A Comparison of Bat Acoustic Monitoring Survey Methods within an Ohio River Riparian Forest



Boone County Conservation District, Kentucky



Abstract

Bats fulfill several integral purposes within an ecosystem including insect control, pollination, seed dispersal, and forest health indication. Unfortunately bat populations are threatened by climate change, habitat loss, dangerous pesticides, human disturbance, and wind turbines. There is a specific need to provide protected habitats. To do this, we need to understand where bat colonies are currently located and what species make up these colonies. The following study was conducted in June and July 2023 to determine what species of bats are present in three riparian forest sites in Boone and Campbell County, Kentucky. After week long stationary surveys and mobile acoustic monitoring of echolocation calls at five sites, a total of eleven species were detected : Big Brown Bat (*Eptesicus fuscus*), Eastern Red Bat (Lasiurus borealis), Evening Bat (Nycticeius humeralis), Hoary Bat (Lasiurus cinereus), Northern Long-eared Bat (Myotis septentrionalis), Silverhaired Bat (Lasionycteris noctivagans), Tricolored Bat (Perimyotis subflavus), Indiana Bat (*M. sodalis*), Small-footed Bat (*M. leibii*), Little Brown Bat (*M. lucifugus*), and Southeastern Bat (*M. austroriparius*).

Introduction

Two ecosystems were evaluated as part of this study: riparian forest and inland habitat. A riparian forest buffer includes an area near a wetland that can provide conservation benefits especially for wildlife habitat (USDAgov 2014). The inland habitats include areas defined by glacial deposits and old growth forest.

The purpose of this study includes detecting the different species of bats present among the selected sites with stationary and mobile acoustic detectors. This is part of an ongoing project between the Boone County Conservation District and partners to learn more about habitat biodiversity and review the overall forest health in the county and nearby areas.

The **Perin Property** is 332 acres located on the Ohio River across from the protected Oxbow area in Lawrenceburg, Indiana. Second Creek runs through the property as an additional and valuable water source. Tree coverage on the property is mainly thick throughout the property with only a few open canopy spaces. St. Anne Woods and Wetlands, is 146 acres located in Eastern Campbell County running along the Ohio River and Four Mile Creek. It consists of open and closed canopy woods with old growth forest. The **Thomas More Biology Field Station** is approximately 25 acres located in the Ohio River watershed in California, KY. Nearby streetlights collect insects as a food source. The forest consists of many snags and old growth forest. Two inland sites were selected to survey for comparison against the riparian sites. The **Boone Cliffs State Nature Preserve** is 74 acres of forest with cliffs formed from glacial deposits. The water source for this location is a tributary to Middle Creek. The **Dinsmore Woods State Nature Preserve** includes approximately 107 acres of old growth forest (never commercially logged), glacial deposits, and rich soil. This is mainly a maple-oak-ash forest. It is also home to running buffalo clover (a previously endangered species).

Acknowledgements

I would like to thank the following for supporting my research and inspiring my continued love of bats:

- Dr. Durtsche for access and support on the St. Anne Woods and Wetlands property
- Dr. Lorentz and Molly Williams for access and support at the Thomas More Biology Field Station property
- Christy Noll and the Boone Conservancy for access and support on the **Perin Property**
- Liz Fet at SD1 for data support and mentoring
- The staff at Boone County Parks Natural Areas
- A special note to Sarah Grote for teaching me about ecology • Jack Phillips for GIS map creation
- The entire staff at Boone County Conservation District for sponsorship, encouragement, mentoring, and advice
- A special note to Jasper Stevenson for teaching me about geology
- To Kamryn Lee for partnership, support, and friendship

The Thomas More Biology Field Station Interns for helping me collect data and friendship



Lillie Daniel and Susan Brown Thomas More University, Boone County Conservation District Kentucky

Methods

The same experimental process was followed at each of the three determined sites.

Stationary Acoustic Monitoring

After entering each location, researchers followed trails to an open area (forest canopy opening) with a nearby water source and snags.

- Anabat Swift was cable locked to a tree and left for a maximum period of one week.
- Anabat Swift was deployed to the Northern Kentucky University's Research and Education Field Station from June 21st -June 27th ,2023; the Thomas More Biology ,2023; Field Station from June 27th -July 5th ,2023; and Perin from July 6th -13th ,2023. Mobile Acoustic Monitoring

The Walkabout is a hand-held device used to walk around the selected area and collect live data.

The Anabat Walkabout along with 3 Echo Touch Meters were used at St. Anne's Woods and Wetlands on June 27th from 8:30 pm-10 pm.

An Echo Touch Meter was used at the Thomas More Biology Field Station on July 12th from 8:30pm-10pm.

Vehicle Acoustic Monitoring

The Anabat acoustic device with car mount was attached to a Boone County Conservation District vehicle. Researchers followed a pre-planned driving route from 9:18pm to 10:51pm on July 18th

All data collected was run through the Kaleidoscope software, an acoustic analysis program, to determine the species. For additional verification, Anabat Insight was used.



Figure 1: Device Placement



Figure 3: Anabat Walkabout



Figure 2: Vehicle Mount



Figure 4: Anabat Swift



Figure 5: Spectrograph Representation of Big Brown Bat produced by Kaleidoscope Software



Results

Data threshold for results was set at minimum five high quality pulses and at least two call files to note a species. After the specified research time period with both stationary and mobile acoustic monitoring of echolocation calls, a total of eleven species were indicated across the riparian and inland sites.

The Big Brown Bat, Evening Bat, Hoary Bat, and Tricolored Bat were the four species indicated at each of the survey locations. The greatest species diversity was found at the Inland locations of Boone Cliffs and Dinsmore.

Table 1: Bat Species by Location	RIPARIAN			INLAND	
		St. Anne Woods	Thomas More		
Bat Species	Perin	and Wetlands	Biology Field	Boone Cliffs	Dinsmore
Big Brown Bat (Eptesicus fuscus)	х	Х	х	х	х
Eastern Red Bat (Lasiurus borealis)	Х	Х		Х	Х
Evening Bat (Nycticeius humeralis)	х	Х	х	Х	Х
Hoary Bat (Lasiurus cinereus)	х	Х	х	Х	Х
Northern Long-eared Bat (Myotis septentrionalis)			х	х	х
Silver-haired Bat (Lasionycteris noctivagans)	х	Х	х	Х	Х
Tricolored Bat (Perimyotis subflavus)	X	Х	х	Х	Х
Southeastern Bat (Myotis austroriparius)				Х	
Indiana Bat (Myotis sodalis)*			х	х	х
Little Brown Bat (Myotis lucifugus)				Х	х
Small-footed Bat (Myotis leibii)				Х	
*currently listed as endangered					

Discussion

During the months of June and July 2023, stationary, mobile, and vehicle acoustic monitoring was conducted to identify the bat species present in three riparian areas. Additionally, two inland areas were monitored for habitat comparison. Data was analyzed through the Kaleidoscope software identifying a total of eleven species across the surveyed areas. Based on the standard Indiana Bat Survey protocol as guidance, the minimum data threshold for species presence selected was five high quality pulses and at least two call files.

The inland sites provided additional habitat characteristics that are attractive to a variety of species. The geology of the area provides greater diversity due to the Cincinnati Arch. The Northern Kentucky area consists of primarily Ordovician bedrock. The State Nature Reserve, Boone Cliffs, is notable in Boone County for its Quaternary glacial conglomerates. The cliffs were formed 250-500,000 years ago from the Pre-Illinoian glacier creating cave-like structures and protected holes for bats to roost in (Stevenson 2023). Inland characteristics attractive to the more cave dwelling species include the glacial deposits, limestone, sinkholes, rock caves. Inland sites contained 11 species as compared to 6 or 7 at the riparian sites.

Throughout this research I picked up Virginia Big-eared bat (Corynorhinus townsendii virginianus) calls at both Dinsmore and Perin. This would have been an exciting discovery as their home range is restricted to an eleven-county area in Eastern, KY from Rowan down to Pulaski County. Although bats do move around and can always surprise us, these were false calls. Virginia Big-Eared bats are extremely habitat specific and only migrate short distances to overwintering sites. Running these calls through a different software, Anabat Insight, showed two important factors for differentiating the calls. The spectrograms are too intense of a call for a "whispering bat". The second key point is the shape of the call. Big Brown bats have call shapes in the shape of "J" while Big-eared bats have small convex humps. With this software I was also able to see that within one call I had three different species, for example, Big brown – Hoary – Tri-colored. These could have been social calls or search face calls.

Literature Cited

Bat Conservation International / Ending Bat Extinctions Worldwide. Bat Conservation International. https://www.batcon.org/. Accessed July 3, 2023.

Fraser et al., eds. 2020. Bat Echolocation Research: A handbook for planning and conducting acoustic studies. Second Edition. Bat Conservation International. Austin, Texas, USA.

Frick WF, Kingston T, Flanders J. 2019. A review of the major threats and challenges to global bat conservation. Annals of the New York Academy of Sciences. 1469(1): 1-21. doi:10.1111/nyas.14045.

Riparian Forest Buffers. 2014. Usdagov. https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php. Accessed July 3, 2023.

Stevenson J. Boone County, KY Geology Summary. 2023.

Tuneu-Corral C, Puig-Montserrat X, Flaquer C, Mas M, Budinski I, López-Baucells A. 2020. Ecological indices in long-term acoustic bat surveys for assessing and monitoring bats' responses to climatic and land-cover changes. Ecological Indicators. 110:105849. doi:https://doi.org/10.1016/j.ecolind.2019.105849.

Welcome - Kentucky Department of Fish & Wildlife. fwkygov. https://fw.ky.gov/Pages/default.aspx. Accessed July 3, 2023.

For Further Information

Lillie Daniel Susan Brown

lddani14@thomasmore.edu susanbrown@bccdky.org





THOMAS MORE

UNIVERSITY

Data Analysis







Photo: Hoary Bat, Kentucky Fish and Wildlife