Bat Drinking Site selection at Ridgetop Wetlands in the Daniel Boone National Forest

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Introduction

Bat populations in the Daniel Boone National Forest have been on the decline due to a combination of white-nose syndrome and human interaction. Wetland ecologist Thomas Biebighauser originally implemented constructed wetlands on ridgetops in the Daniel Boone to allow for more drinking sites of game species but began making specialized wetlands to try and stabilize declining bat populations (Fig. 1). These bat wetlands were longer than those previously created to allow easier drinking passes for the differing bat species. Biebighauser's also made it a point to target federally endanger species like the Indiana Bat (*Myotis sodalis*). High abundance of wetlands across the Daniel Boone were to allow for closer drinking sites to maternity roosts.

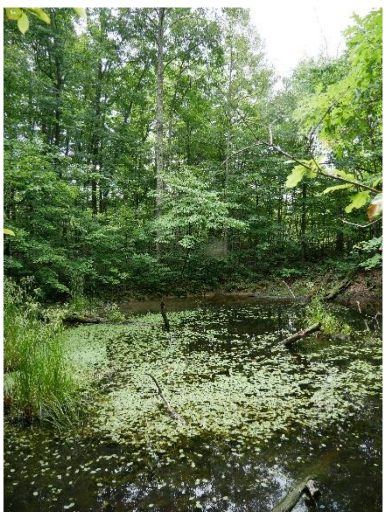

Fig. 1. *Large constructed wetland in the Cumberlands District of the Daniel Boone National Forest*

Few studies have been done to test differences in bat visitation and drinking activity between natural and constructed wetlands. This information is important as the presence of the constructed wetlands has had large ecological effects on amphibian communities in the Daniel Boone. There appears to be too many constructed wetlands present, some of which were built over natural wetlands that were dry for the Summer season, which alters ecological communities that were in that system. Understanding which of these wetlands are being used by bats and what factors effect overall activity can lead to the maintenance of wetlands that most encourage bat activity.

Methods

Thirteen wetlands were selected with eight being natural and five being Beibighauser's constructed design. They differed in size and plant coverage. The Song Meter SM3 acoustic monitor was used with a two-microphone setup in which a high microphone was placed at 3 meters with a painter's poll and a low microphone was placed at 1 meter with a mist netting pole for eight of the sites (Fig. 2). The other five sites were natural wetlands with only a 3m microphone setup. Each monitor ran for seven nights between the hours of 19:30 and 6:30 on their respective nights. To process bat calls, the processor, Kaleidoscope 4.3.1, was used.

Fig. 2. *Two microphone setup with SM3 acoustic monitor*

Two factors were calculated to compare bat calls per night to; Wetland area (m^2) and overall plant coverage. Wetland area data was based on polygon calculations from US Forest Service. Overall plant cover was based on the NDVI (Normalized Difference Vegetation Index) from 2016 1-meter NAIP imagery. It is based on the ratio between pixel reflectance in the red and near infrared, which makes it an index of overall "greenness" of a given wetland. Values range from 0 to 255, with 255 being the highest vegetation.

Data analysis and graphs for comparing the high and low microphone calls in both the natural

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and constructed wetlands were done with paired t-tests through excel. Analysis and graphs of the ecological factors compared to bat calls was completed using correlation tests through Rstudio.

Results

A paired T-test was used to compare high and low microphone registers in both the constructed and natural wetlands separately. The t-test for the natural wetlands yielded a p-value of .002986 with a higher amount of bat calls from the low microphone (Fig. 3). The t-test for the constructed wetlands yielded a p-value of .00014 with a higher amount of bat calls from the high microphone (Fig. 4).

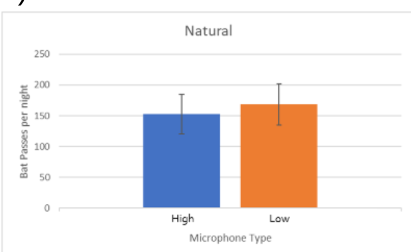

Fig. 3. *Overall high and low microphone registers for the natural wetlands.*

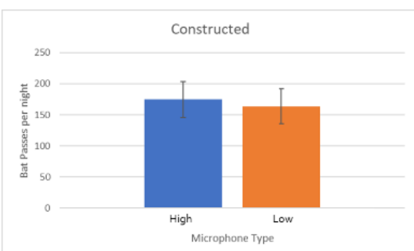

Fig. 4. *Overall high and low microphone registers for the constructed wetlands.*

A correlation test was done through Rstudio to compare the ecological factors of both wetland area (Fig. 5) and plant cover (Fig. 6). They yielded p-values of 0.4516 and 0.26 respectively.

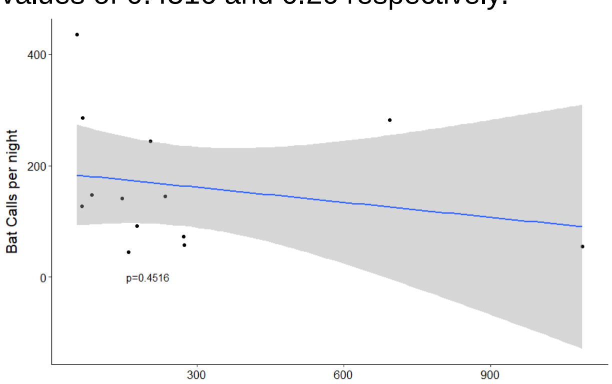

Fig. 5. *Amount of bat calls per night to the area of each wetland.*

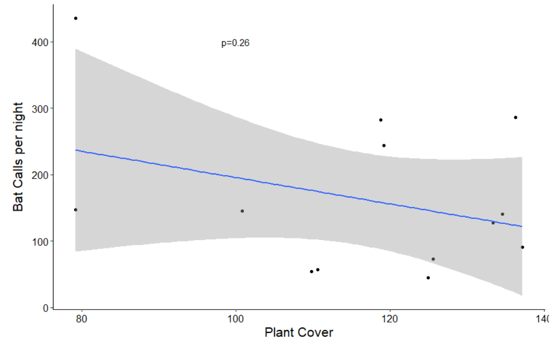

Fig. 6. *Amount of bat calls per night to the plant cover of each wetland.*

Conclusions

Significant data was found between wetland types for bat calls at the differing microphone heights. Though the data shows that there is a significant difference in the microphone registers, there is quite a bit of uncertainty. Any calls that set off both microphones were counted as an individual call for both as it was not clear which microphone the bat would have been closer too, so the two-microphone setup would not be an ideal setup for monitoring of bat drinking frequency.

No significant correlation was found for either wetland area or plant cover. This data may have had some outliers due to the smaller sample size. The largest wetland had some of the fewest calls, so a larger sample size may have followed trends of previous studies displaying positive correlations between wetland size and vegetation present in bat drinking sites (Jackrel et al., 2009). Even with a larger sample size, the bat monitors would not be able to determine whether the bats present are drinking or foraging, so bat calls may still not follow expected trends.

References

Jackrel, S.L., and R.S. Matlack. 2009. Influence of surface area, water level and adjacent vegetation on bat use of artificial water sources. The American Midland Naturalist. 164(1):74-79.

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