Bat Occupancy in Two Habitat Types in Private Conservation Lands of Southeastern Massachusetts

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ABSTRACT

Bats (Order: Chiroptera) are among the most diverse mammalian lineages in North America, and they occupy a wide variety of habitats. Different types of habitats- open spaces, forest edges, and forest interior- substantially vary in resource distribution and spatial structure (clutter), and therefore foraging strategies as well as echolocation signatures of bats can vary substantially among different habitats. In order to explore this hypothesis, we deployed two, SM3BAT automated Bioacoustics recorders (Wildlife Acoustics, Inc.) in a forest-edge habitat and a cluttered habitat located in Mass Audubon's Moose Hill Wildlife Sanctuary, in Sharon, MA. Forest edge habitat is a low-shrub dominant open area surrounded by a deciduous forest edge while the cluttered habitat is a mixed hardwood-coniferous forest containing two vernal pools. Analysis of the bioacoustics data through Kaleidoscope Pro software confirmed the presence of six bat species during the 2017 active season. Our preliminary analysis showed relative high nightly passes of *Myotis lucifugus* (Little Brown Bat) altered from the forest edge habitat in early spring to the closed habitat in mid to late summer. Our preliminary conclusions concerning *M. lucifugus* are that this could be related to either: changes in foliage density as the season progressed or food availability. Further investigation and data is required. We plan on continuing our research and data collection through the 2018 season.

Table 1: Bat species and common names. Max and min call in kHz. Species status.

Species	Common	Call Range (kHz)	State Status	Federal Status	Red List Status
Lasiurus borealis	Eastern Red Bat	<30-50	None	None	Least Concern
Lasurus cinereus	Hoary Bat	15-30	None	None	Least Concern
Lasionycteris noctivagans	Silver-haired Bat	25-<50	None	None	Least Concern
Eptesicus fuscus	Big Brown Bat	<23->60	None	None	Least Concern
Myotis lucifigus	Little Brown Myotis	35+	Endangered	None	Least Concern
Myotis leibii	Eastern Small-footed	35+	Endangered	None	Least Concern
Myotis septentrionalis	Northern Myotis	40-50	Endangered	Threatened	Least Concern
Myotis sodalis	Indiana Myotis	25-40	Endangered	Endangered	Near Threatened
Perimyotis subflavus	Tricolored Bat	40-50	Endangered	None	Least Concern

INTRODUCTION

Bats (Order: Chiroptera) one of the most diverse and distributed mammals around the world, and occupy a wide variety of habitats. From the hundreds of bat species there are nine bat species in Massachusetts, USA. All bats of Massachusetts are insectivores[3]. Based on the habitat types and characteristics of foraging behavior, previous researchers have formed guilds[2].

Bioacoustics is the study of sound produced by animal species. In each recording, there are series of acoustic indices which are like finger prints for the echolocation calls a bat produces as it forages or travels[6]. Each bat species has its own echolocation that each acoustic indices from species to species is different. However, there is some overlap of resemblance with some species such as the *Eptesicus fuscus* and *Lasionycteris noctivagans* (Figure 5). Acoustic indices for each species will allow identification of species that are present in the habitat location. This method helps in determining the activity level of a species, but not the population richness[6]. Does different types of habitats substantially vary in resource distribution and spatial structure (clutter) and will foraging strategies as well as echolocation signatures of bats vary substantially among the different habitats?

A. B. C.
Figure 1: Deployment sites at Mass Audubon, Moose Hill Sanctuary. A. Sharon, MA (42.12N, 71.20W), B. Vernal Pool site, C. Barn site.

RESEARCH QUESTIONS

1. Is there a difference in species richness between vernal pool and barn with control for month?
2. Is there a difference in total pulses between vernal pool and barn with control for session?

MATERIALS AND METHODS

Deployment:

- Two Song Meter SM3BAT were deployed May, 2017 to August, 2017 and redeployed March 27, 2018 in two habitats at the Mass Audubon Moose Hill Wildlife Sanctuary, Sharon, MA; MH1 – Vernal Pool and MH2 – Barn (Figure 1).

Kaleidoscope Pro:

- Auto identification analysis was conducted using Kaleidoscope Pro Software (Wildlife Acoustics, INC). Questionable pulses were then manually identified based on pulse characteristics. Pulse shape, frequency range, and pulse minimum frequency (Fmin) used to identify to species level (Figure 5).

Statistics:

- Wilcoxon-Mann-Whitney Test (Wilcox Test) for difference in species richness between vernal pool and barn with control for month to see if there is a significant difference between species richness per habitat. Wilcox Test for difference in total pulses between vernal pool and barn with control for session to see if there is a significant difference between total pulses per habitat. Excel to graph bat community (bat pulses per deployment night) and bat pulses per species per habitat for a visual on bat pulses throughout the active season.

RESULTS

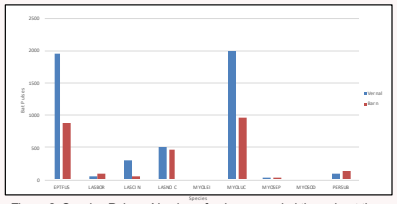


Figure 2: Species Pulses. Number of pulses recorded throughout the active period per species per habitat.

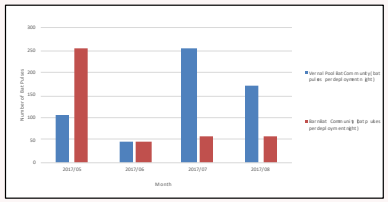
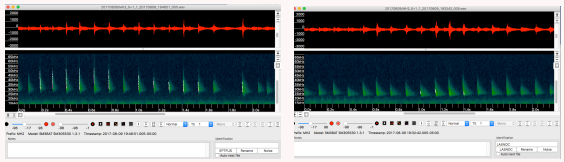


Figure 3: Vernal Pool Vs Barn Per Month. Number of bat pulses per deployment night per habitat.

- First question, is there a difference in species richness between vernal pool and barn with control for month? The species richness of bats between the barn and the vernal pool did not differ significantly (Z = -0.74362, p-value = 0.456).
- Second question, is there a difference in total pulses between vernal pool and barn with control for session? The total pulses between the barn and the vernal pool did not differ significantly (Z = -1.7086, p-value = 0.078)
- Seven species were identified between both habitats (Figure 2). The number of pulses is greater in some species than others and there are some species that with a higher number of pulses one habitat over the other.
- The number of bat pulses at the vernal pool during July and August are greater than the barn. In the month of May there is a greater number of bat pulses at the barn and less at the vernal pool. In June there is relatively the same amount of pulses at both the barn and the vernal pool (Figure 3).



A. B.
Figure 5: Sonograms (frequency-time) and Oscillograms (amplitude-time) of two bats using Kaleidoscope Pro. A. *E. fuscus with a* range of frequency between 23 kHz to 65 kHz, B. *L. noctivagan* with a range of frequency 25kHz to 45kHz

DISCUSSION

- Based off of both results, there is no difference in species richness and total pulses between the vernal pool and the barn, there may be a biological factor that has no significant difference between species richness and total pulses. Insects may be the reason as to why there is no significant difference.
- *E. fuscus* had most of its echo pulses recorded at the vernal pool. *L. cinereus* had most of its pulses recorded at the barn during the active period. *L. noctivagans* was a species that used both the vernal pool and the barn habitat equally. Each species may prefer either open space, forest edge or forest interior, but they all eat insect an will go where the food is located (Figure 2).
- Each habitat has either a higher amount total pulses per night or an equal amount. This can be affected by insects in the given seasons (Figure 3).
- By all the results and variation in pulses in the given habitats there is a biological factor that must be present that causes the bat community to be present in both habitats and have no significant difference. Results show that it is not guilds that they may prefer. Species niche is broader then distinct habitats. Species use many habitats and this information may be important to conservation to include habitat landscape not just one habitat to protect.

FUTURE WORK

- This project will continue this 2018 field season (Figure 6).
- Expanding bioacoustics to Brockton, MA at D.W. Fields Park and the fair grounds would valuable sites to see species and community activity within an urbanized area. Having Brockton, MA as a second area to study for bat community and species presence will give an insight on what urbanization can do in a negative or positive stand point.
- Addition of study on insects in the vernal pool and barn could help with understanding seasonal bat activity by looking at insect population, species composition, and literature review of life cycles of found insect species.

Figure 6: Song Meter SM3BAT Deployment. Deployment of bioacoustics system at MH2. Left Adam (myself) and right Josh Kelleher.

ACKNOWLEDGMENTS

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