New Jersey's Mobile Acoustic Bat Survey, 2025

A project of the Conserve Wildlife Foundation of New Jersey
and NJDEP Fish and Wildlife's Endangered & Nongame Species Program

Report prepared by Leah Wells and MacKenzie Hall, November 2025

NEW JERSEY DEP
Fish and Wildlife

CONSERVE WILDLIFE
FOUNDATION OF NEW JERSEY

Introduction

Acoustic bat surveys are an efficient, non-invasive and relatively simple method to monitor bat communities and population trends over time, owing to a key bat behavior: echolocation. As bats fly through the nighttime landscape, they give off rapid, high-frequency pulses of sound (or "calls"). Their calls bounce off nearby objects and return to the bats' ears as echoes, providing detailed feedback about the size, shape, distance, and trajectory of those objects around them. Coupled with their incredible maneuverability in flight, echolocation allows bats to navigate through the forest, avoid obstacles, swoop down for a drink of water, and hunt for insects in the total darkness of night.

Bat echolocation calls are mostly ultrasonic – meaning they're above the 20 kHz upper range of human hearing. So, we can't hear them, but an acoustic detector can. In addition to "hearing" bat echolocation calls overhead, acoustic detectors allow us to record these calls as .wav files, then download them to a computer and view them as spectrograms to identify the different bat species encountered based on their unique call characteristics. As far as bat surveillance goes, acoustic monitoring offers a reasonably quick and easy way to collect a lot of information, all without having to catch, hold, or even see a single animal.

New Jersey's Mobile Acoustic Bat Survey enlists volunteers to monitor bat activity using a vehicle-mounted acoustic detector/microphone along prescribed driving transects during the summer. Each driving transect covers its own 10 km x 10 km (100 km2) grid cell, following the methodology of the North American Bat Monitoring Program (NABat). In 2017, New Jersey DEP Fish and Wildlife "adopted" twelve grid cells (Fig. 1), by random selection, thus kicking off our role in the NABat network. Within each grid cell, stationary acoustic monitoring (at point locations) is done concurrently with the mobile transects, i.e., both components are done within the same approx. 10-day window of time in a given year. Repeating these surveys at the same locations in successive years gives us an idea of population trends for the nine bat species in our state (Table 1). The acoustic survey data we collect are uploaded to NABat, contributing to more robust, continent-wide analyses of bat species distributions and trends.

Methods

Each volunteer/team of the Mobile Acoustic Bat Survey is assigned a driving transect roughly 15-25 miles long, to survey with a Pettersson D500x "Special Edition" bat detector (which includes a headphone jack so surveyors can hear bat calls in real time). Transects pass through a variety of habitats and land cover types where bats are likely to be active, and follow mostly low-traffic roadways since they must be driven slowly (12-15 mph). Surveys along each route are repeated twice within a designated 10-day window of time between June 1-July 30. Ideally, the same routes are monitored within the same time window each year using the same detector for consistency.

Two mobile acoustic kits are deployed concurrently for this project – one in the northern half of NJ and one in the southern half. Once one volunteer/team completes their two transect runs, they coordinate with the next volunteer/team on the schedule to transfer the equipment.

Our complete mobile acoustic bat survey instructions packet can be found on the Conserve Wildlife Foundation's website.

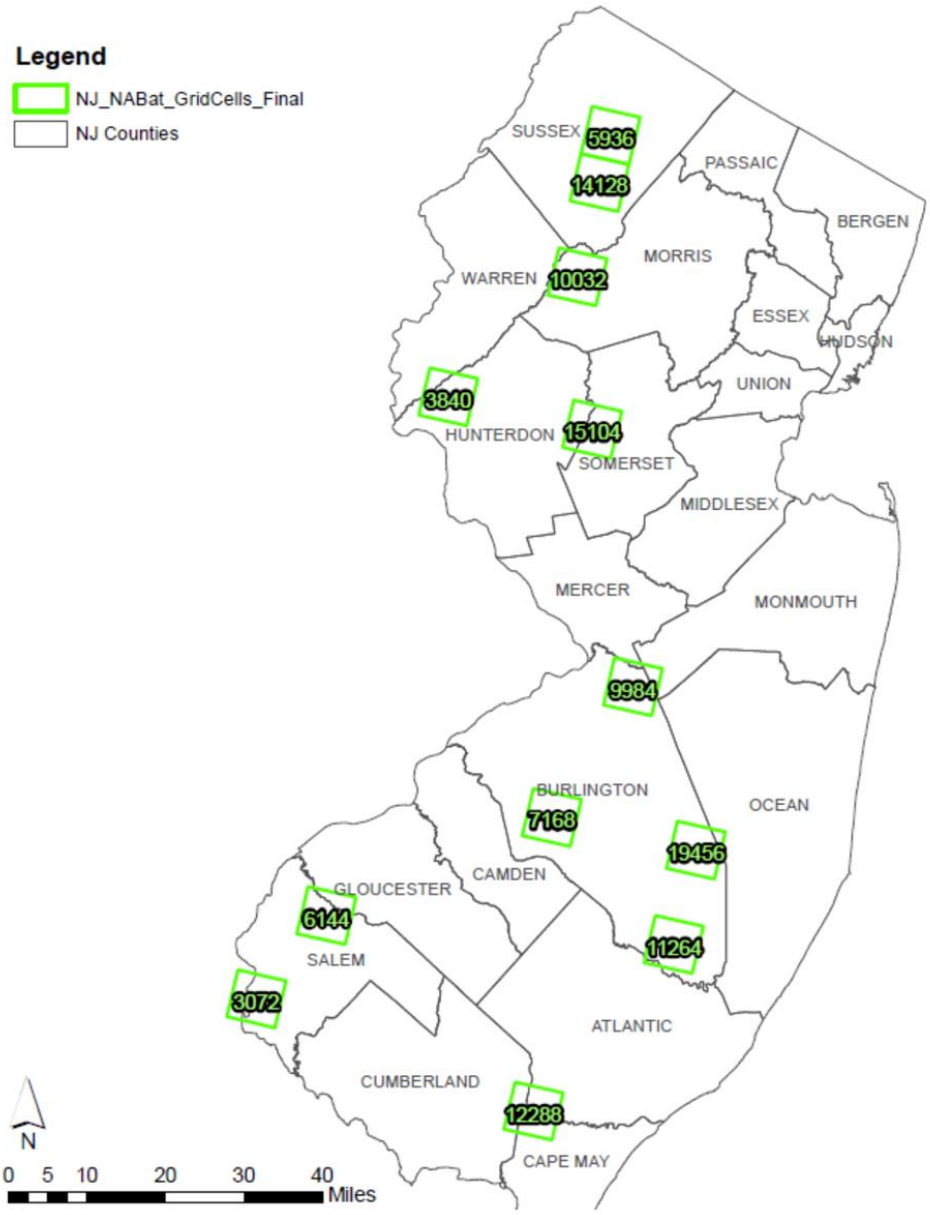


Figure 1. Map showing New Jersey's long-term acoustic bat monitoring grid cells, which are part of the North American Bat Monitoring Program (NABat). Each grid cell contains one prescribed mobile transect and two stationary monitoring points.

Surveys begin 45 minutes after sundown – targeting peak bat activity – on rain-free evenings with low wind. The acoustic detector in the vehicle is programmed to record bat calls to a compact flash data card, while its microphone (connected to the unit by an extension cable) is affixed to a forward-facing window mount. A Garmin GPS unit tracks the route driven and allows us to geo-reference each bat encountered during the survey.

After all surveys are completed and equipment is returned, the project leaders from Conserve Wildlife Foundation and NJ Fish and Wildlife work together to download, organize and process the resulting data. The software program SonoBat (v. 4.4.5) is used to filter out "non-bat" recordings like insects, traffic noise, electrical buzzing, etc., and to attribute and auto-classify all bat call recordings to the species level, when possible. The bat call files are then manually reviewed by our team for correctness, and to categorize unidentifiable bat calls into either a "high frequency" or "low frequency" echolocation frequency group (Table 1).

Table 1. List of all bat species found in New Jersey, with their State and Federal conservation statuses and echolocation call frequency category indicated. Low frequency species' calls generally have a minimum frequency (low point of the call) of ≤30 kHz, while high frequency species' calls generally have a minimum frequency of >30 kHz. Note: Most of the high frequency species are the rare *Myotis* and *Perimyotis* bats affected by White-nose Syndrome but also include the more common Eastern red bat as well as the evening bat, which may occur incidentally in NJ at this time. Eastern red and evening bat calls are most similar to those of *Myotis* bats when flying through high vegetative clutter, actively foraging for insects, or when only a partial call sequence is recorded.

Common Name	Scientific Name	State Status`	Federal Status	Echolocation Frequency
Big brown bat	*Eptesicus fuscus*	Special Concern	*n/a*	Low
Silver-haired bat	*Lasionycteris noctivagans*	Special Concern	*n/a*	
Northern hoary bat	*Lasiurus cinereus*	Special Concern	*n/a*	
Eastern red bat	*Lasiurus borealis*	Special Concern	*n/a*	High
Evening bat	*Nycticeius humeralis*	Incidental	*n/a*	
Tricolored bat	*Perimyotis subflavus*	Endangered	Proposed Endangered	
Eastern small-footed bat	*Myotis leibii*	Endangered	*n/a*	
Northern long-eared bat	*Myotis septentrionalis*	Endangered	Endangered	
Indiana bat	*Myotis sodalis*	Endangered	Endangered	
Little brown bat	*Myotis lucifugus*	Endangered	Under Review	

Because echolocation calls can overlap significantly between certain bat species and can even vary *within* a species depending on a bat's behavior and the environment they are flying through, species identifications are never 100% accurate. Still, they give us a pretty reliable measure of species diversity and abundance and trends over time.

Results

Our team of volunteers and project staff conducted mobile acoustic surveys across 11 of the 12 transect routes in 2025. Eight routes were completed twice, three routes were completed once, and one route was not completed, resulting in an overall project completion rate of 79%. Once surveys were finished, the data were processed and analyzed using SonoBat 4.4.5, then manually vetted to identify or categorize the bat species encountered. The 2025 Mobile Acoustic surveys collected a total of 1,324 bat recordings.

The most common bats detected across the surveys were the big brown bat (*Eptesicus fuscus*; 39% of recordings), Eastern red bat (*Lasiurus borealis*; 28.5%), hoary bat (*Lasiurus cinereus*; 7.5%), and silver-haired bat (*Lasionycteris noctivagans*; 7.2%).

Our state's rarer bat species were detected at very low numbers. Bats in the Myotis/Hi Frequency group made up 3.2% of recordings. The surveys did not turn up any Indiana bats (*Myotis sodalis*) or Northern long-eared bats (*Myotis septentrionalis*) – the two federally endangered bat species found in NJ. One confirmed tricolored bat (*Perimyotis subflavus*) and one confirmed little brown bat (*Myotis lucifugus*) were recorded in southern NJ. These cave-hibernating bats, belonging to the *Myotis* and *Perimyotis* genus, have been hit hard by White-nose Syndrome over the past 16 years, with populations reduced by as much as 95-98% since 2009.

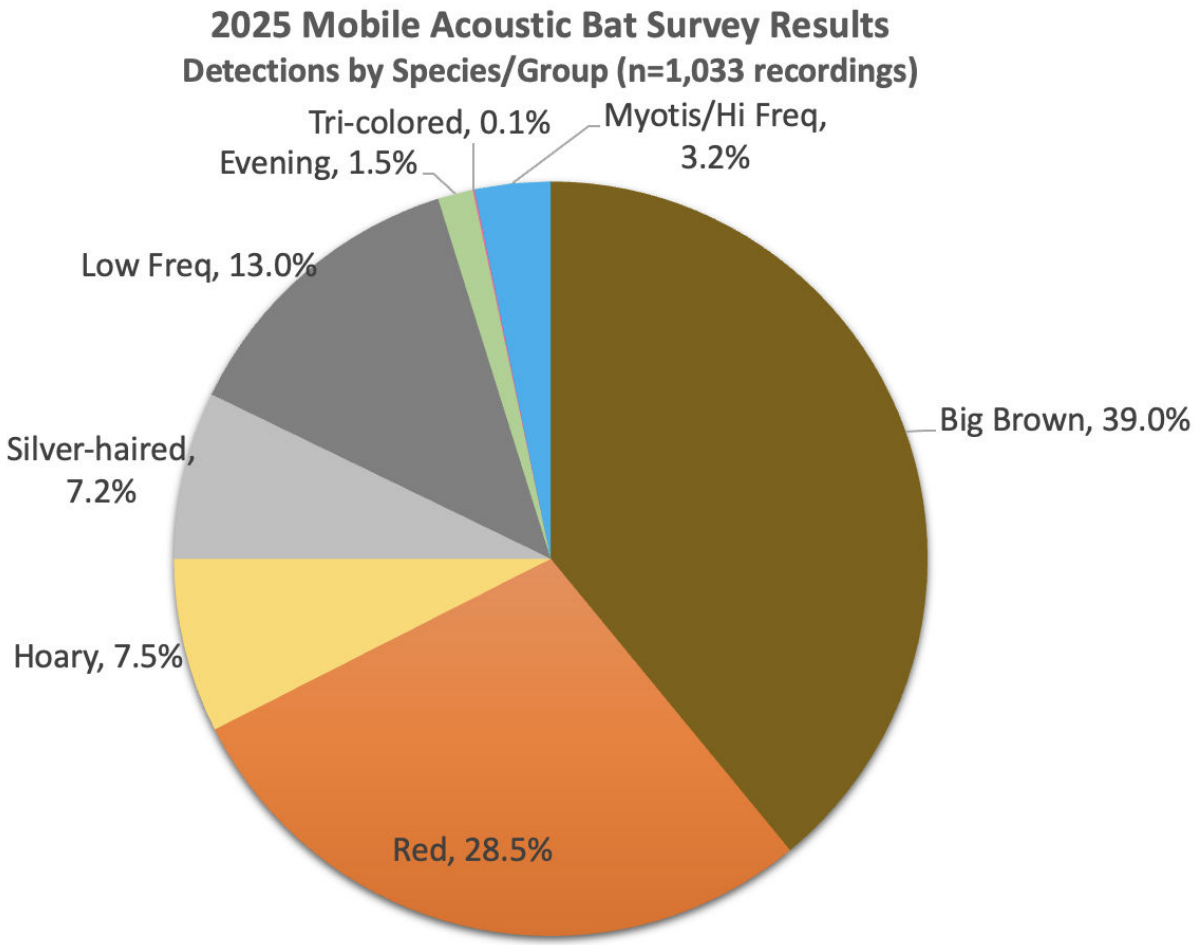


Figure 2. Shows the proportion of bat recordings by species. Pie chart combines all Myotis & unidentified HiFreq (~≥30 kHz) species since they're hard to distinguish.

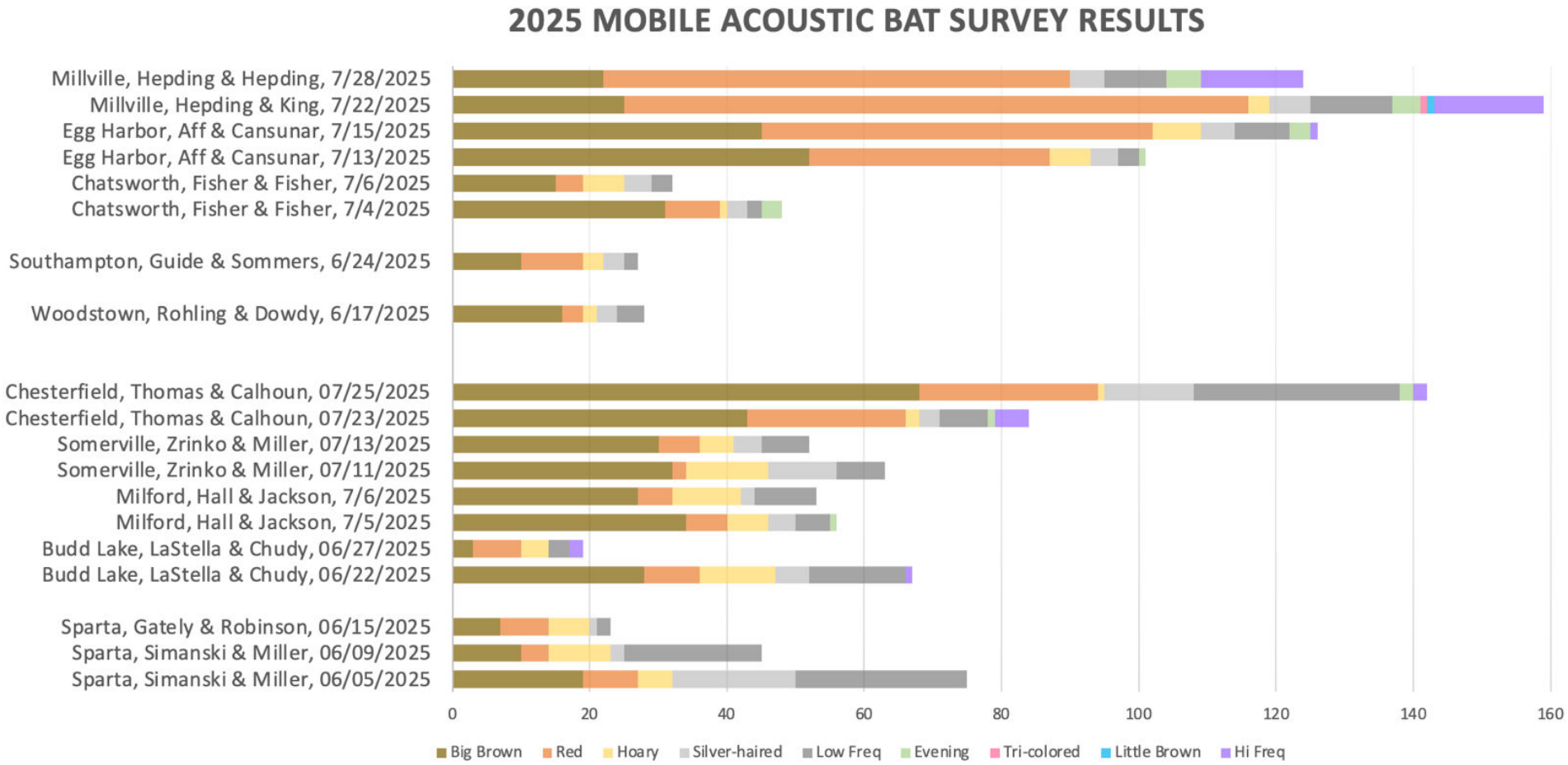
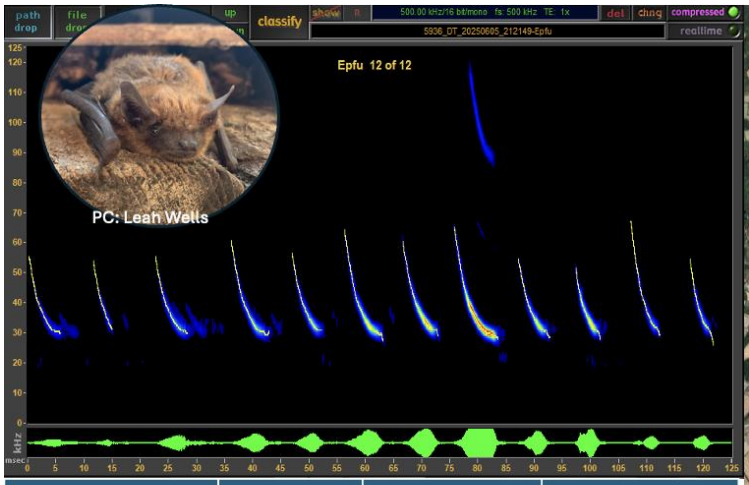


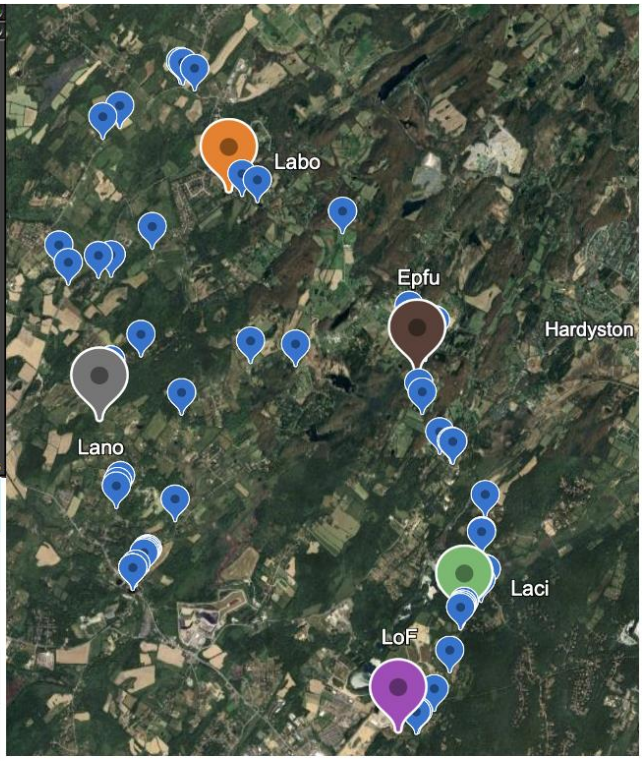
Figure 3. Shows bat composition in each mobile transect route. Routes are labeled by route number, surveyor, and date survey was completed. Bar graph combines all Myotis & unidentified HiFreq species since they're hard to distinguish, all rare and similarly impacted by WNS.

Summaries and highlights from each of the transects are included on the following pages.

Route: 5936 Sussex Co.
Surveyors: Simanski & Miller



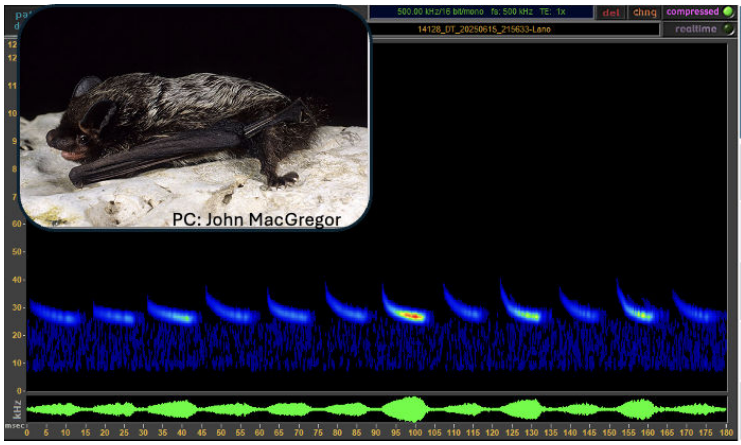
Species	Night 1	Night 2	Total Calls
Big Brown	19	10	29
Eastern Red	8	4	12
Hoary	5	9	14
Silver-haired	18	2	20
LowFreq	25	20	45



Map is showing survey Night 1.
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency call.

The big brown bat, *Eptesicus fuscus*, was the most abundant bat found along your route. This bat is one of North America's most widespread species, found from northern Canada to southern Mexico in habitats ranging from forests to suburban areas. These adaptable bats form maternity colonies in trees, buildings, bridges and bat houses, and feed on a wide variety of insects.

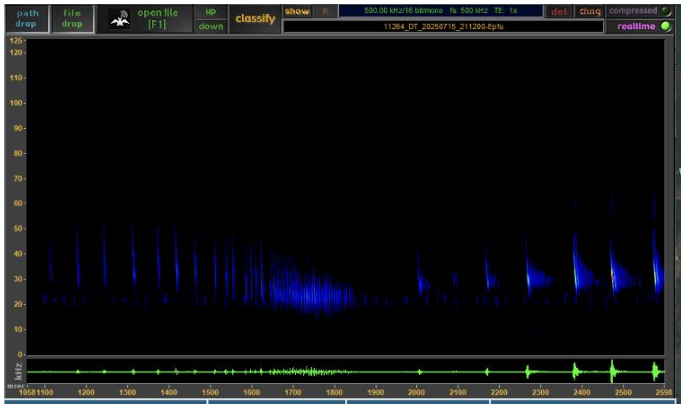
Route: 14128 Sussex Co.
Surveyors: Gately & Robinson



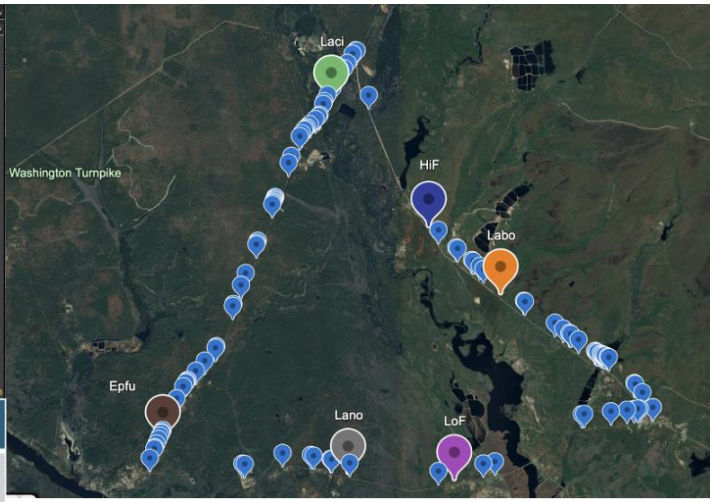
Species	Night 1
Big brown	7
Eastern Red	7
Hoary	6
Silver-haired	1
LowFreq	2

One silver-haired bat, *Lasionycteris noctivagans*, was recorded along your route. This bat is one of three tree-roosting migratory species found here in NJ during the summer (and to some extent, year-round). These bats feed on a wide variety of night-flying insects, often foraging along forest edges, clearings, and streams, where they contribute to natural pest control.

Route: 11264 Burlington Co.
Surveyors: Aff & Cansunar



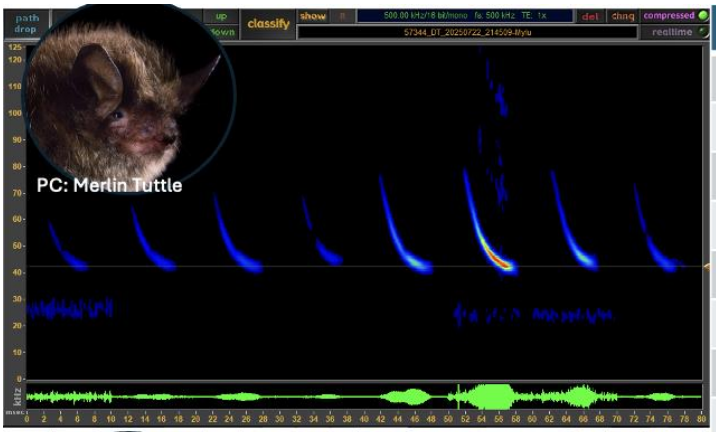
Species	Night 1	Night 2	Total Calls
Big brown	52	45	97
Eastern red	35	57	92
Hoary	6	7	13
Silver-haired	4	5	9
Evening	1	3	4
HighFreq	0	1	1
LowFreq	3	8	11



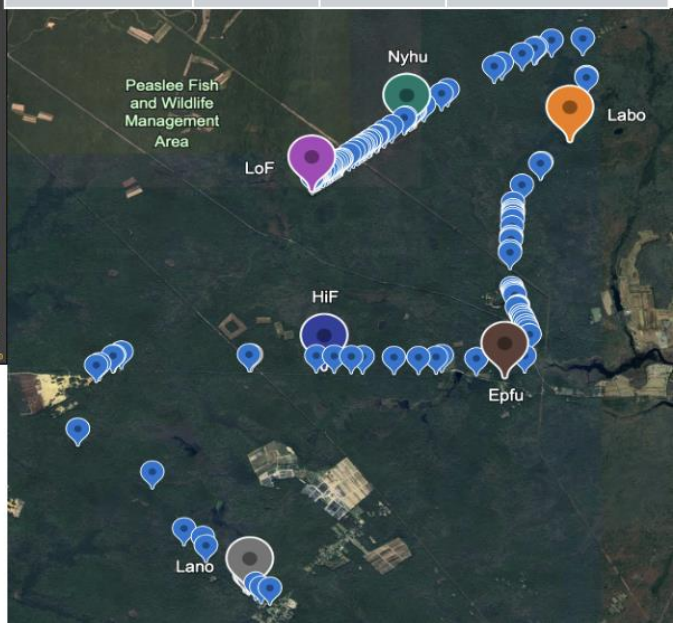
Map is showing survey Night 2. Every teardrop pin marks a bat detection along our survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency call, dark blue = high-frequency call.

Big brown bat and Eastern red bat were the most abundant bat species recorded along your route. The spectrogram pictured here shows a big brown bat foraging along your route. Notice how the calls on the spectrogram are spaced very closely together toward the middle of the sequence - this pattern is known as a *feeding buzz.* It occurs when the bat rapidly increases its call rate while zeroing in on an insect, helping the bat to pinpoint and capture its prey with precision.

Route: 12288 Cumberland Co.
Surveyors: Hepding & King



Species	Night 1	Night 2	Total Calls
Big brown	25	22	47
Eastern red	91	68	159
Hoary	3	0	3
Silver-haired	6	5	11
Little brown	1	0	1
Evening	4	5	9
Tricolored	1	0	1
HighFreq	16	15	31
LowFreq	12	9	21



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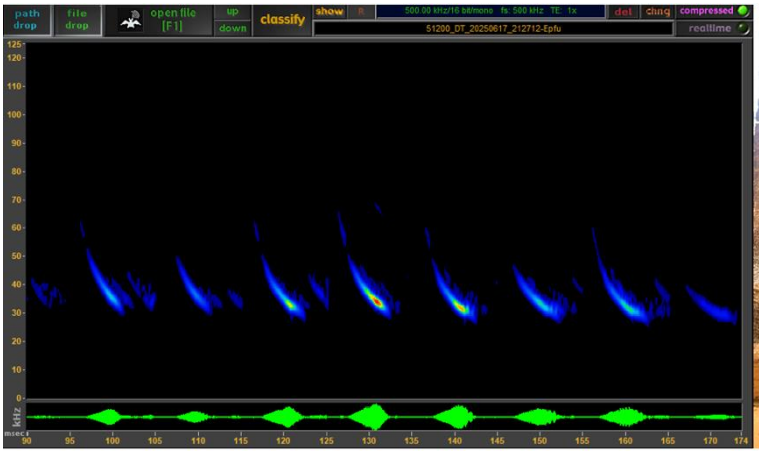
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency call, dark blue = high-frequency call.

You recorded two state-endangered bat species along your route: the little brown bat, *Myotis lucifugus*, and the tricolored bat, *Perimyotis subflavus*. Both species experienced significant population declines in New Jersey due to white-nose syndrome (2009 to present) but continue to persist in small numbers across the state. Detecting them is an exciting and important finding that contributes valuable data to ongoing conservation and recovery efforts. This was the only route to document either of these species during the 2025 mobile acoustic survey!

Route: 6144 Salem Co.
Surveyors: Rohling & Dowdy

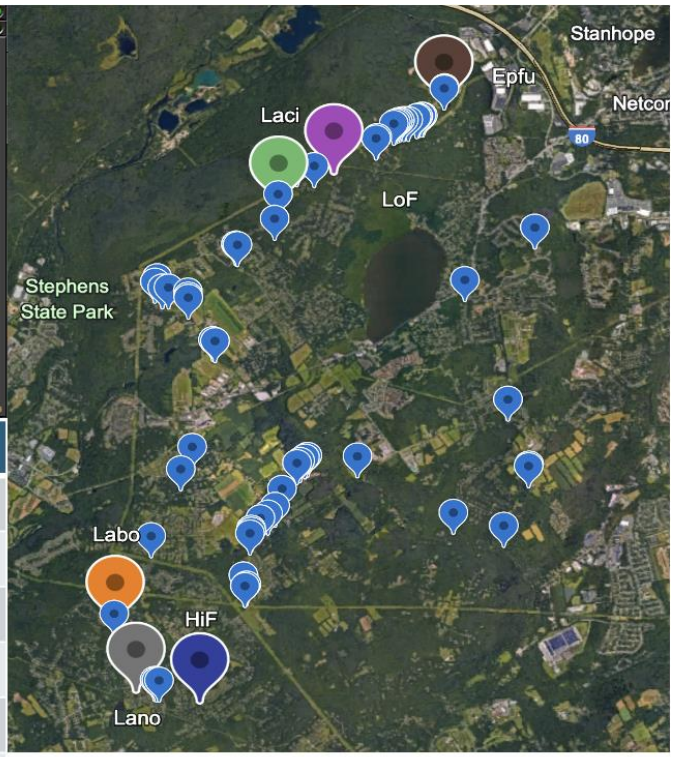


Species	Night 1
Big brown	16
Eastern red	3
Hoary	2
Silver-haired	3
Lowfreq	4

The big brown bat, *Eptesicus fuscus*, was the most frequently observed bat along your route. Big brown bats are one of the most common and familiar bats here in New Jersey. They often roost in man-made structures such as attics, soffits, and even bridges. They are adaptable to a variety of habitats, including forests, urban areas, and agricultural landscapes. Like many other bats native to North America, big brown bats feed on insects, serving as the primary nocturnal predator of nighttime insects.

Route: 10032 Morris Co.
Surveyors: LaStella & Chudy

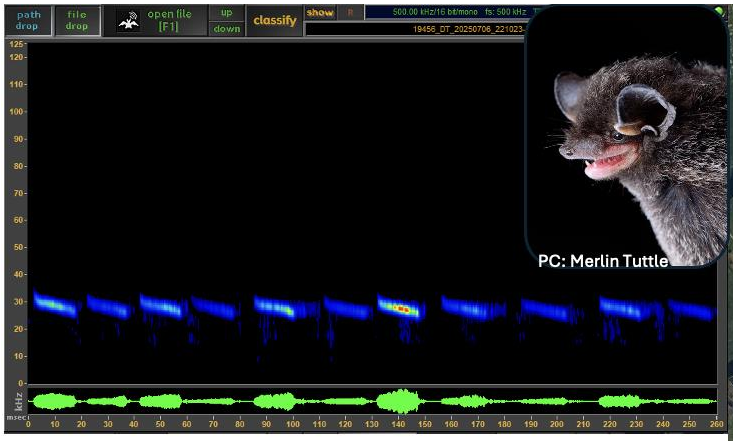
Species	Night 1	Night 2	Total Calls
Big brown	28	3	31
Eastern red	8	7	15
Hoary	11	4	15
Silver-haired	5	0	5
LowFreq	14	3	17
HighFreq	1	2	3

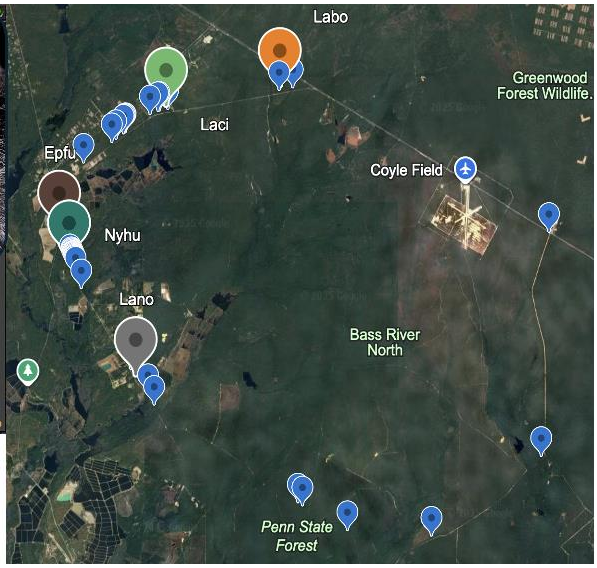


Map is showing survey Night 1. Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency call, dark blue = high-frequency call.

The hoary bat, *Lasiurus cinereus*, was one of the most frequent bats observed along your route. This solitary tree bat inhabits forests, typically roosting among the foliage in overstory trees during the spring, summer and fall months. The hoary bat is a part-time resident here in NJ; during the fall they migrate to warmer, more southern and coastal areas for the winter. They have thick fur that keeps them well insulated and able to withstand colder temperatures.

Route: 19456 Ocean Co.
Surveyors: Fisher & Fisher





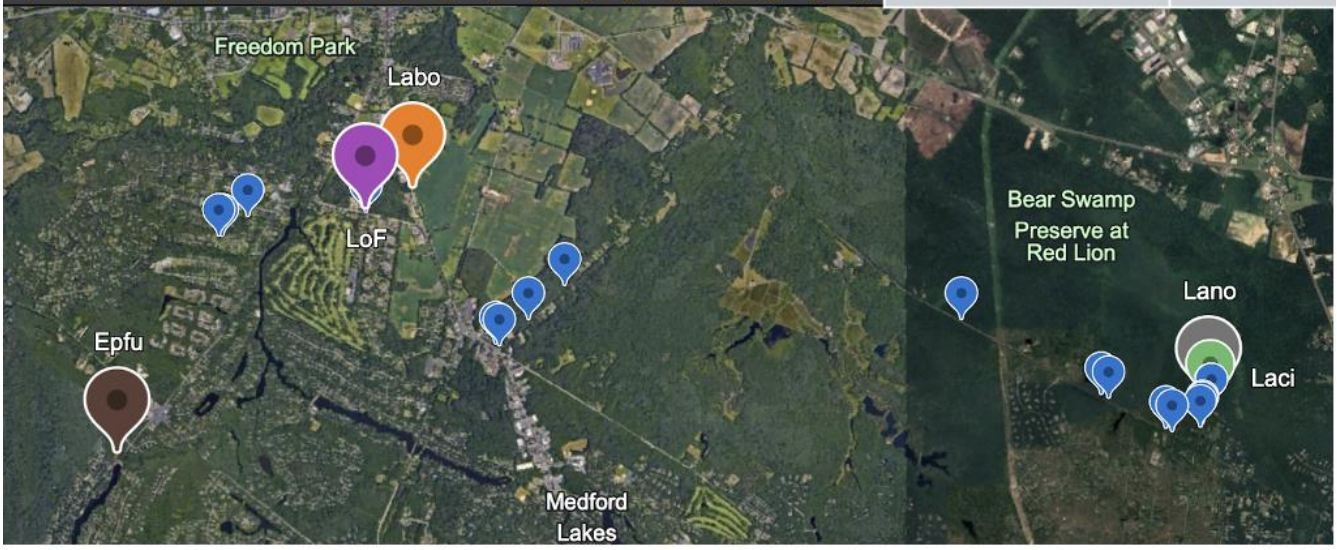
Species	Night 1	Night 2	Total Calls
Big brown	31	15	46
Eastern red	8	4	12
Hoary	1	6	7
Silver-haired	3	4	7
Evening	3	0	3
LowFreq	2	3	5

Map is showing survey Night 1.
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, dark green = evening bat.

Big brown bats were the most common species you encountered along your route, but you picked up several other species as well. The spectrogram shows one of the silver-haired bats you recorded. These are medium-sized, dark bats with frosted fur that gives them their distinctive “silvered” look. They produce relatively low-frequency echolocation calls in a consistent pattern, typically ranging from about 25 to 40 kilohertz.

Route: 7168 Burlington Co.
Surveyors: Guide & Sommers

Species	Night 1
Big brown	10
Eastern red	9
Hoary	3
Silver-haired	3
LowFreq	2



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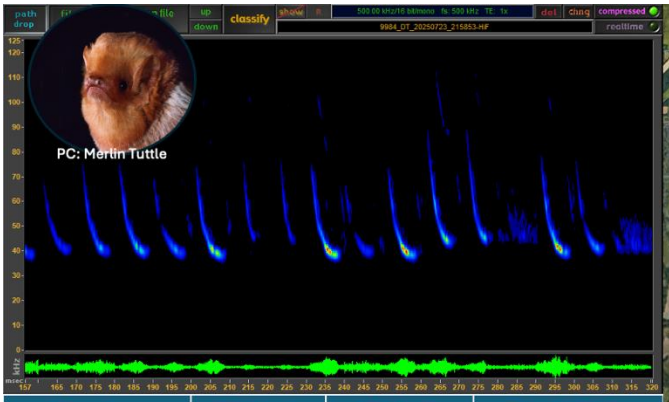
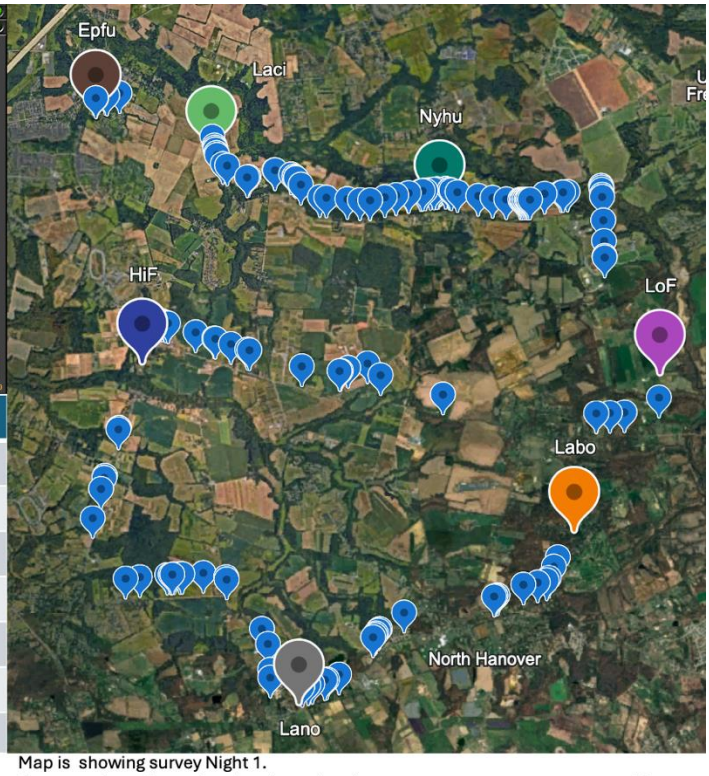
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency.

In this spectrogram, it's exciting to see both a big brown bat and a hoary bat captured in the same recording along your route. You can tell them apart by their echolocation frequencies: the big brown bat's call pattern is at the higher frequency (typically 25–30 kHz) and the calls are shorter and steeper, while the hoary bat's call is lower in frequency (below 20 kHz) with longer duration pulses, allowing the calls to travel farther to locate insects in open areas.

Route: 9984 Burlington Co.
Surveyors: Thomas & Calhoun



Species	Night 1	Night 2	Total Calls
Big brown	43	68	111
Eastern red	23	26	49
Hoary	2	1	3
Silver-haired	3	13	16
Evening	1	2	3
HighFreq	5	2	7
LowFreq	7	30	37



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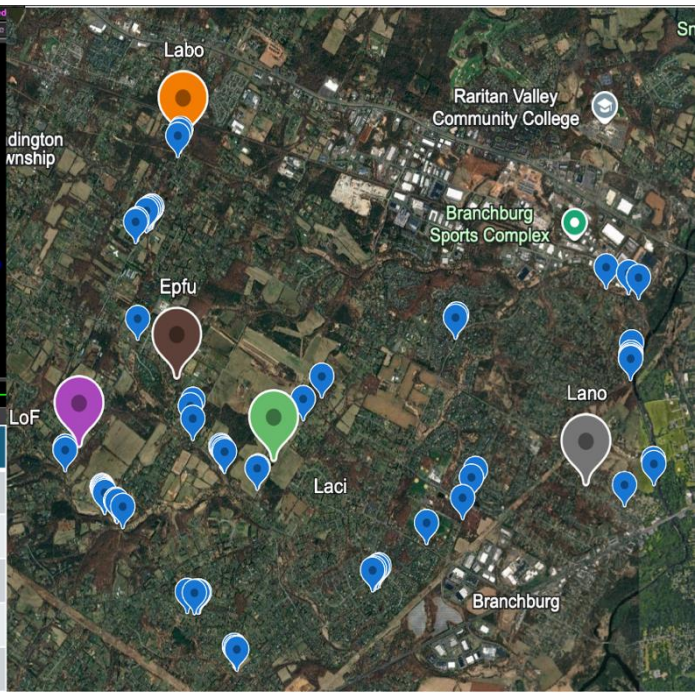
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, dark green = evening bat.

It looks like your route recorded several high-frequency calls. While SonoBat classified them broadly as “HiFreq” species, the call shown here in the example appears to be an eastern red bat. Red bats often have a distinctive, “bouncy” call pattern that distinguishes them. With less diagnostic examples, high-frequency calls can also come from the rarer *Myotis* bat species.

Route: 15104 Somerset Co.
Surveyor: Zrinko

Species	Night 1	Night 2	Total Calls
Big brown	32	30	62
Eastern red	2	6	8
Hoary	12	5	17
Silver-haired	10	4	14
LowFreq	7	7	14



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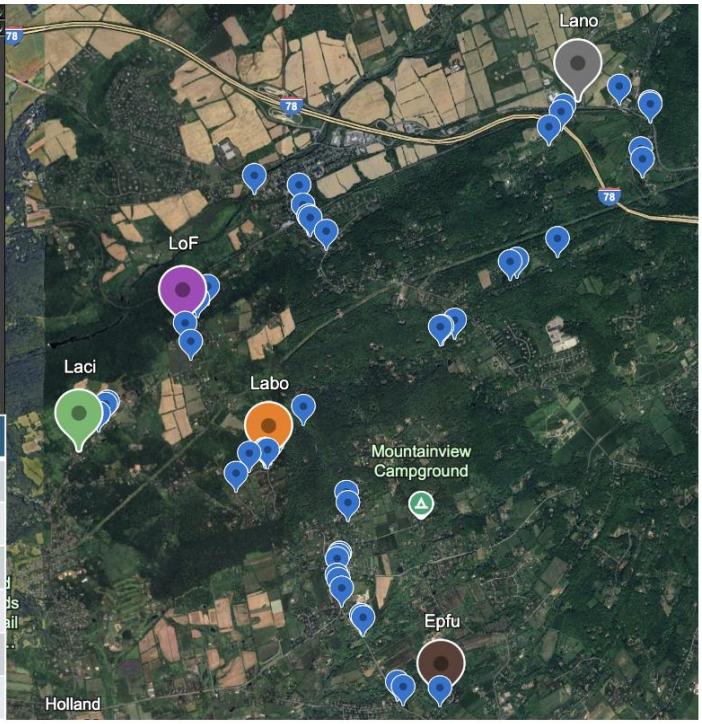
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency.

The Eastern red bat, *Lasiurus borealis*, was one of four bat species detected along your route. In the summertime these bats are among the earliest evening fliers, typically seen foraging in clearings, along forest edges, and around streetlights. Their fluffy fur provides them with extra protection from the cold, and they can also use their tail membrane like a blanket, wrapping themselves up almost completely.

Route: 3840 Hunterdon Co.
Surveyors: Jackson & Hall

Species	Night 1	Night 2	Total Calls
Big brown	34	27	61
Eastern red	6	5	11
Hoary	6	10	16
Silver-haired	4	2	6
LowFreq	5	9	14
Evening	1	0	1



Map is showing survey Night 2.
Every teardrop pin marks a bat detection along your survey route: orange = red bat, brown = big brown, silver = silver-haired, green = hoary, purple = low-frequency.

Several Northern hoary bats, *Lasiurus cinerus*, and Eastern red bats, *Lasiurus borealis*, were observed along your route, and in this spectrogram example they were picked up in the same recording! In NJ, hoary and Eastern red bats are both migratory, tree-roosting species. Hoary bats, the largest bat species in the state, roost high in tree canopies and often travel long distances to warmer southern regions for the winter. Eastern red bats, which are more abundant, also roost in tree foliage and may migrate shorter distances or remain in the area during mild winters, playing an important role in controlling night-flying insects throughout the state.

More Information on Echolocation and Acoustics

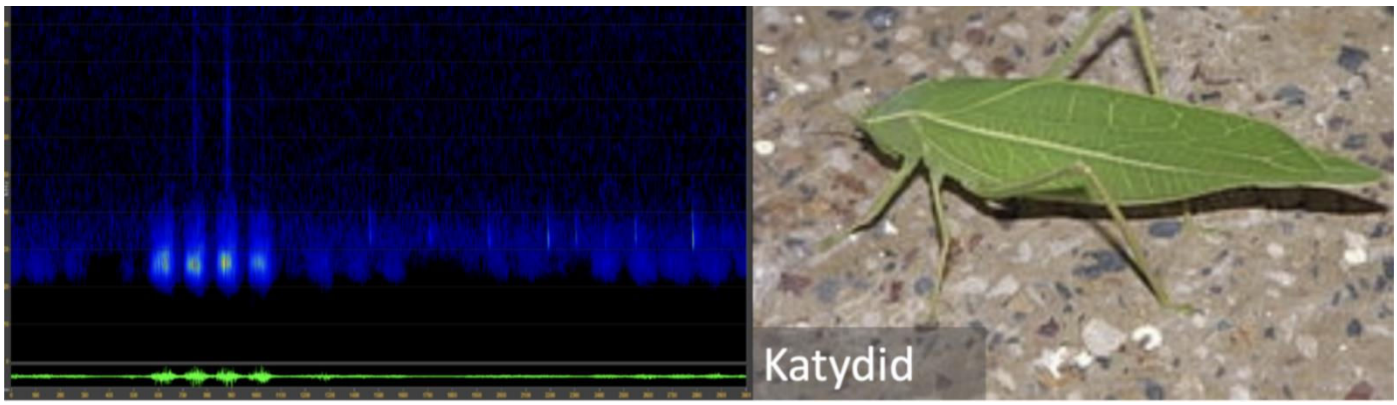
Bats use echolocation for two main functions. The first is navigation, so they can avoid running into things while flying at high speeds in the dark. The second is for foraging. Our bat species here in NJ (and most throughout North America) use echolocation to detect and pursue small night-flying insects like moths, beetles, mosquitoes, mayflies, etc. Some bats also “glean” insects off trees and foliage.

Bats will change their echolocation patterns as they fly from one habitat to another (for example, from a pond or clearing to the inner forest) or as they shift from casually searching for prey to pursuing it. In more “cluttered” settings with branches and obstacles, bats need information quicker to maneuver safely and avoid injury or collision. So, their echolocation pulses are quicker and span a wider frequency range (for detecting different sized objects) in cluttered settings than when they are flying in the open. The same is true of a bat in pursuit of a flying insect – the bat quickens and fine-tunes their echolocation pulses to home in on their prey. As a result, every bat has a wide repertoire of sounds they can make.

Luckily for researchers, many bat species can be distinguished by unique call characteristics such as the typical frequency (in kHz), the shape of the call (a product of frequency and duration), the pattern of calls across a sequence (i.e., whether consistent or variable), and the distribution of power within each pulse across the call sequence.

Other Sounds the Detector Picks Up:

Bats are not the only creatures that produce ultrasonic sounds. Katydids, otherwise known as bush crickets, are nocturnal, medium- to large-sized insects who also produce high frequency “chirps” that register on a bat detector. Katydid “chirps” are not actually vocalizations, but sounds produced by rubbing together their front wings. Fun fact: The tempo of this movement is governed by ambient air temperature, so the number of chirps per unit of time can give a pretty accurate temperature reading.



The droning sounds of cicadas can also trigger our bat detectors. Car brakes, electrical buzzing, general shuffling around (friction between materials) and some letters we speak – especially “S” – also have ultrasonic “notes” that get picked up by the bat detectors. But no, they don’t hear what you say 😊

Many thanks to everyone who volunteered this year!
We couldn’t do this project without you!