Habitat use and spatial patterns of Myotis and large-bodied bat species assessed by the narrow-band acoustic method at the Beaverhill Bird Observatory, Final Report

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2017

1. Overview

The Bat Acoustic Monitoring Internship was conducted by Emily Gillmore at the Beaverhill Bird Observatory (BBO) from May to August 2017. Bat populations at the BBO were monitored to determine an association between habitat type and the presence of *Myotis* and EPFU/LANO bat species at the Beaverhill Bird Observatory (BBO) assessed by the active narrow-band acoustic method. Further, I investigated whether there were interspecific differences in spatial habitat use between the taxonomic bat species. These findings were supplemented with a report, *Habitat use and spatial patterns of Myotis and large-bodied bat species assessed by the narrow-band acoustic method at the Beaverhill Bird Observatory* (Gillmore, 2017), to establish a review for completing the internship. This addendum responds to the Beaverhill Bird Observatory's recommendation by providing an additional five weeks of acoustic data collected from August to September 2017 as a continuation of the previous monitoring survey. The purpose of this addendum is to elaborate on any changes to spatial habitat use by MYLU and EPFU/LANO taxonomic bat species that may have occurred after the addition of the 5 week study period. It is relevant not only to data collected previously at the BBO in 2017, but also to any existing scientific and technical information for the dry mixed-wood sub-region of Alberta and future long-term bat monitoring programs at the BBO.

2. Results

Here I provide additional information about the association between habitat type and the presence of MYLU and EPFU/LANO using narrow-band echolocation activity via feeding buzzes and passes as reported in this paper. As described, a test for association chi-square statistical analysis was performed to test for an association in the distribution of the species response to habitat type. Further, a goodness of fit chi-square test using Yate's correction determined if there was a difference in habitat use by MYLU and EPFU/LANO, whether the observed data fit the expected pattern of frequencies for each habitat type.

Over the 12 week study period, both taxonomic bat species occurred at significantly different rates across habitat categories based on echolocation call type (i.e., total call sequences, and buzzes), indicating a dependent relationship between species presence and habitat type (Test for Association Chi-square for combined passes and buzzes: $\chi 2= 21.453$, $p= 2.19506E-05$, $df= 2$, $p<0.05$; Test for Association Chi-square for buzzes: $\chi 2= 6.46$, $p= 0.03955$, $df= 2$, $p<0.05$). Using

the goodness of fit chi-square test using yates' correction factor, I determined that observed MYLU and EPFU/LANO passes were statistically significant in the forest and water habitats; while feeding buzz echolocation activity was only statistically significant in the forest habitat (Test for Association Chi-square for passes: $\chi 2$= 13.81, p= 7.72268E-05, df= 2, $p<0.05$; Test for Association Chi-square for buzzes: $\chi 2$= 10.24, p= 6.74E-4, df= 2, $p<0.05$). This indicates that habitat use for EPFU/LANO and MYLU were unequal and did not fit the expected pattern of frequencies for the forest and water habitats. MYLU buzzes and passes were greatest in the forest habitat; while EPFU/LANO passes were more frequent in the water habitat in comparison to the forest habitat (Figure 1). Overall, echolocation activity formed a bimodal distribution for MYLU, peaking at week four and nine; while activity progressively increased for EPFU/LANO species until week ten (Figure 2).

3. Discussion

This addendum provides supplementary information to the previous report in regards to the association between habitat type and bat presence, spatial activity patterns, and habitat use for bat species at the BBO. An additional five weeks of acoustic sampling had a statistically significant effect on the results and changed the scientific conclusions presented in the report. At the scale of this survey, we can reject the null hypothesis and conclude that *Myotis* and EPFU/LANO exhibit differential activity patterns across the forest and aquatic habitats due to ecomorphology and echolocation call characteristics, which may restrict their use of specific habitats.

The results from this study support the interpretation that under the experimental conditions reported, echolocation call, characterized by passes and buzzes, from taxonomic bat species is strongly associated with habitat type. The interspecific differences in spatial distribution measured by echolocation activity for *Myotis* and EPFU/LANO species across the forest and aquatic habitats was statistically significant (Figure 1). We can conclude that *Myotis* used the forest habitat primarily for foraging based on the high number of feeding buzzes, as well as a potential roosting site and travel corridor characterized by the high volume of passes throughout the 12 week period (Figure 1). This interpretation is corroborated by other evidence which reported that MYFU preferentially forage and roost in forest habitats as clutter-adapted species (Kalcounis & Brigham, 1995). *Myotis* ecomorphology is characterized by low body mass and wing loading, as well as

short, high frequency echolocation which synergistically enhance their maneuverability, navigation and foraging skills within closed-canopy habitats (Kalcounis & Brigham, 1995). We reported high commuting activity via EPFU/LANO species through the aquatic habitat, which provides compelling evidence of its potential use a travel corridor between roosting and foraging sites (Figure 1). Similarly, Brooks & Ford (2005) reported that large bodied bat species are considered habitat generalists, as their ecomorphology and call characteristics suggest these species lack maneuverability and limit them to using open-habitats for foraging. Overall, it is well known in the scientific community that ecomorphology and echolocation call characteristics are often predictive of spatial habitat-use in temperate bat species, as demonstrated in this report (Brooks & Ford, 2005).

We compared these observed frequencies to results obtained from the first seven weeks of the survey described in the report. Within the first seven weeks, we concluded that echolocation call sequence and habitat type were not associated. In addition, *Myotis* and EPFU/LANO responded similarly to each habitat type in terms of spatial distribution and occur independently of one another. It is important to note that there was no statistical evidence supporting the association of spatial habitat use with the grassland habitat over the 12 week period. As previously discussed in the report, bats will commute longer distances to forage on diverse and energy rich prey items, potentially explaining a statistically insignificant use of the grassland habitat (Clare et al., 2014; Ethier and Fahrig, 2011). *Myotis* activity formed a bimodal distribution and peaked at approximately at the fourth and ninth week (Figure 2). EPFU/LANO activity strongly increased from week five until week nine (Figure 2). Extending our study by an additional five weeks allowed us to obtain a larger sample size, which was a strong limiting factor in the report. Further, it controlled for fluctuations in sample size as a result of pregnancy/lactation, fledglings, and invertebrate prey availability. Habitat use and selection of foraging sites are influenced by a variety of factors that ultimately relate back to the optimal foraging theory (Ethier & Fahrig, 2011; Clare et al., 2011).

Overall, the additional five weeks of data collection affected the results and scientific conclusions presented in the paper. Future studies could consider conducting long-term studies to accurately interpret and explain habitat-use patterns associated with habitat type.

Appendix

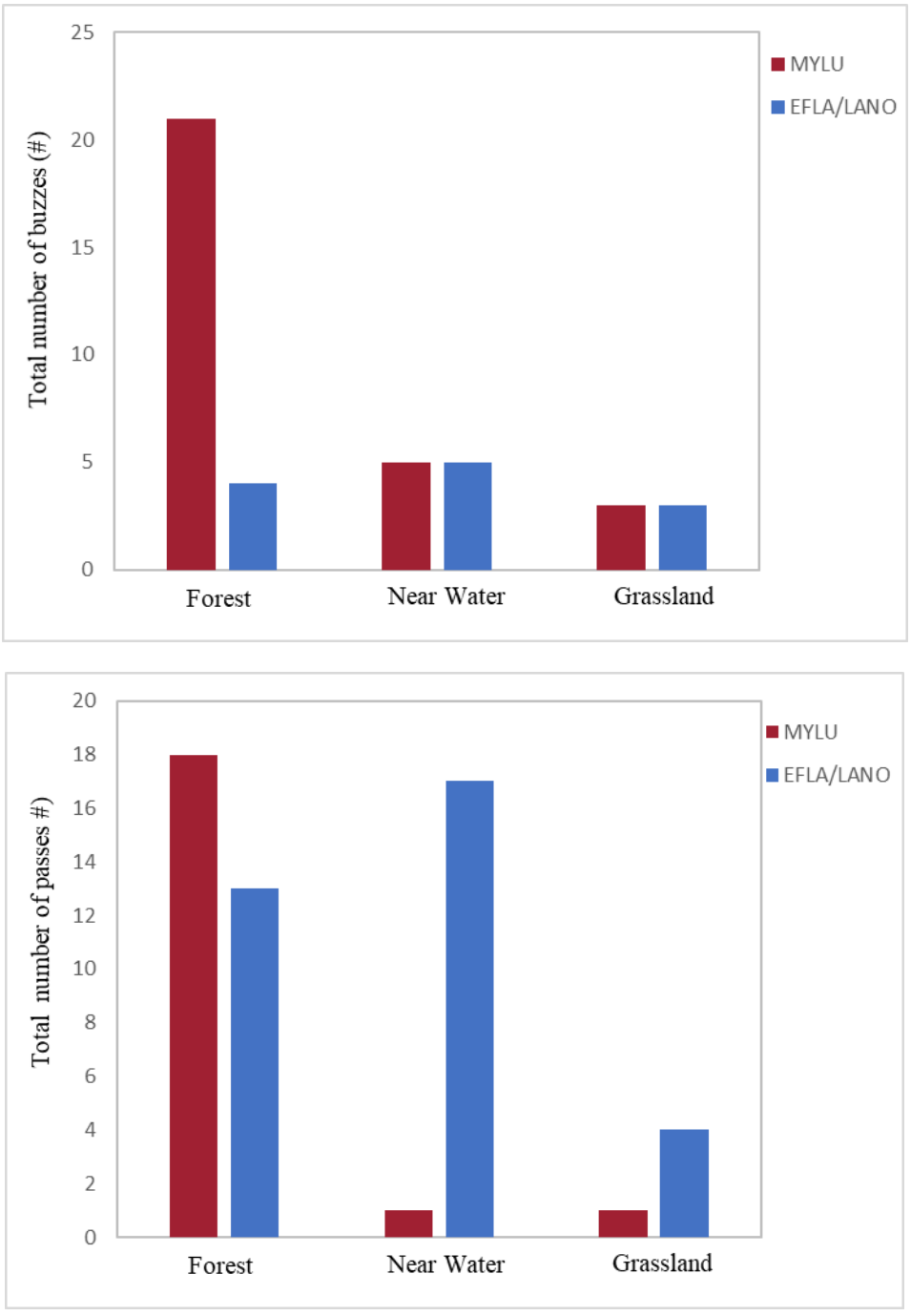

Figure 1. Distribution of buzz (top) and pass (bottom) echolocation call sequences for MYLU (blue) and EFLA/LANO (red) bat taxonomic bat species in the forest, near water, and grassland habitat transects at the Beaverhill Bird Observatory over the 12 week study period.

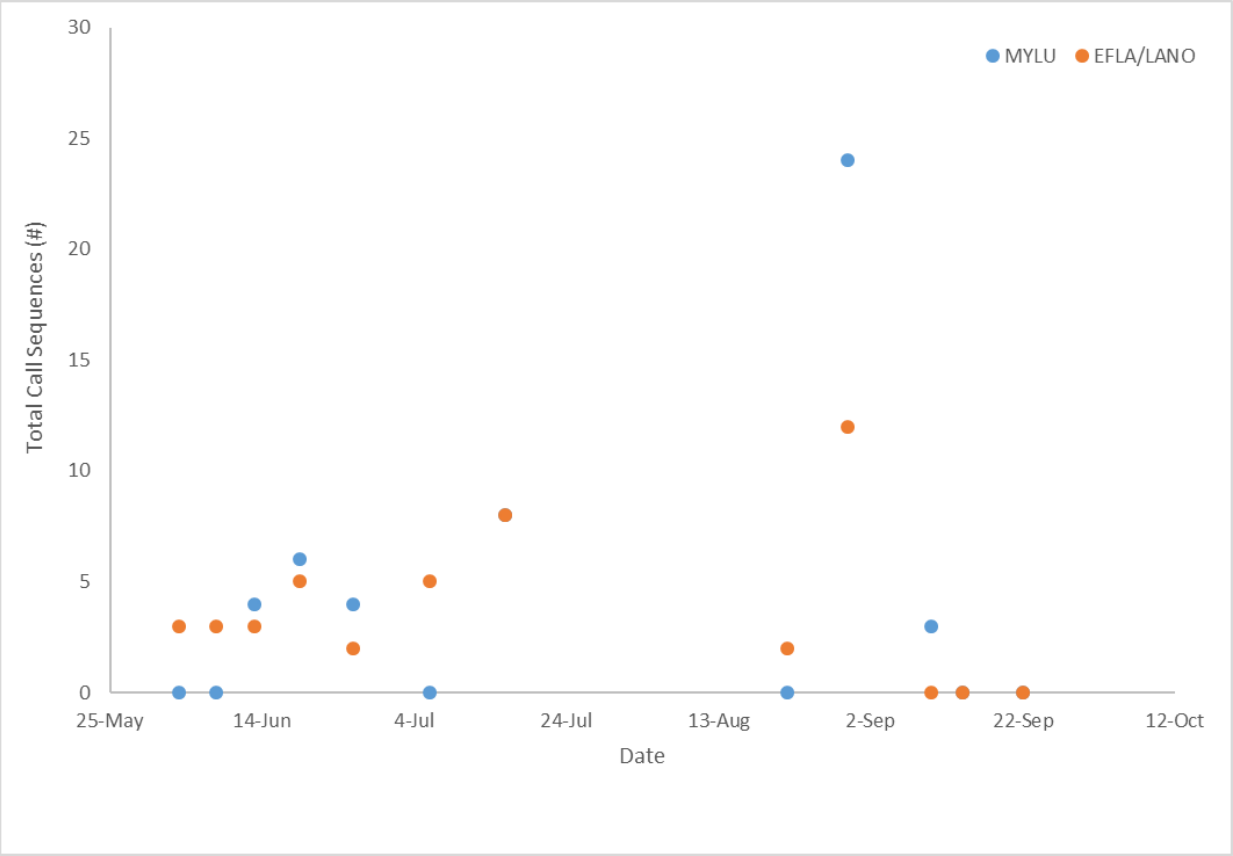

Figure 2. Seasonal trend in echolocation activity (total call sequences) for MYLU (blue) and EFLA/LANO (orange) at recording stations for the forest near water, and grassland habitat transects from June 3, 2017 to September 22, 2017.

References

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