Assessing Potential Shifts in the Nightly Activity Patterns of Bats During the Maternity Season

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Introduction

A variety of bat species inhabit the Appalachian forests of Kentucky. Some of these species include the big brown bat, the Indiana bat, and the little brown bat. Many such species have been recorded in the temperate forests of north eastern United States as well (Brooks & Ford 2005). Humans benefit from bats principally through their control of insect pests (Boyles et al. 2011). Research further indicates that bat predation on herbivorous arthropods can impact insect population dynamics (Kalka et al. 2008). Such studies have built an understanding of bat activity from a spatial perspective.

Aside from understanding where and how bats impact forest landscapes, it is also important to understand the temporal variation associated with the foraging activities of bats. Esberard and Bergallo (2010) recorded their greatest captures of bats captured shortly after sunset, and no bat captures several hours after sunset. Notably these authors also observed a small resurgence of activity before sunrise. Clark (1991) reports higher emergence counts of bats during the maternity season as compared to other months during the year. This is likely due to female bats foraging at higher rates during the maternity season. Population estimates and habitat assessments for bats will be aided by data defining the temporal patterns of bat activity.

Thus, the objective of this study is to define within- and across-night activity patterns of bats during the maternity season at multiple sites in eastern Kentucky. This study was conducted with the expectation of higher bat activity in June rather than July. Additionally, I hypothesized that bat activity before sunrise would remain constant throughout June and July while the amount of bat activity directly after sunset would decrease.

Methods

This four-week study was conducted at two field sites managed by the EKU Division of Natural Areas. Lilley Cornett Woods (LCW) is located in southeastern Kentucky in Letcher County and Maywoods (MAY) is located more centrally in the state in Garrard County (Figure 1). LCW is a 550-acre mixed mesophytic forest with 150 acres being old-growth forest. Maywoods is a 1,700-acre tract of secondary growth with varied forest conditions.

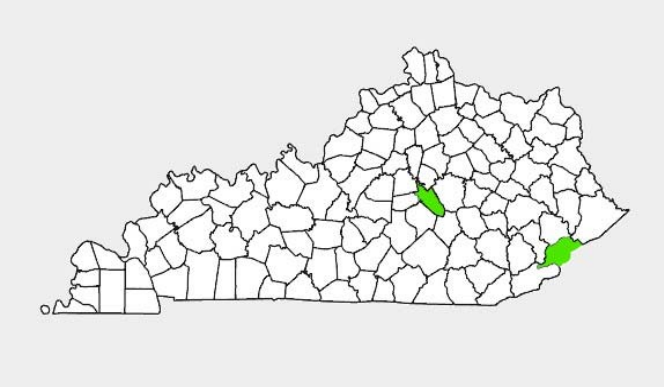

Figure 1. *ArcMap highlighting Garrard and Letcher Counties*.

Acoustic surveys were conducted across three survey points at both LCW and MAY spanning low and high elevations. Methods followed Fulton et al. (2014), with Wildlife Acoustics' Song Meter 2 Bat+ recorders used to record echolocation calls from sunrise to sunset for one week at each survey point. Microphones were attached to acoustic recorders using a 3-meter cable and affixed to a tree. Acoustic recordings were processed using Kaleidoscope Pro v5.1, which ultimately identified bat passes at the species level.

The response variables examined as indicators of bat activity were the total number of passes per detector night, as well as the number of passes either early or late in the night (i.e., before vs. after midnight). Response variables were tested

against the following predictors: elevation (low or high), month (June or July), and location (LCW or MAY). The effect of each predictor was tested with a nonparametric Kruskal-Wallis procedure in RStudio (v1.2.1).

Results

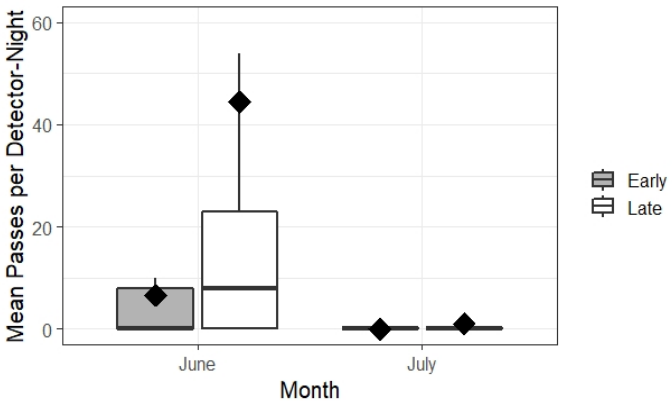

Figure 2. *Temporal variation in bat activity. Diamonds are means of each treatment group.*

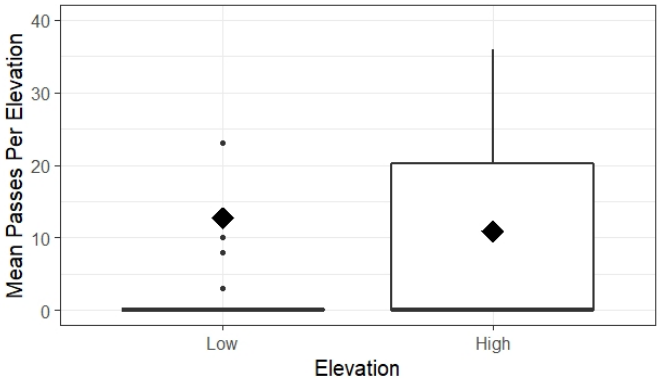

Figure 3. *Bat activity according to elevation. Diamonds are means of each treatment group.*

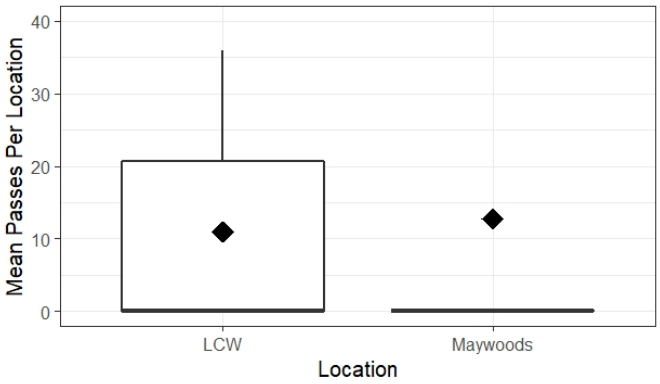

Figure 4. *Bat activity according to site. Diamonds are means of each treatment group*

Surveys across the 6 locations resulted in 49 detector-nights. In total, 137 audio files were collected. Of these, 93 files (68%) were identified as bat calls. A total of 9 species were identified; 92 files could not be attributed to a specific species.

Bat activity varied over both short and long-term time scales (Figure 2). Bat activity was greater in June as opposed to July ($x^2 = 22.2$, df = 1, $p < 0.001$). Additionally, the amount of activity increased during the latter portion of the night ($x^2 = 3.1$, df = 1, $p = 0.07$). These results supported my expectation for seasonal variation but did not follow my expectation for within-night variation.

I also found strong spatial impacts on bat activity in my data set. Bat activity was greater at higher elevations (Figure 3, $x^2 = 12.2$, df = 1, $p < 0.001$). Additionally, greater activity was observed at LCW rather than MAY (Figure 4, $x^2 = 14.1$, df = 1, $p < 0.001$). Notably, as a consequence of outliers in my data, mean estimates of passes remained constant between elevations and locations.

Conclusions

1) Nocturnal bat activity varied within nights, and also was influenced by factors such as habitat, season, and site.

2) Population estimates and activity assessments for bats in the future should be sure to survey the entirety of the night, and span longer season windows as well, in order to capture the ‘full picture’ of when and where bats are foraging at night.

References

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