How Do Large Mammals Weather the Storm: Movement and Habitat Selection of White-tailed Deer During Hurricane Irma

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Extreme weather events can have dramatic impacts on biological systems. However, little information exists on how large mammals cope with such events. Hurricane Irma, hit southwest Florida on September 10, 2017 where we were monitoring 84 white-tailed deer (*Odocoileus virginianus*; hereafter deer) with GPS collars. The eye of hurricane Irma passed within 13 miles of our study area bringing 11.74 inches of rain and sustained winds of 134 mph. We utilized this opportunity to examine survival, movement patterns, and habitat selection of deer during such an event. No collared deer died during the storm. Deer movement patterns differed by sex, but habitat selection did not. Movement rates of females were 49% greater during the storm ($p = 0.003$) compared to a seven days before and after the storm, while males did not significantly alter movement rates ($p = 0.58$). Further, 64% of females and 14% of males left their seasonal home ranges during the storm; home range size was not a determinant as to whether deer left their seasonal home range, rather this behavior was sex specific. On the day of Hurricane Irma,

deer selected pine-dominated uplands, and avoided freshwater marsh and wet prairies. To our knowledge, this study is the first to use GPS collar data to elucidate survival, movement rates, and habitat selection by deer during a hurricane. More broadly, our results demonstrate the resiliency of a species that inhabit frequently disturbed ecosystems.

Presentation preference: oral presentation

BAT AND INSECT RESPONSES TO SHELTERWOOD AND PATCH CUT HARVESTS IN APPALACHIAN HARDWOOD FORESTS

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Activity patterns of bats and insect communities are influenced by horizontal and vertical structure in their foraging environment. Shelterwood and patch cut harvests change these features, altering the structural arrangement and density of clutter from its original state. Two approximately 120-ha sites in eastern Kentucky, Kentucky Ridge State Forest and a site on private timber land, were harvested with a 40-ha shelterwood and 40-ha set of patch cuts performed in each. The remaining 40-ha parcels served as un-harvested units. We monitored shifts in bat activity with SM3 acoustic detectors, and changes in insect communities using light traps to sample primarily Lepidopteran and Coleopteran diversity. Light traps were placed at mid-slope points in shelterwood harvests and patch cuts and compared to the un-harvested sample. Bat detectors were placed at ridgetop, mid-slope, and riparian points in shelterwood and control habitats and ridgetop and mid-slope points in patch cuts. Bat calls were assigned to most likely species using Kaleidoscope software. Both shelterwood harvests and patch cuts increased bat activity in the vicinity of detectors, with activity increases predominately due to eastern red bats (*Lasiurus borealis*) and big brown bats (*Eptesicus fuscus*). Activity of *Myotis* species remained high in un-harvested areas, but dropped in frequency with shelterwood and patch cut harvests. No difference was observed in total insect abundance, Lepidopteran abundance, and Coleopteran abundance between un-harvested and harvested units. For at least the forests sampled, our data support the premise that habitat structure plays a greater role in affecting foraging behavior of bats than does the relative abundance of insects across habitats.

ACOUSTIC MONITORING TO DETERMINE NORTHERN LONG-EARED BAT (*MYOTIS SEPTENTRIONALIS*) DISTRIBUTION IN IOWA

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(Oral presentation)

Iowa is a major contributor to wind energy production in the United States and the number of turbines in the state will continue to increase. However, bat fatalities at wind facilities are a significant conservation concern. A collaborative project among USFWS, Iowa Department of Natural Resources, and MidAmerican Energy aims to better understand the potential impact of wind energy development in Iowa on the recently listed northern long-eared bat (NLEB). In 2016 and 2017 summer acoustic surveys were conducted across 60 counties in central and western Iowa to determine the presence or probable absence of NLEBs within forested areas identified as potentially good habitat. Acoustic methods were also used to monitor the timing and magnitude of NLEB activity during the spring and fall at potential hibernacula in eastern and central Iowa. The greatest numbers of files identified as NLEB calls were recorded in north central Iowa during summer 2016 and 2017. During spring 2016, NLEB calls were first detected in the third week of March. Monitoring began earlier in spring 2017 and NLEB calls were first recorded in the first week of March. In fall 2016, NLEB calls were detected into the last week of November. Monitoring was conducted later into fall of 2017 and NLEB calls were recorded into December. Data from the summer surveys were used to identify areas where NLEBs could be captured to track migration routes using radio telemetry and data from the hibernacula surveys were used to identify sites where video monitoring could help confirm whether NLEB were using the hibernacula sites. Information about where NLEB are present in Iowa, what migration pathways they use, and where they may be hibernating could aid mitigation efforts by allowing wind energy producers to place turbines away from areas that are heavily used by the NLEB.

Current Distribution of Bats in New Hampshire Based on State-wide Acoustic Survey

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(Oral Presentation)

As bat populations of all species face greater pressures due to white-nose syndrome, wind power development, habitat loss, and/or climate change, improved understanding of baseline distributions is increasingly important. Using auto-reviewed acoustic survey data collected from 2015 through 2017, we analyzed the current distribution of New Hampshire's eight resident bat species during the summer season. Our analysis considered 1,635 detector nights, collected at 530 detector locations (average nights/detector = 3.1, range 2-10) along a roughly north-south state-wide transect, representing 42 towns, and 8 of the State's ecoregions. Species and number of species detected were mapped by detector, town, and ecoregion. The influence of number of survey nights on number of species detected was examined at each scale. The influence of elevation and latitude was examined at the detector scale.

Eptesicus fuscus was most commonly detected (35% of detectors), while *Myotis septentrionalis*, *M. leibii*, and *Perimyotis subflavus* were least common, detected at 8%, 2% and 1% of detectors, respectively. *M. lucifugus, Lasiurus cinereus*, *L. borealis*, and *Lasionycteris noctivagans* were recorded at 29%, 29%, 31%, and 23% of detectors, respectively. Although survey effort varied by year, this pattern of relative species abundance was reflected for each survey year. At least 1 bat species was detected at 56% of detectors, with most (48%) detecting from 1 to 4 species. No single detector recorded more than 7 species; 2 towns and 3 ecoregions had all 8 species. Number of survey nights did not appear to influence the number of species recorded at any scale. Both latitude and elevation appear to have a negative influence on number of species recorded at a detector. However, the distribution maps suggest that each of NH's bat species continues to occur throughout the State, with even the rarest species widely detected.

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Presenter status: Student
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BATS ACROSS THE SPACE-TIME CONTINUUM – A THEORY OF RELATIVE ACTIVITY

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For many bat species, populations generally have declined in a consistent pattern with spread of white-nose syndrome (WNS). Nonetheless, the realized impacts have varied within states or geographic regions owing to the vagaries of landscape composition, environmental conditions, bat species distribution, and community assemblage. Together these factors complicate "one size fits all" survey guidelines for Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) monitoring. Our goal was to better characterize the variability of region and landscape within region as well as geographic/temporal relationship to WNS on bats to inform future management efforts. Accordingly, we monitored 36 fixed acoustic stations in matched upland forest canopy gaps, forested riparian corridors and forest/field edges from the Atlantic Ocean to the Mississippi River Valley across Virginia, West Virginia, Ohio and Kentucky from 15 May to 15 August, 2017. As expected, myotid activity was higher in riparian corridors, with upland forest canopy gaps equally important for the northern long-eared bat. Location along the time-since-WNS gradient had a significant impact on relative activity of most affected species. Relative activity of northern long-eared and Indiana bats was higher in the first third of the sampling period, whereas activity levels for less WNS-impacted and/or migratory species were higher in the middle or late summer. The former may provide additional evidence of earlier maternity colony formation followed by earlier colony dissolution and unsuccessful reproduction. VERITAS.

FIRE-ADAPTED? RECREATING HISTORICAL FIRE REGIMES MAY BENEFIT AN ENDANGERED BAT

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(Oral Presentation)

Abstract

Fire suppression has altered ecological communities globally. Prescribed fire regimes strive to restore function to these fire-dependent ecosystems by mimicking natural fire regimes. Although fire frequency is a widely acknowledged component of fire regimes, the importance of fire seasonality for biodiversity is unclear. In subtropical Florida, fire historically occurred primarily at the transition from the dry to wet season (early wet) when dry fuel accumulation coincides with a high incidence of lightning. We investigated the effects of fire frequency and season on endangered Florida bonneted bats (*Eumops floridanus*), a species endemic to a region that evolved with frequent fires. We surveyed bat activity acoustically in 149 sites, and evaluated the effects of fire frequency for all burns, and for burns conducted during three seasons (dry, early wet, wet), using burn records from the previous 18 years. Variation in bat activity was best explained by both fire frequency and season: bat activity decreased with early wet season burn interval and increased with dry season burn interval. Bat activity and foraging activity were highest in sites burned at 3-5 year intervals during the early wet season. Fires during the historic fire season at this moderate frequency may lead to optimal effects on bat habitat through increases in roost, flight space, and insect prey availability. We suggest that Florida bonneted bats are fire-adapted and benefit from prescribed burn regimes that closely mimic historical fire regimes, and encourage consideration of both fire frequency and seasonality when managing ecosystems with fire.

IMPACTS OF WNS ON A PRIORITY ONE INDIANA BAT HIBERNACULA.

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(Oral Presentation)

Magazine Mine was abandoned in 1980; it was first discovered being used by bats in 1998. At that time hibernating bats were documented and a survey was scheduled. In 1999, an official survey documented about 9,000 Indiana bats (*Myotis sodalis*). Continued biannual surveys documented a rapid increase in hibernating population of Indiana bats. By 2011 the population has increased to an estimated 45,000+. Unfortunately, liability concerns prevented access to the site for further surveys. In 2017, the site was acquired by the Organization for Bat Conservation. With that acquisition, surveys were again allowed at the site. In Feb 2018, Magazine Mine was surveyed for the first time since 2011. It also represents the first survey of the site since WNS has affected bats in Illinois. WNS was first documented in Illinois in 2013. Magazine Mine and all of Southern Illinois had multiple documented cases by 2014. The structure of Magazine Mine and similar microcrystalline silica mines promotes a dryer hibernation environment than other sites. It has been hoped that the conditions within these mines including Magazine Mine would minimize the effect of the WNS fungus on bats and therefor increase survival.

Classifier Test Redux: Signal Analysis Software as Survey Tools for Determining *Myotis* Species Occupancy

J.D. Chenger[1] and J.D. Tyburec

Bat detectors may seem an easy, efficient, and effective way to sample for species occurrence without the time, energy, effort, and training involved in identifying bats in the hand. Some permitting agencies have promoted acoustic surveys for bats and have developed guidelines for their implementation. Many researchers have applied these protocols far beyond their intended or perhaps practical use. These guidelines rely heavily upon advances in the automatic classification of echolocation recordings provided by relatively newly developed signal analysis software programs, yet few attempts have been made for cross comparisons among programs. The most well known effort by the US government tests eleven, but is mainly concerned with only two, of the more than forty US bat species. This point is sometimes lost on researchers who may apply auto-classification to bat surveys without full knowledge of their limitations. Sub-optimal field recordings where conditions are noisier and call quality is worse than the library files classifiers are built upon may contribute to the presumed classifier performance not reflecting the true accuracy, particularly with Zero-Cross data most classifiers use. While full spectrum recording reduces issues classifying noisy data, to date few if any tests have been presented analyzing full spectrum recordings. Comparing classifiers requires sets of species-known recordings, most of which come from hand-released or known bats tracked and recorded in ways that may not provide natural call variants as recorded from unfettered bats in actual field settings. Sets of recordings made in natural situations with a strong inference of known species, for example down flight from a known roost, can circumvent such limitations and uncertainties and provide useful comparative tests of classifier performance. We will present comparative classifications from sets of recordings recorded in situations with known species presence from a variety of locations across North America.

Additional Key Words: bats, echolocation, *Myotis lucifugus*, *Myotis grisescens*, *Myotis septentrionalis*, *Myotis sodalis*, *Tadarida brasiliensis*, acoustic recording, acoustic identification, auto-classification software programs, threatened and endangered species

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NORTHERN LONG-EARED BAT SUMMER ROOST SELECTION ON COASTAL PLAIN SOUTH CAROLINA

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(Oral Presentation)

Historically, northern long-eared (*Myotis septentrionalis*) bats were only documented in Greenville, Oconee, and Pickens Counties in upstate South Carolina. However, in the fall of 2016 two northern long-eared bats, an adult female and sub-adult male, were captured in Beaufort County in the coastal plain of South Carolina. Then, in 2017, Ecological Solutions documented a population of this bat species while conducting a research project for Central Electric Power Cooperative Inc. within the Francis Marion National Forest (FMNF). From June-August, Ecological Solutions surveyed 30 sites for a total of 60 net nights in two counties (Charleston and Berkeley) associated with the FMNF. Nine northern long-eared bats (4 adult females, 3 adult males, 1 juvenile female, and 1 juvenile male were captured and tracked to 30 roost trees. Although, large portions of FMNF are intensively managed monoculture pine stands for timber sales and as red cockaded woodpecker (*Picoides borealis*) habitat, there are large areas of mature mixed pine, hardwood forest, and hardwood riparian forest. Of the thirty roost trees documented, 20 roost trees were live pine species including loblolly pine (*Pinus taeda*), longleaf yellow pine (*Pinus palustris*), and shortleaf pine (*Pinus echinate*). Intensively managed, open pine forests are not typically associated with northern long-eared bats as preferred roosting or foraging habitat; however, within the FMNF, many of the transmitted northern long-eared bats were tracked to this habitat type and roosted in live pine trees. As observed, this area provides suitable habitat to support a northern long-eared bat population and may be crucial for this species. However, additional data collection is needed in order to more fully describe the behavior and activity of these disjunct costal populations in managed forest.

DIURNAL ROOSTS AND FORAGING ACTIVITY OF NORTHERN LONG-EARED BATS (*MYOTIS SEPTENTRIONALIS*) AT TWO WIND ENERGY DEVELOPMENT PROJECTS IN SOUTHWESTERN PENNSYLVANIA

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(Oral Presentation)

Summer maternity season surveys during the pre-construction phase of wind energy development provide valuable data on the summer activity of resident bat species. Data yielded by these studies give stakeholders a snapshot of habitat utilization in the context of planned development. We captured a total of 12 northern long-eared bats (*Myotis septentrionalis;* MYSE) at two proposed wind farm locations in Somerset County, Pennsylvania during the 2015 and 2016 summer maternity seasons. Nine MYSE (eight females and one male) were outfitted with radio transmitters and tracked to 28 diurnal roosts using radio telemetry. Foraging movements were tracked with mobile telemetry stations during 21 nights. Nightly minimum convex polygons (MCP) and 95% fixed kernel utilization distributions (UD) were calculated for each tracked individual. All diurnal roosts were located in trees with 43% of roost locations in black locust (*Robinia pseudoacacia*). We compare 18 nightly UD and MCP from 8 bats which varied widely among individuals and between sampling locations.

THE COLD NEVER BOTHERED US ANYWAY: MIGRATION AND TORPOR OF MID-ATLANTIC BATS

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(Oral Presentation)

With the discovery of overwintering northern long-eared bats (*Myotis septentrionalis*) in eastern North Carolina and southeastern Virginia, we undertook a pilot acoustic sampling effort along the Potomac River and I-95 corridors from the District of Columbia (D.C.) to the North Carolina line from October 2016 to March 2017. At 94 locations, we totaled 12,314 detector nights and identified the presence of 9 species. We modeled nightly activity levels using a kernel density estimator across fall, winter and spring seasons. Relative activity levels were highly variable among bat species and trends in activity from north to south during the fall and then south to north during the spring were evident; all species showed some level of activity throughout the duration of the survey effort. During the winter period, southeastern myotis (*Myotis austroriparius*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*) and Indiana bat (*Myotis sodalis*) activity was concentrated in southeastern Virginia, complimenting recent acoustic and mist-net capture findings in eastern North Carolina. Although low, some northern long-eared bat activity was recorded throughout fall, winter and early spring as far north as D.C. metro area. Relative bat activity for eastern red bats (*Lasiurus borealis*) and silver-haired (*Lasionycteris noctivagans*) bats shifted from mid-Virginia to south-central Virginia between the fall and winter. Throughout the study period, big brown bat (*Eptesicus fuscus*) activity remained highest in D.C. and to the northwest along the tri-state Potomac River corridor. Hoary bats (*Lasiurus cinereus*) relative activity showed similar pattern around D.C. but with an additional activity center during the fall and spring in the southwestern portion of the Fall Line. Because caves and mines are absent from this region's geology except for areas northwest of D.C., acquisition of data on overwintering day-roosts or aberrant hibernacula should a conservation priority in Virginia and the surrounding mid-Atlantic.

Post-WNS Northern Long-eared Bat Day-roosts in a Residual Population

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Abstract – White-nose Syndrome (WNS) impacts have been most severe for the northern long-eared bat (*Myotis septentrionalis*). Although pre-WNS knowledge about day-roost use and roost-area size in the Northeast, Appalachians and Ohio Valley is high, post-WNS day-roost characterization is limited by lack of captured bats. At present, however, there appears to be a substantial residual population of northern long-eared bats in the upper Ohio River Valley. Accordingly, we have opportunistically radio-tagged northern long-eared bats in this region to determine if day-roost characteristics e.g., tree species, slope position, have changed since the onset of WNS. In 2015, 2016 and 2017, we mist-netted and radio-tagged northern long-eared bats in Monroe and Noble counties in Ohio and Doddridge, Harrison, Marshall, Ritchie and Tyler counties in West Virginia to examine day-roost type and roost area extent. Of the 50 day-roosts located, we observed use of 13 tree species, an unidentified snag, and a telephone pole. The majority of day-roost found (60%) were in either red maple (*Acer rubrum*; $n = 16$) or sassafras (*Sassafras albidum*; $n = 14$) trees or snags and averaged 23.2 ± 13.1 cm. in diameter. Mean colony roost-area extent based on 9 minimum convex polygons was 1.69 ± 2.0 ha. Based on roost locations, and $n = 3$ roost triangulations, MAXENT analyses (AUC = 85.6 ± 2.5) characterized highly suitable day-roost habitat as mid-aged to older (≥ 50 yr.) hardwood forest patches of at least 100–200 ha at elevations of 300-365 m on southwest to northwest slopes. High (81–100%) and medium-high (61–80%) roosting-habitat suitability classes were

uncommon across the landscape (2.4% and 7.1%, respectively), with the broad medium-to-high classes (41–100%) collectively comprising 27.7% of the region. Overall, day-roost type and landscape position were similar to those reported for northern long-eared bats elsewhere in the Ohio River Valley and Appalachians pre-WNS suggesting that management efforts using pre-WNS data still have conservation relevance in the region for northern long-eared bats.

Type: Oral Presentation

Can Automated Software Tell Bats from Flying Squirrels?

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Automated bat call identification software has expedited the processing of the copious amount of call files collected during ultrasonic acoustic surveys. These software programs determine which call files have tonal qualities and subsequently identify those call files to bat species using classifiers specifying call parameters. Although ultrasonic calls of bats have been studied extensively, ultrasonic calls of other mammals, such as flying squirrels (*Glaucomys* spp.) have been recently discovered and classified. Flying squirrels call between 7-25 kHz. The majority of bat species produce ultrasonic calls ≥30 kHz. However, hoary bats (*Lasiurus cinereus*) produce calls between 15-39 kHz, some of which have a similar shape to common flying squirrel calls. Since automated call identification does not exist for flying squirrels, we have identified acoustic files by hand, separating flying squirrel calls from bat calls. We used visually confirmed flying squirrel and bat calls to test to see if three automated bat call software programs (SonoBat, Kaleidoscope, and EchoClass) misidentified flying squirrel calls as bat calls.

AIRPORT EXPANSION AND ENDANGERED BATS: DEVELOPMENT AND MITIGATION NEAR THE INDIANAPOLIS INTERNATIONAL AIRPORT

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(Oral Presentation)

Economic prosperity and globalization are major drivers for development of international airports, but aviation-oriented businesses and residential development are by-products of airport business models. To address the habitat needs of endangered wildlife species, it may be necessary to mitigate for airport expansion and associated development projects. We analyzed foraging data from 57 Indiana bats (*Myotis sodalis*) during three time periods (1998–1999: pre-mitigation; 2005–2006: during mitigation, and 2014–2016: post-mitigation) of a long-term study near the Indianapolis International Airport. At this site, both developed and forested land cover increased between 1998 and 2016 (34.1% and 3.3%, respectively). Mitigation actions included converting 323 ha of residential lots back to forest, and creation of a 56 ha wetland and an 85 ha multi-use park. With a weighted compositional approach, we related bat use of landscape cover types to changes in land cover during each period. We then compared competing hypotheses to explain changes in bat foraging space use with an information theoretic approach. With the addition of a major highway interchange within the bat colony's foraging area, bats increased space use, presumably in search of new habitat. In all periods, bats selected for forested habitat; as trees in replanted forest and designated parks matured, bats reduced their foraging ranges. Restoring hardwood forest, creating wetlands, and setting aside parklands were effective proactive mitigation measures for the colony of Indiana bats near the Indianapolis International Airport. Similar actions should also benefit other wildlife where human development and habitat needs intersect.

USING CITIZEN SCIENTISTS AND CAMERA TRAPS TO SURVEY FOR EASTERN SPOTTED SKUNKS IN ALABAMA

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(Oral Presentation)

Eastern spotted skunks (*Spilogale putorius*) have significantly declined in abundance across their range over the last half century. In Alabama, eastern spotted skunks are a state-protected species of high conservation concern and appear to be relatively rare. Given their secretive and noxious habits, little is known about their basic natural history and distribution in the state. Our objective was to conduct a statewide survey during 2017 in Alabama to determine the distribution and landscape associations of eastern spotted skunks. We collaborated with local land managers to deploy 209 camera traps across public lands in Alabama. We also encouraged the general public to report sightings of skunks through social media and iNaturalist.org. Camera trap surveys only detected 2 eastern spotted skunks, whereas citizen scientists reported 20 sightings, the majority of which included coordinates and a picture. Eastern spotted skunk sightings occurred across the state suggesting the species is still widely distributed, but likely rare in abundance. Sightings of live animals primarily occurred in forested areas throughout the state and at higher elevations north of the fall line. Our results highlight the effectiveness of citizen scientists in documenting rare and elusive species compared to more intensive survey efforts by professional scientists.

FINE SCALE HABITAT SELECTION BY EASTERN SPOTTED SKUNKS IN THE SOUTH CAROLINA APPALACHIANS.

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(Oral Presentation)

For many years eastern spotted skunks (*Spilogale putorius*) were considered locally extinct in South Carolina. In 2015, an extant population was discovered in the northwestern corner of the state where the Appalachian mountains drop off into the foothills of South Carolina. During the summers of 2016 and 2017 we used ground-based VHF radio-telemetry to track 15 spotted skunks (10 males, 5 females) to their precise daytime resting sites in the South Carolina Appalachians. We performed a discrete choice analysis to evaluate fine scale habitat selection of eastern spotted skunks by collecting vegetation and topographic habitat data at both the identified rest sites and a "paired-available" site within a nightly-traversable distance for spotted skunks (50-250 meters). Over the course of two summers we identified 226 rest sites at 198 unique locations (12% re-use). We observed that 62% (n=140) of sites were in underground burrows, 27% (n=61) were located in tree cavities, and 10% (n=22) were in fallen logs or coarse woody debris (CWD). Only two sites were found in rocky outcrops, and one rest site was found in an above ground stick pile. Results from our discrete choice analysis indicate that spotted skunks in this region prefer areas with high understory cover, which is consistent with several previous studies of eastern spotted skunks in other portions of their range. We also found that spotted skunks preferred sites nearer to ravines or drainages and areas with a higher abundance of CWD. Our findings suggest that drainages could represent travel corridors and preferred foraging habitat, particularly where there is abundant understory cover and CWD which likely provide cover from avian predators and access to protective rest site structures. These findings also suggest that for eastern spotted skunks, current management aimed at reducing understory complexity and accumulated CWD may actually be detrimental.

IMPACTS OF RECENT HURRICANES TO THE ENDANGERED ANASTASIA ISLAND BEACH MOUSE (*PEROMYSCUS POLIONOTUS PHASMA*)

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(Oral Presentation)

The Anastasia Island beach mouse (AIBM; *Peromyscus polionotus phasma*) occurs only in St. Johns County, along the Atlantic coast of Florida, and is federally listed as Endangered. The current range of the AIBM is limited to Anastasia Island, where most potentially suitable habitat occurs in Anastasia State Park (ASP), at the northern end of the island, and approximately 16 km south in Fort Matanzas National Monument (FMNM), at the southern end of the island. On 7 October 2016, Hurricane Matthew moved north along the Atlantic coast of Florida causing major flooding, wind damage, and erosion along the east coast, producing extensive degradation and destruction to the dune habitats occupied by AIBM. Assessments of AIBM immediately after the hurricane found no signs of mice in FMNM; AIBM were found at ASP, though only in areas farthest inland from the ocean. Post-hurricane trapping surveys at ASP did not detect AIBM in October 2016 or March 2017. As concerns over the status and persistence of AIBM increased, we initiated a supplemental feeding and monitoring project at both ASP and FMNM in May 2017. AIBM detections increased from 6% in May to 40% in July at ASP and from 0% in May to 80% in July at FMNM. However, recovery of the AIBM populations and their habitat was set back on 10 September 2017 when Hurricane Irma hit Florida. Again, Anastasia Island experienced heavy flooding and storm surge which caused further loss of dune habitats. To better evaluate the scope and impacts from these hurricanes to the AIBM populations and their habitats, we are implementing an occupancy-based monitoring protocol to investigate population trends for this species at both ASP and FMNM.

PROMOTING ACTIONS TO CONSERVE BATS - BATCONSERVATIONALLIANCE.WIKIDOT.COM

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(Oral Presentation)

One of the challenges facing conservation scientists is ensuring their information reaches managers undertaking conservation actions. Many practitioners do not stay current with scientific literature and, even if aware of new research, may not link the results to management actions. The North American Bat Conservation Alliance (NABCA) was formed to facilitate coordination and communication among parties interested in bat conservation in North America. To support this mandate, as a first step, we worked with the bat community to identify and assess threats to bat populations. A publication describing the results of this process is currently in preparation. As a second step, we launched a Wiki (http://batconservationalliance.wikidot.com/) to share information on ways to address threats to bats. A Wiki is a website where any member of the community (including general public) can register and enter or edit existing information (the best known example being Wikipedia). The NABCA Wiki is organized based on IUCN threat classifications, with a brief overview of each threat and its potential importance. The main feature is a flexible area for discussing and sharing information on ways to address these threats. As with Wikipedia, users are encouraged to contribute new information as well as review, correct or augment existing information. Ideally, information will be presented in easy to read summaries with links to more detailed documents or scientific literature. Scientists could highlight implications of their recently published research; managers could describe what worked (or didn't). Contributors are encouraged to present different perspectives, to recognize uncertainty, and to provide links to evidence in support of a perspective. The success of this venture will depend on whether the scientific community uses it to share information, and whether the conservation community finds it useful to identify options and actions to conserve bats.

EVALUATING PATTERNS IN BAT OCCUPANCY AND RELATIVE ACTIVITY ACROSS TOPOGRAPHIC CLASSES AT MARINE CORPS BASE QUANTICO AND PRINCE WILLIAM FOREST PARK

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(Oral Presentation)

A priori identification of bat travel corridors and foraging areas can help improve the efficiency of both acoustic and mist-net survey efforts. Because most research has shown that riparian corridors and bottomland areas typically contain the highest levels of bat activity on most landscapes or that distance to water is an important correlate to activity, more nuanced understanding of landform topography influence on bats merits investigation. To examine this, we characterized Marine Corps Base Quantico and Prince William Forest Park, located along the Fall Line in northeastern Virginia, into three landform classes: concave/sheltered, flat/transitional, and convex/exposed using landform index within a GIS and placed numerous zero-crossing/frequency division acoustic detectors within each class in the summer of 2017. We used Kaleidoscope Pro to identify echolocation pulses to species to compute site/night occupancy and nightly relative activity values. Results from generalized linear mixed models showed that Myotid bats, i.e., *Myotis austroparius, Myotis lucifugus* and *Myotis septentrionalis*, had higher levels of activity in concave landform classes. Other species showed similar trends, albeit not at a statistically significant level. *Lasiurus cinereus* was most associated with convex (ridge) landform classes. Work combining other landscape and vegetation metrics in conjunction with landform class is ongoing.

SPATIAL DISTRIBUTION OF INSECT-DERIVED NUTRIENTS AT MAMMOTH CAVE NATIONAL PARK

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(Oral Presentation)

Nutritional studies have provided evidence that insectivores, including bats, may forage selectively. Although taxonomic selection may be impossible due to acoustic constraints, the ability to differentiate among prey of various sizes is well-established. This may provide adequate opportunity for nutrient-specific foraging. Our objective was to characterize the nutrient composition of insect communities at Mammoth Cave National Park, Kentucky. Insects were collected using 10-W blacklight traps deployed along randomly generated transects. Captured insects were identified to order and counted. We estimated the elemental composition and mean C:N ratio of Coleoptera, Diptera, Hymenoptera, and Lepidoptera collected in each trap on the basis of measurements reported in the literature. We generated maps visualizing mean insect abundance and C:N ratios across the landscape. Moran's I statistic was not significant for the insect abundance dataset ($P = 0.07$) or the C:N ratio dataset ($P = 0.40$). We fit generalized linear mixed models to test for differences in insect abundance and C:N ratio across the landscape. For both models, site was included as a fixed effect and month within year as a nested random effect. Site was a significant predictor of insect abundance for only 2 of 20 land parcels (both $P = 0.01$). For all other sites, $P > 0.05$. Site was a significant predictor of C:N ratio for 2 of 20 land parcels (both $P = 0.04$), neither of which significantly predicted abundance. For all remaining sites, $P > 0.05$. We observed little variation in the elemental composition of insect communities across the dataset. Given these site differences, as well as the observable differences between maps of insect abundance and C:N ratios, our findings suggest spatial patterns in C:N ratio do not reflect the distribution of insects across the landscape and may provide evidence that an optimal bat diet may require selective foraging.

BAT BEHAVIORAL RESPONSES TO WHITE-NOSE SYNDROME AND IMPLICATIONS FOR RESISTANCE AND TOLERANCE

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(Oral Presentation)

Years after the onset of white-nose syndrome (WNS), an emerging infectious disease of hibernating bats caused by the fungus *Pseudogymnoascus destructans* (Pd), bat colonies continue to survive in contaminated areas despite episodes of mass mortality. However, the ultimate fate of remnant populations of affected bats remains uncertain, and the future trajectory of these populations may depend upon intraspecific differences in affected bats' behavior and physiology, which may engender differences in pathogen exposure and disease susceptibility. Specifically, it remains unclear to what extent behavioral changes including altered activity levels during hibernation are adaptive and whether they vary with bats' age and previous exposure to the disease. We thus aimed to clarify how bats from different age classes and with varying experience with WNS behaviorally respond to Pd infection. Using infrared video recordings, we quantified and systematically compared behavioral changes during the hibernation period in response to WNS in juvenile and adult little brown bats (*Myotis lucifugus*) that had been captured from colonies with different WNS experience. Analysis suggests all groups of infected bats initially exhibited increased grooming and overall activity relative to controls, but also seemed to reduce some active behaviors in late winter. These behavioral differences may represent adaptive changes by experienced bats to reduce infection loads while maximizing energy conservation. Investigating how these variables relate to infection severity, WNS mortality, and physiological variables influencing host susceptibility will clarify the influence of behavior on bat responses to WNS and deepen our comprehension of WNS pathogenesis and epidemiology. Such deeper understanding will enable managers to more effectively predict the progression of the disease and its effect on bats over time, and to target individuals most vulnerable to the disease.

IMPLEMENTING NEW METHODS TO ASSESS THE SCALE OF EFFECT OF LANDSCAPE VARIABLES ON OCCURRENCE OF MYOTIS SEPTENTRIONALIS

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Oral Presentation

The spatial scale at which an environmental variable influences species occurrence (i.e., "scale of effect") is often unknown. Current methods to ascertain the spatial scale of selection focus on buffering sample locations with concentric polygons and selecting the most appropriate polygon size through model selection. However, this process has several problems. First, selecting scales using concentric polygons is contrived, and never achieves a true estimate of scale. Second, every portion of the landscape feature within the polygon is treated as if it has equal influence, when in reality the effect of the landscape feature should decrease as you move away from the sample location. We applied a newly developed method that accounts for these shortcoming to better assess the scale at which landscape variables effect the occurrence of *Myotis septentrionalis* in Georgia. This technique uses weighted kernels to assess the influence of landscape variables based on proximity to sampling locations. Scale parameters of the smoothing kernel and the effect of the variable on occurrence are estimated using maximum likelihood. Results from this approach are compared to models constructed using concentric polygons, where polygon sizes were selected based on biological relevance.

TEN YEARS OF ACOUSTIC BAT SURVEYS: DOCUMENTING TRENDS IN MYOTIS ACTIVITY IN THE NORTHEAST

Pamela Griffin and Trevor Peterson

Stantec Consulting Services Inc., Topsham ME

Oral Presentation

Analysis of a long-term acoustic dataset reveals distinct changes in activity of bat species affected white-nose syndrome (WNS) in several northeastern states (ME, NH, VT, NY, PA, WV). We analyzed trends in annual bat activity and determined whether activity decreased as expected after the discovery of WNS in each state, whether these decreases varied in intensity by region, and whether timing of decreases corresponded with the year of discovery. Whereas acoustic data provide limited information on bat population size on a local scale, widespread trends over long time periods can provide evidence of population-level effects of WNS. Such information can supplement quantitative population estimates from winter hibernacula counts, which are known to undercount certain species, and which are limited for some states. As well, current research suggests summer populations of Myotis species have declined at a slower rate than species counted in hibernacula. This study helps clarify regional patterns in bat activity while supplementing hibernacula counts and providing additional spatial coverage, providing new information about the spread of WNS and its devastating effects on the populations of affected species.

DEN SITE SELECTION OF FLORIDA SPOTTED SKUNKS (*SPILOGALE PUTORIUS AMBARVALIS*) IN A DRY PRAIRIE ECOSYSTEM

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(Oral Presentation)

The eastern spotted skunk (*Spilogale putorius*) has experienced a major decline since the mid-20th century, and the species is of conservation concern in many states. However, recent research indicates that the subspecies inhabiting peninsular Florida, *S. p. ambarvalis*, is relatively abundant in the endemic dry prairie ecosystem. Previous research has revealed that the subspecies is an important nest predator of the Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), a critically endangered resident of the dry prairie, highlighting a conservation need to better understand spotted skunk ecology in this ecosystem. We studied spotted skunks at Three Lakes Management Area in central Florida to evaluate potential factors influencing den site selection of skunks in this ecosystem (e.g., habitat characteristics, den characteristics, prescribed fire management). In 2016 and 2017, we fitted 36 skunks with radio collars to track them to their den sites. We characterized habitat and den covariates at 757 used sites and 757 unused, available sites. Spotted skunks used five types of den site, but they were seven times more likely to select a mammal burrow over an above-ground den (the second most common site type). Additionally, the odds of a spotted skunk selecting a den site were positively correlated with the amount of visual obstruction, the number of nearby burrows, and the percent of palmetto leaves at a site. The percent of water at a site was negatively correlated with the odds of a skunk selecting it. This study represents one of the first detailed studies on *S. p. ambarvalis*, increasing our knowledge of this subspecies and allowing for further comparisons with other subspecies. Furthermore, the importance of cover to spotted skunk den site selection will allow us to recommend possible management strategies, such as more intense prescribed fire applications, to mitigate predation pressure on the declining Florida grasshopper sparrow.

A GENERALIZABLE RAPID RESPONSE MODEL FOR REDUCING BAT FATALITIES AND IMPROVING POWER PRODUCTION AT WIND ENERGY FACILITIES

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(Oral Presentation)

Migratory tree bats comprise a large proportion of bat fatalities known to occur at North American wind energy facilities, while *Myotis* species, along with other species that do not migrate on continental scales, are also being impacted. However, we know little about the relative impacts of curtailment techniques on bat species that interact with wind turbines. Here we evaluate the performance of a generalizable rapid response model for reducing bat fatalities and improving power production at wind facilities. This study was conducted at a wind energy site in Wisconsin during 2015 and used information derived from a Turbine Integrated Mortality Reduction (TIMR) system that used real-time acoustic bat activity and wind speed data to make curtailment decisions at randomly-selected control turbines (N=10) versus treatment turbines (N=10). We combined searcher efficiency and carcass persistence estimates with carcass data using 3 approaches to fatality estimation: the Erickson et al., the Huso, and the Korner-Nievergelt et al. estimators. Our results show that the TIMR approach significantly reduced fatality estimates for treatment relative to control turbines for pooled data, and for each of 5 species: pooled data (-83.6%); eastern red bat (*Lasiurus borealis,* -84.6%); hoary bat (*Lasiurus cinereus,* -78.1%); silver-haired bat (*Lasionycteris noctivagans,* -98.3%); big brown bat (*Eptesicus fuscus,* -75.0%); and little brown bat (*Myotis lucifugus,* -89.5%). The TIMR approach reduced curtailment time by 48% for treatment turbines relative to estimated production using blanket 7 meter/second curtailment, and increased production by 135 megawatt hours per turbine per season. Although future studies are needed to validate this approach, we conclude that this curtailment model significantly reduced fatalities associated with all species evaluated, each of which has broad distributions in North America and different ecological affinities. We anticipate that this approach is likely to significantly reduce bat fatalities in other ecoregions and with other species assemblages.

TESTING THE MANY-EYES HYPOTHESIS OF INTERSPECIFIC INTERACTIONS: RACCOONS ARE VIGILANCE PARASITES OF DEER

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(Oral presentation)

Vigilance of prey is linked to predation risk, and vigilance creates a tradeoff between foraging and mitigating the risk of being killed. When prey species overlap spatiotemporally, interspecific interactions that affect vigilance and feeding rate may influence fitness of the prey species. Prey should benefit from the presence of more individuals, including those of other prey species, according to the "many-eyes hypothesis." However, few studies have documented mutualistic interspecific shared vigilance among prey species. We used camera traps at standardized forage patches to quantify feeding rates of and the interaction between white-tailed deer (*Odocoileus virginianus*) and raccoons (*Procyon lotor*) at Fort Bragg Military Installation, North Carolina. We predicted that deer and raccoons would increase feeding rate as interspecific group size increased based on the many-eyes hypothesis. In August 2011 – 2013, we collected 51,492 and 9,504 photos of deer and raccoons, respectively; they co-occurred in 2,527 photos. Deer and raccoon feeding rates were positively correlated, indicating they were vigilant to the same risk cues. However, raccoons increased feeding rate 11% in the presence of deer, whereas deer decreased feeding rate 42% in the presence of raccoons. Thus, raccoons apparently benefited from the presence of deer by increasing feeding rate, indicating the many-eyes hypothesis provides a plausible explanation for raccoons. However, why raccoons have an apparently antagonistic effect on deer feeding rate is unknown. Our data indicate that some prey may interspecifically share vigilance even when the interaction is antagonistic to the other prey species.

SEARCHING FOR BAT HIBERNACULA IN IOWA WITH SCENT DETECTION DOGS

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(Oral Presentation)

Determining where bats overwinter is challenging due to the fact that suitable habitat includes not only large, obvious caves, but also narrow fissures in rock faces where visual inspection is not feasible, and acoustic monitoring may be overwhelming. Working Dogs for Conservation (WD4C) was contracted to explore detection dogs as a means of adding *scent* monitoring to other available methods. To that end, WD4C trained two dogs to the scent of *Myotis* species with the use of gauze swabs rubbed along the bodies of wild bats, and then live *Myotis* and *Eptesicus* bats. Dogs were fielded in central Iowa late in the hibernation season (February/March 2017) and again in early season (November 2017) at locations ranging from those never-before-scouted, to those which are known to be frequently used by bats. The dogs located 19 and 16 points of interest in the spring and fall, respectively. At one location the handler visually confirmed two bats flying out of a fissure where the dog had just demonstrated interest. However, during the fall deployment, AnaBat detectors were unable to confirm current bat presence at the points of interest.

From these two deployments, we confidently assert that dogs are helpful in narrowing down areas to focus additional monitoring resources. However, if managers want to use conservation detection dogs' points of interest as definitive data points of current presence—without confirmation by other means—there is more work to be done. We have yet to quantify detection (and false positive) rates. WD4C invites and welcomes collaboration that would help quantify this issue, such as pairing with telemetry, or other means to work dogs in a "known" scenario which would be required for quantification. This presentation will discuss the advantages and challenges of the methodology, and offer suggestions for future use.

PSEUDOGYMNOASCUS DESTRUCTANS REMAINS A PROBLEM IN REMNANT *MYOTIS* POPULATIONS

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Pseudogymnoascus destructans presence was found on 4 of 49 captured *Myotis* bats (2 *Myotis lucifugus*, 2 *Myotis leibii*) as well as a roost site of a lactating female *Myotis leibii*. A juvenile *Myotis leibii*, caught in August, tested positive for *Pd*, which matched deformities and scarring on both ears. The *Pseudogymnoascus destructans* positive results represent 8% of the sampled bats and approximately a 90% increase from bats captured and tested in 2016 (1/108, [<1%]). Similarly, from 2016 to 2017 there was an increase of 10.6% in the number of bats that received a Wing-Damage Score of two or greater. 2017 results suggest that depressed populations of bats remain very susceptible to *Pseudogymnoascus destructans*. We explore relationships to weather, continued use of infected roost sites, and other factors.

(Oral Presentation)

NORTHERN LONG-EARED BAT FALL ACTIVITY IN WEST VIRGINIA: WHAT ARE THEY DOING?

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(Oral Presentation)

The northern long-eared bat (*Myotis septentrionalis*; MYSE) is listed as a federally threatened species due to declines from white-nose syndrome (WNS). Basic life history data are incomplete, including where the majority of these bats overwinter. We captured and radio-tagged nine MYSE in autumn 2017 in northern West Virginia with the intent to track migrating bats. In September and October, bats were fitted with radio transmitters and tracked using ground-based crews and a Cessna 172 aircraft. Duration of tracking varied per bat. We found bats to forage predominately within deciduous forests with average foraging areas of 305.5±90.3 ha and 74.7±20.6 ha for 95% and 50% kernel analysis, respectively. Bats roosted mainly in live maple trees (*Acer* sp.). On two occasions, two individual bats were not heard during aerial day searches but were heard at night foraging within their typical foraging areas suggesting that bats may have been roosting in rock shelters. We did not document any bats migrating during the project which concluded on 11 October. The signals for two bats were lost on nights when ground crews were deployed because weather prevented the plane from flying. These signals were not heard the following days during ground and aerial searches, so bats could have gone into hibernacula on these nights with inclement weather. It is inconclusive if the remaining tagged bats were going to migrate since four bats were still fitted with active transmitters on the last day of the project. It is possible that these bats do not migrate in this region of WV and instead, use rock features within their summer grounds. Additional research is needed later in the fall to determine if MYSE migrate to overwinter hibernacula, or if they choose alternate hibernacula such as rock crevices.

STATUS OF A NON-HIBERNATING POPULATION OF *MYOTIS SEPTENTRIONALIS* IN COASTAL PLAIN NORTH CAROLINA

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(Oral Presentation)

When the Northern Long-eared Bat (*Myotis septentrionalis*) was listed as a federally threatened species in April 2015, its distribution and behavior in eastern North Carolina was poorly understood. Although previously well-documented in the Blue Ridge Mountains Region of western North Carolina, *M. septentrionalis* was only recently discovered in eastern North Carolina in 2007. A five-year effort was begun in 2015 to better understand the species' distribution and behavior in eastern North Carolina. I report several new county records of *M. septentrionalis* from the Coastal Plain Region of North Carolina obtained through mist netting efforts in 2015–2018. Captures occurred during all four seasons of the year. I also report the occurrence of non-hibernating winter behavior of *M. septentrionalis* in the Coastal Plain of North Carolina. Transmittered *M. septentrionalis* were tracked through all months of winter and were observed utilizing multiple tree roosts. This portion of the state is nearly devoid of caves or mines suitable for hibernacula, but also experiences milder winters in comparison to most of the species' range. Without dependence upon caves or mines for hibernation, this population of *M. septentrionalis* is less likely to experience mortality from white-nose syndrome (WNS). The lack of mist net captures within the Piedmont Region of North Carolina suggests geographically disjunct populations of *M. septentrionalis* in North Carolina, with most of the centrally-located Piedmont separating the WNS-affected population in the west from the non-WNS-affected population in the east. This hypothesis is supported by North American Bat Monitoring Program acoustic data which suggest little to no presence of *M. septentrionalis* in most of the Piedmont of North Carolina.

TROPHIC NICHE PARTITIONING WITHIN A POST-WHITE-NOSE SYNDROME BAT COMMUNITY IN WESTERN KENTUCKY

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(Oral Presentation)

The decline of cave-dwelling bats since the introduction of white-nose syndrome (WNS) to North America led to changes in community interactions as evidenced by spatial and temporal partitioning investigations. Indirect effects, such as disease-mediated competition at the community level, can influence the ability of imperiled species to recover because of competitive exclusion. To further investigate community structure following WNS, we assessed the diet of sympatric species with differential WNS susceptibility using molecular techniques. In western Kentucky, *Perimyotis subflavus* (susceptible) populations severely declined following WNS occurrence. Conversely, *Nycticeius humeralis* (non-susceptible) populations increased markedly. We collected guano from *N. humeralis* (n=37) and *P. subflavus* (n=9) captured in mist nets during summer 2016. Arthropod DNA was extracted from the guano and a 157-177 bp target region of insect-COI was amplified. Sequences were analyzed to the lowest taxonomic level provided by the online Barcode of Life Database. *Nycticeius humeralis* consumed 184 genera belonging to 12 arthropod orders, while *P. subflavus* ate 90 genera from 7 arthropod orders. Coleoptera and Diptera were the most commonly consumed prey items for both bat species. All orders consumed by *P. subflavus* were also eaten by *N. humeralis*. There was high interspecific dietary niche overlap observed at the ordinal level, however, there was not a significant overlap observed at the MOTU level. These data contribute to our understanding of the prey requirements of an imperiled and expanding bat species, post-WNS bat community structure, and the value of molecularly derived diet data.

Activity patterns of bats at Shenandoah National Park

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Considering bats' euthermic nature, high energetic demands, and interspecific competition, differential utilization of complex, mountainous landscapes among species seems plausible. To investigate potential spatiotemporal activity trends of bats in the central Appalachians, we conducted acoustic survey at Shenandoah National Park by deploying detectors in 5 transects of 6 sites each oriented by elevation (high >985m, mid 800-985m, and low <800 m) and aspect (xeric - 157.5-292.5° and mesic - 0-112.5°; 337.5-0°) from May-August in 2016 and 2017. Generalized linear mixed models revealed significant interactive effects of Julian date and elevation on nightly activity for: big-brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), and tricolored bat (*Perimyotis subflavus*). Activity of northern long-eared bats was highest at mid elevations, peaking from late-June to late-July. Indiana and little brown bat activity exhibited similar trends being greatest at high elevations with bimodal peaks in the first and third weeks of June. Tricolored bat activity was most dynamic, showing peaks in activity at low elevations in mid-May, high elevations in July, and low elevations in mid-August. Big brown bat activity was greatest at high elevations, peaking in late July; eastern red bat activity was greatest at mid elevations with a sharp peak in the last week of June; and hoary bat activity showed a sharp peak at high elevations at the end of May. Further analysis will include aspect and weather in modeling activity, as well as examination of hourly activity.

ROOST SELECTION OF SOUTHEASTERN MYOTIS IN AN OLD-GROWTH BOTTOMLAND HARDWOOD FOREST

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Little is known about the roosting habits of southeastern myotis, *Myotis austroriparius*, in Coastal Plain forests. Our objective was to quantify characteristics of roosts selected by southeastern myotis in Congaree National Park, an old-growth bottomland hardwood forest in the Upper Coastal Plain of South Carolina during Winter (November-March) 2015-16 and 2016-17 and Summer (May-August) 2015 and 2016. We located roosts through opportunistic cavity searches and tracking radio-tagged bats to roosts. We quantified tree characteristics, the herbaceous layer in front of the cavity opening, the surrounding vegetation, canopy closure, and cavity opening size of roost and random trees. We ran logistic regression models to test which characteristics were the most important for distinguishing all roosts versus random trees, winter roosts versus summer roosts, summer roosts versus random trees, and winter roosts versus random trees. Although we located many canopy roosts during the study, our analyses were conducted only on roosts with basal cavity openings. There were no significant differences between winter and summer roosts or between winter roosts and random trees. Tree stand composition, percent herb cover in front of the cavity opening, and canopy closure were not significantly different between all roost and random trees. However, roost trees had significantly smaller cavity opening areas than random trees (P = 0.006), significantly larger diameter at breast height (P =0.016), and smoother cavity interior texture (P = 0.062). Cavity opening area and diameter at breast height also differed significantly between summer roost and random trees (P =0.024 and P= 0.039, respectively). This suggests that roosts are selected for their cavity properties rather than for their surrounding habitat, perhaps to decrease risk of predation, improve thermoregulation, and provide larger spaces for maternity aggregations.

DRONES FOR RECORDING BATS: CHALLENGES, RESULTS, AND ETHICAL CONSIDERATIONS

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(Oral Presentation)

Brazilian free-tailed bats form large maternal colonies numbering in the millions across Unmanned aerial vehicles (UAVs) are becoming popular for wildlife monitoring, but direct recordings of animal vocalizations have not been accomplished, likely due to the noise generated by the UAV. Echolocating bats, especially *Tadarida brasiliensis,* are good candidates for UAV recording due to their high-speed, high-altitude flight. We developed a UAV system that physically isolates UAV noise so we can record, with 3D maneuverability, ultrasonic audio and spatial thermal data of bat flight at altitude. We tested the noise of our UAV with various payloads and microphone configurations to characterize the ultrasonic noise of our system, physically isolate drone noise from the microphone, and maximize UAV flight performance. Over 84 minutes of recordings, we captured 3,847 echolocation signals from bats with corresponding thermal data of bat flight. Furthermore, this first documented successful recording of animal sounds in their natural habitat demonstrate that UAVs can be important tools for bioacoustic monitoring, and we discuss the ethical considerations for such monitoring.

UNEXPECTED USE OF ANTHROPOGENIC STRUCTURES AND URBAN AREAS BY THE NORTHEN LONG-EARED BAT

Meghan S. Lout. *VHB, 40 IDX Drive, Building 100, Suite 200, South Burlington, Vermont 05403*

The Vermont Agency of Transportation (VTrans) intends to replace two deteriorated bridges over a railroad in Addison County, Vermont. VHB completed three consecutive nights of acoustic monitoring and exit surveys at the bridge locations during July 2016 to determine the presence/ probable absence of bridge-roosting bats. Exit surveys revealed that between one and six bats emerged from each bridge during every survey night. The times of emergence observations were correlated with the time stamps of echolocation calls, which suggested that Indiana bats, northern long-eared bats and/or little brown bats were present.

Due to ongoing deterioration of the bridges and the related public safety concern, the bridges were scheduled for emergency demolition in the summer of 2017. Accordingly, exclusionary measures were deployed to prevent bats from reoccupying the bridges in the preceding spring. The original intended plan to mist-net the bridges to determine which species may be roosting inside of them was therefore not possible. However, the flight corridor beneath the bridges was targeted instead to capture bats flying nearby. Three of the six female northern long-eared bats that were captured in a single night were transmittered and tracked for up to 10 days. Tracking and exit surveys at six newly discovered urban roosts was a collaborative effort between the Vermont Fish and Wildlife Department, VTrans, and VHB. The data collected during this survey effort, conducted in part as mitigation for the unavoidable loss of bridge roosting habitat, supplements the knowledge base for the northern long-eared bat.

(Oral Presentation)

DIGITAL ENDOSCOPE: A TECHNIQUE TO MONITOR ARTIFICIAL ROOSTING STRUCTURES FOR BATS

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(Oral Presentation)

Bat boxes and other types of artificial roosting structures are becoming more prevalent for project mitigation or conservation measures. Agencies often require follow-up monitoring of these structures to determine occupancy and, if possible, species abundance and composition. Due to the number of structures being installed on the landscape, there is a need to increase monitoring efficiency while also trying to minimize disturbance or stress to roosting bats. Common methods employed for monitoring occupancy include guano inspections, listening for bat vocalizations, and looking up into structures using flashlights. Determining occupancy estimates or species abundance or composition normally requires further investigations, and often include methods such as acoustics, emergence surveys, and/or mist netting. All of these methods have intrinsic strengths and weaknesses, which are heavily influenced by site and environmental conditions, available equipment and manpower, and types of roosting structures. During monitoring efforts in the summer of 2017, GAI Consultants, Inc. (GAI) biologists tested the use of a digital endoscope to inspect the interior of roosting structures in order to visually identify and count bats. Use of the endoscope allowed real-time viewing of the roosting structures and collection of video and photographic data for follow-up verification and documentation. Using a multi-tiered approach that included use of the endoscope, GAI inspected a total of 154 artificial structures (including standard 3-chamber boxes, standard 1-chamber boxes, 1-chambered rocket boxes, and artificial bark poles) and identified a combined total of approximately 100 *Myotis septentrionalis* and *Eptesicus fuscus* occupying the structures. Benefits of endoscope use include portability, applicability among varying structure types, reduced disturbance compared to mist netting, visual documentation of data, and highly increased labor efficiency.

AN INVESTIGATION OF THE NIGHTLY FORAGING PATTERNS OF BATS IN RELATION TO AUDITORY PREDATOR CUES

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(Oral Presentation)

The relationship between foraging bats and nocturnal predators is understudied in eastern North America. While there are no known specialized bat predators, evidence of owl predation is documented in the literature. Our study objective was to determine if bats alter nightly foraging activity in response to a perceived predation threat. Full-spectrum acoustic monitoring was used to assess bat activity at a Kentucky Army National Guard installation in the Interior River Valleys and Hills Ecoregion of western Kentucky. Survey locations were selected at sites previously identified in 2016 to have relatively high amounts of bat activity. Replicate detectors were deployed for three consecutive nights across four such sites, with different auditory treatments broadcast from water-proof speakers each night. Treatments were broadcast at 80.5 ± 0.8 dB within 1 m of detectors. Auditory treatments were randomly assigned across survey points nightly and included: owl calls (*Strix varia* and *Bubo virginianus*), ambient noise as a mixture of insect and frog sounds, and a silent control. Treatments were broadcast for 30 sec every 10 min throughout survey nights. Echolocation passes, comprised of five or more individual pulses, were identified using Kaleidoscope Pro. Passes were then sorted into hourly bins (post-sunset). Sampling spanned 36 survey locations, and accounted for 90 detector-nights and 7754 identified bat passes. The total number of bat passes recorded within a survey night did not vary across sites, nor as a consequence of auditory cues or season ($P > 0.05$). Data analyses to date suggest auditory cues did not alter hourly activity patterns of large-bodied bats (*Eptesicus fuscus*, *Lasiurus borealis*) nor small-bodied bats (*Perimyotis subflavus*). Our study implies that bats were not responsive to auditory cues, but did exhibit differential patterns of hourly activity.

LASIURINE BATS AND WIND ENERGY: A UNITED NATIONS-BASED INITIATIVE FOR CONSERVATION AND SUSTAINABLE ENERGY

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(Oral presentation)

Bats of the genus *Lasiurus* are widespread and usually abundant, and they are also severely affected by wind farms. We worked with the government of Peru and international NGOs to have four species listed under Appendix II of the Convention on Migratory Species. After a side event where we presented the urgency to enlist the species, the proposal was presented by Peru in Manila, the Philippines in October 2017 and adopted by consensus. The CMS is a United Nations-based convention with headquarters in Bonn, Germany. It provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the so-called Range States, and provides a legal foundation for internationally coordinated conservation measures throughout the migratory range of particular species. Listing a species in CMS Appendix II means that the parties should prepare and implement agreements covering the conservation and management of migratory species included in it. Given the severe impact wind energy has on this group of species, and the relatively easy and inexpensive mitigation measures, we encouraged parties to the CMS to enact these mitigation measures in a coordinated, cooperative fashion. Several countries pledged immediate action along those lines. This needs to be endorsed, adopted, and enacted across the range of the species, from Canada to Argentina and Chile. Different agreements, from the Trilateral Committee for Wildlife and Ecosystem Conservation and Management to the Convention on Biological Diversity and others provide suitable platforms to join forces across countries to protect these and other species by improving wind energy production

practices. Future uplisting into Appendix I, which requires parties to provide immediate protection for migratory species included in it, is not ruled out.

MODELING THE EFFECTS OF WHITE-NOSE SYNDROME ON THE BAT COMMUNITY IN WISCONSIN

Jordan J. Meyer*[1], Robin E. Russell[2], Scott E. Hygnstrom[1]
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(oral)

White-nose syndrome (WNS) is a disease of bats caused by an invasive fungal pathogen (*Pseudogymnoascus destructans),* that is traumatically affecting several cave-dwelling species of North America. The disease has spread to numerous counties in Wisconsin since its initial discovery in 2014. The disease has impacted half of the species of bats in Wisconsin, including the big brown bat (*Eptesicus fuscus),* little brown bat *(Myotis lucifugus),* northern long-eared bat *(Myotis septentrionalis),* and tri-colored bat (*Perimyotis subflavus).* Our study's objective is to determine the historic site occupancy of bats in Wisconsin from 2007 to present in relation to WNS exposure. We used recorded echolocation calls from 5 permanent long-term bat monitoring stations (LTBMS) located across Wisconsin in 2007-2017. We used Kaleidoscope to automatically classify calls to species and manually vetted each that was identified. We used Bayesian multispecies site occupancy models to compare community dynamics of bats before and after 2014. This study could greatly improve the understanding of the impact WNS poses as it spreads across North America.

IMPORTANT HABITAT CHARACTERISTICS FOR EASTERN RED BAT REPRODUCTION IN SOUTHEAST OHIO

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(Oral Presentation)

The eastern red bat (*Lasiurus borealis*) is believed to be experiencing population declines due to collisions with commercial wind turbines and habitat loss. To determine the effects of habitat degradation on red bats, and to generate recommendations for land use managers to improve conditions for the species, we studied mist-net capture rates, acoustic activity, and day-roosting habitat at two study locations in southeastern Ohio. We gathered these data within a state dedicated nature preserve and at a recently reforested coal mining property to assess effects of habitat degradation. During the summers of 2016 and 2017, we netted a total of 40 nights and captured 72 red bats. Capture rates differed for both females and males between the mined land and nature preserve. We caught 1.08 males and 0.4 females per night at the preserve in comparison to the 0.80 males and 0 females per night at the mined land. Preliminary analyses suggest that day-roosts (n = 19) used by females (n = 10) and day-roosts (n = 22) used by males (n = 27) at the preserve were larger in diameter ($H = 26.5$, $P < 0.01$) and height ($H = 21.7$, $P < 0.01$) than trees used at the previously mined forest. We also found that the nature preserve had a higher basal area of larger trees than our mined site ($H = 10.3$, $P < 0.01$). These data suggest that forests at the mined site are not sufficient for reproductive female red bats due to overall smaller trees and a poor forest structure. Additional information to be presented will include thermoregulatory data collected from eastern red bats throughout the summer of 2017.

Presentation Type: Oral

Presenter Status: Student

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EFFECTS OF HABITAT STUCTURE IN LONGLEAF PINE FORESTS ON BATS

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Overharvesting and fire suppression have resulted in a 97% reduction in acreage of longleaf pine (*Pinus palustris*) forests, which are endemic to the southeastern United States. As forest managers restore the longleaf ecosystem, interest in how the resulting habitat will affect bats is increasing. Mature, well maintained longleaf pine forests have a unique structure that consists of widely spaced trees with little to no midstory and a relatively open canopy. Research in other types of forests have found patterns of forest use by bats that are associated with different forest structure, with some species of bat selecting more open habitats and others selecting moderately cluttered habitats. However, there is little information on the effect of structure in longleaf pine forests on occupancy by bats. The goal of our study was to determine how habitat structure in longleaf pine forests affects occupancy by bats. During May-July 2017, bats were acoustically recorded at 19 longleaf pine stands in Conecuh National Forest in south Alabama. Detectors recorded bats simultaneously at 1m and 11m above the ground for three consecutive nights at each stand. Habitat structure of the midstory and canopy was measured using typical field methods, including diameter at breast height, tree height, height to the first limb, and midstory density. In addition to field measurements, habitat structure was evaluated using a portable, ground-based light detection and ranging (LiDAR) scanner. The effects of habitat structure in longleaf pine forests on bats was assessed using occupancy modeling. The results of this study will help forest managers restore longleaf pine forests in a way that is beneficial to longleaf while also providing suitable habitat for bats within the forest.

OBSERVATIONS OF FALL MIGRATORY BEHAVIOR FROM TWO SPECIES OF MYOTIS BATS IN CENTRAL IOWA

Kevin L. Murray[1], Aaron MacAlexander[1], Benjamin T. Hale[1].
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(Oral Presentation)

Little is known about the migratory ecology of northern long-eared bats (*Myotis septentrionalis*) and little brown bats (*Myotis lucifugus*), especially during the fall. Existing studies generally focus on the spring migratory period and on different, but related, species (i.e., the Indiana bat; *Myotis sodalis*). Without data on the fall migratory ecology of these bat species, it is difficult to understand what resources are critical to migrating bats and to determine the risks they face during migration. Western EcoSystems Technology, Inc. (WEST), in collaboration with the Iowa Department of Natural Resources (IDNR), U.S. Fish and Wildlife Service (USFWS) and MidAmerican Energy Company (MEC), conducted a pilot study during Fall 2016 to evaluate migratory movements of the northern long-eared bat and little brown bat. The primary objectives of the pilot study were to characterize the timing and trajectory of fall migration for these bats in Iowa and to evaluate the effectiveness of a passive telemetry tower array for studying bat migration. Bats were captured during the late summer and fall of 2016 in the core study area in Pocahontas County and Humboldt County, Iowa. Bats were tracked using Lotek NanoTag coded radio transmitters and an array of telemetry towers equipped with Lotek VHF Receiver Dataloggers (Lotek Wireless, Inc, Ontario, Canada). Sixteen bats, including thirteen northern long-eared bats and three little brown bats, yielded information on migration timing and direction. Bats exhibited a variety of flight behaviors and trajectories including long-distance movements (> 1 mile) along the Des Moines River corridor and bidirectional movements, i.e. long-distance movements that occurred in opposing directions in the same night. Bats were tracked up to 34.9 linear km from the core study area and individual bats moved up to 61.8 km in a single night. These long-distance movements occurred from August 31 to September 22.

DRIVERS OF FALL AND SPRING HOURLY ACTIVITY PATTERNS OF MIGRATORY BAT SPECIES IN THE CENTRAL APPALACHIANS.

Michael S. Muthersbaugh*, Alexander Silvis, and W. Mark Ford. *Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University (MM); Resource Environmental Solutions (AS); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF)*

Wind energy development continues to expand in the East. Although a "green" renewable energy source with no carbon footprint, impacts on migratory bat populations are significant. Despite high bat mortality at some wind energy sites, especially in the central Appalachians during the spring and autumn, seasonal and spatial bat activity patterns are poorly known in the region. Nonetheless, these data are critical for assessing current and future wind energy risks to migratory bats. To examine bat activity patterns in the fall and spring in the central Appalachians on landscapes with moderate to high wind resources, we used acoustics to capture bat activity on five ridgelines and adjacent sideslopes in the autumn of 2015 and 2016 and the spring of 2016 and 2017. Overall migratory bat activity decreased through the sample period in autumn, with a slight peak in mid-October. Overall migratory bat activity generally increased but was more variable through the sample period in spring. Drivers of activity varied among bat species, but date, hour of night, and ambient temperature generally had the largest effects on hourly migratory bat activity. Understanding hourly drivers of migratory bat activity patterns may assist with the development of wind energy best management practices or mitigation strategies to reduce bat mortality.

2018 USFWS BAT UPDATES

Robyn A. Niver, Mike Armstrong, Barbara Douglas, Andrew King, Lori Pruitt, and Shauna Marquardt. *U. S. Fish and Wildlife Service (USFWS), Cortland, NY 13045 (RN)*; *USFWS, Frankfort, KY 40601 (MA); USFWS, Elkins, WV 26241 (BD); USFWS, Bloomington, IN 47403 (AK and LP); USFWS, Colombia, MO 65203 (SM)*

This presentation will serve as an update on several U.S. Fish and Wildlife Service national efforts for the federally-listed endangered Indiana bat (*Myotis sodalis*), gray bat (*M. grisescens*), Virginia big-eared bat (*Corynorhinus townsendii virginianus*) and threatened northern long-eared bat (*M. septentrionalis*). The presentation will include any available updates on recent winter counts, summer survey guidance, future training opportunities, 5-year reviews, rangewide consultations, national in-lieu fee option for Indiana bat mitigation, and northern long-eared bat litigation. We will also provide any available updates on status assessments for other bat species.

Presentation Type: Oral
Presenter status: Student
Presenter's email: tnocera@vt.edu

WNS-INDUCED TEMPORAL AND SPATIAL CHANGES IN LITTLE BROWN BAT ACTIVTY

*Tomás Nocera**, Christopher A. Dobony, Alex Silvis, W.M. Ford. Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA 24060 (TN); Fort Drum Military Installation, Natural Resources Branch, Ft. Drum, NY 13602(CD); RES, Warrenton, Virginia, 20187 (AS); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF)*

How bat distribution and habitat associations have changed at the local to sub-landscape scale has received little attention to date despite being a critical information needed for managers. To better understand the spatial nature of population decline, we modelled, activity patterns from acoustic surveys for the little brown bat (*Myotis lucifugus*) on Fort Drum Army Installation in New York over 15 summers (2003-2017) that span the pre-WNS, WNS advent (2009) and post-WNS periods- using a set of generalized linear mixed models. As expected, our top model indicated significant differences between years ($p < 0.05$) with significant declines in activity post-WNS. Little brown bat activity was most associated with woody wetland habitats over the entire study duration, however, the spatial patterns of high activity areas were variable over years, with the areal extent of these high activity areas decreasing post-WNS.

Presentation Type: Oral
Presenter status: Student
Presenter's email: tnocera@vt.edu

LET'S JUST AGREE TO DISAGREE: COMPARING AUTO-ACOUSTIC IDENTIFICATION PROGRAMS

Tomás Nocera, Christopher A. Dobony, Alex Silvis, W.M. Ford. Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA 24060 (TN); Fort Drum Military Installation, Natural Resources Branch, Ft. Drum, NY 13602(CD); RES, Warrenton, Virginia, 20187 (AS); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF)*

With the declines in the distribution and abundance of WNS-affected bat species, increased reliance on acoustic monitoring is now the new "normal". As such, the ability to accurately identify individual bat species with acoustic identification program has become increasingly important. We assessed rates of misclassification between the three USFWS-approved acoustic identification software programs (Kaleidoscope Pro 4.2.0, Echoclass 3.1, and Bat Call Identification (BCID) 2.7d) using acoustic data collected in the summer from 2003-2017 at Fort Drum, New York. Levels of disagreement between programs were assessed through pairwise comparisons on an individual file level using annual confusion matrices. Yearly file comparisons between programs allowed us to assess shifts in program accuracy as bat species abundance and composition changed. Inter-program agreement, estimated by Cohen's Kappa, showed high levels of fluctuations among years (0.2 - 0.6), indicative of poor agreement between programs on a file level. However, night/site level pairwise comparative analysis indicated that the programs are consistent in determining simple occupancy.

Presentation Type: Oral
Presenter status: Student
Presenter's email: tnocera@vt.edu

WNS-INDUCED TEMPORAL AND SPATIAL CHANGES IN LITTLE BROWN BAT ACTIVITY

Tomás Nocera, Christopher A. Dobony, Alex Silvis, W.M. Ford. Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA 24060 (TN); Fort Drum Military Installation, Natural Resources Branch, Ft. Drum, NY 13602(CD); RES, Warrenton, Virginia, 20187 (AS); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF)*

How bat distribution and habitat associations have changed at the local to sub-landscape scale has received little attention to date despite being a critical information needed for managers. To better understand the spatial nature of population decline, we modelled, activity patterns from acoustic surveys for the little brown bat (*Myotis lucifugus*) on Fort Drum Army Installation in New York over 15 summers (2003-2017) that span the pre-WNS, WNS advent (2009) and post-WNS periods- using a set of generalized linear mixed models. As expected, our top model indicated significant differences between years ($p < 0.05$) with significant declines in activity post-WNS. Little brown bat activity was most associated with woody wetland habitats over the entire study duration, however, the spatial patterns of high activity areas were variable over years, with the areal extent of these high activity areas decreasing post-WNS.

ACOUSTIC MONITORING OF INSECTIVOROUS BATS OF MEXICO: INITIATIVES, IMPLEMENTATION, AND POLICY MAKING

Jorge Ortega[1], *Verónica Zamora-Gutiérrez*[2], *María Cristina MacSwiney González*[3], *Abigail Martinez-Serena*[4], *Marco Tschapka*[5,6], *Ana Ibarra*[7], *and Rodrigo A. Medellin*[7]

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(Oral presentation)

Mexico is rapidly becoming a leader in acoustic monitoring of bats. With the sixth largest bat fauna in the world, this is not easy to do. Two different approaches have been taken to this effect. A group of Mexican researchers belonging to different universities, research

centers and governmental agencies, started an acoustic project in Mexico with a major goal to obtain the echolocation recordings of all insectivorous bats of Mexico. The proposal was funded CONABIO (National Commission of Biodiversity), with some specific goals such as developing a standardized protocol to record bat calls in the whole country and to construct an online platform with the bioacoustics records shared open. This project has documented 1500 bat calls of 60 insectivorous species belonging to 7 different families. Additionally this library has 2184 bat calls obtained by different recording methods. Another initiative, led by scientists from Mexico, Germany, and Panama, was invited by the Ministry of the Environment (SEMARNAT) to prepare an acoustic monitoring protocol that has so far been implemented in 500 sites in 10 Mexican states, gathering tens of thousands of calls. Experts of both groups taught seven different workshops in four different countries, training over 100 biologists to record bat sounds in Mexico, east Africa, Costa Rica, and other places. An online platform housed in CONABIO will provide free access and will be continuously updated with new records. Future goals include the developing of an interactive field guide with specific recordings, publication of data in professional journals, and influencing policy using bats as indicators of ecosystem functioning.

THERMAL VIDEO AND ACOUSTIC MONITORING OF POTENTIAL NORTHERN LONG-EARED BAT (*MYOTIS SEPTENTRIONALIS*) HIBERNACULA IN IOWA

Joshua Otten[1] and Terry VanDeWalle[1]
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(Oral presentation)

The northern long-eared bat (NLEB) is known to occur throughout the state of Iowa during the summer; however, little is known about its use of winter habitat (hibernacula) in the state. Threats, such as white-nose syndrome (WNS) and collision with wind energy turbines, make it necessary to understand life history traits that may make NLEB susceptible to such risks. North-central Iowa NLEB populations are found in areas of the state without any cave or mine structures, which are known to serve as hibernacula in other parts of the species' range, posing the questions how do NLEB utilize the Iowa landscape during the winter, and how does this use affect susceptibility to WNS? The purpose of this study was to monitor and collect acoustic data and thermal and near-infrared video from potential NLEB hibernacula in Iowa. Collected data were used to assess bat presence (all species), and activity at each monitored hibernaculum. This study is in conjunction with radio-telemetry data from Copperhead Consulting (Paint Lick, Kentucky) and previously identified locations from Working Dogs for Conservation (Bozeman, Montana) trained in NLEB scent identification. In 2017, eight potential NLEB hibernacula (seven via dogs, one via radio-telemetry) were monitored with acoustic detectors and thermal and near-infrared cameras from September-November. The number of NLEB calls recorded varied significantly between sites; however, timing and activity spikes were similar. Thermal cameras recorded bat activity with varying levels of success. Few bats were recorded on thermal cameras, potentially due to a limited number of individual bats utilizing the survey locations. The type of habitat where hibernacula were determined, as well as the number individuals found using these areas for hibernation, may limit the susceptibility of these populations to WNS.

EFFECTS OF FOREST MANAGEMENT TECHNIQUES ON BAT HABITAT USE AT FORT INDIANTOWN GAP, PA

Carolyn P. Paul, Lisa Powers, Christopher Hauer, Shannon Henry, Tim Haydt, Dave McNaughton and Brent J. Sewall. Department of Biology, Temple University, Philadelphia PA 19122 (CPP, LP, CH, BJS); Pennsylvania DMVA Forestry, Fort Indiantown Gap – National Guard Training Center, Annville PA 17003 (SH, TH, DM)*

(Oral Presentation)

Bats are currently facing a host of threats, including habitat destruction, wind power, and white nose syndrome. Recent research suggests that conservation of summer habitat may be one of the most effective conservation strategies for threatened bat species, even for bats negatively affected by threats other than summer habitat loss. It is thus imperative to gain a greater understanding of the habitat needs of bats, but it remains unclear how current forestry practices, such as prescribed fire and thinning, affect the bat community. Both burning and thinning reduce clutter and increase insect abundance, which should be beneficial to bats. Additionally, both techniques are expected to shift the forest community from being maple/birch dominated back to an oak/hickory system, which may also be beneficial for bat species. The objective of this study was to assess the impacts of forest management techniques on bat community composition and species richness. We focused on the bat community at Fort Indiantown Gap National Guard Training Center, a military installation in south-central Pennsylvania, where data on forest composition, management treatments, and bat species presence has been collected since 2003. We combined these existing data with data from passive acoustic monitoring and mist-netting during the summers of 2016 and 2017, permitting an examination of changes in the bat community by forest treatment over time. We hypothesized that bat community composition will change following prescribed burning and forest thinning. Specifically, we predicted that species richness would be greater with higher burning rates from prescribed fire and higher rates of mechanical thinning. Investigating these relationships can further our understanding of the effects of forest management on bat diversity, and better inform land managers of best practices to manage bat summer roosting and foraging habitats.

Kelly J Pearce*, Dan J Feller, Tom L. Serfass. *University of Maryland Center for Environmental Sciences, Appalachian Laboratory (KJP, TLS); Maryland Department of Natural Resources, Natural Heritage Program (DJF), Frostburg State University, Department of Biology and Natural Resources (KJP, TLS).*

(Oral presentation)

POPULATION ESTIMATES OF THE ALLEGHENY WOODRAT (*NEOTOMA MAGISTER*) IN MARYLAND BASED ON LONG-TERM CAPTURE-RECAPTURE DATA

Allegheny woodrats (*Neotoma magister*) are experiencing population declines in the northeastern portion of their range, and are ranked as S1 and listed as Endangered in Maryland. As a response to reported declines in these states, woodrats have been the focus of ongoing population monitoring in Maryland since 1990. Annual live trapping has occurred at 3 sites, including Savage River State Forest's High Rock Area in Garrett County, Dan's Mountain Wildlife Management Area and Fort Hill Nature Conservancy Preserve in Allegany County. Biennial live trapping has occurred at 2 additional sites, including Indian Springs Wildlife Management Area in Washington County and Frederick City Watershed in Frederick County. Between 10-35 ($\bar{X} = 24$) Tomahawk live traps baited with oats and peanut butter were placed (10-20m apart) near known, or likely, woodrat middens or latrines, including near overhangs, and talus areas for 2 trap-nights. To date, over 7,000 trap-nights have been conducted. Population size estimates for the 5 sites over the 26-year period will be analyzed using the spatially explicitly recapture program (SECR) in R. Preliminary analysis of the data supports the hypothesis that woodrat populations are continuing to decline in Maryland, and that there are certain sites in Maryland which represent critical habitat and strong-holds for woodrats. The results of this data-set will be used to support a larger project that is identifying and targeting intervention strategies for woodrat recovery in Maryland.

MULTI-YEAR COLLABORATIVE STUDY TO ASSESS THE DISTRIBUTION AND MIGRATORY MOVEMENTS OF NORTHERN LONG-EARED BAT (*MYOTIS SEPTENTRIONALIS)* ACROSS THE STATE OF IOWA

Kelly Poole[1], Jesse Leckband[2], and Amber Schorg[3]
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(Oral presentation)

With the decline and subsequent federal listing of the northern long-eared bat, there has been a growing interest in this species, especially in the context of understanding the risk to the species from wind turbines. Over the past three years, IADNR, MidAmerican Energy, USFWS, Iowa State University, WEST, Inc., Copperhead Consulting, Stantec, and Working Dogs for Conservation have worked in partnership on a large-scale, multi-faceted study to define the life history and ecology of northern long-eared bats across Iowa. Through acoustics, active and passive radio-tracking, infrared camera recordings, and trained conservation dogs, we have greatly increased not only our understanding of northern long-eared bat summer, winter, and migration habits in the State of Iowa but also the efficacy of the methods available to study them in this landscape. In this introduction, we describe the context, impetus, and public-private partnerships established to enable the completion of this large study.

EFFECTS OF FOREST THINNING ON BAT FORAGING ACTIVITY IN THE NORTHEASTERN UNITED STATES

Lisa E. Powers[1], Christopher Hauer[1], David McNaughton[2], Shannon Henry[2], Timothy Haydt[2] and Brent J. Sewall[1]
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(Oral Presentation)

Many North American bat species are experiencing severe population declines due to white-nose syndrome and other threats. While researchers seek direct solutions to these threats, wildlife managers need strategies to improve habitat that will create immediate positive effects on bat populations. This includes evaluation of the effects of common forest management practices, such as selective tree harvest, on a wide range of bat species. Our study evaluated the effects of forest thinning on nightly bat activity at Fort Indiantown Gap National Guard Training Center in central Pennsylvania. The chosen forest stands were extremely dense due to fire suppression that was typical of the northeastern United States over the past century. In spring 2017, we selectively thinned half of these forest plots to promote fire-tolerant tree species that were more typical of the region prior to anthropogenic land use. We used acoustic sampling to compare bat activity in forest plots that were thinned to adjacent unthinned forest plots. We recorded for three nights at each location with Pettersson d500x detectors and analyzed calls using Sonobat 4.0.7. We included the following predictors in our generalized linear models of bat activity: thinned vs. unthinned, stand basal area, elevation, and distance to road. We used Akaike Information Criterion to select the best model to explain bat activity. Forest thinning was positively associated with most species: *Eptesicus fuscus*, *Myotis leibii*, *Lasionycteris noctivagans*, *Lasiurus borealis*, and *Lasiurus cinereus*. The association was negative for *Myotis septentrionalis*, which is a species adapted to foraging in clutter. Recordings of *Myotis lucifugus/sodalis* and *Perimyotis subflavus* calls were too rare to construct reliable models. We plan to replicate the study this year to determine whether the benefits of selective forest thinning persist across years.

DISTANCE SAMPLING FOR SOUTHEASTERN POCKET GOPHERS (*GEOMYS PINETIS*)

JT Pynne[1,2], Steven B. Castleberry[1], L. Mike Conner[2], Elizabeth Parsons[3], Robert Gitzen[3], Sarah Duncan[4], Robert McCleery[4], James D. Austin[4]
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(Oral presentation)

Natural open pine forests, particularly longleaf pine (*Pinus palustris*), contain diverse faunal communities. Due to extensive degradation and fragmentation, many taxa within the longleaf pine forest are species of conservation concern. The southeastern pocket gopher (*Geomys pinetis*) is a fossorial rodent that can be considered an ecosystem engineer within open pine forests due their consumption of roots and vegetation and due to their creation of mounds of soil resulting from tunneling activities. To better understand and manage this species, we developed a modified line transect distance sampling protocol to assess suitable habitat and monitor population abundance of southeastern pocket gophers. The methodology will aid in the development of a decision support tool to inform management strategies for the species, including implications for translocation protocols. We implemented this protocol throughout the range of the species at 58 sites in Alabama, 55 sites in Florida, and 76 sites in Georgia randomly selected and stratified within accessible private and public land with a National Landcover Database category including pine or grassland. I am currently analyzing the data and will present preliminary results including the protocol design and abundance and detection indices from distance sampling.

NABAT: NORTH AMERICA UNITES TO SYSTEMATICALLY DOCUMENT BAT POPULATIONS

Brian Reichert[1]

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(oral presentation)

North American bats face unprecedented risks from continuing and emerging threats including white-nose syndrome, wind energy development, and habitat loss. Many species of bats are thought to be experiencing unparalleled population declines never before documented. To better understand the true ecological consequences of these observed population declines, the North American Bat Monitoring Program (NABat) was conceived. As a statistically robust and standardized bat monitoring program, NABat is focused on the 47 species of bats that are shared by Canada, United States, and Mexico and is designed to be a multi-national, inter-agency collaborative monitoring effort. NABat seeks to improve the state of conservation science for bats by providing standardized protocols and facilitating cross-boundary agency coordination and sharing of limited resources. NABat will provide managers and policy makers with the information they need on bat population distributions and trends to effectively manage bats, detect early warning signs of population declines, assess species vulnerability to potential threats, and measure recovery. Since implementation in 2015, NABat monitoring is now occurring in more than 40 states and 10 Canadian provinces. As monitoring data increases through time, NABat will provide analyses of status and trends, document changes in species distributions, help focus conservation efforts, and monitor efficacy of conservation and adaptive management efforts. I will present an overview of the NABat program, discuss available resources for NABat partners, and identify goals for NABat in 2018 and beyond. I will highlight early successes of the program and illustrate the utility of NABat for 'scaling up'—allowing NABat Partners to address local research questions while contributing to larger, landscape-scale efforts to improve our understanding of range-wide population trends and threats to North American Bats.

INTEGRATING MULTIPLE SURVEY TECHNIQUES DOCUMENT SHIFTING BAT COMMUNITIES IN THE WAKE OF WHITE-NOSE SYNDROME

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The long-term study of bat communities often reflects a diverse set of sampling methodologies that are difficult to integrate into a single measure of relative abundance. We developed a Bayesian state-space model to integrate such data into a common currency, captures per unit effort. We used acoustic monitoring and mist-net capture data over an eight-year period (2006 – 2014) from a bat community in central New England to test the model. Integrating these data is critical to characterize changes in community structure or composition over time, such as one would expect following an emergent infectious disease such as White-nose Syndrome ('WNS'). The integrated data model shows a significant decline in the abundance of little brown myotis (*Myotis lucifugus*) since 2006, and an increase in abundance of the eastern small-footed myotis (*M. leibii*), the eastern red bat (*Lasiurus borealis*), and the big brown bat (*Eptesicus fuscus*). These results are consistent with our understanding of the impact of WNS on these species. The success of this model provides opportunities to quantify shifts in other communities where multiple sampling methodologies were employed with inconsistent sampling effort, and therefore provides natural resource managers quantitative data to inform conservation and management recommendations.

AUTUMN BEHAVIOR OF NORTHERN LONG-EARED BATS (*MYOTIS SEPTENTRIONALIS*) IN CENTRAL IOWA

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(Oral presentation)

Recent threats to bats in the form of White-nose Syndrome (WNS) and interactions with wind facilities have sparked an impetus for filling life history gaps of previously common species in order to mitigate these threats. The objective of this study was to collect land use and behavior information on federally threatened northern long-eared bats (NLEB) during autumn near the western edge of the WNS Buffer Zone and within proximity of the state's wind facilities. A total of 230 bats of 8 species were caught at 18 sites during 148 net nights in Franklin and Hardin counties from 28 August – 1 October 2017, including 37 NLEB. Radio-tracking resulted in the location of 84 roosts which included live and dead trees, anthropogenic structures, and rock roosts, 1 of which was a talus slope hibernaculum. Thirty-nine nights of aerial telemetry resulted in 1,700 location points used to describe nocturnal behavior of 28 bats (27 NLEB and 1 little brown bat). Although located in a primarily agricultural landscape, bats utilized forested areas more heavily than other landcover types, although bats did forage over corn fields, and less often, soybean fields. Bat movement across the landscape (7 – 25 km) peaked in mid-September and males were still active on the landscape on 15 October. Several bats disappeared suddenly at night during aerial tracking, but were not found on the landscape that night or in subsequent days. Due to the ability of the plane to locate wayward bats up to 30 km away and the autumn time of year, we conclude that many of these bats may have chosen underground hibernacula but were not detectable from the surface. Roosting behavior, swarming areas, and potential hibernacula located and characterized by this study will aid in ongoing efforts to conserve this species and its habitats.

Indiana bat (*Myotis sodalis*) maternity roost habitat preference within Midwestern United States upland Oak-Hickory (*Quercus-Carya*) forests

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The Indiana bat (*Myotis sodalis*) is a federally listed endangered species negatively impacted by human disturbance, habitat change, and disease. Habitat protection and management of summer roosting habitat and hibernacula are recommended for the recovery of this species. We studied roost tree and landscape characteristics of 19 known summer maternity roosts in Illinois and Iowa upland oak-hickory forests. Landscape variables can be highly correlated in fragmented forest habitats and not all the roost tree and landscape variables are relevant to roost tree selection. We employed an algorithm to approximate the data set by using singular value decomposition (SVD) to identify the primary factors governing the selection of maternity roosts. The proposed method (formally referred to as a feature selection algorithm) approximates the data by discarding highly correlated features and features that can be removed without incurring much loss of information. Results indicated that maternity roosts were trees closer to forest edge, larger in diameter and typically trees with crowns in the upper canopy of the forest. Although live or dead shagbark hickory (*Carya ovata*) were preferred as roosts, snags of other tree species common to Midwest upland oak-hickory forests were also used. There was sufficient evidence to infer that the chosen live trees were taller and in more favorable locations compared to the chosen snags. We further observe that the joint distribution for quantitative attributes among dead or declining shagbark hickory was not significantly different compared to the other chosen tree species, indicating a lack of shagbark hickory may not limit the Indiana bat population. Knowledge of these complex relationships regarding maternity roost habitat preferences is useful for future management of the Indiana bat throughout Midwest oak-hickory forests.

(Oral Presentation)

BATS, BUZZES, AND DRINKING:

A PILOT STUDY AND PHOTOGRAPHIC JOURNEY

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(Oral Presentation)

During fall of 2016 and 2017, Copperhead set manned camera traps at small water sources in forested landscapes in southeastern Kentucky in an attempt to capture high resolution photos of drinking bats. In 2016 it became clear that we could capture reasonably clear photos of drinking activity, with bats typically identifiable to species. During the 2017 efforts, AnaBat SD2 acoustic detectors (Titley Electronics) were set adjacent to the waterbodies to record approach echolocation calls that may be associated with drinking. Preliminary results found bats used a "buzz" type call similar to the more familiar "feeding buzz" to orient themselves during the approach for a drink. However, this type of call was not produced on every pass, suggesting bats may be using memory to navigate on subsequent drinking passes. Additionally, some species-specific behaviors were observed that show how different species may approach the dilemma of drinking on the wing. While our sample size is too small to draw any firm conclusions at this time, we feel these initial findings are worth sharing and hope to continue to peruse this topic.

TORPOR PATTERNS AND HIBERNACULA CONDITIONS OF *PERIMYOTIS SUBFLAVUS* IN WHITE-NOSE POSTIVE AND NEGATIVE SITES

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(Oral Presentation)

Tri-colored bat (*Perimyotis subflavus*) populations have experienced >90% declines in the southeastern U.S. due to white-nose syndrome (WNS), despite milder and shorter winters. Data are lacking on *P. subflavus* response to WNS and hibernacula temperatures in the south; therefore, we conducted a study in the winters of 2015-16 and 2016-17 to compare torpor patterns and hibernacula conditions of *P. subflavus* in a WNS+ site in South Carolina and WNS- sites in Florida and Mississippi. We used temperature sensitive radio transmitters and Lotek dataloggers to record individual skin temperatures (T_{sk}) and iButtons to record hibernacula temperatures (T_H) and humidity. We collected data on 29 *P. subflavus* in SC, 12 in FL, and 8 in MS. Mean T_H in SC ranged from 9.3°C to 12.1°C and mean T_H was 13.6°C in FL. Bats in MS rarely went into deep torpor. Average torpor T_{sk} in SC (15.5°C) did not differ significantly from average torpor T_{sk} in FL (15.9°C) and T_{sk} in both sites was well within the optimal range for *Pd* growth. Torpor bout length ranged from 1 to 15 days and numbers of torpor bouts did not differ significantly between SC and FL ($P = 0.12$). Arousal length ranged from 30 to 593 minutes and arousal frequency did not differ between SC and FL ($P = 0.22$). Bats typically aroused during the evening 2-3 hours before sunset at all three sites. Based on similar torpor patterns in SC and FL we conclude that bats in the very southern part of the range that use caves with stable cold temperatures may be highly susceptible to WNS but bats that use other types of roosts such as culverts may be less susceptible.

WINTER ROOST SELECTION BY TRI-COLORED BATS AND SOUTHEASTERN MYOTIS IN FLORIDA CAVES

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(Oral Presentation)

In recent years, understanding how bats select cave hibernacula has become of greater importance as white-nose syndrome (WNS), caused by the fungus *Pseudogymnoascus destructans (Pd)*, has spread and led to large-scale mortality of wintering bats. Currently, *Pd* and WNS has not been detected in Florida. From 2015-2017, we conducted 399 surveys of 162 caves in Florida to develop pre-WNS baseline information on hibernacula use. We assessed the distribution, occupancy, and abundance of bats and determined cave features that were important for hibernacula. Across all three years, tri-colored bats *Perimyotis subflavus* were detected in 126 (77.8%) caves, southeastern myotis *Myotis austroriparius* were detected in 51 (31.5%) caves, and a Rafinesque's big-eared bat *Corynorhinus rafinesquii* was detected in only one cave. We modeled cave occupancy and abundance as a function of cave habitat variables for tri-colored bats and southeastern myotis. Tri-colored bat occupancy was positively influenced by water drips and disturbance and negatively influenced by temperature. Tri-colored bat abundance was greater in longer, cooler caves with pitting, solution holes, and multiple unobstructed entrances that were closer to a source of water. Southeastern myotis occupancy was greater in longer, domed caves with a large water source present that were closely associated with forested habitats and further from bodies of water. Factors affecting southeastern myotis abundance could not be evaluated due to extreme values in the data. Our results increase our understanding of winter distribution and abundance of these bat species and the effects of cave structure and surrounding habitat on their selection of hibernacula sites. This information is essential for more effective management, conservation, and monitoring strategies to address the expected impacts from WNS.

A POPULATION GENETICS ASSESSMENT OF THE NORTHERN LONG-EARED BAT

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(Oral Presentation)

Disease dynamics involve complex relationships between host, pathogen, and environment. One such interaction is the capacity for pathogens to exert powerful selection pressure for host populations to adapt. White Nose Syndrome, a fungal infection causing high levels of mortality in several species of North American bats, has provided a unique opportunity to investigate selection pressure and resultant changes in population genetic structure for one such species, the northern long eared bat (*Myotis septentrionalis*). Using a RAD-Seq approach, this population genetics study aims to investigate the status of this endangered species with the goal of determining whether there is evidence for adaptation at the molecular level in response to the causative agent of White Nose Syndrome, *Pseudogymnoascus destructans*, as well as significant changes in the effective population size.

SMARTER CURTAILMENT FOR BATS

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Wind energy fatalities may pose a serious risk to bat populations (Frick et al. 2017). Low blade rotation (2 to 3 RPM) rates greatly reduce fatalities (Fieldler 2004). Achieving such low RPMs requires pitching the blades out of the wind (curtailing) which precludes energy generation. The loss of energy yield and revenue is cited by wind farm operators as the primary reason for not implementing standard curtailment regimes.

Standard curtailment regimes rely primarily upon wind speed which results in a high false positive rate; turbines are curtailed when wind speed are low but bats are absent from the rotor swept zone and the risk of fatality is zero. Curtailing during false positive events reduces energy yield, increases the cost of curtailment for wind farm operators, and has zero conservation benefit.

Eliminating false positive events minimizes the financial impacts of curtailment while still achieving the conservation objective (e.g., % reduction in fatalities, avoidance of take of endangered species) and should make curtailment acceptable to a wider range of wind farm operators. The most direct method to eliminate false positives is to monitor bat exposure within the rotor swept zone and curtail only when bats are present and wind speeds are low. This approach reduced fatalities of all species significantly (83%, Sutter et al. 2017) and reduced the impact on energy yield by ~40%. This strategy of real-time risk-based curtailment provides the optimum balance between conservation and energy production.

Site suitability for using this risk-based curtailment approach can be assessed using pre- and/or post-construction nacelle-height acoustic data in combination with meteorological data. These datasets are used to model various curtailment scenarios and estimate conservation benefits (reduced fatality rate) and the economic benefit (increased energy yield) of each scenario to determine if a site would benefit from this smart curtailment approach or not.

COMPARISON OF PASSIVE AND ACTIVE ACOUSTIC SAMPLING IN A BAT COMMUNITY IN SOUTH-CENTRAL SOUTH CAROLINA

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(Oral presentation)

Acoustic monitoring techniques have become more heavily relied on in bat population monitoring studies over the past two decades. There are two broad categories of acoustic monitoring in use today: active and passive. While both methods have advantages, a direct comparison between the two methods has not been conducted in the southeastern United States. Our objective was to compare passive and active acoustic sampling designs. We hypothesized that (1) average number of calls collected by each method would be significantly different and (2) method, amount of clutter at a point, precipitation (mm), temperature (°F), and basal area (m^2/ha) would have an effect on detection probabilities of bats. In summer 2017 we used Anabat Express detectors to record bat calls both actively (20 minutes) and passively (20 minutes and all night) at the Savannah River Site. We collected 113 calls through active sampling and 75 calls were collected through simultaneous passive sampling during the same 20-min time period. We collected 3899 passively when detectors were active the entire night. Calls were grouped into five species groups according to call frequencies. Using the Kruskal-Wallis test we found that the average number of calls per 20 minutes was significantly higher for passive sampling all night than for active sampling for each species group. Using multi-covariate detection models, we found that the global model was the top predictive model for each species group, with results indicating that we were more likely to detect each species group in low clutter, as temperature increased, and when using passive sampling all night and less likely to detect bats in high clutter, using active sampling or sampling passively for 20 minutes. We conclude that passively sampling throughout the night is the best method to use when surveying for bats.

UNDERSTANDING THE ECOLOGICAL IMPACTS OF TIMBER HARVEST TECHNIQUES ON THE BAT COMMUNITY IN A MIDWESTERN HARDWOOD FOREST

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(Oral Presentation)

Abstract. Timber harvesting is an essential tool for habitat management of several wildlife species present in Indiana State forests, especially bats. Despite a long history of timber harvesting and forest management in the Midwest, there is a paucity of information regarding the immediate and long-term effects of these practices on forest dwelling bat species. Considering recent population declines of several cave dwelling bat species due to White-nose Syndrome that have been observed across the eastern U.S., understanding community wide bat response to habitat management practices are of immense importance. To fully elucidate the ecological consequences of harvesting practices on the bat community, we acoustically surveyed 132 sites across the Morgan-Monroe and Yellowwood state forests in southern Indiana during the 2016-2017 summer seasons (May-August). As a part of the Hardwood Ecosystem Experiment, a long-term (100 yr.) ecological study, we used paired random sampling techniques to survey bat occupancy in four different harvest treatment types including clear-cuts, shelter wood cuts, single-tree selection cuts, and recently unharvested forests. Echolocation calls were recorded using Wildlife Acoustics SM2+ echolocation detectors and calls were identified using Bat Call ID v.2.7D (BCID), and Echoclass v.3.1. Over 55,000 call files were recorded over the course of the study. We constructed species specific detection histories and modeled false-positive occupancy for both seasons. Results will be discussed in full following complete analyses.

EXAMINING TEMPORAL TRENDS OF NATIVE BATS IN NORTHWEST OHIO THROUGH CITIZEN SCIENCE

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(Oral Presentation)

Citizen science is becoming an important tool for mass data collection, and can be critical in engaging the public in both local scientific research and in species that can be misunderstood, such as bats. We examined species diversity and activity over three natural parks in the Oak Openings Region of northwest Ohio, a major biodiversity hotspot. Native bats in this region face numerous threats, from habitat loss due to anthropogenic pressures to the fungal disease White Nose Syndrome (WNS). This long-term study began in 2011, one year after the first detection WNS in Ohio and has continued through 2017. Using non-invasive acoustic monitors, multiple trails were sampled in each of three parks (Oak Openings, Secor, and Wildwood) on consecutive nights in June, July, and August. Walking transects were conducted by citizen scientist volunteers after being instructed on the project details and use of the monitors. We recorded 458 calls over 9 recording nights in this year's study. The number of identified species decreased in two of the three parks between 2011 and 2017 (from 8 species to 6 in Oak Openings and 8 to 5 in Secor). Wildwood, the smallest park and closest to an urban center, recorded 7-8 distinct species every year and exhibited the highest species diversity (Simpson's Diversity = 0.791 versus 0.318 in Oak Openings and 0.464 in Secor). This could be a result of the higher density of forest habitat in that park. It is also possible that this park is acting as an urban refugia for native bats. Total amount of calls decreased continually in all parks through the study, suggesting a decrease in total activity over time. Citizen science has shown to be a valuable tool for studying these temporal trends and creating a long term data set.

ESTIMATING POPULATION SIZES OF *MYOTIS LUCIFUGUS* THROUGH NOVEL METHODS AND ANALYSES

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(Oral Presentation)

There is an urgent need to better understand the population ecology of bats throughout North America given the precipitous population decreases that have resulted from white-nose syndrome. To better conserve bat species believed to be at risk of extinction or extirpation, novel and efficient tools are required to assess current population statuses and improve surveillance for potential future population declines. Although numerous field methods and analytical tools are available for gathering and evaluating population-level data, there have been relatively few attempts to do so in North American myotis species. Here, we present a novel approach by using high-frequency radio-frequency identification (HF-RFID) technology, in combination with an analytical approach unused by bat ecologists. For use with these techniques, 218 female little brown myotis (*Myotis lucifugus*) in Yellowstone National Park have been implanted with HF-RFID tags. Three buildings across 39 km of Yellowstone's northern range, which are used by little brown myotis as seasonal maternity roosts, have been collectively equipped with 6 continually operating HF-RFID readers and 42 antennas. We also performed 26 emergence counts outside of monitored roosts throughout the 2017 season. Since 6/19/2017, 1,854,619 detections of tagged bats have been recorded, detecting 59.6% (130/218) of total tagged bats. Of bats captured at these monitored buildings, we detected 44.1% (15/34) of bats tagged in 2015, 52.3% (34/65) of bats tagged in 2016, and 91.3% (63/69) of bats tagged in 2017. Using mark-resight models in program MARK, we estimated pre-partition population highs at two colonies to be 746.1 (95% CI = 518.4 – 1073.6) and 201.5 (95% CI = 123.4 – 329.2). With the birth of juvenile bats (increase in unmarked individuals) and the emigration of marked adults, the estimated post-partition population highs at the same two colonies are 1488.6 (95% CI = 881.8 – 2512.9), and 559.6 (95% CI = 368.0 – 851.0). In addition to population estimates, we will also present data on individual roost fidelity, connectivity between roosts, and seasonal arrivals and departures from summer roosts. Through continuously tracking detections of tagged bats, a dataset has been started that will provide biologists with a tool that can track long-term population trends. These data provided by this monitoring system and mark-resight analyses will allow for estimates of local population sizes to be made and uncover aspects of little brown myotis ecology that will be essential for managing bats populations in Yellowstone.

DEVELOPMENT OF CONSERVATION AREAS FOR ENDANGERED/THREATENED BATS IN WEST VIRGINIA: WHAT WORKS AND WHAT DOESN'T

Ryan L. Ward and Eric S. Schroder. *AllStar Ecology, LLC, 1582 Meadowdale Road, Fairmont, WV 26554 (ASE)*

Since 2015, AllStar Ecology, LLC (ASE) has applied various methods to select locations for conservation and to enhance and restore bat habitat for Indiana and northern long-eared bats (NLEBs) in West Virginia. To identify potential conservation sites, ASE has utilized multiple approaches including landscape modeling, known presence records, and presence/absence sampling. To restore and enhance summer roosting habitat on conservation and impact sites, we have utilized various methods including reforestation, creating potential roost trees through girdling and creation of tree cavities, and installing artificial roosts. We have attempted to create and improve foraging areas through the construction of vernal pools, permanent wetlands, and stream bank stabilization efforts. We have found varying degrees of success with different methods and approaches and have examined the effectiveness of practices and overall conservation values achieved to help drive and refine our efforts. We have had success in locating areas with both Indiana and NLEB presence and have had the successful use of artificial roosts by maternity colonies of NLEBs. Continued monitoring and evaluation of applied methods is underway to further our understanding and improve our conservation efforts.

(Oral Presentation)

HABITAT PREFERENCE AND MOVEMENT PATTERNS OF FLORIDA BONNETED BATS (*EUMOPS FLORIDANUS)*

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(Oral Presentation)

The Florida bonneted bat is an endangered species endemic to Florida. Little is known about its basic ecology, including habitat preferences and foraging behavior; acquiring this information is vital to the development of effective management strategies for the species. We conducted this study to determine seasonal and sexual differences in movement patterns and habitat preference of adult, nonreproductive individuals. We attached GPS collars to 37 individuals at Babcock-Webb Wildlife Management Area in Punta Gorda, Florida in April, August, and December 2015-2016. Altitude values were obtained for a subset of individuals. We found that Florida bonneted bats are capable of flying long distances and flying at high altitudes. Bats were detected a maximum distance of 40km from their roosts, with females traveling a greater maximum distance from their roost than males. Nightly path lengths ranged from 1.3km to 90.6km, and females traveled a greater nightly path length ($\bar{x} = 36.3 \pm 23.4km$) than males ($\bar{x} = 20.3 \pm 15.1km$) Maximum distance from the roost was significantly greater in December than in August, and total nightly path lengths were significantly greater in December than in August or April. The highest altitude recorded was 604m. Florida bonneted bats have the ability to travel long distances from their day-roosts, highlighting the need for management strategies far from known roost locations. Florida bonneted bats require landscape-level consideration for the most impactful conservation.

BAT SURVEY HAZARDS: RISK REDUCTION AND AVOIDANCE

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(Oral Presentation)

Three bat biologists have died while conducting bat-related field work in the last six years. Tragedies and minor injuries can be avoided by identifying the hazards and setting controls to eliminate or reduce the risks. We assessed the potential hazards and consequences associated with mist net, acoustic, habitat, and ground telemetry surveys. The unique survey techniques, supplies, and circumstances associated with bat surveys call for specific controls to be implemented. These controls can reduce the risks of a variety of incidents including electrocution, hand injuries, falls, damages to equipment, and injuries related to exhaustion. We aim to help bat biologists understand the importance of developing a safety and communication plan as well as how to complete a thorough job hazard analysis. Implementing these essential safety methods will decrease the likelihood of an incident. By stressing the importance of safety in the bat biologist community, we can reduce injuries and save lives.

ARCHIVING ACOUSTIC DATA TO MONITOR BATS OVER THEIR FULL ANNUAL CYCLE

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Providing for effective conservation of North American bat populations requires an understanding of their population status and stressors throughout their full annual cycle. The North American Bat Monitoring Program (NABat) provides an efficient and statistically-robust framework to monitor the population status of most species during the summer active season using echolocation monitoring. However, the use of acoustic monitoring has grown explosively in recent years and is employed throughout the year to determine species presence and activity patterns to address a multitude of local research and conservation concerns. The Bat Acoustic Monitoring Portal (BatAMP; http://batamp.databasin.org/) is an existing, open access, web-based tool that enables upload and display of echolocation monitoring data. BatAMP allows results from local echolocation monitoring or research efforts to be dual-purposed to help understand regional- or continental-scale phenomena such as migratory connectivity or foci of winter activity. As such, it has utility as a source of data to help address pressing conservation issues such as White-nose Syndrome and wind energy development that arise over multiple years and wide geographic scales. Results from over 100,000 detector-nights across 16 states and 1 province have been uploaded to BatAMP, dwarfing all previous compilations of bat species occurrence. However, results compiled to date are strongly biased to locations in the western United States. I will demonstrate the capabilities of BatAMP for visualizing patterns of bat activity that occur at large spatial scales and over multiple seasons--making the case for increased participation from the eastern half of North America. In addition, I will address developing synergies between BatAMP and NABat leading to a more comprehensive ability to monitor bat populations of North America throughout their full annual cycle.

BAT HIBERNACULA PRESENCE ABSENCE SURVEY USING ACOUSTIC DETECTORS

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(Oral Presentation)

During pre-construction surveys for the Transcontinental Gas Pipe Line Company, LLC (Transco) natural gas pipeline project in Pennsylvania (Atlantic Sunrise Project), potential bat hibernacula portals were discovered, which necessitated spring presence/absence surveys. While United States Fish and Wildlife Service (USFWS) guidelines do allow spring trapping surveys, Pennsylvania Game Commission (PGC) guidelines do not. Therefore, acoustic surveys were conducted from mid-March through May 1, 2017, using Anabat SD1 and SD2 detectors in 15 potential portals. To minimize false positives, microphones were placed between 10 and 50 feet into the portals. Recorded files were reviewed using standard filter parameters and USFWS-approved auto-classifier programs. Zero bat calls were identified. However, raw unfiltered files were manually vetted and numerous potential bat call files were identified. After consultation with Anabat inventor Chris Corbin, it was determined that the call files were likely produced by bats exiting the portals. As a result, Transco assumed the presence of the federally endangered Indiana bat (*Myotis sodalis*) and adopted several conservation measures into the project design to avoid impacts on both the hibernacula and hibernating bats. Trapping surveys were conducted prior to construction for a total of 20 consecutive nights between September 15 and October 4, 2017, at all portals where bat passes were identified during the spring acoustic survey. During fall trapping surveys, several tri-colored bats (*Perimyotis subflavus*), eastern small-footed bats (*Myotis leibii*), and one little brown bat (*Myotis lucifugus*) were captured, which confirmed the presence of bats detected with Anabat detectors and manual vetting. This offered a unique opportunity to compare spring acoustic survey results with fall trapping surveys.