

Differences in Seasonal Occurrence and Activity of Bat Species within Conservation Land in Massachusetts

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ABSTRACT

There are nine Vespertilionid species of bat documented within Massachusetts; five of these have been state-listed as Endangered. The long-term assessment of bat activity and presence may offer valuable population data on the affect environmental and human-driven pressures (wind turbines, human disturbance and diseases including White Nose Syndrome) have on our regional bat populations. This study has investigated bat species composition and occurrence within two habitat types (forest edge and forest interior) in Mass Audubon's Moose Hill Wildlife Sanctuary in Sharon, MA. Passive ultrasonic recordings were made using the automated bioacoustic recorder SM3BAT (Wildlife Acoustics Inc.) during active season months in 2017. Recordings were then run through Kaleidoscope Pro Analysis Software and manual species identification was conducted. Throughout the active season, *Eptesicus fuscus* (Big Brown Bat) was consistently present at both deployment sites. The months of May and June have a greater presence per recorded night of two migrating species within the forest interior when compared to mid or late summer months: *Lasiurus cinereus* (Hoary Bat) and *Lasiomyotis noctivagans* (Silver-haired Bat). Finally, *Perimyotis subflavus* (Tricolored Bat) echolocation pulses were only recorded in May for the forest edge site, but present in the forest interior during early, mid, and late summer. We plan on correlating these preliminary results with classified foraging and migratory strategies of Massachusetts bat species to help determine a baseline for species occurrence and activity levels. This first season of data will aid in a long-term study of bat populations within this protected area.

Table 1: Information on Massachusetts Bat Species and their Bioacoustics 1,5

Species	Common name	Fmin range of pulse	North Eastern Ecology
	Big Brown Bat	25 kHz	Urban to rural locations including more traditional bat habitats such as mines and trees.
	Northern Long-eared Myotis	35-40 kHz	Can be found in forested areas in warmer months. Hibernates in mines and natural caves.
	Indiana Bat	30-35 kHz	Can be found in forested areas in warmer months. Hibernates in mines and natural caves.
	Little Brown Bat	35-40 kHz	Can be found in small caves, buildings, trees, under rocks, and in wood piles in Summer. Hibernates in mines and caves.
	Eastern Small-footed Bat	40 kHz	Can be found in buildings in the Summer. Hibernates in mines and natural caves.
	Silver-haired Bat	Always >25 kHz	Inhabits forested areas along rivers and lakes.
	Hoary Bat	Undulates	Inhabits forested areas especially near lakes and rivers. Known to hibernate and migrate depending on location.
	Eastern Red Bat	Undulates	Inhabits forested areas especially near lakes and rivers. Migrate south in the Winter.
	Tricolored Bat	35 kHz	Inhabits forested areas especially near lakes and rivers. Hibernates in mines and natural caves.

INTRODUCTION

- Nine species of bat have been documented in Massachusetts, all insectivores belonging to the family Vespertilionidae (Table 1).
- These bats are aerial hawking specialists; pursue and consume their prey in flight. This behavior can be visualized in the bat echolocation pulses of a sonogram (Figure 1)².
- Acoustic studies on bats can be used many ways for determining the biodiversity of a habitat to understanding species richness or abundance³.
- Proximity to still water is vitally important to bats. Bodies of water provide hydration and a sustainable habitat for the insects (Table 1). This combination of food and hydration is why bats can often be found near a water source⁴.
- Several species in MA are at risk due to several factors: the epizootic disease called White Nose Syndrome, barotrauma due to wind turbines, and human disturbance⁵. These conservation issues have led us to seek out which species are most abundant in Southeastern Massachusetts in order to see which species are being affected by these factors. Looking at abundance in the two locations we have selected will also tell us which species prefer which kind of habitat.

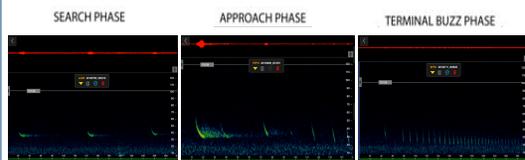


Figure 1: Feeding phases of an aerial hawking bat. In the search phase, the bat will send out a steady pulse to locate prey. In the approach phase, the bat has located prey and increases the number of pulses. In the terminal buzz phase, the bat sends out more and more pulses until it catches the prey

RESEARCH QUESTIONS

1. Is there a difference in activity levels between sites for each species?
2. Does activity of the bat community change with respect to month, not accounting for site?

MATERIALS AND METHODS

Acoustic Recorder Deployment: Our lab deployed two SM3BAT ultrasonic recording devices (Wildlife Acoustics, INC.) at two sites within Mass Audubon's Moosehill Wildlife Sanctuary in Sharon, MA. Site 1 (the barn) represented an forest edge habitat and site 2 (vernal pool) represented a cluttered habitat (Figure 4 and 6). These devices passively recorded any ultrasonic waves within a forty foot radius over a 4 month period from May 2017 through August 2017.

Analysis of Recordings: Recordings were run through Kaleidoscope Pro software (Wildlife Acoustics, INC.) using the auto ID function. This uses the software and its libraries of bat calls to assign identification to sound files. Following this, questionable pulses were manually identified to species; only using search phase pulses (Figure 2). Here we assessed for specific markers such as (Frequency minimum of pulse (Fmin) and frequency range on order to confirm species.

Statistics: Statistical programming was done in R. To help answer our questions we ran our data using Wilcoxon-Mann-Whitney Test and Kruskal-Wallis Test.

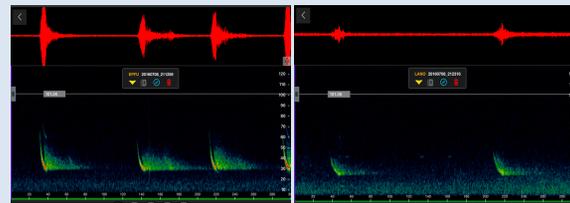


Figure 2: Kaleidoscope Pro Analysis of an Oscillogram (amplitude-time) top rows and full spectrum sonogram (frequency-time) bottom rows of A. *E. fuscus* and B. *L. noctivagans*

RESULTS

- At Site 1, vernal pool, *E. fuscus* and *M. lucifugus* had more passes per night average in July and August then in May and June (Figure 3A).
- At Site 2, the barn, *E. fuscus* had more passes per night average in May and June, while *M. lucifugus* was only recorded at the site in May (Figure 3B).
- Using the Mann-Whitney Test to answer our first questions: was there differences in activity between sites for each species. We did not see any significant difference.
- The Kruskal-Wallis Test was used to answer our second question, Does activity of the bat community and individual species change with respect to month, not accounting for site? Results showed that as a whole community, there was no significant difference between month activity levels. When asking this question per species there was a significant difference evident in *E. fuscus* and *P. subflavus*.

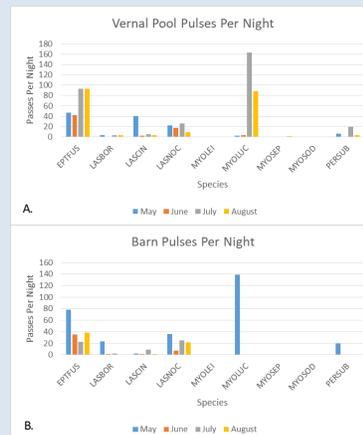


Figure 3: Graphs showing pulses per night for A. Site 1 Vernal Pool and B. Site 2 Barn



Figure 4: Map of Moose Hill. Marker A is the barn site and marker B is the vernal pool site.

DISCUSSION

- Although both sites were equally active for all species in 2017 season, we take into account that each site had a variety of habitats surround them. Recordings were omnidirectional so different habitat types beyond cluttered or forest edge could have been on the recordings.
- Observing no significant difference between activity levels could be due to low sampling effort. Recording equipment was deployed 8-15 days each month. More consistent sampling, yielding a larger sample size, might reveal significance in our data.



Figure 5: Josh and Adam at the vernal pool recording site, March 2018



Figure 6: SM3BAT recorder at vernal pool site

FUTURE STUDY

- All results looked at were preliminary results. We are currently in the process of manual identification.
- Sampling effort will be increased moving forward with the project (Figure 5).
- We have taken recordings of anuran along with the bat recordings. Analyzing these will provide further information about the ecosystem surrounding the recorders and the area soundscape.
- Improved and constant monitoring of the recording systems including more frequent changing of the batteries will result in a more complete set of data.

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