

## **BAT ACTIVITY FOLLOWING REPEATED PRESCRIBED FIRE IN THE CENTRAL APPLALACHIANS**

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To restore and manage fire-adapted forest communities in the central Appalachians, land managers are now prioritizing use of prescribed fire. However, it is unclear how the bat community will respond to the re-introduction of fire assemblages after long periods of fire suppression and mesophytic closed canopy forest development. Additionally, the WNS-induced changes in cave-hibernating bat abundance and changes in bat niche partitioning during this period add an interesting ecological component to the response. Accordingly, we monitored and compared bat activity in burned and unburned habitat across a temporal gradient in the mountains of western Virginia on the George Washington National Forest and Shenandoah National Park. We observed evidence for slightly positive fire effects on the northern long-eared bat (*Myotis septentrionalis*), Indiana bat (*Myotis sodalis*), little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*)/silver-haired bat (*Lasiurus noctivagans*) group, high frequency bats combined, and total activity. We observed temporal effects only for the big brown bat, with a negative relationship between activity and time since fire.

(Poster Presentation)

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## **PRESCRIBED FIRE EFFECTS ON SNAGS IN THE SOUTHERN APPALACHIAN MOUNTAINS**

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Snags, or standing dead trees, are an influential part of forest ecosystems and provide habitat for many species of birds and bats. Alabama alone is within the ranges of 45 species of birds and 8 species of bats which utilize snags at some point in their life histories. Alabama is also within the historical range of longleaf pine (*Pinus palustris*) which requires frequent, low intensity fires to maintain its open-canopy structure. Current restoration efforts in the southeastern U.S. employ mechanical thinning and prescribed fire to promote longleaf pine and its associated species. The effect on snags preferred by wildlife within a prescribed fire regime has not been well documented. Our objective is to evaluate how different burn intervals, or times between fire events, affect the density and characteristics of snags. The study area is located in the Talladega National Forest in northeastern Alabama. We will use belt transects on ridgetops, mid-slopes, and drainages to assess the density, size, and condition of snags within stands of varying management intensities. Preliminary results from circular habitat plots show that snag density increases as the burn interval increases. Heavily managed stands also proportionally produced more mid-sized snags preferred by wildlife, but less pine snags. These early results indicate that prescribed fire may reduce overall snag density, but provide snag characteristics preferred by wildlife. This emphasizes the benefit of a landscape with stands varying in management intensities. A subsequent study will be done to assess more detailed characteristics of snags and snag density under varying management and fire intensities.

**DETECTION EFFICIENCY OF THE ALLEGHENY WOODRAT (*NEOTOMA  
MAGISTER*) IN VIRGINIA**

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The Allegheny woodrat (*Neotoma magister*) has shown significant decline in population size and narrowed population distribution since 1928. Declines have been attributed to constrained habitat requirements specific to high elevation rocky outcrops. The rough terrain limits the ability of researchers to access these isolated habitat fragments, resulting in low detection rates and high costs of effort. We launched a collaborative effort between Radford University, Virginia Department of Game and Inland Fisheries and the USGS Virginia Cooperative Fish and Wildlife Research Unit Cooperative Unit in an effort to gather data at new and historical woodrat sites across Virginia. Collectively, we paired remote-sensing cameras and tomahawk traps at 31 sites from May through October of 2017. We estimated probability of detection and site occupancy using package *unmarked* in Program R. The aim of this study was to compare detection efficiency between trapping methods to determine the most efficient method of detection for the species in challenging research environments. Results will be presented in light of recent analyses.

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## THE INFLUENCE OF HABITAT AND WEATHER PARAMETERS ON BATS IN NORTHERN INDIANA

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(Poster Presentation)

Many different species of Chiroptera forage all over the United States, but only 11 species have been documented in Indiana, and 9 in Northern Indiana, which includes a common endangered species, *Myotis sotalis*. However, acoustic surveys, besides studies on the *Myotis sotalis*, are lacking for Northern Indiana. Our study focuses on species specifically in South Bend, Indiana, and the effect of habitat type and weather on species variation and detection. In the spring, late summer, and early fall of 2017, two SM3BAT devices were set up on Saint Mary's College campus: one in an open area by a campus pond and one in a forested nature area. The device was activated at sunset and recorded only when bat calls were detected. Weather parameters including temperature, precipitation, humidity, and moon phase were also documented. Data from the SM3BAT devices were processed in Kaleidoscope and analyzed using R studio. Automatic species classification indicated we found 9 species across our two recording locations, but differences in bat species between habitat site. Additionally, habitat affected the total number of detected calls, with more detected calls in the forested area compared to the open area. We also investigated the effect of weather parameters on acoustic activity. Our results provide baseline information on bat activity in Northern Indiana, and we will continue to acoustically monitor for subsequent years to determine how long-term weather and climate affect bat activity in our region.

## **EFFECTS OF THE AMOUNT OF AGRICULTURE IN A FOREST MATRIX ON MEDIUM AND LARGE-SIZED MAMMALS IN SOUTHWEST VIRGINIA**

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(Poster Presentation)

Researchers and managers alike are interested in mammal diversity in human-dominated landscapes. Communities of medium and large-sized mammals can drive food web dynamics in eastern forests and elsewhere. The effects of human-dominated landscapes on mammal communities is not clear cut. On one hand, mammalian carnivores and omnivores may be at increased risk of death and injury when they use human-dominated areas. Alternatively, human-dominated landscapes can provide food resources which increase abundances of these mammals. We used wildlife cameras to census medium and large-sized mammals (opossum, striped skunk, raccoon, fox, bobcat, coyote, black bear, and domesticated/feral dog) in forest landscapes that varied in the amount of adjacent agricultural area: Havens Wildlife Management Area (10% agriculture to 90% forest) and Buzzard Rock (20% agriculture to 80% forest). We censused the two sites for six weeks each during January – May 2017 and six-weeks each during December – March 2018. We used four Reconyx Rapid Fire 800 Cameras giving us 686 trap nights. Each week, we baited two cameras and put the other two cameras on a game trail and moved cameras every two weeks. Raccoons, coyotes, and black bears accounted for 76 to 86% of all captures. The Buzzard Rock site (more agriculture) had more than three times as many captures (0.32 animals/trap night) compared Havens WMA (less agriculture; 0.09 animals/trap night). The increased number of medium to large-sized mammals in area with more agriculture increases the opportunity for conflicts with humans. Our work suggests that the benefit of the increase in food resources available on agricultural lands outweighs the increased risk that these mammals face from conflicts with humans.

**BABY IT'S COLD OUTSIDE: FALL 2017 AND WINTER 2018 BAT ACTIVITY ON  
THE COASTAL PLAINS OF NORTH CAROLINA**

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(Poster Presentation)

Previous research on the northern long-eared bat (*Myotis septentrionalis*) has documented them overwintering in caves, but recent range expansions into coastal plain regions prompted many questions including habitat use and activity patterns during fall and winter. In North Carolina, temperatures in the coastal plains differ from other regions in the state and may have an effect on the behavior of coastal bat species. As part of a programmatic agreement between the North Carolina Department of Transportation, Federal Highway Administration, United States Army Corps of Engineers, and the United States Fish and Wildlife Service, focused research continues to investigate the northern long-eared bat's distribution, habitat use, and fall and winter activity in eastern NC. In 2017, during the months of November and December, and January – March in 2018, under contract with Ecological Engineering, Ecological Solutions conducted mist net surveys in the Croatan National Forest where temperatures at the time of capture and roost emergence were surprisingly low with averages between 11°C to  $\pm 3^\circ\text{C}$ . The lowest temperature documented at a time of capture was 3°C for a *Perimyotis subflavus* and a *Nycticeius humeralis*. Based on the data collected during this research, coastal bat species may adjust their behavior (activity, roost selection, and torpor bouts) and remain active for winter months due to the temperate temperatures of coastal plain regions. Ongoing research will help us understand how different bat species are using varied climate regions, and research in these more temperate areas will contribute an understanding of how species may behave in a changing climate.

Type: Poster Presentation

## Habitat Occupancy and Detection Rates of Northern Flying Squirrels in Pennsylvania Using Ultrasonic Acoustics

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The northern flying squirrel (NFS, *Glaucomys sabrinus*) is listed as State Endangered in Pennsylvania. Within the Appalachians, northern flying squirrels can be difficult to detect using traditional methods (live trapping, nest boxes). Flying squirrels produce ultrasonic calls that can be detected using acoustic bat detectors. Within Pennsylvania, NFS are sympatric with southern flying squirrels (SFS, *G. volans*). These species can be differentiated using ultrasonic acoustics, making this technique appropriate where both species co-occur. We surveyed 6 sites in the Pocono Mountains in Pennsylvania during June 2017. We considered 3 sites high occupancy (“high”) and 3 site low occupancy (“low”) sites for NFS. We surveyed sites for 9 nights using Pettersson D500x ultrasonic detectors (N=108 detector survey nights). We estimated probability of detection (POD) and latency to detection (LTD; i.e., number of survey nights until the initial detection) between high and low sites. We obtained 478 flying squirrel calls: 384 NFS, 58 SFS, and 48 unknown flying squirrel species calls. We recorded NFS at 4 sites (3 high, 1 low) and SFS at all 6 sites. For NFS, POD between the high and low sites were  $0.28 \pm 0.06$  and  $0.09 \pm 0.07$ , respectively. LTD for NFS were  $2.7 \pm 0.8$  nights at high sites and  $7.83 \pm 1.5$  nights at low sites. For SFS, POD was  $0.13 \pm 0.05$  and  $0.17 \pm 0.05$  at high and low sites, respectively. LTD was  $5 \pm 1.6$  nights at high and  $3.8 \pm 1.5$  days at low sites. This study highlights the effectiveness of acoustic monitoring for rare NFS that are sympatric with SFS.

**AN ASSESSMENT OF GENETIC STRUCTURE IN THE FLORIDA MOUSE  
(*PODOMYS FLORIDANUS*)**

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(Poster)

The Florida mouse (*Podomys floridanus*) is endemic to Florida and considered a Species of Greatest Conservation Need. Florida mice occupy xeric, upland sandhill and scrub habitats. Those xeric communities are distributed as discrete patches that typically occur on or are associated with geologic ridges, which vary in size and in the distance separating them from other patches of similar habitat. Florida mice are believed to have limited ability or propensity to move among suitable habitat patches. We examined the amount of gene flow, or connectivity, among populations across the range of the Florida mouse. We obtained tissue samples from and genotyped 1001 *Podomys*. Of those, we were able to retain 994 for microsatellite analysis and successfully sequenced the cytochrome *b* mitochondrial gene (*cyt b*) for 263 individuals. Sequence data from *cyt b* revealed a high level of haplotype variation overall, with 47 unique haplotypes detected range-wide, and little haplotype sharing across ridge (geographic) groups. Phylogenetic divergence among haplotypes was shallow, with no monophyletic phylogenetic structuring among ridges. The Lake Wales ridge system and Atlantic Coastal ridge system represent regions of relatively high mtDNA diversity. Microsatellite variation, like mtDNA, also fit a model of a primarily ridge-based genetic structure. Multiple lines of evidence suggest that the Atlantic Coastal ridge populations have had the most stable demographic history and have apparently been isolated from populations on ridges to the west for a considerable period of time. The apparent reduced gene flow among *Podomys* from sites across the Lake Wales ridge system suggests those populations are experiencing negative impacts from reduced habitat connectivity at the landscape scale. The high level of microsatellite structuring and evidence for non-existent gene flow between isolated regional groups justifies not moving *Podomys* beyond short (tens of kms) distances or across major potential barriers such as rivers.



## LAND MAMMALS OF THE VIRGINIA BARRIER ISLANDS

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(Poster presentation) I will supply an easel.

The Virginia barrier islands are a dynamic natural laboratory for the study of ecological and evolutionary patterns and processes. We have studied the ecology, distribution, and genetics of non-volant mammals on these islands since the mid-1970s. We have trapped, tracked, and observed mammals on 30 barrier and marsh islands and at more than 25 locations on the adjacent mainland in Accomack and Northampton counties, Virginia. We also have assembled published and unpublished reports from other researchers who have studied mammals on the islands and the Delmarva Peninsula, which is made up of the state of Delaware and parts of Maryland and Virginia. In this report, we identify 34 species of land mammals that are native to this region. Of those, 20 species have been observed on at least one island. In addition, we identify 4 non-domesticated, exotic, species that have been observed on at least one island.

## **THE MICROBIOLOGY OF FRESH, SURFACE, AND DEEP BAT GUANO SAMPLES, INCLUDING DETECTION OF POSSIBLE PATHOGENS**

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(Poster Presentation)

Bat guano plays an integral role in the ecological balance of the cave environment. In addition, guano serves as a food source for microorganisms such as bacteria, potentially including zoonotic pathogens. Past studies on the microbiological populations of guano were limited to isolated pellets or guano from the surface of a pile. Here, we present the first comparison of bacterial populations cultured from fresh, surface, and deep (~ 2m) guano samples from a large maternal colony of Brazilian free-tailed bats (*Tadarida brasiliensis*) in Sierra County, New Mexico. We cultured and isolated bacteria on three types of nutrient agar: tryptic soy agar, blood agar, and a special recipe consistent with the composition of bat guano ("bat guano medium"). Using 16s rDNA PCR and genetic sequencing technology, we identified 15 species of bacteria including one possible new species. Further research determined that a number of these species that were cultured and sequenced have been present in clinical samples and designated as pathogenic and threatening to cave visitors. The data collected in this research can be utilized to supplement the microbiological knowledge concerning the cave environment and guano as well as to elucidate the health risks involved in cave dwellings.

**ARTIFICIAL ROOST USE BY NORTHERN LONG-EARED BATS  
IN WEST VIRGINIA FROM 2016-2017**

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(Poster Presentation)

Forest loss has been a contributing factor in the decline of Myotine bat species in West Virginia (WV). In order to supplement natural roosts following forest disturbance, the United States Fish and Wildlife Service (USFWS) West Virginia Field Office (WVFO) has required conservation measures in the form of artificial roosts. AllStar Ecology, LLC (ASE) has designed and manufactured artificial roosting structures in the form of two-chambered rockets, four-chambered nursery boxes, and artificial bark while using the Myotine Suitable Habitat Assessment Model (MSHAM) to aid in placement. ASE installed a total of 490 artificial roosts (380 two-chambered rocket boxes, 53 four-chambered nursery boxes, and 57 artificial barks) within WV and monitored them for bat occupancy and species composition from 2016-2017.

Site occupancy across all 59 sites averaged 72.9% for both years of monitoring. Occupancy rate rose by 24.64% for boxes in their 2<sup>nd</sup> year on the landscape compared to the same boxes in their 1<sup>st</sup> year. In 2016, eight Northern Long-eared Bat maternity colonies were discovered in the artificial roosts with the number of maternity colonies increasing to 14 in 2017. Site fidelity was witnessed at 5 of 59 sites. Out of bats caught emerging from artificial roosts from 2016-2017, 359 (98.36%) were northern long-eared bats. The more suitable a habitat class, according to MSHAM, the higher the occupancy rating—adding credence to the model. Based on the data set, northern long-eared bats use artificial roosts as part of their roosting network and will use artificial roosts for reproduction, showing that artificial roosts may serve as viable conservation measures after tree clearing.

\*Will not supply easel—if you anticipate running out let us know and we can certainly buy one

## **BAT ACTIVITY SURROUNDING THE SILVER MOUNTAIN HIBERNACULUM DURING SPRING EMERGENCE AND FALL SWARM**

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To explore bat activity patterns and habitat use around a hibernaculum during spring emergence and fall swarm, we deployed 12 SM3Bat detectors across a 4 km<sup>2</sup> landscape centered on the cave entrance in 2016-17. Within this landscape, twelve 0.5 km<sup>2</sup> sites were sampled by placing a detector at the center of each site in 2016, and in 2017, by placing detectors > 100 m away in a random direction. Detectors were deployed on average 35 days each season coinciding with beginning and end of hibernation. Using SonoBat V4.2.2 autoclassifier, there was an unexpected 130% increase in calls (passes) in 2017 compared to 2016 given White-Nose Syndrome was first detected at the mine winter of 2015-16. However, the percentage of High Frequency calls during spring emergence declined by 78% in 2017 compared to 2016. We used N-mixture models within R package 'unmarked' and a model selection framework to explore the relationship between bat activity to local-scale (detector) and site-scale covariates. In general, bat activity patterns were associated more with site-scale covariates rather than local-scale covariates during both seasons. Call frequency of *Myotis lucifugus* increased with the length of stream within the sampling site (0.5 km<sup>2</sup>) during the spring season, and during fall swarm, amount of wetland and open habitat in addition to length of stream influenced activity levels. Call frequency of *Eptesicus fuscus* increased to these same covariates and also greater topography (i.e., terrain ruggedness) at the site-scale. Our initial analysis shows landscape features such as stream length (corridors), topography, and amount of open and aquatic habitats in the surrounding landscape were more important than distance to mine, most likely reflecting spatial differentiation based on foraging and moving behavior. Further refinement and sampling within landscapes surrounding other caves will be required to determine the applicability of our results to other landscapes.

## ACOUSTIC SCANNING BEHAVIOR IN THE NORTHERN LONG-TAILED SHREW

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(Poster Presentation)

Shrews are some of the smallest mammals on the earth. They are a diverse group that have adapted to many habitats all over the world. Shrews have poor eyesight and acute hearing, so they may have the potential to echolocate. A few studies have explored this possibility and found that some shrew species echolocate while exhibiting scanning behavior. In this study, we investigated the link between scanning behavior and acoustic signals in the Northern Short-tailed shrew (*Blarina brevicauda*). A shrew was captured from the Saint Mary's College nature area and recorded in the laboratory with a GoPro video camera and a Wildlife Acoustics SM3Bat acoustic recorder. From our recordings we identified portions of scanning behavior from the video and extracted the corresponding audio file. We extracted 10 selections of scanning behavior and 168 calls. We used Audacity to calculate call duration, frequency range, and inter call interval (ICI). Call duration ranged from 4 to 15 ms, with energy between 3 to 48 kilohertz, and the ICI ranged from 49 to 393 ms. Our results indicate that *Blarina brevicauda* may use echolocation to sense their environment. Future work can identify scanning behavior and changes in acoustic signals in different environments.

## COMPARISON OF AUTOMATED BAT CALL CLASSIFICATION SOFTWARE VERSIONS: WHEN TO UPGRADE?

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(Poster Presentation)

Many bat researchers rely heavily on commercially available automated software programs to aid in identifying bat calls to species. However, the software can be expensive and data processing time can be significant. For those working with large datasets or long-term monitoring, the frequent release of software upgrades can be problematic because it is not clear whether purchasing the new version will be worth the time and expense required to re-analyze all data in the latest version. It is also unclear how comparable the different versions are in terms of autoclassifier results. To address these questions, we analyze a single dataset using two versions of each of two widely used software programs: Kaleidoscope Pro and Sonobat. Our dataset consists of full spectrum acoustic files that were collected through passive recording of bats at two national parks in the Upper Midwest during the period June-August 2016. We compare the software outputs in terms of species classifications and potential biases towards or against certain species. Note that because we are not using a known dataset, this study will not directly address questions of software accuracy. Our results will help bat researchers understand what differences to expect among software versions and provide insight on decisions of if and when to upgrade software.

## **EFFECTS OF VARIATIONS IN FOREST CANOPY OPENNESS, PREY ABUNDANCE, AND ABIOTIC FACTORS ON BAT ACTIVITY IN THE NANTAHALA NATIONAL FOREST**

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(Poster Presentation)

Disturbed and open sites with early successional vegetation provide foraging habitat for bats. As part of a larger study to examine early successional habitat created by logging, we compared activity of open- and clutter-adapted bats within and among canopy openings of varying aggregation and size within mixed hardwood forest of the Nantahala National Forest, North Carolina. We asked if 1) open-adapted bats are more active within openings, while clutter-adapted bats are more active in forest corridors and 2) open-adapted bats are more active above the canopy, while clutter-adapted bats are more active below the canopy. Preliminary results suggest bats are more active a) in dispersed openings, b) within openings than in the forest corridors between them, and c) below the canopy than above; activity was not affected by opening size. These results suggest logging that creates dispersed early successional patches would provide foraging habitat for both open-adapted and clutter-adapted bat species.

**NORTHERN LONG-EARED BAT MATERNITY COLONY ROOST TREE CHARACTERISTICS IN THE CENTRAL APPALACHIANS: HAS WHITE NOSE SYNDROME CHANGED ROOST SELECTION?**

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Most extant northern long-eared bat maternity colony day-roost data was gathered prior to the onset of white-nose syndrome (WNS). Despite the informational need with listed status, the difficulty in catching northern long-eared bats has meant that locating and describing post-WNS day-roost characteristics to compare to pre-WNS is limited. Post-WNS (5+ years), we were able capture and radio-track pregnant or lactating female northern long-eared bats to day-roosts in the summers of 2015 and 2016, in the central Appalachians of Bath County, Virginia. We compared recorded day-roost characteristics to those recorded pre-WNS at Fernow Experimental Forest, Tucker County, WV, and Westvaco Wildlife and Ecosystem Research Forest, Randolph County, WV within similar vegetation types and elevations. We found significant differences for some day-roost characteristics including tree/snag height, roost height, and roost DBH; with post-WNS day roosts being smaller. However, we found no significant differences for canopy closure, surrounding forest basal area, and day-roost condition between pre- and post-WNS day-roosts. Changes in day roost characteristics may not be due to true behavioral changes, but perhaps instead caused by changes in population sizes and resulting smaller maternity colony sizes or more incidences of single females. Care should be taken when incorporating pre-WNS findings in assessment and management of northern long-eared bat day-roost habitat in the central Appalachians, however meaningful stand-level characteristics appear to be similar.



## POTENTIAL BENEFITS OF REFORESTED AGRICULTURAL RIPARIAN ZONES FOR BAT COMMUNITIES

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(Poster Presentation)

Bat conservation must occur in multiple habitats beyond national parks and protected forests if the ecosystem services bats provide are to be protected. This project contributes to our understanding of the efficacy of current conservation practices in mitigating bat habitat loss within agricultural settings. Current research suggests that restored riparian forests within an agricultural matrix provide bat species with improved feeding opportunities and act as covered corridors between habitats. Our findings will help inform stakeholders and government agencies as to the value of riparian forests established through the Conservation Reserve Enhancement Program (CREP) for promoting bats. Pettersson acoustic detectors were used to determine if CREP riparian zones (compared to control sites with denuded riparian areas) promote increased bat diversity within the Shenandoah Valley of Virginia. The species richness and diversity of recorded bats were analyzed across treatments. Flying insects were collected throughout the field season using combined malaise and pan traps deployed simultaneously with the bat detectors. Insects were identified to Order with *Coleoptera* and *Lepidoptera* being identified to Family when possible. Transects, 100m x 20m, were established at each site and were surveyed for tree diversity, canopy cover, snag count, and DBH. Results were analyzed using statistics packages in 'R' to determine significance of different CREP characteristics. By analyzing multiple aspects of these riparian forests, we hope to better evaluate specific characteristics of CREP sites correlated with increased bat activity and help inform land managers and government agencies involved with CREP and other riparian projects.

## CHANGES IN BAT CAPTURE RATES AND COMMUNITY COMPOSITION AT FORT INDIANTOWN GAP, PENNSYLVANIA

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(Poster Presentation)

Populations of many North American bat species are in decline as the result of numerous threats, most notably White-nose Syndrome (WNS). WNS has caused severe regional-scale declines of several cave-hibernating bat species, however, the community-level impacts of the disease remain poorly studied. Resource managers will need to understand how bat communities have changed over time when making current and future management decisions. The objective of our study, therefore, was to compare species-specific capture rates and bat community composition during summer mist-netting surveys conducted at 12 sites in 2004 and 2017 at Fort Indiantown Gap (FIG), a military training site in south-central Pennsylvania. Given species-specific responses to WNS, we hypothesized that capture rates of *Myotis* species would decline between 2004 and 2017, while capture rates of *Eptesicus fuscus* and *Lasiurus borealis* would remain stable or increase. Moreover, we predicted there to be a dramatic shift in the overall composition and abundance of the bat community between years. In 2004, *Myotis septentrionalis* ( $n = 98$  captures) and *M. lucifigus* ( $n = 31$ ) were relatively common, however, in 2017, we failed to catch a single individual of either species, suggesting a significant decline (-100%) in both species. Capture rates (bats/unit of net effort) of *E. fuscus* have increased significantly (+300%) over this time period, while capture rates of *L. borealis* did not change. A PERMANOVA also revealed a significant difference ( $P = <0.001$ ) in the overall structure of the bat community between 2004 and 2017. These results are consistent with a WNS-driven decline in *Myotis* species that were previously abundant at the site, and suggest that *E. fuscus* populations at FIG could be expanding in the absence of competition from these species. Together, these changes have led to a community-level shift among bats, with important implications for their arthropod prey.

## OPTIMIZATION OF CAMERA TRAPPING METHODS FOR SURVEYING MESOPREDATORS IN THE APPALACHIAN FOOTHILLS

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(Poster Presentation; we will need an easel for displaying)

The global decline of apex predators has allowed mesopredator populations to increase, a phenomenon described by the mesopredator release hypothesis (MRH). However, some mesopredator species are of conservation concern, such as the eastern spotted skunk (*Spilogale putorius*), whose populations have noticeably declined in the past 40 years despite an ability to inhabit human altered habitats. Mesopredators generally prefer edges and corridors, landscape features that are increasingly common throughout the forests of eastern North America. We tested deployment strategies for surveying mesopredators using baited camera traps in Kentucky, a state for which systematic methodological data is lacking. We surveyed 72 sites across 10 counties over more than 1,100 trap nights from May 2017 to February 2018, focusing on features associated with mesopredator presence such as corridors, edges, and trails. Cameras were deployed on tree trunks ca. 0.5 m off the ground facing a bait station that was 2-3 m away. Our 2×2 design allowing for the evaluation of bait type (sardines only or sardines + fatty acid scent tablet) and deployment duration (2 weeks or 4 weeks). To date, opossums (*Didelphis virginiana*) and raccoons (*Procyon lotor*) comprise over 90% of recorded mesopredator species. Other mesopredators recorded include striped skunks (*Mephitis mephitis*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*). These data are being used to inform ongoing camera trapping efforts in the Appalachian region of Kentucky. In addition to diversity indices, species accumulation curves will be created and factors of alpha-biodiversity of sites will be explored. Ultimately, mesopredator habitat selection will be assessed using ArcGIS data layers to determine preferred site characteristics, thus allowing targeted, more efficient camera trapping efforts in the future.

## REACHING OUT TO NEW AUDIENCES FOR BAT CONSERVATION

*Catherine .J. Hibbard. U.S. Fish and Wildlife Service, Hadley, MA 01035*

(Poster)

Most recreational cavers and cave researchers are aware of risks of spreading *Pseudogymnoascus destructans* (Pd), the fungus that causes white-nose syndrome disease of hibernating bats, and protocols to reduce those risks. Several types of outdoor recreationists however, may not be aware that they might enter areas where the fungus occurs. These user groups pose a lower, but real risk of spreading Pd.

The White-nose Syndrome Communications and Outreach Working Group created postcards for climbers and infrequent cave explorers to encourage them to take simple measures to reduce their risk of spreading Pd: check, scrape, wash, and protect. The group distributed the postcards, also available at [www.whitenosesyndrome.org](http://www.whitenosesyndrome.org) in several languages, to show caves. Stop by the poster and learn about this effort and other recent activity of the working group.

## HOME RANGE DYNAMICS AND HABITAT SELECTION OF THE EASTERN SPOTTED SKUNK IN THE OZARKS

Summer D. Higdon\* and Matthew E. Gompper. *School of Natural Resources, University of Missouri, Columbia, MO 65211*

(Poster presentation)

The eastern spotted skunk (*Spilogale putorius*) is a small, once common mesopredator and member of the Mephitidae family. Beginning in the 1940s, it declined across its range, which includes the Ozark Ecoregion. Reasons for the range-wide decline are still unknown, but currently the species is considered threatened, rare, or of conservation concern by many states within its range and one subspecies has been petitioned for listing under the U.S. Endangered Species Act. Despite several new studies aiming to understand the basic ecology of the species, few efforts have focused in the Ozarks. Thus, we developed a project to assess home range dynamics and habitat selection of the eastern spotted skunk in north-central Arkansas. Beginning in March 2017 and continuing presently, we deployed camera traps across a large-scale grid in Ozark National Forest and Gene Rush Wildlife Management Area to assess landscape-level habitat selection. We confirmed the presence of eastern spotted skunks in the Arkansas Ozarks at three camera trap sites. Efforts to live-trap and radio-tag skunks to determine home range dynamics began in winter 2017 and will continue into 2018. This project will shed light on the effects of common habitat management actions like prescribed burns and timber harvest on movement patterns of eastern spotted skunks. It will provide guiding information for eastern spotted skunk managers across the Ozark region.

## FALL BEHAVIOR OF *MYOTIS SEPTENTRIONALIS* ON ISLANDS

Samantha Hoff\*<sup>1</sup>, Carl Herzog<sup>2</sup>, Amanda Bailey<sup>2</sup>, Zara Dowling<sup>3</sup>, Danielle O'Dell<sup>4</sup>, Luanne Johnson<sup>5</sup>, Elizabeth Baldwin<sup>5</sup> and Wendy Turner<sup>1</sup>

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(Poster Presentation)

From late summer to early fall, *Myotis* species in North America exhibit swarming behavior near mines and caves. This fall swarm serves important functions; mating has been observed, and it is believed that young-of-the-year may be introduced to hibernation sites. Understanding how threatened species interact during this time is critical for conservation. *Myotis septentrionalis* populations have declined drastically since the onset of white-nose syndrome. In New York, winter counts show a 99% decline, with extirpation from many hibernacula. One source of hope lies in coastal populations inhabiting New York and New England, which appear to support a relative abundance of this threatened species. However, these coastal areas seem to be devoid of natural hibernacula, creating uncertainty as to where these individuals swarm and hibernate. *M. septentrionalis* have recently been found in human structures during the hibernation season on Long Island, NY; Martha's Vineyard, MA; and Nantucket, MA, with activity stretching into the traditional hibernation period. We propose that previously undocumented hibernation behaviors have reduced disease severity and/or exposure, leading to higher host survival. To assess hibernation behavior and timing, we radio-tracked individuals throughout late fall to document roosts, assess movement, and identify potential hibernacula. Netting occurred mid-October through early November at sites with previous net captures or recent acoustic activity. Five *M. septentrionalis* were tracked over three weeks on both Long Island and Nantucket. We tracked four individuals to human structures, confirming at least one hibernacula. The farthest distance traveled between roosts was 10.5 km, with most individuals remaining local to capture locations. Acoustic detections on the landscape continued into mid-December. This pilot study will be expanded next fall to support greater netting and tracking effort, as our preliminary results indicate the potential to learn vital information about the behavior of this species.

## **EASTERN SMALL-FOOTED MYOTIS (MYOTIS LEIBII) HABITAT ON THE NIAGARA ESCARPMENT**

Christy L. Humphrey, Heather A. Fotherby. *Natural Resource Solutions Inc., Waterloo, ON, N2K 4M8.*

(Poster Presentation)

Eastern Small-footed Myotis was listed as Endangered in Ontario in 2014, and recovery efforts in the province to date have primarily focused on understanding more about the specific summer habitat types used by the species in Ontario, as well as its distribution and abundance. In 2017 we carried out a study to improve our understanding of both the distribution and roosting habits of Eastern Small-footed Myotis (*Myotis leibii*) on the Niagara Escarpment in Ontario. Focusing on rocky habitats associated with the limestone escarpment, we examined 4 sites containing open, south-facing talus slopes adjacent to cliffs and forests. We mist netted directly in open or semi-open talus habitats, or on forest trails near open talus between late May and September 2017. Eastern Small-footed Myotis captured during mist netting were radio-tracked to identify specific roost sites. We also conducted ground-based visual searches of accessible rock habitats at each study site, as well as nearby roadside rock-cuts. Visual searches were ineffective at identifying roosts for any species of bat. As a result of mist net surveys, Eastern Small-footed Myotis were captured on just over half of all survey nights, represented 43% of bats captured, and were captured at 3 of 4 study sites. Roosts were located for 6 of 11 tracked bats. These were found primarily in crevices in cliffs adjacent to the capture locations, but one juvenile male was also confirmed to roost in the crevice of a large talus boulder in August. Our results confirm that cliff crevices in the Niagara Escarpment provide roosting habitat for adult and juvenile Eastern Small-footed Myotis, including maternity roosting habitat. They also suggest that visual searches are not an effective way to identify roosts of Eastern Small-footed Myotis in the cliff and talus habitats of the Niagara Escarpment.

## TWENTY YEARS OF MIST-NETTING IN WV: BAT POPULATION AND COMMUNITY CHANGES

*Catherine M. Johnson*<sup>1</sup>, *Craig W. Stihler*<sup>2</sup>, and *Chris Sanders*<sup>3</sup>

<sup>1</sup>*USDA Forest Service, Monongahela National Forest, Elkins, WV 26241 (CMJ)*; <sup>2</sup>*West Virginia Division of Natural Resources, Elkins, WV 26241 (CWS)*; <sup>3</sup>*Sanders Environmental Inc., Bellefonte PA 16823 (CS)*  
(Poster Presentation)

The Monongahela National Forest (MNF) has been conducting bat mist-netting since 1997, with over 12,000 bats captured and many tracked to roosting locations. Long-term sites have been resurveyed multiple times since 2003 using standardized methodology and level of effort, which allows for tracking of general trends in those locations. The West Virginia Division of Natural Resources (WVDNR) has been collecting state-wide mist-net data and conducting hibernacula surveys for over 30 years. The combined efforts of the MNF and WVDNR have resulted in a long-term data set that provides a unique resource for assessing changes in bat populations and communities across a broad area before and after the onset of White-nose Syndrome in West Virginia in 2009.

Our analyses indicate dramatic declines among WNS-affected species (e.g., *Myotis septentrionalis*, *M. lucifugus*, and *Perimyotis subflavus*) similar to those seen in other parts of eastern North America, though the rate and extent of decline in WV does appear to differ for some species. Concurrent increases in local populations of other bat species not affected by WNS also have been observed. Additionally, our long-term data allow for an assessment of changes in local distribution of summer populations across the million acres of habitat on the MNF. A better understanding of both species status and spatial distribution of surviving populations can allow us to better manage the landscape to ensure persistence of these declining species and hopefully enhance recovery of local populations post-WNS.



## **BAT ROOSTS IN BRIDGES: ASSESSING ILLINOIS BRIDGES FOR BAT USE**

Jocelyn R. Karsk<sup>1</sup> and Jean M. Mengelkoch<sup>1</sup>, and Janet Jarvis<sup>1</sup>. <sup>1</sup>*Illinois Natural History Survey, Prairie Research Institute, University of Illinois Urbana Champaign, Champaign, IL 61820*

The Illinois Natural History Survey (INHS) works with the Illinois Department of Transportation to conduct bat presence/absence surveys in compliance with the Endangered Species Act. In 2017, INHS conducted 173 structure assessments on bridges and culverts in 58 counties throughout the state following protocols from the Indiana Bat and Northern Long-eared Bat Section 7 Consultation and Conservation Strategy for the Federal Highway Administration, Federal Railroad Administration and Federal Transit Administration. All bridges were checked during the daytime, using high powered headlamps to illuminate crevices and expansion joints. Binoculars were used to assess portions of bridges that were inaccessible due to water depth or height of the structure. We found evidence (guano or staining) of bats roosting in 32 of 173 structures surveyed (18.5%) and we observed bats present in 10 structures (8 bridges, 2 culverts; 5.7%).

(Poster presentation; I will not be supplying my own easel)

**THE EFFECT OF ALTITUDE ON FREQUENCY, DURATION, AND BANDWIDTH OF ECHOLOCATION CALLS OF TADARIDA BRASILIENSIS RECORDED WITH AN UNMANNED AERIAL VEHICLE**

*Morgan Kinniry<sup>1\*</sup> and Laura N. Kloepper<sup>1</sup>*

<sup>1</sup> *Saint Mary's College, 262 Science Hall, Notre Dame, IN, 46556*

(Poster Presentation)

*Tadarida brasiliensis* emit acoustic signals in the form of echolocation calls to locate prey and orient themselves with their environment. Additionally, these bats are able to navigate in darkness back to their roost from high flight altitudes at high speeds. Little is known about how these bats echolocate at altitude during re-entry. To examine the calls made in close proximity to the roost during the re-entry period, an airborne radio-controlled drone was used to determine if echolocation calls vary at different flight altitudes. For this study, a drone was piloted and hovered at increments between five and forty meters during the re-entry period. Calls recorded from different heights were extracted and analyzed to determine if start frequency, end frequency, and duration varied depending on altitude. There was no significant effect of altitude on start frequency, end frequency, or duration. This indicates that echolocation calls from *Tadarida brasiliensis* are not altered at heights of 40 meters or less when returning to the roost.

## **IMPROVING CAPTURE METHODS TO INCREASE CAPTURE SUCCESS RATE AND REDUCE HANDLING TIME AND POTENTIAL STRESS LEVELS OF BATS IN ARTIFICIAL STRUCTURES.**

Neil W. Lafleur, AllStar Ecology, LLC. *Fairmont, WV 26554*

(Poster Presentation)

As the need for bat habitat conservation measures increase due to growing industry, artificial roosting structures such as rocket boxes have been implemented in an attempt to mitigate the effects of habitat loss and potential natural roosts. Our goal in implementing these artificial structures is to provide roosting structures for threatened and endangered species such as Indiana bats (*Myotis sodalis*), and Northern long-eared bats (*Myotis septentrionalis*), and promote sustainability. In order to monitor success, all structures were checked for presence/absence at two intervals, once in the early season when maternity colonies would be formed and potentially birthing, and once in the later season when pups would be volant. Species data was collected via trapping individuals during emergence. In the previous year, mist-nets were used in close proximity around the roost structure in order to capture emerging bats. This method worked, however it proved to be inadequate in which bats escaped, thus not providing total accuracy of individuals present. The following season, a new trap was developed specifically to meet the needs of acquiring absolute data in the form of 100% capture rate. This trap was also developed with the intent to minimize handling time in order to quickly process bats and reduce stress amongst individuals, primarily when monitoring a maternity colony. Lastly, the trap was designed to increase monitoring productivity.

Results clearly showed an increase in capture rate, however some individuals still escaped and corresponding data is limited due to overall duration of study and scope of project since capture rate comparison was not the focus. Further monitoring efforts will incorporate capture success rate and potentially stress rate.

## Basal Hollow Maternity Roosts of Southeastern *Myotis* in Alabama

Mattea Lewis\*<sup>1</sup>, Kaitlyn Torrey<sup>1</sup>, Andrew Edelman<sup>1</sup>, Joe Johnson<sup>2</sup>, and Jonathan Stober<sup>3</sup>

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<sup>3</sup>*Talladega National Forest, U.S Forest Service, Heflin, AL 36264*

Southeastern myotis (*Myotis austroriparius*) is an insectivorous bat that occurs in bottomland hardwood forest along the coastal plain and Mississippi River from southern Illinois to Florida. Female southeastern myotis form large maternity roosts containing several hundred to 90,000 individuals during the spring and summer months. These maternity roosts are primarily located in caves, but have also been found in tree cavities. In Alabama, only two known maternity roosts for southeastern myotis exist and both are located in caves along the coastal plain. Southeastern myotis are considered a species of highest conservation concern in Alabama and little is known about their distribution and natural history in the state. We discovered three maternity roosts of southeastern myotis in the southern Appalachians of northeastern Alabama over a hundred miles outside the known range of this species. Over three years of netting at our study site, we captured 47 adult and juvenile southeastern myotis. We radio tagged nine females and tracked their day roost usage. All bats exclusively used one of the three basal hollow roosts. The maternity roosts were located in basal cavities of two tulip popular (*Liriodendron tulipifera*) and a blackgum (*Nyssa sylvatica*) in upland riparian forest habitat. Emergence observations revealed several hundred bats were using these roosts during the breeding season. Due to the lack of ecological knowledge of this species, we cannot conclude if their range has extended or has previously been undetected in the area.

## **EFFECT OF OMNIDIRECTIONAL MICROPHONE HEIGHT AND DISTANCE FROM EDGE ON PROBABILITY OF DETECTING BATS IN KENTUCKY**

Susan C. Loeb<sup>1</sup>, Brooke A. Hines<sup>2</sup>, and Michael P. Armstrong<sup>3</sup>

<sup>1</sup>USDA Forest Service, Southern Research Station, Clemson, USA; <sup>2</sup>Hines Ecological Services, Paris, USA; <sup>3</sup>U.S. Fish and Wildlife Service, Frankfort, USA

(Poster Presentation)

Due to declines of many North American bat species from white-nose syndrome (WNS) and difficulties capturing them in mist-nets, acoustic methods are an increasingly important survey method. Many factors affect the probability of detecting bats acoustically including microphone type, height, and orientation; atmospheric conditions; the surrounding environment; and bat behavior. Recently, the U.S. Fish and Wildlife Service approved the use of omnidirectional microphones for Indiana bat (*Myotis sodalis*) and northern long-eared bat (*M. septentrionalis*) summer surveys. However, little is known about the effect of omnidirectional microphone placement on detection probabilities of these species or others affected by WNS (i.e., little brown bats, *M. lucifugus*, and tri-colored bats, *Perimyotis subflavus*). Our objective was to determine the best height and distance from clutter required to achieve high detection of WNS affected species with omnidirectional microphones. We set up 9x9 arrays of Anabat Express and Wildlife Acoustics SM4BAT FS detectors with omnidirectional microphones near Indiana bat colonies at two sites in Kentucky during July and August 2016. Detectors were set in open areas 1.5, 5, and 9 m from the ground and 1, 3, and 5 m from the nearest edge for 3-6 nights each month. We used Program Presence to estimate probability of detection and included height, distance from clutter, heightXdistance, and several environmental variables as covariates. Probability of detecting Indiana bats and tri-colored bats were not affected by height, distance, or their interaction. However, the probability of detecting little brown bats increased with detector height 1 m from clutter but decreased with height 5 m from clutter. This interaction was also important for other species suggesting that survey design may need to vary depending on the target species.

## UPDATE ON THE DEVELOPMENT OF THE U.S. FISH AND WILDLIFE SERVICE ELECTRONIC BAT DATABASE.

Keith Lott, U.S. Fish and Wildlife Service Ohio Ecological Services Field Office, 4625 Morse Road, Suite 104, Columbus, Ohio 43230

In 2015 Region 3 (Midwest) of the Fish and Wildlife Service (Service) developed a spreadsheet for submitting data collected during bat surveys. The goal of creating this spreadsheet was to standardize the data submitted to the Service, while reducing redundancy, increasing efficiency of data submittal, and minimizing errors. This format was quickly adopted by three other Regions of the Fish and Wildlife Service (Regions 4-6). Now submittal of this spreadsheet is a condition of surveyors' section 10(a)1(A) permits for those that work within the Indiana bats (*Myotis sodalis*) range. After the 2016 field season approximately 117 completed spreadsheets were submitted to the Service. The purpose of collecting this data is to facilitate section 7 and 10 consultations for listed species, and assessing bat populations for listed and non-listed species.

# A MULTI-YEAR WHITE-NOSE SYNDROME TREATMENT AT BLACK DIAMOND TUNNEL

\*Kelly Lutsch, Kyle T. Gabriel, and Christopher T. Cornelison

*The BioInnovation Laboratory, Kennesaw State University, Kennesaw, GA*

## Poster Abstract

In an effort to mitigate precipitous declines in bat populations due to white-nose syndrome (WNS), a multi-year treatment strategy has been implemented at Black Diamond Tunnel (BDT) in Clayton, Georgia. Ideal hibernation conditions made BDT the largest known tri-colored bat population in Georgia. However, since the detection of *Pseudogymnoascus destructans*, the causative agent of WNS, in 2013, BDT has seen a 95% decline in tri-colored bats. Treatment involves utilizing gaseous antifungal volatile organic compounds (VOCs) that have demonstrated an *in vitro* ability to inhibit *P. destructans* growth. The compounds being evaluated are associated with a naturally-occurring, plant-associated microbe and are generally recognized as safe (GRAS) by the FDA. Antifungal compounds are dispersed in gaseous a form throughout the tunnel at even intervals. Treatment is carried out three times per hibernation season. Bat population surveys are performed before and after the hibernation season to gauge potential impact. The first treatment applications occurred the first week of November and December of 2016 and January of 2017. Bat population surveys pre- and post-treatment have been both surprising and positive.

## **ESTABLISHMENT OF THE CHARITON HILLS BAT CONSERVATION BANK IN NORTHEAST MISSOURI**

Josiah J. Maine<sup>1</sup> and Mark A. Tucker<sup>1</sup>

<sup>1</sup>*Burns & McDonnell Engineering Company, Inc., Kansas City, MO 64114*

(Poster Presentation)

Approximately one-third of the known Indiana bat population hibernates in a single site in northeast Missouri. Upon emergence from the hibernaculum in the spring, female Indiana bats establish summer maternity colonies in suitable habitat throughout northern Missouri, southern Iowa and western Illinois. The concentration of Indiana bats in this tri-state area presents significant opportunities to benefit the species within its entire range through summer maternity habitat preservation and long-term management. Accordingly, Burns & McDonnell is establishing the Chariton Hills Conservation Bank (CHCB) in northeast Missouri. The CHCB will protect and manage over 1,300 acres of summer maternity habitat in Schuyler and Adair Counties, and will provide mitigation credits to offset impacts to Indiana bat and northern long-eared bat habitat in Missouri. We worked closely with state and federal agencies to select CHCB sites using landscape ecology principles. Our site-specific analyses included historical record searches to confirm occurrences of the Indiana bat, detailed habitat assessments, and mist-net surveys to document presence of the species. We used a comparison to county-wide data and established habitat parameters from the Indiana bat recovery plan to determine habitat quality and likelihood of occupancy. Our analysis indicated that two potential properties met or exceeded most of the important summer habitat variables outlined in the Indiana bat recovery plan, and that they could be maintained or improved through adaptive management. Management actions on the properties will be directed toward maintaining the quality of the habitat and improving any habitat that does not meet values outlined in the Indiana bat recovery plan and other literature. These may include thinning, girdling, prescribed burning, and tree planting. When finalized, this will be the first conservation bank approved by Region 3 of the U.S. Fish & Wildlife Service and will protect a substantial amount of Indiana bat maternity habitat in perpetuity.



## WELCOME HOME: BRAZILIAN FREE-TAILED BATS ADJUST THEIR ECHOLOCATION CALLS TO DETECT CAVE OPENING

Kathryn A. McGowan<sup>1\*</sup> and Laura N. Kloepper<sup>1</sup>

<sup>1</sup> Saint Mary's College, Notre Dame, IN, 46556

(Poster Presentation)

Bats use different types of signals to sense their environment. Brazilian free-tailed bats (*Tadarida brasiliensis*) adjust their call structure based upon their environment, producing lower-bandwidth, constant-frequency (CF) calls in open environments, and higher-bandwidth, frequency-modulated (FM) calls in cluttered environments. In this study, we examined how Brazilian free-tailed bats change the bandwidth of calls when locating the cave opening in a flat, non-cluttered environment. We extracted individual echolocation calls from two locations around the cave, one away from the cave opening and one next to edge of the cave opening, with the only distinctive difference in the environment of the locations being the presence of the cave edge. For each echolocation call, we calculated the starting frequency and stopping frequency, and compared bandwidths between the two locations. The results indicated a significant difference in the starting and stopping frequencies between the two locations, and demonstrated an increased bandwidth for the location next to the cave opening. This higher bandwidth suggests the bats may rely on edge detection to locate the cave opening, and change the bandwidth of their signals to improve target resolution when returning to the roost.

## **THE MAMMAL COLLECTION AT EASTERN KENTUCKY UNIVERSITY: A RESOURCE FOR NATURAL HISTORY EDUCATION AND CONSERVATION**

Carson E. McNamara\* & Luke E. Dodd. *Department of Biological Sciences, Eastern Kentucky University, Richmond, KY 40475*

(Poster Presentation)

Natural history collections are often underutilized resources, yet contain a multitude of valuable information. Specimens and their collection data can be used to reveal biogeographical patterns, species richness in a study area, and historic occurrences that allow evaluation of extinction and extirpations. Additionally, collections now serve as repositories for genetic material. Recently collections have been used to investigate biogeographic shifts in response to our increasingly altered world. Eastern Kentucky University (EKU), located in Madison County, houses five unique natural history collections: plants, invertebrates, birds, fish, and mammals. Recently, these collections have been relocated to new facilities and, in doing so, the mammal collection has been assessed and re-catalogued. The mammal collection at ECU holds over 1,000 specimens, primarily comprised of dry preserved skins and skeletal materials. While the majority of specimens were collected within the Commonwealth of Kentucky, many other midwestern and southeastern states are represented, such as Illinois, Indiana, Ohio, West Virginia, and Virginia. There are also specimens from all three North American countries. Distributions of Kentucky's mesopredators will be presented at the county level using our specimen records. While the mammal collection at ECU has been predominately used for teaching, community outreach events, and student research opportunities, this poster serves as a first step towards exploring the biogeographic data within the collection for research purposes.

## **Baseline Data on Overwintering Bats and Hibernacula in Texas**

*Melissa B. Meierhofer*<sup>1</sup>, *Krysta D. Demere*<sup>2</sup>, *Brian L. Pierce*<sup>2</sup>, *Joseph M. Szewczak*<sup>3</sup>, *Jonah W. Evans*<sup>4</sup> and *Michael L. Morrison*<sup>1</sup>

*1 Department of Wildlife & Fisheries Sciences, Texas A&M University, College Station, USA; 2 Natural Resources Institute, Texas A&M University, College Station, USA; 3 Department of Biological Sciences, Humboldt State University, Arcata, USA; 4 Wildlife Diversity Program, Texas Parks and Wildlife Department, Boerne, USA*

White-nose syndrome (WNS) has led to precipitous declines in population size of cave-dwelling bat species in eastern United States. Of the 33 species documented in Texas, five species have known susceptibility to the fungus. Based on current rates of expansion, we expected that the fungus and potentially WNS could be documented in Texas within the 2016-2019 period. To understand the potential threat of WNS to bats in Texas, we monitored for the fungus and signs of WNS, as well as collected data on bat species distribution, abundance, and environmental characteristics at 20 sites from January-March 2016, and 207 sites for the 2016-2017 winter season. We submitted 142 swabs from bats for testing of *P. destructans* using real-time PCR in the 2016 winter season. All swabs were negative for the fungus. Additionally, we submitted 163 samples for testing between January and March 2017. Of the 10 sites swabbed, 5 produced positive results for *P. destructans* DNA. Throughout our surveys, we documented baseline data for winter roost sites of seven bat species and obtained winter distribution information for one species (*Nycticeius humeralis*). These baseline data will play a critical role in developing management plans prior to the arrival of WNS, and provide guidance on how to proceed should it arrive.

## **SURVIVAL AND RECRUITMENT OF A PERSISTING COLONY OF LITTLE BROWN MYOTIS IN SOUTHERN ONTARIO**

Derek Morningstar<sup>1,2</sup> and Al Sandilands<sup>3</sup>

*1 Myotistar, Cambridge, Ontario, CAN; 2 GHD, Waterloo, Ontario, CAN; 3 Gray Owl Environmental Inc., Branchton, Ontario, CAN*

(Poster Presentation)

The precipitous decline of bats in response to White-nose Syndrome (WNS) in eastern North America has heightened the need to gain a better understanding of their ecology. The behavior, diet, fecundity, philopatry, adult survival and juvenile recruitment of affected bats are critically important to the conservation and recovery of populations. Through four years of study, the Sandilands Roost has a sustained colony of Little Brown Myotis (*Myotis lucifugus*), despite WNS infection. Bats were captured in mist nets and harp traps, banded, PIT tagged, tested for WNS and radio-tracked to other roosts. The roost is part of a network of at least nine roosts, which bats move among and there are trends in association patterns of individual bats. Significant differences were observed between 9 mm and 12 mm PIT tag retention. Acoustic activity at the roost varied between and within years, but adult and juvenile capture rates in July were relatively constant 2015-2017, with return of some juvenile bats to the natal roost and reproduction in their first year. WNS was identified on bats in May, but not in July, and all showed minimal signs of skin or wing damage. Molecular sequencing of guano revealed that Ephemeroptera were most abundant in the diet followed by Trichoptera. This colony indicates that some Little Brown Myotis, including juveniles, are surviving the effects of WNS and still reproducing. Although the reproductive rate of this species is low, this colony could serve as a source for the rebound of Little Brown Myotis in Southern Ontario.

## **MOBILE ACOUSTIC SURVEY DURATION, SEASONALITY, AND REPETITION INFLUENCE INFERENCES ON BAT ACTIVITY AND SPECIES RICHNESS**

Holly K. Ober, Shelly A. Johnson, and Sarah E. Friedl. *Department of Wildlife Ecology and Conservation, University of Florida, Quincy, FL 32351*  
(poster presentation; I will not bring my own easel)

Mobile acoustic surveys are commonly used to monitor trends in bat occurrence and activity over time. We set up an experiment to investigate 4 issues that may cause biases in data collected at a local scale through this survey approach: survey duration, season, starting location, and repetition. Our objectives were to determine for our study area whether inferences on bat activity and species richness would vary according to the duration of our mobile surveys, the time of year we conducted them, the starting location, or the number of repeat mobile surveys we conducted. We used Anabat II echolocation detectors coupled with ZCAIMs to record bat activity, with high mount microphones attached to the roofs of two vehicles. Each survey night, both vehicles surveyed the same 60 mile circular route, beginning simultaneously from one of two locations along the route (i.e., one vehicle always began the route at mile marker 0 and the other at mile marker 30). Both vehicles simultaneously surveyed the circular transect 3 nights/week in April, June, and August, which corresponds to peaks of pregnancy, lactation, and volant young in the area. We then used Kaleidoscope Pro software to objectively classify each high quality sequence of recorded echolocation calls to species. We detected most species expected in the region: EPFU, LABO/LASE, LACI, LAIN, NYHU, PESU, and TABR. Activity levels of each species peaked at different times of night and varied among seasons. Number of species detected varied according to number of nights surveyed as well as survey starting location. Overall, results suggest that survey duration, season, starting point, and repetition strongly influence inferences drawn from mobile acoustic surveys at the local scale, and highlight the importance of careful advance planning when designing long-term monitoring protocols that expect to reliably estimate bat occurrence and activity through mobile surveys.

## COMMON MANUAL VETTING MISTAKES EVERY NOVICE MAKES

Kathleen O'Connor, Lisa Kleinschmidt, Prescott Weldon, Michael Fishman, Leslie Rodman-Jaramillo, and Zoe Bryant. *Environmental Resources Management, Syracuse NY 13214.*

(Poster Presentation)

Acoustic detection surveys are a powerful survey tool for bats. However, they remain a tool that is dependent on an experienced vetter to review calls and interpret results. Although there are myriad talking points and discussion topics regarding a successful acoustic analysis, our experience has shown that misunderstandings and misinterpretations most often fall into three categories. The first broad category is failing to properly contextualize the files that are being analyzed. A manual vetter should have a basic knowledge of how the detector was deployed, with information on clutter, nearby roosts, and feeding areas being factors that may change interpretation of files. Furthermore, locational data is critical to interpreting what species may truly be present in an area and what species are unlikely or highly unlikely. The second category includes is a lack of understanding of acoustic software, including the importance of call libraries and understanding how the Maximum Likelihood Estimator (MLE) works. The third category of common vetting mistakes is perhaps the most common and is simply the tendency of new vettors to attempt to identify low quality calls, including quiet calls and non-search phase behavior. We present these common pitfalls not only to point out difficulties inherent to acoustic analysis, but also to suggest some of the practices we've implemented to face these challenges. Although nothing can replace supervised practice to improve one's vetting skills, it is our hope that an awareness of the most common problems may assist those new to the field and open a dialogue about how to improve analyses for novices and experts alike.

## **“CRASH INTO ME:” HOW BRAZILIAN FREE-TAILED BATS AVOID COLLISIONS DURING CAVE EXODUS**

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(Poster Presentation)

In nature, many animals form concerted groups. Animal groupings are formed based on different attractive and repulsive forces. Attractive forces provide benefits for an individual to be close to others in a group such as safety from predators, whereas repulsive forces maintain a distance between individuals so that individuals do not collide with one another. The balance of these separate forces is what drives the individual to form a group structure. *Tadarida brasiliensis*, or Brazilian free-tailed bats, fly in large groups with complex three-dimensional dynamics. Every night, these bats exit the cave flying in groups and fast speeds to travel to foraging locations. Therefore, in the formation of these groups, what forces dictate bat grouping behavior? We predicted that bats will alter their individual flight path in the presence of conspecifics, based on either repulsive or attractive forces. Specifically, we hypothesized that an individual bat would alter its flight path and trajectory to either avoid a physical collision with a bat (if repulsive forces dominate), or to become closer to another bat (if attractive forces dominate). We analyzed thermal imagery of paired bats in flight during cave exodus using a toolbox in MATLAB. We found no significant change in bearing angle, distance between each bat, nor deviation relative to original flight path as two bats flew together over time. These results suggest that bats do not change their flight trajectory in the presence of other bats, which may be due in part to the equaling out and balancing of attractive and repulsive forces.

**Activity patterns at Gray bat (*Myotis grisescens*) summer cave roosts in the Upper Tennessee River Basin, Southwestern Virginia: preliminary results using the Bat Call Data Recorder (BCDR)**

**WIL ORNDORFF\*, TOM MALABAD, KATARINA KOSIČ FICCO, KAREN E. POWERS, RICK REYNOLDS, AND CHRIS HOBSON**

At least seven caves along rivers in the Upper Tennessee River basin in Virginia serve as summer Gray bat (*Myotis grisescens*) bachelor roosts with over a thousand individuals, with smaller numbers observed at additional sites. To assess bat activity while evaluating the instrument's potential for roost monitoring, Bat Call Data Recorders (BCDR) were deployed from March through October at three sites: Bacon Cave (Powell River, Lee County); Big Entrance Crawl (BEC) Cave (Clinch River, Scott County); and Grigsby Cave (Copper Creek, a Clinch tributary, Scott County.) The BCDR records the number of sonic events in the frequency range used by bats, and does not distinguish between species or call type. Summer use at the sites is >99% gray bats, so species identification is not required. Results were encouraging, revealing complex, systematic patterns of activity. Data were recorded at 10 minute intervals from 7 p.m. to 6 a.m., with data gaps (Bacon: March 18 thru May 4; BEC: April 19-May 3, June 9-27) due to battery issues. Data were split nightly into emergence (7-11 pm) and post-emergence (11 pm to 7 am) bins, with emergence used to assess relative occupancy. Bats arrived at sites the last week of March, activity increasing through early April. Bat activity at roosts ceased by mid-October. Activity varied more early in the season, with vacancies of several days common through mid-July. Typically more activity was associated with emergence, but each site exhibited intervals mid-season when post emergence dominated, possibly reflecting use of the cave as night roost by bats foraging in the area but not using the cave as a day roost. Late season activity patterns were more consistent at all sites, with emergence activity much greater than post-emergence. Data suggest male Gray bats use multiple roost sites for a variety of functions over the season.

Preference: Poster Presentation

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## SPECIES-SPECIFIC PROBABILITY OF WINTER ACTIVITY ACROSS A TEMPERATURE GRADIENT IN BATS

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(Poster Presentation)

Low winter-temperatures drive hibernation and migration in temperate region bats which in turn can influence mortality via white-nose syndrome (WNS) and wind turbine interactions. However, the low-temperatures at which bats are able to be active remains unknown. The goal of this study was to describe the species-specific winter low-temperature thresholds ( $T_{LT}$ ) for bat activity across the state of North Carolina (NC), USA. NC has 3 regions, with a wide range of winter climates and is well situated latitudinally to study  $T_{LT}$ . We defined the  $T_{LT}$  as the mean daily temperature at which there was a 50% probability of activity. We had 2 hypotheses: 1.) different species of bats would have different  $T_{LT}$  2.) for each species,  $T_{LT}$  will vary by regional climate. For the first hypothesis, we predicted larger species would have lower  $T_{LT}$  due to their smaller surface area to volume ratio. For the second hypothesis, we predicted that  $T_{LT}$  would be lower in cooler regions than in warmer regions. We acoustically monitored winter bat activity from sunset to sunrise nightly from December to February at 11 sites across a large temperature gradient (-10 °C to 25 °C). We recorded bat activity in at least one site every night of winter (927 recording nights total). Silver-haired bats (*Lasiorycteris noctivagans*) had lower  $T_{LT}$  than big brown bats (*Eptesicus fuscus*), and tri-colored bats (*Perimyotis subflavus*) had higher  $T_{LT}$  than big brown bats. We found that big brown bats and Silver-haired bats had lower  $T_{LT}$  in cooler regions. However, tri-colored bats showed no difference in  $T_{LT}$  between regions. We found lower  $T_{LT}$  in species less affected by WNS, suggesting that behavioral adaptations to winter temperatures affect WNS susceptibility. Our results can be used to model winter bat activity in the southeastern USA where WNS affected species may be active in winter.

## BAT UTILIZATION OF FORESTED HABITAT ON THE CUMBERLAND PLATEAU, TENNESSEE.

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(Poster)

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Previous work has found that forest management, including the use of prescribed fire and thinning, increases bat activity for some species by altering forest structure. Therefore, developing an understanding of the bat habitat associations and responses to management are critical to making informed management decisions. The objectives of our study were to 1) compare bat activity and diversity among forest types, including managed and untreated upland areas of the Southern Cumberland Plateau; 2) evaluate the effects of forest clutter on bat activity and diversity among the forest habitat types; and 3) compare bat activity and diversity on upland sites with lower elevation and untreated areas. In Summer 2017, we used acoustic recording of bat echolocation call sequences (Wildlife Acoustics SM4BAT ZC) to compare bat activity in 4 forest types including closed canopy, recently thinned, >1 yr post thinning with burning regime, and cove habitat. All monitors were placed at each sites for equal time periods. We recorded 150,989 calls, of these 11,766 were No ID and 103,650 were Noise, and we recorded a total of 12 species. Species with similar call characteristics were combined to minimize error and included: LABO/NYHU (eastern red bat [*Lasiurus borealis*] and evening bat [*Nycticeius humeralis*]), EPFU/LANO (big brown bat [*Eptesicus fuscus*] and silver-haired bat [*Lasionycteris noctivagans*]), LACI- hoary bat (*Lasiurus cinereus*), PESU - tri-colored bat (*Perimyotis subflavus*), CORA- Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and MYOT (*Myotis* spp.). Preliminary data from these sites indicated that unmanaged upland forest habitat had the least amount of bat activity and diversity with 1,515 calls recorded over the survey period. Upland sites that were thinned to 50ft<sup>2</sup>/acre and burned three times had the most calls (17,456). Data collection and analysis is ongoing and when complete, management recommendations will focus on forestry practices to enhance bat habitat in select areas of Sewanee's forested property.

## CITY BAT LIFE

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(Poster abstract proposal, easel needed)

Bats in North America are under grave threat by White Nose Syndrome (WNS), caused by the fungus *Pseudogymnoascus destructans* (Pd). Since Pd requires cold and humid environments to survive, urbanization's "heat island effect" may alter Pd's impact on bat populations. The "heat island effect" results from urbanization's impervious surfaces and manmade structures creating warmer and drier climates. These structures, planted trees, artificial lights, and additional water sources may inadvertently offer bats roosting, commuting, and foraging habitat. Therefore, I hypothesize that, with the appropriate combination of landscape features, urban areas within a WNS-positive region could serve as habitat for WNS-sensitive bats. To test this overarching hypothesis, I deployed bat acoustic detectors, insect traps, light loggers, and sound meters every week from March through October from 2015-2017 among three urbanization levels in Mid-Atlantic States. To date, almost 300,000 echolocation calls were recorded over 1,100 nights. There were significantly more total bat calls in highly urbanized sites. Interesting, there was a positive relationship in highly urban areas between total bat calls and precipitation and a negative relationship between total bat calls and canopy cover. Therefore, management recommendations for heavily urbanized areas in this region will likely include forestry practices. Next steps include conversion of all echolocation calls to presence/absence for WNS-sensitive species followed by Generalized Linear Mixed Modeling (GLMM) and Linear Regression to determine important habitat features associated with WNS-sensitive presence locations.

## ACOUSTIC MONITORING OF GRAY BAT SUMMER COLONIES IN SOUTHWESTERN VIRGINIA

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The gray bat (*Myotis grisescens*) is a federally-endangered species whose summer range is restricted to far southwestern Virginia. Given the advance of White-nose Syndrome into the Commonwealth in recent years, we began a long-term effort to monitor bat acoustic activity at eight caves and one long-box culvert known to house gray bat colonies in summer months. We deployed 10 detectors (1 per cave; 2 at either end of long-box culvert) from mid-July until early November, 2017. Analyses using automated identification software, Kaleidoscope 4.3 (294,841 files identified as non-noise bat calls) and EchoClass 3.1 (479,899 files identified as non-noise bat calls), revealed mixed results with identification of gray bat calls – even at sites known to exclusively house gray bats. This issue with auto-identification is likely due to detector placement and call plasticity in cave-emerging gray bats. Given issues with reliable identification to genus or even large-bodied versus small-bodied bats, we present our results as average number of bat calls per site per night across the survey period. We compare daily activity patterns between programs, and discuss general trends in activity between sites. This acoustics project will resume in late spring to detect and monitor gray bats as they return to these summer sites.

Preference: Poster Presentation

## **COYOTE BEHAVIOR AND INTERACTION WITH MESOPREDATORS IN A FOREST/AGRICULTUREAL LANDSCAPE IN ROANOKE VALLEY, VA**

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(Poster Presentation)

Mammalian carnivores have strong top-down effects in food webs in eastern deciduous forests. Historically, wolves and mountain lions were apex predators and controlled mesopredators in this region. With their extirpation of these species and the range expansion of coyotes in recent decades, we explored whether coyotes are acting as top predators or mesopredators in the region. Additionally, we are interested in how coyote behavior is affected by human-dominated landscapes. We addressed these ideas using four trail cameras from December 2016 to March 2018 (960+ total trap nights) at three sites in the Roanoke Valley. Within sites, we located cameras along a gradient from interior forest to the edge of agricultural land and other development. We had a coyote capture rate of 0.05 captures/trap night. Raccoons and opossums did not avoid areas with coyotes. Coyotes were photographed 89% of the time at night/dusk/dawn suggesting that their behavior allows them to avoid humans. Coyotes were lured to the bait but never took the bait suggesting a high level of neophobia. Taken together, our results show that coyotes are likely on the same trophic level as mesopredators and not acting as apex predators. Further, their wary-of-humans behavior likely reduces some direct conflict with humans. Understanding the behavior and niches of coyotes gives managers interested in the conservation of mammals useful information.

## SUMMER FORAGING RESOURCE SELECTION OF LOCAL BATS

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(Poster Presentation)

Conservation of bats requires detailed knowledge of their habitat use. Bat populations in Dayton, OH have been monitored by environmental consulting groups and the US Fish and Wildlife Service for decades. In 2000, two female Indiana bats (*Myotis sodalis*) were radio-tagged to a maternal roost in Wright State University's (WSU) campus woods post-capture. This 82ha wooded property consists of 58% primary forest and 42% secondary forest. Since Indiana bats were recorded on the property and are known to be selective when choosing optimal summer habitats, we determined the property would be sustainable for many Ohio bat species in summer months. Additionally, each bat species in Ohio is state and/or federally listed; thus, surveying all bat activity is critical for determining baseline habitat use and furthermore establishing conservation management strategies for the WSU campus woods. We hypothesized that bats would select primary forests over other habitats for foraging based on Ohio bat anecdotal natural history. We also predicted greater habitat selection in riparian areas than in interior or edge habitats because of the importance of hydric habitat proximity to foraging habitat selection. In Summer 2017, 10 walking bat acoustic routes with georeferenced detections were completed. Echolocation calls were recorded with a Wildlife Acoustic's Echo Meter Touch microphone and Echo Meter Touch app for iOS on an Apple iPad Air. We created a generalized linear model and determined probabilities of occupancy for different foraging habitats. We found the greatest probabilities of occupancy were in riparian habitats of both primary (0.71 probability) and secondary (1.00 probability) forests. Our model provides predictions for areas where bat activity is the greatest during summer months for use in conservation management strategies. Further analysis with acoustic classification and species models may also provide predictions for species specific management practices.

## USE OF LONG TERM MONITORING TO STUDY IN-FLIGHT SOCIAL CALLS OF NORTH CAROLINA BATS

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(Poster Presentation)

Bat species exhibit a high diversity of social group size, ranging from one to over one million individuals. Within gregarious bats there is also a broad range in the complexity of interactions; such as simple congregations, fission fusion dynamics, and reciprocal altruism. Their diversity in sociality makes bats a potentially useful model for understanding how the social environment shapes communication behavior. However, as bats are nocturnal, volant, often small, and produce predominantly ultrasonic vocalizations the existing literature focuses mostly on social calls in roost or laboratory settings. With the increase in long term bat monitoring projects for conservation purposes, it may be possible to obtain sufficiently sized samples of in flight social calls. The objective of this study is to investigate in flight social calls using data from large scale bat monitoring projects in North Carolina. We hypothesized that bat social call characteristics (shape, frequency, duration, etc.) differed by species. We used data from bat monitoring projects in North Carolina to identify social calls. Manually identified social calls were then used as training data for machine learning. We analyzed if the differences in call characteristics between species were greater than within species. We were able to identify several distinct types of social calls produced by different species of bat. These preliminary results demonstrate the viability of using monitoring data to study bat social communication.

## HIBERNACULA COUNTS REVEAL MAJOR DECLINES IN MARYLAND CAVE BATS

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(Poster Presentation)

North American populations of cave-hibernating bats are experiencing devastating declines caused by white-nose syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans*. Since its initial detection in western Maryland in 2010, white-nose syndrome has affected cave bat populations throughout the western region of the state, and acoustic and capture surveys suggest negative effects on bat populations statewide. To quantitatively assess changes in bat populations following the emergence of WNS, we used hibernacula counts collected over a 31-year period in 12 western Maryland hibernacula. We estimated percent decline between pre- and post-WNS years and used localized regression to visualize count trends over the study period. From 1977 – 2017, we counted 9,621 bats of 5 species including tri-colored (*Perimyotis subflavus*), little brown (*Myotis lucifugus*), eastern small-footed (*Myotis leibii*), northern long-eared (*Myotis septentrionalis*), and big brown (*Eptesicus fuscus*) bats. Total bat counts declined by 85% following the detection of WNS. Tri-colored, little brown, and northern long-eared bats exhibited significant declines of 92–93%, though big brown bat counts increased by 58% following the emergence of WNS. Similarly, visual assessment of trends using localized regression showed declines in tri-colored, little brown, and northern long-eared bats following the emergence of WNS, but suggested a slight increase in counts of big brown bats. Our



findings demonstrate that WNS has caused major declines in populations of several Maryland cave bat species.

## NORTHERN LONG-EARED BAT MATERNITY ROOST SELECTION IN MINNESOTA

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(Poster Presentation)

The northern long-eared bat (*Myotis septentrionalis*; NLEB) was listed as a threatened species under the Endangered Species Act (ESA) in 2015, mainly due to the impacts of white-nose syndrome (WNS). Mortalities from WNS were first observed in Minnesota in winter 2015/2016. Under the ESA, NLEB maternity roost trees are protected from harvest during June and July, when bat pups are non-volant. Little information is available on NLEB roosting habitats and reproductive timing in the upper Midwest. We captured bats throughout the forested region of Minnesota during the summers of 2015-2017. Pregnant and lactating NLEB were given radio-transmitters and were tracked to their maternity roost sites. We tracked 84 female NLEB to 237 roosts, 233 of which were in trees. These roosts were located in at least 22 different species of trees of varying diameter, height, and decay stage. Roost trees were, on average, larger and more decayed than random trees. Bats spent an average of 1.3 days in each roost, and moved an average of 278 m (range 2 – 2083 m) between consecutive roosts. Our results suggest that female NLEB prefer larger more decayed trees as maternity roosts, but have flexible roosting habits and may therefore not be limited by roost availability. Parturition may occur as late as the third week of July in Minnesota, meaning some pups may still not be able to fly during the first weeks of August. These results can be applied to future management actions to assist recovery of NLEB in Minnesota.

# INFLUENCE OF OFF-ROAD VEHICLE TRAILS ON SMALL MAMMAL COMMUNITY STRUCTURE AND BAT ACTIVITY IN WESTERN MARYLAND

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(Poster Presentation)

## Abstract

Anthropogenic habitat disturbance is recognized as a primary contributor to loss of biodiversity and overall degradation of natural landscapes. Roadways that divide forest ecosystems reduce habitat connectivity and disrupt wildlife behavior. Most research to date has focused on major roadways with high traffic volume with less focus on smaller roads and trails. Policy changes regarding off-road vehicle (ORV) use on public lands has concentrated environmental impacts in specific areas. The first objective of this study was to provide the first comprehensive survey of small mammal population distributions and abundances along St. John's Rock ORV trail in Savage River State Forest. We hypothesized that small mammal abundances would be greater near the trail, whereas species richness and diversity would be greater further from the ORV trail. Transects established along the trail were trapped to quantify small mammal community structure and distribution. The second objective of this study was to further our understanding of the impacts of forest trails on bat activity. We hypothesized that bat activity would be greater along the ORV trail compared to locations further from the trail. Acoustic bat detectors were deployed within 5m and 250m from the trail to quantify bat activity and occupancy. We observed ten small mammal species across all sampling locations, with *Peromyscus* spp. being the most abundant. We detected at least 6 bat species across all locations, with *Lasiurus borealis* and *Eptesicus fuscus* being the most abundant. Preliminary results indicate that small mammal abundances and bat activity were greater near the ORV trail. Modeling small mammal abundances and detection probabilities with microhabitat characteristics will provide an understanding of distributions and activity levels. The results of this study can be used to determine the extent to which anthropogenic recreation and small mammals can coexist in a multiuse natural landscape.

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[Poster Submission]

**CHANGES IN SUMMER BAT CAPTURE RATES AT MAMMOTH CAVE NATIONAL PARK: PRE/POST WHITE-NOSE SYNDROME ARRIVAL**

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Thirteen species of bats have been documented during summer capture surveys at Mammoth Cave National Park, Kentucky. White-nose syndrome (WNS) was first confirmed in the park in early January 2013. This disease has been confirmed in seven bat species on the park, and the fungus which causes the disease has been found on three park species, but without confirmation of the disease. Biennial winter bat counts from 2007 to 2017 in selected park caves showed increasing numbers for the gray bat (*Myotis grisescens*), big brown bat (*Eptesicus fuscus*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and decreasing numbers for the little brown bat (*M. lucifugus*), the tri-colored bat (*Perimyotis subflavus*) and the Indiana bat (*M. sodalis*) over the 11-year period. Capture data from summer bat inventory efforts on the park prior to the arrival of WNS (2004-05) and after the arrival of WNS (2017) were used to examine changes in capture rates among bat species between the two time periods. Several species showed declines, a few species showed increases, and several species showed little or no changes in capture rates. Results from summer capture studies were similar to changes observed during the winter bat counts. These findings are similar to results reported elsewhere following the arrival of WNS.

Presentation Type: Poster

Presenter status: Student

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**A MULTIVARIATE ANALYSIS OF COMPLEX RELATIONSHIPS BETWEEN DEN SELECTION BY EASTERN SPOTTED SKUNKS (*SPILOGALE PUTORIUS*) AND ENVIRONMENTAL VARIATION**

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Eastern spotted skunk (*Spilogale putorius*) populations have been in decline since the 1940's. The cause of this decline is thought to have been a combination of several factors including increased competition with sympatric carnivore species, spread of introduced diseases, and habitat loss and fragmentation. In Virginia, ideal spotted skunk habitat occurs in small, disjunct patches throughout the Appalachian and Blue Ridge Mountains. Management recommendations include the use of prescribed burning and other disturbance based management to increase habitat connectivity and maintain areas of current spotted skunk habitat. However, to construct and implement effective wildlife habitat management plans, it is critical to understand microhabitat use and resource selection by the species in need of management. We tracked 19 radio-collared spotted skunks from January 2016 through November 2017 at three sites throughout the George Washington and National Forests. Our aim was to investigate the complicated relationships among characteristics of dens selected by spotted skunks. We conducted a redundancy analysis (RDA) to extract and summarize the variation in den selection that can be explained by site-specific environmental variables, variation in weather conditions, and reproduction condition. We hypothesized spotted skunks would select den types and locations that offer protection from predation and exposure to inclement weather. We predicted that these relationships would be strongest during times of higher vulnerability, i.e. during mating season in late winter and kit rearing in late summer. We expect our results to influence the selection and timing of management methods and implementation in respect to eastern spotted skunk habitat restoration and management.

Presenter Type: Poster

Presenter Status: Student

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## **INTERACTIONS BETWEEN IMPREILED BAT SPECIES AND A FIRE DEPENDENT ECOSYSTEM IN THE SOUTHERN APPALACHIANS**

Kaitlyn Torrey<sup>1\*</sup>, Andrew Edelman<sup>1</sup>, Joseph Johnson<sup>2</sup>, and Jonathan Stober<sup>3</sup>

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Longleaf pine (*Pinus palustris*) ecosystems of the southeastern U.S. require low-intensity fire to maintain their open-canopy forest structure. Efforts to restore this once widespread ecosystem are being implemented by use of prescribed fire and forest thinning. These restoration efforts may, however, have negative impacts on the threatened northern myotis (*Myotis septentrionalis*) and the endangered Indiana myotis (*Myotis sodalist*), which are declining due to white-nose syndrome. Our objective is to examine roost site selection and foraging patterns of northern myotis and Indiana myotis across prescribed fire regimes. The study area is located in the Shoal Creek Ranger District of the Talladega National Forest in northeastern Alabama. We mist netted for and radio tagged northern myotis and Indiana myotis during the summer of 2016 and 2017. We tracked tagged individuals daily to find day roosts, and we obtained foraging points nightly. We measured habitat characteristics for each day roost and nearby random tree. Our preliminary results suggest that northern myotis and Indiana myotis had a greater proportional home range use in areas with more frequent prescribed fire. Indiana myotis roosted in tall pine snags with high DBH, whereas northern myotis roosted in a variety of living and dead pine and hardwood trees with a lower DBH. These early results suggest that extensive prescribed fire management associated with longleaf pine ecosystem restoration is compatible with the habitat needs of the northern myotis and Indiana myotis.

**ARTIFICIAL ROOST STRUCTURES AS A SURROGATE FOR NATURAL ROOSTS  
IN THE EASTERN SMALL-FOOTED MYOTIS, *MYOTIS LEIBII***

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(Poster presentation)

The focus of this project is the development of artificial roosts for *Myotis leibii*. This species roosts in rock crevices, so the conservation application is limited, although rock roosts may occasionally collapse. If the bats use these structures, we will manipulate the structures by changing variables (e.g. crevice width, angle of exposure to the sun, height, and crevice temperature) to test hypotheses about roost preferences of this species. In the spring of 2017, we placed 8 roost boxes, approximately 1 m<sup>2</sup> each, at locations on Surry Mountain Dam. The boxes are placed in pairs, anchored to the slope, and face southeast. We monitored the boxes weekly during the summer, and also successfully netted *Myotis leibii* to confirm their presence in the area. Bats often require time to find and utilize artificial roosts, so we will continue monitoring the boxes for at least two additional years. Because no bats used the boxes in summer 2017, we have modified the roosts in anticipation of the 2018 bat season. Specifically, we lowered one of each pair of boxes so that the bats might locate it more easily, and we painted the lowered box interior black. We hope this will better simulate the rock crevices this species prefers. In addition, the boxes will be available earlier this year, because they are set up and waiting through the winter months. This may mean that bats will locate the roosts earlier in the spring, and then adopt them for the summer 2018 season. We will be able to record the dates of bats returning to roost in the area, and also data about whether roosts are preferred lower to the ground.

## **BATS IN BRIDGES: SEARCHING FOR SUITABLE ACOUSTIC METHODS AND ANALYSIS**

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(Poster)

Many bats, including several species listed as threatened or endangered, rely on highway bridges as both day and night roosts, and even as maternity colony sites. Bridges are regularly inspected for signs of bat use, and must be checked before any maintenance or construction activities that might disturb roosting bats. But it can be difficult to determine exactly which bat species may be present in the structure. Roosting sites may be inaccessible and capture techniques can be challenging and dangerous in proximity to busy highways. Acoustic detectors and analysis software can be used to identify free-flying bats, but species recorded foraging or passing through the area may or may not actually be using the structure. We used several acoustic detectors in different configurations to look for differences in call quality and activity patterns at a bridge known to house roosting bats in Wythe County, VA, and consider statistical analysis to compare classification data as initial steps in developing a strategy to differentiate between bat species roosting in the bridge from those just using the area around it. Lack of replication is a current constraint, but results can be enhanced and techniques refined as we incorporate additional sampling sites.



## BAT TRACKING AND COUNTING WITH LOW-COST THERMAL CAMERAS

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Obtaining accurate counts of bats is important for population monitoring and species management. High-end thermal cameras have been used for counting bats, but they are expensive for an individual or non-profit organization. There are lower-cost thermal cameras available, but the low resolution can make accurate counting difficult due to high background noise. In this paper, we designed a new algorithm for bat tracking, and tested our algorithm across a range of bat caves under different environmental conditions. We use energy distribution of the bat body in our algorithm to obtain a robust tracking and counting method for low-cost cameras and tested the performance with different levels of background noise. Our recursive algorithm has low computation complexity in both counting accuracy and speed, is open-source, and is easy to use. We assessed the counting accuracy of our algorithm from 4 different caves and different weather conditions. The average performance accuracy was 87%, with a maximum accuracy of 97%. This new counting algorithm can be helpful for users desiring a low-cost, user-friendly bat counting method.