

Acoustic Sampling of Arkansas Bat Species Richness Across Different Seasons and Habitats

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Introduction

- Arkansas is home to 16 insectivorous bat species
- Bats provide crucial ecosystem and economic services
 - Keystone species
 - Pest control and decreased use of fertilizers for agriculture
 - Help limit the spread of insect transmitted diseases
 - Guano as a natural fertilizer and used in cosmetics
- Several species in Arkansas are listed as threatened or endangered by the USFWS



Goal: To explore which factors influence bat species richness and presence between different seasons and locations in Arkansas

Study Objectives

- Objective I:** Explore how season impacts species richness
- Objective II:** Explore how different locations impact species richness
- Objective III:** Explore what other variables impact species richness
- Objective IV:** Explore if any of the observed variables could be related to number of calls

Study Areas in Russellville, AR

Site I: Field by Hull Student Union and M Street, Arkansas Tech University

- Little canopy cover and open
- Well-lit by streetlamps at night
- People and car activity

Site II: Washburn Park

- Canopy cover
- Unlit at night
- Parking lot unoccupied with little activity



Methods

Non-Invasive Acoustic Measurements

- Echo Meter Touch 2 Pro from Wildlife Acoustics
- Connects to your phone with Echo Meter Touch Bat Detector App
- Records and identifies calls to species-level from frequency and pattern
 - Can misidentify calls and cannot distinguish unique individuals
 - Best suited to determine the presence or absence of species



Acoustic Data Collection

- Acoustic data collection during spring (April-May 2022) and fall (August-September 2022)
- Data collected 6 nights in the spring and fall during a two-week period at each site
- 24 hours of acoustic data between both sites and seasons
- Other variables recorded included moon phase, temperature, and windspeed

Statistical Analysis

- Two generalized linear models for regression
 - Species richness or number of bat calls as response variable
 - All other variables measured as explanatory
- Data analyzed using R Studio version 4.2.1



Results

- 1,050 bat calls recorded from 11 different species
- Greater species richness in the spring (10 spp.) compared to the fall (9 spp.)

Study Site Richness

Site	Spring	Fall
ATU Campus	8	7
Washburn	10	6

Species Detected

- Big Brown Bat
- Eastern Red Bat
- Evening Bat
- Grey Bat*
- Hoary Bat
- Little Brown Bat
- Mexican Free-tailed Bat
- Ozark Big-eared Bat*
- Seminole Bat
- Silver-haired Bat
- Tri-colored Bat

Species Richness Results

Objective I: Species richness was significantly higher in the spring compared to the fall ($\beta = 3.93 \pm 1.71, P = 0.035$; Fig. 1)

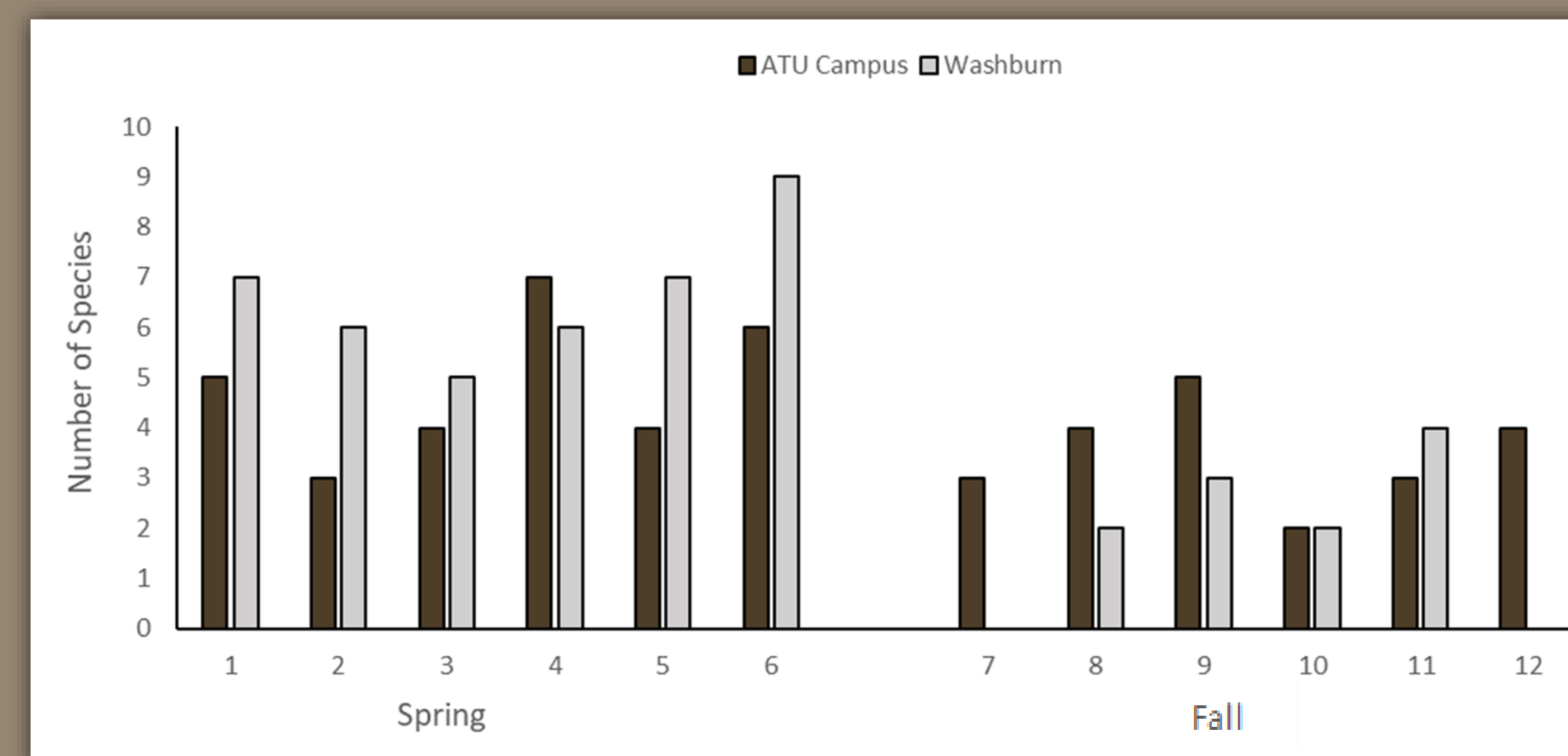


Fig. 1. Species richness compared between the ATU Campus and Washburn study sites during the twelve nights of surveying across the spring and fall season

Objective II: Site did not have a significant impact on species richness

Objective III: No other measured variable (moon phase, temperature, or windspeed) had a significant impact on species richness

Call Number Results

Objective IV: Explore if any of the observed variables could be related to number of calls

- Season:** Significantly more calls detected during the spring compared to the fall ($\beta = 28.66 \pm 11.38, P = 0.014$; Fig. 2)

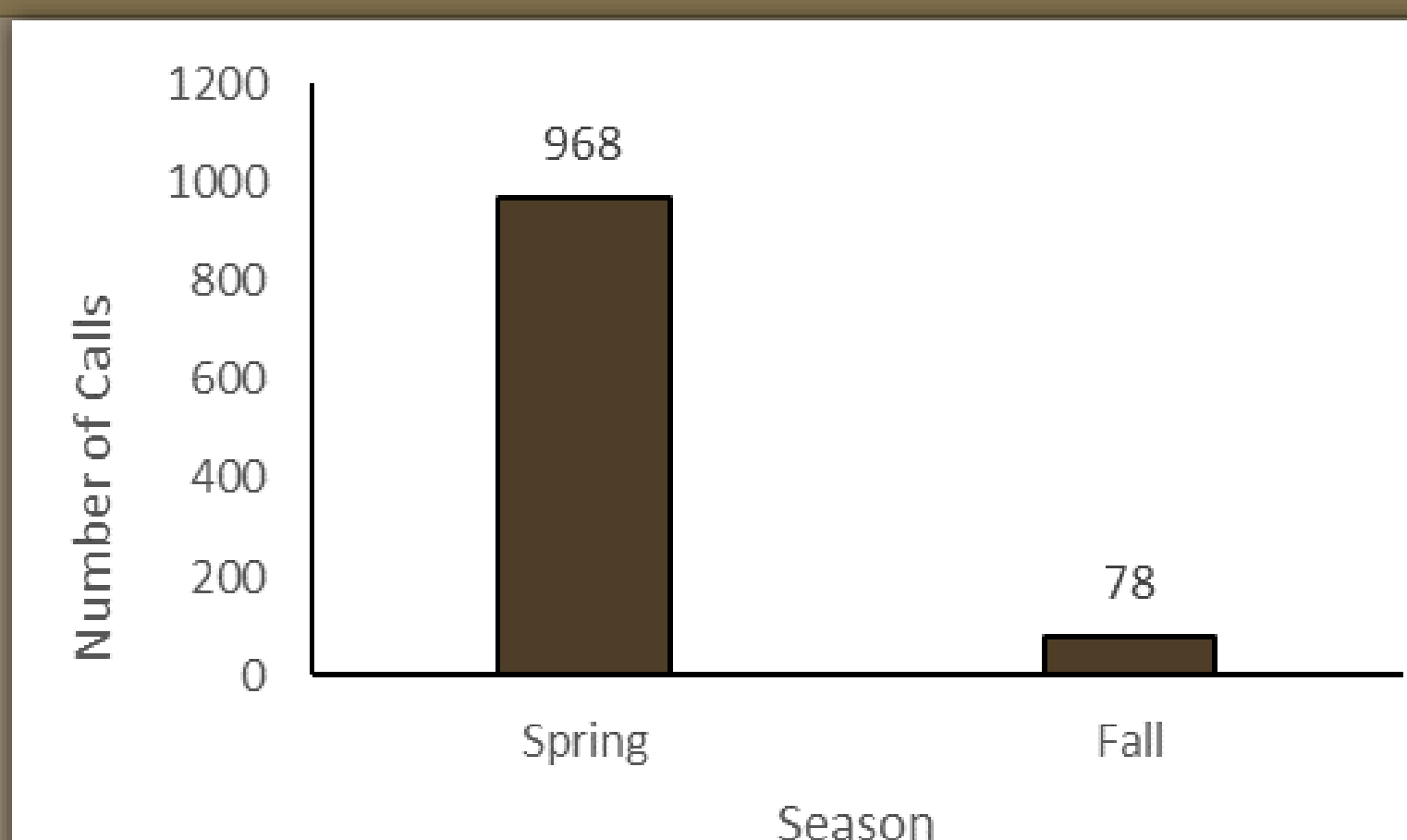


Fig. 2. The total number of bat calls recorded from all species sampled at both sites during the spring and fall season

- Site:** Significantly fewer calls detected at Washburn compared to the ATU campus ($\beta = -13.03 \pm 5.14, P = 0.013$; Fig. 3.)

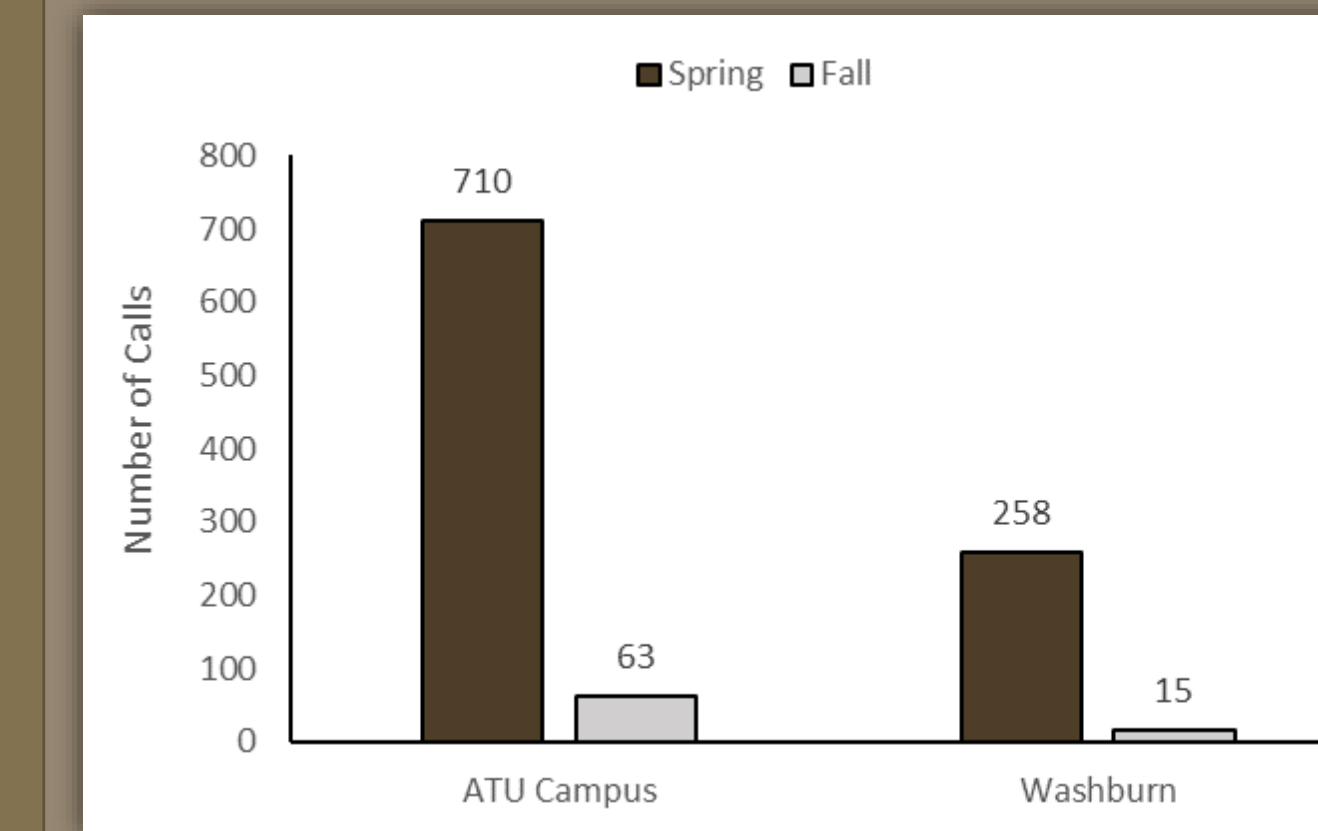


Fig. 3. The total number of bat calls recorded from all species sampled across the ATU Campus and Washburn study sites in the spring and fall season



- Moon Phase:** Significantly more calls detected during the waxing crescent phase compared to the waning crescent ($\beta = 17.10 \pm 6.54, P = 0.010$; Fig. 4.)
- T-test Results:** Waxing crescent had a significant positive impact on calls compared to the waxing gibbous moon phase ($t_{43} = 2.56; P = 0.014$)

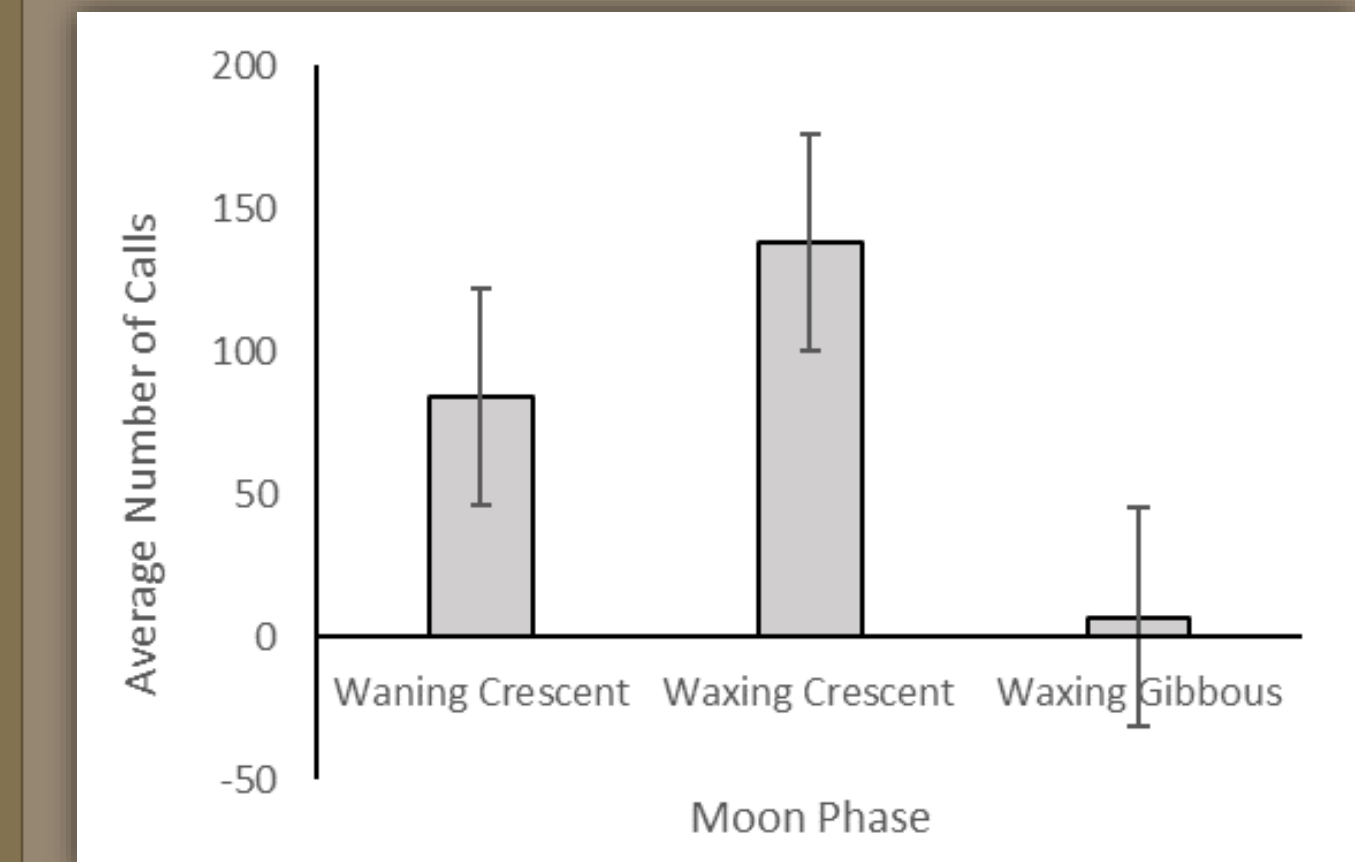


Fig. 4. Average number of bat calls (\pm SE) recorded during the three moon phases, across the ATU Campus and Washburn study sites in the spring and fall season

Discussion

Species Richness, Number of Bat Calls, and Season

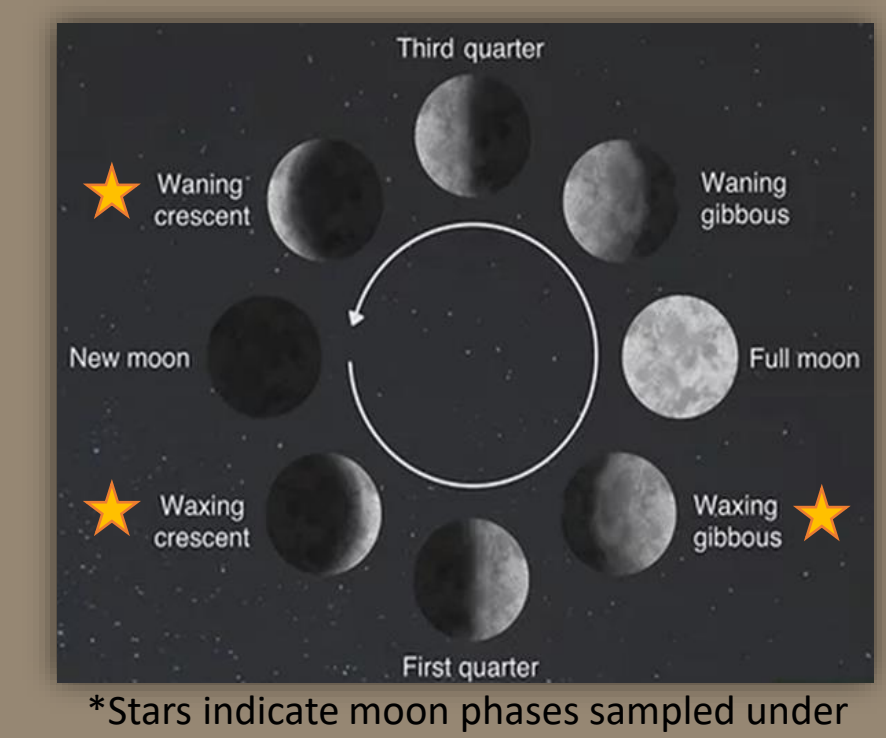
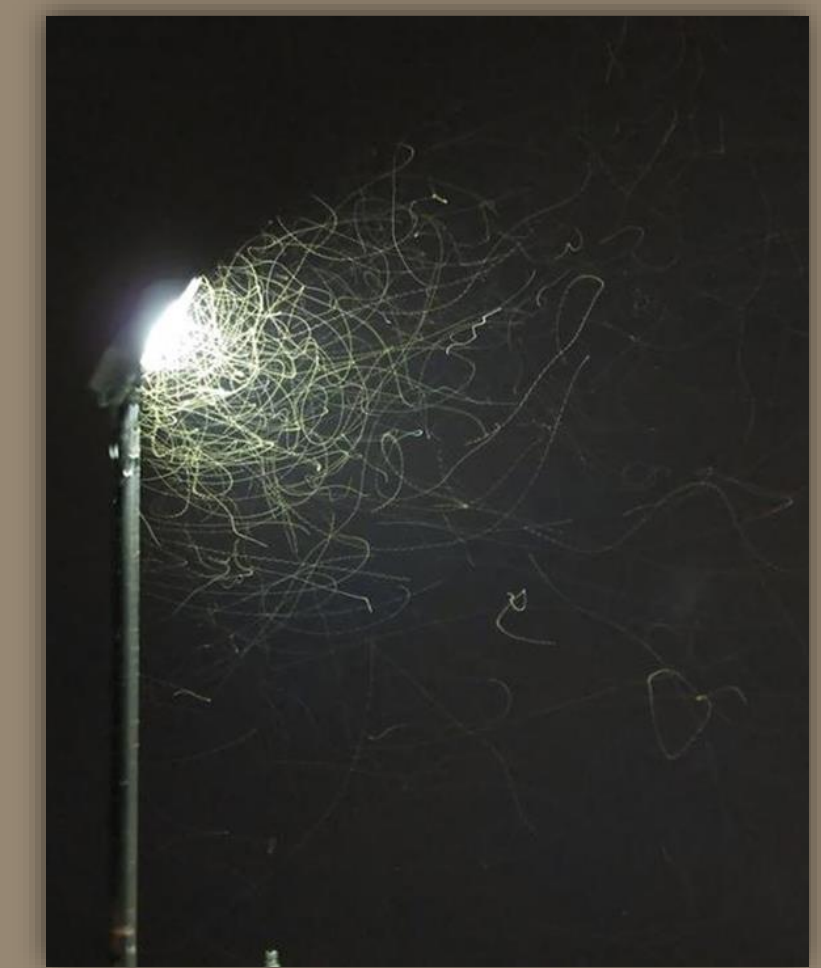
- All 16 Arkansas bat species insectivorous
- Abundant food resources in the spring
- Site on the Number of Bat Calls*
 - Artificial light attracted insects that drew generalists to exploit the open area
 - 71.8% of calls from Mexican Free-tailed and Seminole Bat

Moon Phase on the Number of Bat Calls

- Decrease activity with greater light intensity to avoid predation

Presence of Endangered Species

- Grey Bat and Ozark Big-eared Bat detected multiple times at Washburn in the fall



Conclusion

- The conservation of these valuable species is necessary to ensure healthy populations and continued ecosystem benefits
- We can accomplish this by taking inventory of our bat species and explore other variables that impact their abundance
- Future variables to explore include insect abundance, human nighttime activity, impact of artificial light sources (ALAN), vegetation density, and many others
- By exploring crucial factors like these, we can better manage and protect natural areas that reflect beneficial habitat variables for bats and encourage future population growth

References

- International Union for Conservation of Nature (IUCN). 2022. The IUCN red list of threatened species. Version 2022-1. <https://www.iucnredlist.org>. Accessed 22 Nov 2022.
- McAllister, Chris, T. "Bats." Encyclopedia of Arkansas, 11 Feb. 2022, <https://encyclopediaofarkansas.net/entries/bats-5819/>.
- Perry, R.W., P. R. Moore, K. M. Armstrong, and L.W. Robbins. 2018. Bats of Arkansas. ISU Center for Bat Research, Outreach, and Conservation. Terre Haute, Indiana, USA. Photo credits to Merlin Tuttle