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April 27, 2021

Time (CDT)	Session Name	Title	Presenter
10:30		Opening remarks	Katie Gillies
10:45	Methods	Novel Uses of LiDAR in Subterranean Habitat Conservation and Management	Jackson Bain & Ethan Sandoval
		Evaluating Bat Activity at Wildlife Underpasses along Interstate-90 in Washington State	Jenna Chapman
		Maximizing Kaleidoscope Lite (FREE) for Manual Vetting	Paul Howden-Leach
		Raffle & Video: Acoustic Methods for Tracking Bats to Maternity Roosts	Caitlin Kollander
11:45		Break	
12:00	Methods	Canopy-Level Acoustic Survey Methods Enhance Understanding of Seasonal Bat Activity in California Redwood Forests	Chelsea Andreozzi
		Multiyear Bat Community Monitoring in Northern Nevada	Danielle C. Miles
		Do Winter Acoustic Recordings of Cave-exiting Bats Predict Number of Individuals in Hibernacula?	Jericho Whiting
		Raffle & Video: Evaluation of the Current and Historic Distributions and Morphometric Variations in *Lasiurus borealis* and *Lasiurus frantzii/blossevillii*	Rose Haidar
13:00	**Sponsor presentation**	**Titley Scientific Lunch and Learn**	
13:30		Lunch break	
14:00	Natural History	Eastern Red Bats Breeding in California: Do they need a new common name?	Pat Brown
		Solar-Powered Bat Conservation: Installing Long-Term Bat Detectors to Search for New Species and Monitor Population Trends	Emily Hamblen
		Big Browns in the 'Burbs: Big Brown Bat Foraging Ecology at the Urban-Wildland Interface	Jill Carpenter
		Foraging Ecology of the Hawaiian Hoary Bat on Maui	Dave Johnston
		Sponsor Video: Wildlife Acoustics	
15:20		Break	
15:35	Citizen Science	Bats in my backyard: a citizen science case study in Peace River, Alberta	Courtney Hughes
		Backyard Bat Chats: The Power of Informal Science Communication	Katrina Smith
		Audible Bats Present Opportunities for Citizen Scientists	Tom Rodhouse
		Raffle & Video: Conservation in Action: Bat Outreach on Santa Catalina Island	Emily Hamblin
16:35		Closing remarks	Katie Gillies

April 28, 2021

Time (CDT)	Session Name	Title	Presenter
10:30		Welcome - Day 2	Katie Gillies
10:45	Natural History	Context-Dependent Selection of Maternal Roost Sites by Northern Long-Eared Bats	Ellen Whittle
		Movement Patterns of Migratory Tree-Roosting Bats During Autumn Migration	Erin Swerdfeger
		Seasonal Composition of Bats in Higher and Lower Elevations Along the Kern River in California	Erika Noel
		Raffle & Video: Post-Fire Bat Activity in California – How Quickly do Bats Return to an Affected Area?	Bethany Schulze
11:45		Break	
12:00	Natural History	Pallid Bats Visit Agave lechuguilla Flowers in the Chihuahuan Desert	Loren Ammerman
		In search of bachelorettes: Dorsal patches in male *Leptonycteris yerbabuenae* in the southwestern United States	Theresa Laverty
		Closed Canopies Crowd Out Bats: Planning Artificial Gap Creation	Alana Simmons
		Raffle & Video: Monitoring the Resilience of Oak Woodland Bat Communities following the Mendocino Complex Fire	Kendall Calhoun
13:00	**Sponsor presentation**	**Biomark Lunch and Learn**	
13:30		Lunch break	
14:00	Breakout Session A: Bat Hubs	Introduction	Bethany Straw
		Bat Hubs facilitate NABat monitoring and collaboration across the Pacific West and Southwest	Kathy Gerst, Nat Goodby
		Collaboration via the Northwest Bat Hub Enables Continued Success in Implementing NABat in the Pacific Northwest	Roger Rodriguez
		Scaling Down: Using the NABat Framework to Develop a Monitoring Plan for National Parks of the Mojave Desert Region	Allen Calvert
14:00	Breakout Session B: Motus	An introduction to the Motus Wildlife Tracking System	Stuart Mackenzie
		The current status of Motus for studying bats in the West	Bronwyn Hogan
		A Motus case study	Dr. Liam McGuire
15:00		Break	
15:15	Breakout Session A	Bat Hubs Open Discussion, Q&A with panelists	
15:15	Breakout Session B	Motus Open Discussion, Q&A with panelists	
16:00		Closing remarks and final raffle	Rob Schorr
16:15		Online social time	
17:00		**Conference conclusion**	

Abstracts

Pallid Bats Visit *Agave lechuguilla* Flowers in the Chihuahuan Desert

Virginia G. Jaquish and *Loren K. Ammerman

Department of Biology, Angelo State University, San Angelo, Texas

Pallid bats, *Antrozous pallidus*, though primarily insectivorous gleaning predators, consume nectar of the cardón cactus, *Pachycereus pringlei*, in the Sonoran Desert. It was unknown whether a similar nectar feeding behavior occurred in the Chihuahuan Desert of Texas, where several researchers have captured pallid bats covered in pollen. We collected pollen samples from 67 pallid bats in Brewster County, Texas between April and August 2018. Pollen-covered pallid bats were captured in every month sampled. The pollen collected in all samples was homogeneous and identified as *Agave* pollen. Although two species of *Agave* occur in this region of Texas, *A. havardiana* and *A. lechuguilla*, a linear discriminant analysis classified 701 of 723 of the pollen grains analyzed as *A. lechuguilla.* Additional evidence from infrared video footage collected in August 2018 indicated that pallid bats became covered in *A. lechuguilla* pollen as a result of nectarivory. Pallid bats might be engaging in facultative nectarivory across their range and could be important nocturnal pollinators.

Canopy-Level Acoustic Survey Methods Enhance Understanding of Seasonal Bat Activity in California Redwood Forests

*Chelsea L. Andreozzi and Adina M. Merenlender

Department of Environmental Science, Policy, and Management, University of California Berkeley, Berkeley, CA

Previous studies have revealed that certain bat species overwinter or migrate through California coast redwood forests but much about these populations' seasonal movements and activity patterns remains unknown. If bats are active in the winter, these populations might be less susceptible to white-nose syndrome than elsewhere in their range. Despite promising innovations in ultrasonic acoustic technology, acoustic monitoring is limited by detection range. We installed passive acoustic recorders to simultaneously record bat activity at the top of coast redwood trees and nearby at ground level to investigate how treetop detections compared with contemporaneous ground-level sampling. We conducted these comparisons at five Northern California forest properties, including both old-growth groves and working forests. We deployed the monitors for twelve months, from October 2019 to October 2020. We found that treetop deployment significantly increased detections of putative tree-roosting species *Lasiurus blossevillii*, *Lasiurus cinereus*, and *Lasionycteris noctivagans* as well as a non-lasiurine migrant, *Tadarida brasiliensis*. During winter, *Lasiurus cinereus* was detected at one site by the treetop detector only. Across the other four sites, *L. cinereus* was detected on average 5.6 times more nights by treetop detector than by ground detector. Similarly, during both winter and spring, *T. brasiliensis* was detected at three sites and only by treetop recorders. At one site, an average of 30 *T. brasiliensis* calls per winter monitoring night were confidently identified despite no *T. brasiliensis* calls being detected at ground-level over the same monitoring period. These results suggest that standard survey methods underrepresent the value of redwood forest habitat for sensitive bat species.

Novel Uses of LiDAR in Subterranean Habitat Conservation and Management

*Jackson Bain and *Ethan Sandoval
Bat Conservation International, Flagstaff, AZ

Recently developed handheld Light Detection and Ranging (LiDAR) technology has been a game changer worldwide in Bat Conservation International's (BCI) subterranean habitat conservation and management efforts. BCI has recently incorporated this technology as a critical tool in domestic and international conservation projects. We have used LiDAR to provide accurate and detailed spatial knowledge of underground resources such as caves and abandoned mines. In contrast to traditional LiDAR methods, handheld LiDAR technology provides a cost-effective and time-efficient method to provide spatial data to inform subterranean habitat management. The geospatial LiDAR products produced by BCI's Habitat Protection and Restoration Program have been used to guide conservation and management efforts in a number of ways, from informing abandoned mine safeguarding, to advocating for protection of high-quality bat habitat, to advising bat habitat optimization strategies for important sites.

Eastern Red Bats Breeding in California: Do they need a new common name?

*Patricia E. Brown and William E Rainey

Brown-Berry Biological Consulting, Bishop, CA

From 2014-2020, we recorded echolocation signals on Santa Cruz, Santa Catalina and San Nicolas Islands that were lower in frequency than those typical of western red bats (*Lasiurus frantzii/blossevillii*) and higher than those of western yellow bats (*Dasypterus xanthinus*). We coined the term "orange bats" for those calls. We also recorded higher frequency (presumably western) red bat sequences on the islands. On Santa Cruz Island, we captured two juvenile male red bats in mid-July 2017 and another juvenile male in 2018, all with large epiphyseal gaps. We took wing punches from the juvenile captured in 2018. Using 16S mtDNA, this sample was identified as an eastern red bat (*L. borealis*). Subsequent analysis of mainland California red bat preserved specimen tissue samples by D. Fraser of the CDFW Wildlife Genetics Research Lab identified four eastern red bats: a female (October 2007) from Los Angeles County; a male (June 2000) and pregnant female (June 1997) from Santa Barbara County; and a female (September 2016) from San Diego County. Geluso and Valdez (2019) had already documented the expanded range of the eastern red bat to eastern Arizona and Utah. We now ask: are the two species sympatric over all or part of their range? Planned research will examine museum and public health specimens and wind turbine casualties to see if the pelage, morphometrics and DNA support any geographic hypothesis. Western red bat acoustic records (including those submitted to NA Bat and Bat AMP) should be reviewed for lower frequency "orange" bat call sequences. Both eastern and western red bats occur and breed in California, and a new common name is needed for *L.borealis*.

Scaling Down: Using the NABat Framework to Develop a Monitoring Plan for National Parks of the Mojave Desert Region

*Allen W. Calvert and Kimber N Godfrey

National Park Service, Mojave Desert Inventory and Monitoring Network, Boulder City, Nevada

The Mojave Desert Inventory and Monitoring Network (MOJN) conducts long-term research of natural resources within nine National Park units that span the Mojave and Great Basin deserts of Nevada, Arizona, and California. Due to the decline of bat populations across the country; primarily from White-Nose Syndrome (WNS) and wind energy development, a need for tracking populations across the network was identified. In 2017, a bat monitoring protocol was developed to collect baseline population data before the arrival of WNS in the region. Winter and summer acoustic data are collected following a modified version of the North American Bat Monitoring Program (NABat). A combination of priority and non-priority sampling cells were selected. A total of 32 NABat monitoring cells have been established across six park units. A total of 20 species have been detected across all parks. Long term analysis will look to detect trends in species composition over time at each park. Capture surveys are conducted in the same six park units during spring to swab bats for the presence of the fungus that causes WNS. Lastly, large scale capture and acoustic efforts, known as bat blitzes, are conducted in one of the six park units on a yearly rotation in collaboration with several state and federal agencies. Collaboration between park and MOJN staff have been integral in implementing long-term monitoring in the network.

Monitoring the Resilience of Oak Woodland Bat Communities following the Mendocino Complex Fire

*Kendall Calhoun and Justin Brashares

Department of Environmental Science, Policy, and Management, University of California Berkeley, Berkeley, CA

The intensifying threat of wildfire continues to challenge how California and other parts of the world manage their ecosystems. Megafires especially can have catastrophic effects on human livelihoods, natural environments, and wildlife species. While wildfire remains an important natural disturbance for many of these systems, the effect of these larger scale fires on the persistence of wildlife is not well understood. Conservation status of many of California's bat species and how megafires may affect their ecology are poorly understood. In 2018, the Mendocino Complex megafire burned more than 450,000 acres of land in Mendocino County and was at the time California's largest recorded wildfire. Although there is some recent work that has focused on observing the impacts of megafires on bat populations in forested ecosystems, our search of the literature found that less is known about how bat communities respond to megafires in the biodiverse oak woodland landscapes that make up much of California's rangelands and where bats provide important ecosystem services for agriculture. To address this gap, we deployed ultrasonic recorders across a systematic grid at the Hopland Research and Extension Center following the Mendocino Complex fire. We compare bat species diversity in the burned and unburned portions of the property and describe our monitoring plan to assess how fire severity and oak mortality may impact local bat populations and especially, identify species that are potentially vulnerable or resilient to future woodland megafires and inform conservation management.

Big Browns in the 'Burbs: Big Brown Bat Foraging Ecology at the Urban-Wildland Interface

Jill M. Carpenter

LSA Associates, Inc., Irvine, CA 92614

Although the big brown bat (*Eptesicus fuscus*) is considered a common and well-studied bat species in North America, regional populations in Southern California have been declining over the past few decades and little is known about big brown bat behavior at the urban-wildland interface, particularly in habitats unique to Southern California. Given that this species is well adapted to using anthropogenic structures for roosting, current hypotheses attribute its regional decline to urban development and fragmentation of foraging habitat. We conducted a radio telemetry study in late summer 2020 to gather information on the foraging behaviors and habitat preferences of a big brown bat maternity colony in Chino Hills, California, prior to the anticipated destruction of its roost in early 2021. Radio transmitters were attached to twelve big brown bats captured at a culvert beneath a road that serves as a boundary between open space and residential neighborhoods. The bats were tracked by ground-based crews for 14 nights and were observed day roosting and night roosting in trees, houses, and the culvert at which they were captured. Preliminary analysis of data indicates that while some of the radio-tagged bats commuted across neighborhoods and a freeway to access foraging habitat, others never crossed the neighborhood or freeway and foraged only in the open space during the tracking study. The data collected during this study will aid in guiding future conservation and management decisions for projects involving impacts to big brown bat roosts in developed environments.

Evaluating Bat Activity at Wildlife Underpasses along Interstate-90 in Washington State

*Jenna Chapman and Kristina Ernest

Department of Biological Sciences, Central Washington University, Ellensburg, Washington

Roads destroy, degrade, and isolate wildlife habitats. Despite the ecological importance of bats and the assumed effect roads have on access to foraging, breeding, and roosting habitats, investigation into whether crossing structures facilitate bat movements in road-fragmented areas are relatively uncommon in North America. Washington State Department of Transportation (WSDOT) has created multiple wildlife crossing structures along Interstate-90 (I-90), a major highway near Snoqualmie Pass in the Cascades. We evaluated species presence and activity of insectivorous bats along I-90 where it intersects with wildlife underpasses to investigate whether bats might preferentially cross the highway at crossing structures. To monitor activity patterns and species composition of bats, we recorded echolocation calls at locations along the highway with and without underpasses. We also sampled in adjacent forest habitats. We used mixed-effects models to examine bat activity along the highway where underpasses are present, where underpasses are absent, and in forest habitats adjacent to the highway. All bat species detected in the adjacent forest were detected along the highway. Total bat activity was higher near the highway than in forest habitats, but not different between locations with underpasses and those without. Several factors could explain these differences. However, our study provides baseline information on bats in the area. We recommend more intensive monitoring to better understand the effectiveness of crossing structures in reducing the impacts roads have on bats.

Bat Hubs Facilitate NABat Monitoring and Collaboration across the Pacific West and Southwest

*Kathy Gerst[1], *Nat Goodby[1], Amanda Adams[1], Bethany Straw[2], Jonathan Reichard[3], Brian Reichert[2], and Winifred Frick[1]

1 *Bat Conservation International, Austin, TX;* ***2*** *U.S. Geological Survey, Fort Collins, CO;* ***3*** *U.S. Fish and Wildlife Service, Hadley MA*

The implementation of standardized monitoring methods is critical for understanding both continental scale trends as well as regional and local population dynamics. Likewise, access to tools for visualizing, analyzing, and reporting patterns enables these data to be more readily useful for decision-making for management and conservation applications. In January 2021 two new bat hubs launched to facilitate the implementation of the NABat program across the Pacific West region (California and Nevada) and the Southwest (Arizona and New Mexico). These efforts represent collaborations between the NABat program, Bat Conservation International, and numerous state and federal agencies. The goals of the bat hubs are to
(1) identify stakeholder needs for bat data and information, (2) facilitate training to carry out acoustic monitoring using NABat protocols, (3) coordinate the monitoring of cells among partners throughout the regions, and (4) cultivate a community of practice for knowledge sharing and collaboration. In addition, the bat hubs will serve to help partners meet their needs for survey equipment, reporting, and data processing and analysis via the National Data Processing Lab (NDPL). We will describe the capacity of the hubs, summarize their progress to date, and outline our plans for growth and sustainability.

Evaluation of the Current and Historic Distributions and Morphometric Variations in *Lasiurus borealis* and *Lasiurus frantzii/blossevillii*

Zeinab (Rose) Haidar

Department of Biology, Humboldt State University, Arcata CA

Having highly dynamic movements and specialized life histories, members of the genus *Lasiurus* – one of several genera of North American tree bats - have uncertain ranges and distributions. Recent accounts of overlap, historic misidentification, and possible phylogenetic variations regarding two species of this genus – the “western red bat” (*Lasiurus (frantzii) blossevillii*) and the “eastern red bat” (*Lasiurus borealis*) - highlight our limited understanding of this taxon. Recent findings of *L. borealis* occurring in California have clouded our understanding of the distribution, speciation, and assumed allopatry of spatial activity for *L. borealis* and *L. frantzii/blossevillii*. Genetic sequencing utilizing tissues collected from museum and field specimens throughout California and adjoining states may help clarify historical and current distribution as well as identify genetic variation. In our study, definitive species classification by region will be achieved utilizing mitochondrial DNA analysis and more comprehensive analysis at the nuclear and genomic level will be accomplished through low-coverage whole-genome sequencing. Our analysis will include morphometric analysis to strengthen our ability to infer congruence in segregating the two species. The results acquired from this study will hopefully broaden our limited understanding of the genus *Lasiurus* and its status and distribution in North America while facilitating future research and informing conservation actions.

Conservation in Action: Bat Outreach on Santa Catalina Island

Emily E. Hamblen
Santa Catalina Island Conservancy, Avalon, CA

Santa Catalina Island is home to more species of bats than all other mammal species combined. Installation of two on-island solar-powered bat acoustic stations has allowed us to further increase the number of documented species beyond what was known from previous surveys. These solar-powered bat acoustic stations have also allowed contemporaneous creation of several educational outreach programs and opportunities. The Conservation, Education, and Development departments of the Santa Catalina Island Conservancy worked closely together to organize informal talks by bat biologists; write multiple articles for newspapers and magazines; create educational posts on Facebook; and install a temporary bat educational booth in Avalon, the island's main residential area and business hub. Additionally, we are designing an educational plaque at the most accessible solar-powered bat detector in the Wrigley Memorial Botanical Garden for visitor education. We compared the effectiveness of each outreach method in terms of number of participants reached and insights gained during these experiences. We have found that using multiple methods allowed us to reach a greater number of visitors and residents. This project was funded by the Western Bat Working Group Bonnie the Bat Education Grant with matching contributions provided by the Santa Catalina Island Conservancy.

Solar-Powered Bat Conservation: Installing Long-Term Bat Detectors to Search for New Species and Monitor Population Trends

*****Emily E. Hamblen[1], Patricia E. Brown[2] and William E. Rainey[2]
1 *Santa Catalina Island Conservancy, Avalon, CA* ***2*** *Brown-Berry Biological Consulting, Bishop, CA*

In May 2019, two long-term solar-powered Anabat Swift Passive Bat Detectors were installed on Santa Catalina Island: one observable by the public in the Wrigley Memorial Botanical Gardens near the city of Avalon and the other at Thompson Reservoir near Middle Ranch. Prior to this research project, eight bat species had been documented as occurring on the island through capture and/or acoustic identification (Brown and Rainey 2018). With the autonomous acoustic detectors, two more species have been added to the island fauna: the relatively rare big free-tailed bat (*Nyctinomops macrotis*) and the red bat (*Lasiurus borealis* and/or *L. frantzii*). During 2020, red bats have been detected most months at Thompson Reservoir, as have California (*Myotis californicus*), Yuma myotis (*M. yumanensis*), Townsend's big-eared bat (*Corynorhinus townsendii*), and Mexican free-tailed bats (*Tadarida brasiliensis*). In addition, a significant pulse of acoustic activity from apparently migrating hoary bats (*Lasiurus cinereus*) was recorded in September and October. This research was funded by the Western Bat Working Group Bob Berry Scholarship Titley Electronics Award, the Santa Catalina Island Conservancy, and the Donald Slavik Family Foundation.

The Current Status of Motus for Studying Bats in the West (and why we should care)

Bronwyn Hogan
US Fish and Wildlife Service, Sacramento, California

As interest in Motus builds, the lack of towers in the west continues to be pointed out at meetings attended by resource agency folks. So why should anyone, particularly resource agencies, be interested in and support Motus networks and research using Motus towers? I will discuss questions that agencies tasked with conserving bats could address with Motus and relate what I know of current projects that are planned and where they will occur. I will emphasize that Motus towers don't care what taxa a transmitter is affixed to and that Motus sites established for avian and butterfly studies can be used for bats too - and vice versa. This makes cross-program collaboration (and funding?) an important strategy.

Maximizing Kaleidoscope Lite (FREE) for Manual Vetting

*Paul Howden-Leach
Wildlife Acoustics

For researchers just starting or already involved in using acoustics to monitor bats, please join us to learn how to use the free Kaleidoscope Lite to view, analyze, and label bat calls. This session is great for researchers who don't have large budgets to purchase software or who don't want to use an automated classifier, but still desire an efficient workflow to sort through and identify recordings efficiently while also producing useful outputs for reports.

Bats in my backyard: a citizen science case study in Peace River, Alberta

*Courtney Hughes[1] Cathȩrine Brown[2], and Rolanda Janny Steenweg[1]

1 *Alberta Environment and Parks, Grande Cache, AB;* ***2*** *Independent Researcher, Edmonton, AB*

Recognizing the central role local people play in bat conservation efforts and the need to fill data gaps on boreal bat species, we developed a citizen science program in Peace River, Alberta. Through a collaborative partnership between local provincial government staff alongside the Center for Boreal Research and Peace River Library (Library), we created and loaned out bat monitoring kits for local citizen scientists. Each kit included one Wildlife Acoustics EchoMeter Touch 2 bat detector, available for either Android or iOS smartphones; user instructions; data sheet; and a species identification keyring with bat images and information. We held two public engagement presentations to garner interest and explain the project in hopes of recruiting local participation from citizen scientists. The bat kits were made available for sign-out at the Library, and library staff provided additional educational information on bats for participating citizen scientists. The library also showcased a physical map of the area that identified target monitoring locations and encouraged citizen scientists to mark with a push pin the locations at which they sampled. Our presentation discusses the challenges of establishing a smartphone-based citizen science program including leadership and training needs; financial and human capital investments for program sustainability; and implementation considerations during a pandemic. We also discuss the benefits of bat citizen science, which may include leveraging limited human resources to collect data; sparking curiosity and increasing understanding among citizens in scientific methods and data uses; developing appreciation for boreal bat species and their habitats; and ultimately encouraging stewardship and conservation action.

Foraging Ecology of the Hawaiian Hoary Bat on Maui

*Dave S. Johnston[1], Kristin A. Jonasson[2], Brad Yuen[2]

1 *H.T. Harvey & Associates, Wildlife Department, Los Gatos, CA;* ***2*** *H.T. Harvey & Associates, Wildlife Department, Honolulu, HI*

The foraging ecology of the Hawaiian hoary bat (*Lasiurus semotus*) has been poorly characterized and lack of information is hampering efforts to develop an effective *L. semotus* recovery plan. Our study area encompassed 34,226 hectares on the north-facing and windward slopes of Haleakala on the island of Maui, Hawai'i. From September 2017 - September 2018 we collected acoustic monitoring data from 45 sites in each of nine habitat types for a total of 315 deployments. We mist netted on 78 nights and radio-tracked 16 bats on 109 nights. We used two or more hand held Yagi antennae to determine the 95% kernel analysis Foraging Range (FA) and 50% kernel analysis Core Use Area (CUA). We sampled available prey through black light trapping in each of the nine habitats. We used DNA barcoding of the bats' guano to determine prey consumed. Bats spent more time foraging in gulch, low-density developed, and grassland habitats, although differences existed between months. We found habitat type to be highly significant at a level of $\alpha = 0.05$ ($P < 0.01$). The mean CUA was 3,991 hectares and the mean FA was 17,362 hectares. Bats ate primarily moths (68%), as well as flies (12%), termites (9%), crickets and katydids (5%), beetles (4%), and true bugs (2%). Insects eaten by bats were both native and nonnative and bats were somewhat selective in prey species. Our data suggest foraging flexibility in the species with the use of habitat types changing during different seasons.

Acoustic Methods for Tracking Bats to Maternity Roosts

*Caitlin A. Kollander, Danielle M. Owens and Douglas Causey

Department of Biological Sciences, University of Alaska Anchorage

Over the past decade, risks associated with capturing and handling bats have only increased due to factors including climate change-related stressors, White-nose syndrome, and SARS-CoV-2. Therefore, finding less invasive methods for studying and monitoring bats is crucial. Juvenile little brown bats (*Myotis lucifugus*) emit various low-frequency calls [high frequency (HiF) ~20kHz] during postnatal physical and vocal development, and these calls have been detected near maternity roosts in summer months. Since juvenile bats are still developing flight muscles during the first few weeks after birth, we predicted that young *M. lucifugus* do not travel very far from maternity roosts and that juvenile-specific low-frequency echolocation calls may be used to determine how far young *M. lucifugus* travel from these roosts. For five consecutive nights in July of 2020, we deployed ultrasonic acoustic monitors at predetermined distances ranging from 0-100m from a known maternity roost on Joint Base Elmendorf-Richardson (JBER) in Anchorage, Alaska. Acoustic files were analyzed for low-frequency calls. A Kruskal-Wallis test suggested there were significantly ($p<0.05$) fewer low-frequency calls at greater distances from the roost. However, similar calls were detected at other locations on JBER, and we suspect that there may be several undiscovered maternity roosts. We plan to deploy acoustic grids of detectors in July 2021 to narrow down the locations of these roosts. Additionally, we plan to collect environmental data that will be used to develop a model that will predict the distance of a maternity roost from an acoustic monitor based on simple acoustic and habitat data.

In search of bachelorettes: Dorsal patches in male *Leptonycteris yerbabuenae* in the southwestern United States

*Theresa M. Laverty and Kathryn E. Stoner

Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO

The lesser long-nosed bat (*Leptonycteris yerbabuenae*) is a partially migratory, nectarivorous species that exhibits reproductive asynchrony across its range. Both migratory and resident populations of sexually active males of *L. yerbabuenae* may form an odoriferous dorsal patch during their mating season, which is believed to influence female mate choice. First documented in the literature in 2008, dorsal patches are created by using a foot to smear saliva, urogenital fluids, and anal secretions over the interscapular dorsal region. We report new observations of male *L. yerbabuenae* with dorsal patches captured at the northern extent of their migratory range in the southwestern United States and cite previously unreported observations that we obtained by contacting other researchers. We compare the timing and locations of these new sightings from New Mexico (Big Hatchet Mountains) and Arizona (Hilltop and Patagonia), with published findings of male *L. yerbabuenae* presenting dorsal patches (all in Mexico). Much of the reproductive biology of this migratory pollinating bat species remains unknown. Our new observations suggest that *L. yerbabuenae* may breed in New Mexico and Arizona between June and August, but follow- up studies are needed to confirm this behavior. Identifying regions where males present dorsal patches may not only assist in locating and protecting mating roosts but may also further our understanding of the population ecology of this migratory species.

The Motus Wildlife Tracking System

Stuart A Mackenzie
Birds Canada, Port Rowan, Ontario, Canada

The Motus Wildlife Tracking System (Motus) is an international collaborative research network that uses coordinated automated radio telemetry to facilitate research and education on the ecology and conservation of migratory animals. Motus is a program of Birds Canada in partnership with collaborating researchers and organizations. The Motus collaborative is currently composed of more than 400 research projects that are collectively maintaining an array of more than 1,000 monitoring stations across 31 countries. Tracking devices deployed are light enough to track even the smallest birds, bats, and large insects like dragonflies, and butterflies. Collaborators have used the system to track more than 25,000 animals of more than 220 species. Animals are tracked with high temporal and geographic precision when in range of automated stations. They can be tracked between stations over great distances, revealing important aspects of their life movements, connectivity, ecology, and life histories. Motus combines the collective impact of local, regional, and even hemispheric projects into one massive collaborative effort that expands the scale and scope of each researcher's work and maximizes the use of scarce resources. Motus also makes data available and hopefully more useful for future projects, collaborative endeavors, and large-scale meta-analyses. Motus will play a vital role in increasing our understanding of migratory animals with the additional benefit of supporting critical outreach and education objectives.

Motus Wildlife Tracking System: Applications for Bat Movement Studies

Liam P McGuire
Department of Biology, University of Waterloo, Waterloo, Ontario

Bat movement patterns have long been of great interest, whether nightly foraging, dispersal, or long- distance migration. However, tracking a moving bat is challenging. Bats are nocturnal, highly mobile, can travel long-distances, and are often too small to carry many tracking devices. To address movement ecology questions, researchers require a toolbox of techniques, matching their question to the best available technique. Each technique has advantages and trade-offs and provides different information that can be used to address certain questions. Along the spectrum of tracking methods, banding is simple and light weight, but requires recapturing the animal. On the opposite end, GPS/satellite tracking provides detailed movement data remotely, but is generally too heavy for most bats. I will discuss the Motus Wildlife Tracking System as a tool that researchers can include in their toolbox. Motus is an open-source collaborative network that takes advantage of digitally coded radio transmitters to passively track large numbers of animals over great spatial areas. Like any other tracking technique, this system is best suited to address certain questions and inappropriate for others. I will describe some of the studies I have conducted with Motus, including successes and spectacular failures and relate lessons learned that will hopefully provide guidance to others considering this system in their own research programs.

Multiyear Bat Community Monitoring in Northern Nevada

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Across the northern Great Basin, many land stewardship agencies such as the Bureau of Land Management and the U.S. Forest Service are clearing large tracts of piñon–juniper woodland (P-J) to restore habitat for the greater sage-grouse. We are using these conifer removal projects as experimental replicates to investigate the effects of conifer removal on bat communities across 5 regions of northern Nevada. Bat populations can be extremely sensitive to alterations in vegetation structure and may depend on P-J for foraging and roosting. Here we report on our findings from passive acoustic monitoring in the 2017-2020 field seasons, which includes our contribution of over 50,000 bat detections across 46 sites to the North American Bat Monitoring Project. Besides habitat loss from P-J removal, the inevitable arrival of White- Nose Syndrome (WNS) is likely to soon impact the northern Great Basin region. We will additionally present results of pilot work to monitor winter activity at talus habitats with varying levels of P-J canopy cover and assess differences between summer and winter roost selection. In 2021 and 2022, we will use short-term GPS tracking to quantify movements and identify critical habitats for Big Brown Bats (*Eptesicus fuscus*), Hoary Bats (*Lasiurus cinereus*), and Pallid Bats (*Antrozous pallidus*). The results from this study will inform conservation and management decisions for bat communities of the Northern Great Basin and will provide a critical baseline for assessing the impact of WNS in the future.

Seasonal Composition of Bats in Higher and Lower Elevations Along the Kern River in California

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Knowledge of seasonal occupation, migration patterns, wintering locations, and use of riparian areas by bats in California is very limited. This presumably hampers efforts to assess impacts and provide effective conservation. I investigated seasonal activity of bats along the Kern River watershed from low elevation areas of the southern San Joaquin Valley to higher elevations of the Kern River near Kernville and Lake Isabella, California. I hypothesized that season affects the presence of bat species within an elevation gradient. I predicted that the composition and distribution of the bat species cohort will differ seasonally with greater species richness at higher elevation sites in summer than at lower elevation sites with the reverse being true in winter. To investigate this hypothesis, I deployed four Pettersson D500x acoustic detectors in randomly selected areas within the Kern River watershed. I placed two acoustic detectors in each upper and lower elevation zone for seven consecutive nights every month for 12 consecutive months. Detectors were deployed at a total of 41 different sites in randomly selected 2-km survey cells created in ArcGIS. I processed 50,725 acoustic calls and attributed 10,907 calls to 13 species. The Mexican free-tailed bat, *Tadarida brasiliensis,* was the most detected bat year-round with 6,755 total detections. In my presentation, I will summarize my preliminary findings and discuss seasonal distribution trends of bats detected within the Kern River watershed. I anticipate my study will provide a more comprehensive knowledge of the distribution of bat species and periodic composition in areas not previously studied along an elevation gradient of the southern Sierra Nevada.

Audible Bats Present Opportunities for Citizen Scientists

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Bat conservation has been impeded by a lack of basic information about species distributions and abundances. Public participation in closing this gap via citizen (community) science has been limited. However, audible bats that produce low-frequency calls provide an overlooked opportunity for collaborative citizen science surveys. We were joined by community members to survey and expand our knowledge of a rare audible desert bat, the Spotted Bat (*Euderma maculatum*), in western North America through a structured survey design broadly adaptable for practitioners across the globe where audible bats occur. Our study was integrated into a statistically robust but flexible master sample in use by the North American Bat Monitoring Program ensuring representativeness of data contributions. We used survey results to update a Bayesian species distribution model that accounted for imperfect detection. We encourage future surveys to use recording devices to obtain voucher calls from potential occurrence locations to address false-positive detection errors that arise with inexperienced volunteers.

Collaboration via the Northwest Bat Hub Enables Continued Success in Implementing NABat in the Pacific Northwest

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Since 2016, state and federal agency partners have been successful in implementing the North American Bat Monitoring Program (NABat) in the Pacific Northwest. The formation of the Northwest Bat Hub in 2018 allowed this success to continue into subsequent years and expansion throughout the region. This unique collaboration among state and federal agency partners with academic researchers allows the pursuit of questions of common interest about bat conservation status and trends and inform evidence-based conservation decision-making. The mission and organization of the Northwest Bat Hub enables pooling of resources and an economy of scale, leveraging individual partner investments for coordinated regional conservation knowledge and action. Despite issues related to the COVID-19 pandemic, the Northwest Bat Hub and its partners were able to successfully conduct NABat stationary acoustic monitoring in Oregon, Washington, and Idaho in 2020. We will present on updates to NABat implementation in the region as well as on our methods for coordinating a region-wide and multi-partner effort and provide insight on successes and challenges. We believe the successes of the Northwest Bat Hub has benefited NABat more broadly as the "Bat Hub" concept has expanded with the establishment of hubs in other regions of the country and through collaboration with NABat statistical partners for refinement of survey design and modeling.

Post-Fire Bat Activity in California – How Quickly do Bats Return to an Affected Area?

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Research on bat activity in post-fire landscapes in the western United States is often limited to monitoring conducted a year or longer after an event. Knowledge of how quickly bats return to burned habitat and which species return first is negligible. My project opportunistically assessed bat activity at three sites burned in the San Mateo–Santa Cruz Unit (CZU) Lightning Complex and River fires in late summer of 2020 as part of a larger study investigating foraging associations of foliage-roosting bats across urban-natural habitat gradients. I began this study just over one month after the CZU and River fires had been contained. Three acoustic bat detectors, one per site, were deployed for four consecutive nights each month. Bat activity was recorded during the first deployments at all three sites. To date, I have confirmed burned area use by eight species, including both open-space foraging bats and clutter-adapted foraging bats. Bat activity in severely burned areas occurring so soon after a fire incident could have implications for land managers and post-fire clean-up. Additional activity monitoring beginning as soon as possible after fire containment, is needed to further our understanding of post-fire habitat use by bats.

Closed Canopies Crowd Out Bats: Planning Artificial Gap Creation

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Recently, state and federal agency partners have implemented a program to promote biodiversity in coastal forests of Oregon by creating forest gaps in even-aged stands. As bat conservation concerns have increased, interest has grown in how these artificial gaps can promote bat activity. This program may have important implications for open- and edge-adapted bat species that are reliant upon forest gaps as energy efficient foraging grounds within closed canopy forests. This project provides a comprehensive approach to gap creation for the benefit of bats in the Pacific Northwest region. Extensive literature review revealed that physical gap characteristics including size, shape, and elevation as well as spatial context in relation to roosting habitat, waterbodies, and roads likely influence the utility of gaps for bats. Using these findings and common geospatial tools, we conducted a weighted overlay analysis to identify strategic locations for gap creation within a national forest on the Oregon coast as a case study. This approach of creating artificial forest gaps according to specific landscape and habitat characteristics that best meet the needs of bats can be applied by forest managers throughout the region. By creating gaps with these criteria, forest managers can support the foraging activity of open- and edge-adapted bats as well as support high levels of bat diversity in even-aged, closed canopy forests.

Backyard Bat Chats: The Power of Informal Science Communication

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My Bob Berry Scholarship supported an outreach project to share my knowledge of the amazing diversity and behavior of bats to improve and encourage conservation and biodiversity stewardship. While this project was originally intended for open presentations to the public, private landowners, and non-profit interest groups, reduced in-person gatherings associated with the COVID-19 pandemic caused me to restructure my audience. I adapted an approach to accommodate socially distanced, small group settings and limited informal outdoor gatherings. These "backyard bat chats" provided outreach for people who may not have normally attended a structured public program. Using an ultrasound microphone, tablet, and SonoBat LIVE© (J. Szewczak, Humboldt State University), I combined real-time visualization of echolocation calls with pertinent bat facts and provided answers to common bat questions. This method proved successful in establishing a meaningful connection between technology and audience as well as disseminating general information on such topics as bat species diversity, protection of building roosts, and the risk of rabies. As an example, in consort with the landowner, I identified a large colony of bats that have been roosting for decades in the family's barn as Big Brown Bats (*Eptesicus fuscus*). I subsequently connected the property owner with a citizen-science monitoring program. Beyond my public information programs, the data I collected was submitted to the Bat Acoustic Monitoring Portal (BatAMP) in support of this program that will help improve the collective understanding of bat species ranges and activity patterns. In summary, science communication benefits abound even within nontraditional outreach experiences, which can be structured to create strong personal connections between humans and the wildlife that surround us.

Movement Patterns of Migratory Tree-Roosting Bats During Autumn Migration

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Migration routes of long-distance migratory tree-roosting bats (*Lasiurus cinereus, L. borealis and Lasionycteris noctivagans*) in North America are poorly understood. Large numbers of bat fatalities recorded at wind energy facilities are contributing to likely population declines of these species. Most documented migratory bat fatalities at wind energy installations occur during autumn migration. There is some urgency to better understand migration patterns of these bats, because, like many other jurisdictions, the Province of Saskatchewan plans to dramatically increase wind power generation capacity. We installed passive acoustic detectors in southern Saskatchewan during the migration period to measure migratory bat activity. We placed one set of detectors in a three-by-three grid pattern across the study area in locations with high wind energy potential and prominent landscape features. We installed a second set of detectors along 5 km transects perpendicular to four of the province's major rivers. Sites located in riparian areas and the southeastern portion of the province contain more forested landscapes than other sampling sites, which we located primarily in uplands and grassland ecoregions. We found higher levels of migratory bat activity in the eastern portion of the province. Activity was also generally higher in riparian areas and decreased with distance from rivers. This pattern is consistent with access to resources such as roosting habitat and watercourses, which are considered important in bat migration route selection. Our results will inform siting decisions for future wind energy projects.

Do Winter Acoustic Recordings of Cave-exiting Bats Predict Number of Individuals in Hibernacula?

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White-nose syndrome and wind energy development make it imperative to document population fluctuations of bats. Little work has been done assessing the relationship between recorded acoustic data of bats flying out of caves in winter and number of bats counted in hibernacula. We acoustically monitored and counted two species of bats in 9 hibernacula from November to March 2011 to 2018. We hypothesized that acoustic data recorded from Townsend's big-eared bats (*Corynorhinus townsendii*) and western small- footed myotis (*Myotis ciliolabrum*) exiting hibernacula could estimate abundance of those species in hibernacula. Across seven years, we conducted 29 hibernacula surveys and simultaneously set passive acoustic detectors during winter when those surveys were conducted. Acoustic monitors recorded for 1,063 winter nights. Detectors recorded 2,459 files of Townsend's big-eared bats and 9,094 files of western small- footed myotis. For all hibernacula and years combined, mean (± *SD*) number of Townsend's big-eared bats counted in a cave was 96 (± 139.9, range = 0 to 443 bats); mean number of western small-footed myotis counted in a cave was 7 (± 12.0, range = 0 to 52 bats). Number of acoustic recordings of bats flying out of caves was positively related to number of hibernating bats counted in hibernacula for both species but differed by cave for Townsend's big-eared bats. Our results indicate that researchers can estimate number of bats hibernating in caves using passive acoustic data, which could benefit long-term monitoring of bats and reduce the number of occasions that biologists enter caves to count bats.

Context-Dependent Selection of Maternal Roost Sites by Northern Long-Eared Bats

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Northern long-eared bats (*Myotis septentrionalis*) have experienced catastrophic population declines caused by white-nose syndrome (WNS). Maternal roost trees are critical to sustain populations by providing shelter and thermoregulation for females rearing offspring. Suitable trees often are limited, especially in systems altered by human activities. We characterized preferred roost habitat for female northern long-eared bats at the edge of their range in the Black Hills National Forest, Wyoming, USA. We tracked reproductive females to day roosts and recorded habitat metrics at the roost cavity, roost tree, and roost patch (a 0.04-hectare circle), and at random available sites. We then tested whether site selection was affected by weather conditions and season with a generalized linear mixed model. Maternity colonies were located most often (62%) in quaking aspen (*Populus tremuloides*). Bats selected trees with a larger diameter and more advanced decay compared to what was available on the landscape; however, over half the roosts were live trees. The use of different tree types was associated with weather conditions and season. Bats roosted in quaking aspen on cooler, wetter days earlier in the spring, and used ponderosa pines on warmer, drier days in late summer. Roost patches had high canopy cover (average 78%) that did not vary with weather. Our results suggest that female northern long-eared bats may require a range of roost types to adjust their habitat selection in response to weather conditions. Forests with diverse tree structures and characteristics may provide thermal refuge to bats, especially in a changing climate.