Building a Species Inventory and Characterizing the Foraging Behaviors of Bats in the University of Idaho Experimental Forest Using Acoustic Monitoring

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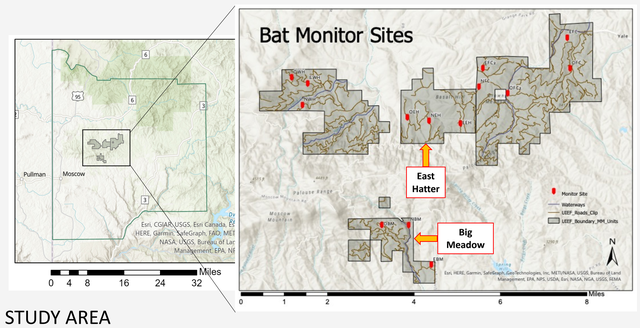
INTRODUCTION & OBJECTIVES

Echolocation allows bats to sense their surroundings and is used for foraging, navigating, and communicating. Most bats echolocate by emitting a series of ultrasonic pulses which bounce off nearby surfaces and return to the bat. The bat can use this information to determine the orientation, size, and distance of surrounding objects. Bat species have diverse, and sometimes distinct, echolocation patterns that are influenced by the habitat and food sources they specialize in[1]. Acoustic monitoring is an emerging non-invasive technique that can be used to study bats[2]. Because many species of bats have unique calls, recordings of bat calls can be identified to species on a spectrogram using diagnostic features such as frequency and shape[3,4]. There are fourteen species of bats native to Idaho, all belonging to the Family Vespertilionidae – the most common family of insectivorous bats in North America[5]. This study used acoustic monitoring to identify bats detected in the University of Idaho Experimental Forest (UIEF) and to characterize their foraging behaviors. The objectives of this study are listed below.

Objective 1: Create a species inventory of bats detected in the UIEF.
Objective 2: Compare nightly peaks in activity levels between species.
Objective 3: Assess variables that may affect bat activity levels across the study period, including precipitation, temperature, reproductive season, and habitat type.



STUDY AREA

Data for this study were collected in the main four units of the University of Idaho Experimental Forest (UIEF). Fourteen Audiomoth monitors[6] were stationed throughout the four units, strategically selected to be representative of the three classifications of bat habitat: open, edge, and narrow[7]. These classifications refer to the soundscape. A dense forest has a narrow soundscape and a pasture would be open. Edge has both narrow and open, often where a forest ends and opens into a clearing or meadow. The data displayed here only represent data collected from the six monitors in the East Hatter and Big Meadow units. At this time, only data from those monitors have been fully processed.

PROJECT TIMELINE

DATA COLLECTION
- Choose monitor locations
- Place monitors
- Monitor Maintenance
- Collect Monitors
- Download & Organize Data

DATA PROCESSING
- Kaleidoscope Identification
- Manual Identification
  - Big Meadow
  - East Hatter
  - Flat Creek
  - West Hatter
- Consult & Verify Identifications
- Create Species Inventory

I AM HERE

DATA ANALYSIS
- Acquire meteorological data
- GIS evaluation of monitor sites
- Create models
- Compare models
- Finalize results

SHARE FINDINGS
- Write paper
- Present at UI Symposium
- Present for ECB thesis
- Submit to journals

METHODS

After the monitor locations were chosen, the monitors were tested to determine the optimum settings for recording. The monitors were programmed to record for one minute in ten-minute intervals from 7:30pm to 6:00am. The monitors were stationed from May 27th to August 9th during which time they received maintenance every 2-3 weeks to replace batteries and SD cards. The recordings were downloaded and processed through a Wildlife Acoustics program called Kaleidoscope Pro[8]. Kaleidoscope conducted an automatic species identification and filtered out recordings that did not have a bat call. Then each recording with a bat call was manually processed and given a species identification in order to verify or correct Kaleidoscope's assessment. Once this is complete, a species inventory can be created and further analysis can begin. This will require meteorological data from the UIEF's weather stations and a GIS evaluation of monitor sites to properly classify habitat types. Correlation models can be tested to determine what variables affect bat activity levels in UIEF.

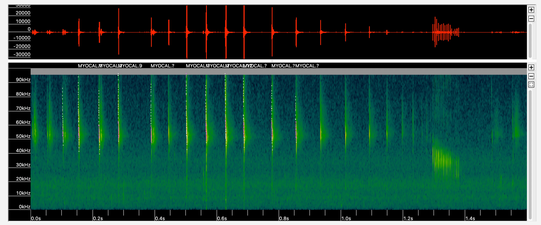
CURRENT RESULTS & SPECIES OBSERVED

5,155 bat calls recorded

13 species detected

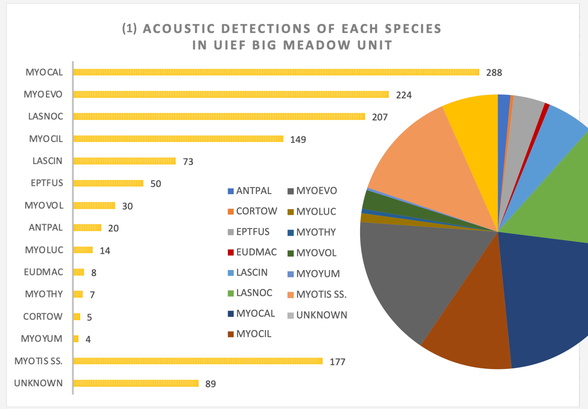
40% recordings identified

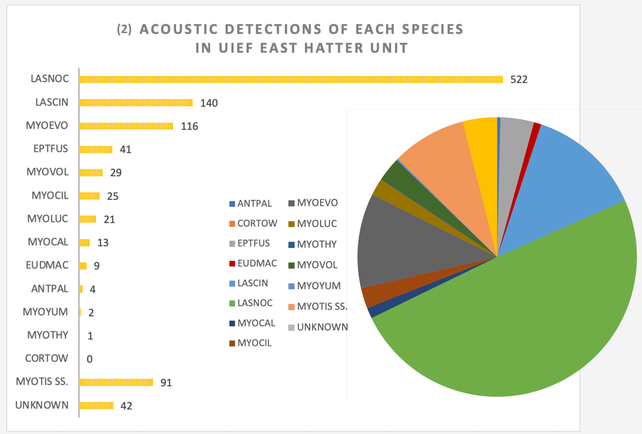
Of over 5,000 recordings of bat calls collected during the summer of 2022, 40% have been manually identified. All recordings have been automatically identified through Kaleidoscope, but those results are not displayed here. 13 of the 14 species native to Idaho have been detected in the UIEF. The only species not detected is *Parastrellus hesperus*, the canyon bat, whose Idaho range is limited to deserts in the southwest as they depend on habitat with caves and lava tubes[9].



As a bat approaches an insect, the time between pulses emitted reduces as the distance between the bat and its target decreases, creating a "buzz". This is an example of a feeding buzz from a *Myotis californicus* recorded in Big Meadow.

SPECIES ANALYSIS





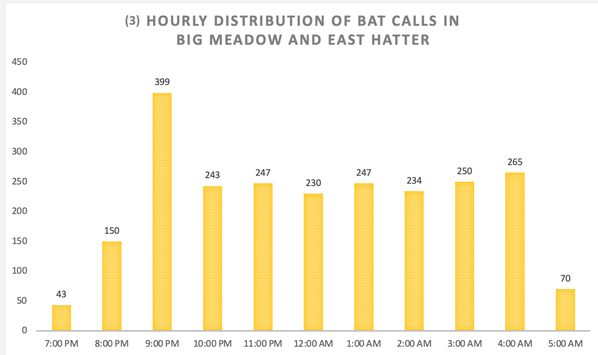
(Figure 1) Two thirds of the recordings collected in the Big Meadow unit were of a Myotis species. This is more than double the proportion of Myotis species detected in East Hatter. 19.7% of the recordings were unable to be identified, but 43.9% of these were determined to be a Myotis species.

Top Species: ***Myotis californicus***, or the California myotis, can be found along the west side of North America, from Guatemala to mid-British Columbia. They typically roost solitarily or in small groups in a variety of habitat types, including forests. They are one of the smallest bats in the United States and have one of the highest frequency feeding calls[10].

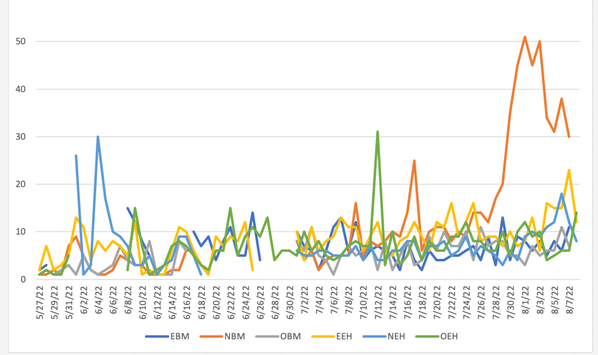
(Figure 2) LASNOC (*lasionycteris noctivagans*) accounted for 49.4% of the total bat detections recorded in East Hatter. Comparatively, in Big Meadow, LASNOC made up only 15.3% of the total recordings. 12.5% of the recordings could not be identified to species confidently, most of which were a Myotis species.

Top Species: ***Lasionycteris noctivagans***, commonly known as the silver-haired bat, is found across the United States, southern Canada, and north up to southern Alaska. They primarily roost under tree bark in old-growth forests and feed in disturbed areas[11]. Two of the three EH monitors were in areas with recent logging and all three were near a road.

TEMPORAL ANALYSIS



(Figure 3) The nightly activity of bats in East Hatter and Big Meadow units is mostly uniform except for a distinct peak in activity between 9-10pm, at dusk.



(Figure 4) The number of acoustic detections each night was variable between monitor sites. Most notable are peaks from the narrow East Hatter (NEH), open East Hatter (OEH), and narrow Big Meadow (NBM) habitats. Later analysis will test if precipitation, temperature, seasonal changes, or habitat type are correlated to these fluctuations.

FURTHER WORK TO BE COMPLETED

This is an ongoing study. As shown in the project timeline, only recordings from six of the fourteen monitors have been manually identified so far. The next steps are to finish the manual identification of recordings from the remaining monitors, to consult an expert in acoustic identification to verify results, and to begin data analysis. Analysis will consist of creating models which test how meteorological variables, habitat types, time of night and reproductive seasons might influence activity levels. It will also be of interest to see if different species respond to variables differently. The final data processing and analysis is projected to be completed in early 2023.

SPECIES NAME INDEX

Abbreviation	Binominal Name	Common Name
ANTPAL	*Antrozous pallidus*	Pallid bat
CORTOW	*Corynorhinus townsendii*	Townsend's bat
EPTFUS	*Eptesicus fuscus*	Big brown bat
EUDMAC	*Euderma maculatum*	Spotted bat
LASCIN	*Lasiurus cinereus*	Hoary bat
LASNOC	*Lasionycteris noctivagans*	Silver-haired bat
MYOCAL	*California myotis*	California myotis
MYOCIL	*Myotis ciliolabrum*	Western small-footed myotis
MYOEVO	*Myotis evotis*	Long-eared myotis
MYOLUC	*Myotis lucifugus*	Little brown myotis
MYOTHY	*Myotis thysanodes*	Fringed myotis
MYOVOL	*Myotis volans*	Long-legged myotis
MYOYUM	*Myotis yumanensis*	Yuma myotis
PARHES	*Parastrellus hesperus*	Canyon bat
MYOTIS SS.	---	(Myotis species, unable to identify)
UNKNOWN	---	(Unable to identify species)

WORKS CITED