SUBFLAVUS) IN SOUTH CAROLINA

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Ten culverts along the I-26 route in South Carolina may be impacted by a proposed interstate widening project. During a statewide culvert inventory, SC Department of Natural Resources discovered tri-color bats (*Perimyotis subflavus*) roosting in some of these culverts. In order to determine the extent of use, SCDOT contracted Stantec to conduct inspections throughout the year to determine which culverts were being used and to what extent. Surveys were conducted in late August and early December 2022 as well as January 2023 and will continue until May or June 2023. Biologists entered each culvert with a headlamp and conducted pedestrian surveys, identifying and counting bats. During surveys in August bats were alert and scattered, however during the December and January surveys numbers increased and the bats were in a state or torpor indicating our hypothesis of bats using these culverts as a hibernaculum is supported. It should be noted that other bat species were also surveyed within the culverts and may be utilizing them as day roosts. In addition, it is likely that male tri-color bats may use these sites year round.