

BAT MONITORING AT THE CROSSROADS AT BIG CREEK PRESERVE, DOOR COUNTY, WISCONSIN: 2021

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Dan Collins deploys the ultrasonic recording equipment at Site 1.

EXECUTIVE SUMMARY

We surveyed three locations for bats at the Crossroads at Big Creek Preserve during the 2021 maternity season (June–July, when bats are breeding) utilizing a zero crossing ultra-sonic acoustic recorder. Analyses of acoustic data indicated that three species were common: Big Brown Bat, Hoary Bat and Little Brown Bat. Both Big Brown and Little Brown bats are state Threatened Species. We also confirmed three additional species as present and possibly breeding: Eastern Red Bat, Silver-Haired Bat and Tricolored Bat (or Eastern Pipistrelle). Tricolored Bat is also a state Threatened Species. Of the latter three species Silver-Haired Bat showed the greatest activity and is most likely to be breeding at the Crossroads Preserve.

We recommend that surveys continue for additional years to collect more comprehensive baseline data from additional sampling sites and habitats during the maternity season, as bat populations vary annually based on weather and insect availability. We also recommend that full spectrum recorders and analyses be performed in order to improve statistical confidence of automated species identifications from acoustic data.

Several habitat management recommendations are made to improve bat roosting and nesting features, improve flying insect production as forage for bats, and to follow avoidance guidance for listed species.



Little Brown Bat, a State Threatened Species, was relatively abundant during the breeding season at the Crossroads Preserve.

INTRODUCTION

Crossroads at Big Creek, Inc. is a non-profit learning center and nature preserve within the city limits of Sturgeon Bay, Door County, Wisconsin, where the Big Creek Estuary connects with Lake Michigan (Figure 1). Established in 1992, the preserve encompasses approximately 200 acres of remnant forest and stream, with areas of old orchard, farm lands, grasslands, woodlots, and swamp forest, in varying stages of restoration. The Door County location is a peninsula along the northeastern coast of Lake Michigan, and important migratory flyway.

An ecological restoration plan is being implemented for the Preserve, with monitoring and reassessment checkpoints. Improved habitats will include sedge meadow and alder thicket, northern wet-mesic forest, mesic forest, and transitional meadow habitat. The restoration will be guided by Crossroads' significance as a migratory bird stopover site, and by improving habitat for spawning fish. Improved trails and programs to expand community science and empower participation in the restoration work will support and amplify the on-the-ground restoration. Crossroads has received encouragement in this project from many longstanding partners, including the Door County Soil and Water Conservation Department, the City of Sturgeon Bay, The Nature Conservancy, the Door County Land Trust, and a number of state and federal agencies.

OBJECTIVES

Objectives of this study were to collect baseline data on bat species utilizing the preserve, and identify species present and bat activity levels.

METHODS

Acoustic surveys were conducted in 2021 at three sites between 31 May and 26 July during the maternity season for bats (Map 1, Table 1). Surveys were completed with a zero-cross ultrasonic recorder programmed to begin data collection from 30-minutes before sunset to 30-minutes after sunrise (Song Meter SMCZ, firmware version SYS1-07A; Wildlife Acoustics, Inc., Maynard, Massachusetts, USA).

Table 1. Survey Sites, Crossroads at Big Creek, 2021.

Site	LatDD	LongDD	Deploy Date	Data Start	Data End	N Passes	Notes	Habitat
Site 1	44.834248	-87.342755	5/31	5/31	6/23	3677		along stream in wet meadow at edge of woodlot
Site 2	44.830115	-87.344217	6/23	6/23	7/5	1343	batteries died	along trail at interface of forested wetland and upland woodlot in large grassland matrix
Site 3	44.826432	-87.346399	7/20	7/20	7/27	490	retrieved in August	along wooded/shrub edge of open water inlet of estuary

Data processing

Data were processed using Kaleidoscope 5.4.0 (Wildlife Acoustics, Inc.) using the Bats of North America 5.4.0 classifier on the “0 Balanced (Neutral)” setting as recommended by the U.S. Fish and Wildlife Service

(<https://www.fws.gov/midwest/Endangered/mammals/inba/surveys/inbaAcousticSoftware.html>).

Kaleidoscope signal parameters were set to:

16-120 kHz

2-500 ms

500 maximum inter-syllable gap (ms)

5 minimum number of pulses

For species determinations, maximum likelihood estimation (MLE) values <0.10 were accepted as indicating likely presence, manual review of representative recordings completed. Data collection is triggered by passive detection of ultrasonic calls, therefore greater bat activity near a recorder triggers more samples recorded, usually indicating higher quality bat habitat.



Map 1. Survey locations for the 2021 summer maternity season, Crossroads at Big Creek. Aerial imagery from 2017 National Agriculture Imagery Program (NAIP).

RESULTS

Based on Kaleidoscope automated species determinations, the species with the highest activity at the Crossroads Preserve was the Hoary Bat (*Lasiurus cinereus*) with peak activity occurring in early June at Site 1 (Figure 1). The second most common species was the Big Brown Bat (*Eptesicus fuscus*) also at Site 1. Activity across species was low at Sites 2 and 3. There was however relatively high Little Brown Bat (*Myotis lucifugus*) activity, a State Threatened Species, compared to other locations in the region.

Maximum likelihood estimates from Kaleidoscope for species determinations identified Big Brown, Eastern Red (*Lasiurus borealis*), Hoary (*Lasiurus cinereus*), Little Brown, Evening (*Nycticeius humeralis*) and Tricolored (*Perimyotis subflavus*) bats as likely present (Appendix A).

Manual review confirmed presence of Big Brown, Eastern Red, Hoary, Silver-haired (*Lasionycteris noctivagans*), Little Brown and Tricolored bats. Northern Long-eared (*Myotis*

septentrionalis) and Evening bat detections were not confirmed, but Silver-haired Bat was accepted despite a minimum MLE value of 0.28.

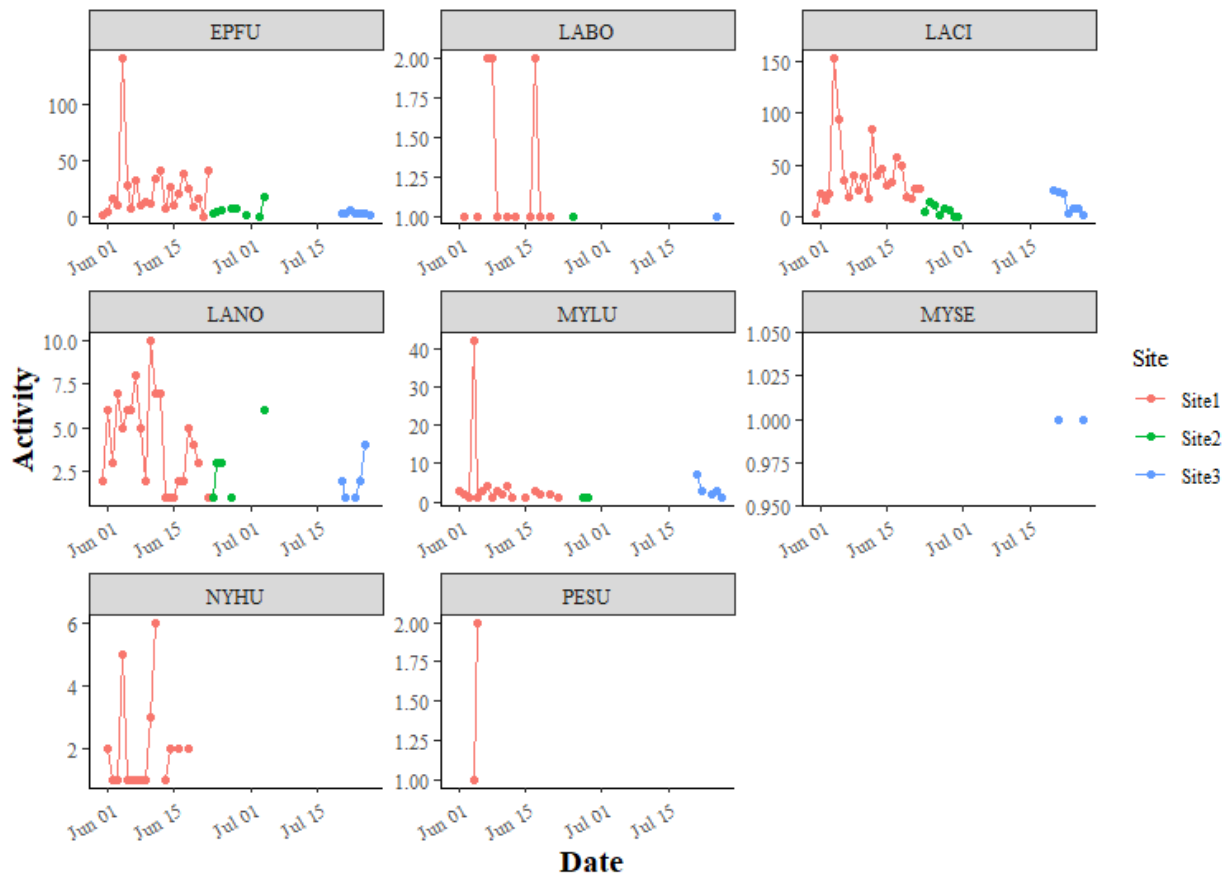


Figure 1. Bat activity levels by date and species from the Crossroads Preserve using auto-identification output from Kaleidoscope for 2021. Species codes: EPFU (Big Brown Bat), LABO (Eastern Red Bat), LACI (Hoary Bat), LANO (Silver-haired Bat), MYLU (Little Brown Bat), MYSE (Northern Long-eared Bat), NYHU (Evening Bat), PESU (Tricolored Bat).



Hoary Bat was the most common bat species at the Crossroads Preserve.

DISCUSSION

High activity for the Hoary Bat at Site 1 is interesting as this species is larger and often associated with more open habitat. They may occur in high numbers at Crossroads due to the access to large water bodies. Recent research suggests that with the increase of wind energy, this migratory species may experience significant population threats (Frick et al 2017). This may be a good location to monitor Hoary Bat population trends. Little Brown Bat activity at Crossroads is notable as it is higher than many other locations in the region. This species has been heavily impacted by White-nose Syndrome in the Midwest (Petitt and O'Keefe 2017), is a state Threatened Species, and is under review for federal protection (<https://ecos.fws.gov/ecp/species/9051>). Low bat activity levels at Site 2 may be due to a truncated sampling period (batteries failed on July 5 or later) or to habitat considerations (upland habitat not close to wetlands). Lower activity at Site 3 may be due to the shoreline location being suboptimal habitat, or if bat flight paths in this area were more dispersed or too far from the recorder to pick up. Later sampling periods usually have greater activity due to young becoming volant in late July. Fluctuations in activity throughout the summer season also occur due to variation in weather and insect emergences (Fukui et al. 2006). Selection of survey locations can also impact results, for example if vegetation is blocking the microphone from recording high quality sounds (Weller and Zabel 2002), although no such blockage was apparent at these survey sites.

A preliminary bat checklist is provided (Appendix B). This survey utilized a zero crossing recorder at only three sites in a single season. To obtain more comprehensive baseline data we recommend that full spectrum recordings be made at multiple sites over a period of three years in order to, a) improve probabilistic species determinations (with species determinations run in two separate software packages), b) sample additional flight paths and habitats, and c) obtain multi-year data to better reflect annual variation due to weather.

Management Considerations:

- A) Establish and monitor bat nursery housing. These can provide safe rearing sites where tree cavities are uncommon.
- B) Leave standing cavity trees wherever possible.
- C) Select appropriate tree species to replace dying ash. Large leaved trees, and species with loose bark and prone to developing cavities, are recommended (i.e., maples, oaks, hickories).
- D) Habitat Considerations: Many bat species are associated more with structural features of habitat (i.e., roosts) than with any particular native plant community. Bats commonly roost in trees but also in man-made structures and bat houses. Tree bats often roost under bark close to the tree trunk, in tree crevices, and within clumps of large leaves. Wetlands are important foraging and water sources for bats. Wetland management and restoration can improve flying insect production for bats.
- E) Avoidance Measures for Listed Bat Species: Since several listed species of bats are present at the Crossroads Preserve, following avoidance measures in Wisconsin DNR guidance for the Northern Long-eared Bat is recommended (<https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=>

AMACC01150). In general this means no disturbance of potential roosting areas (wooded areas) between 1 June and 15 August. In particular avoid any tree cutting during this period.

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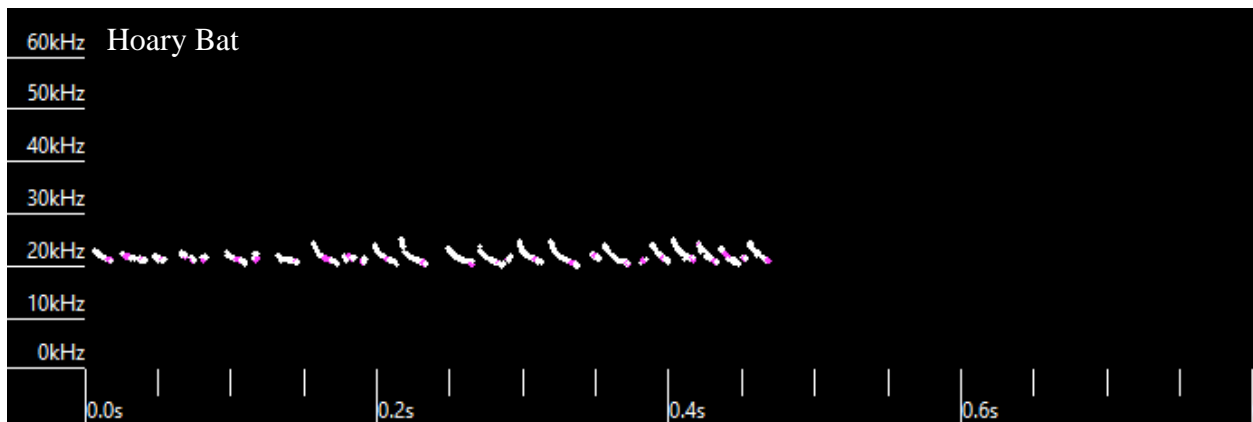
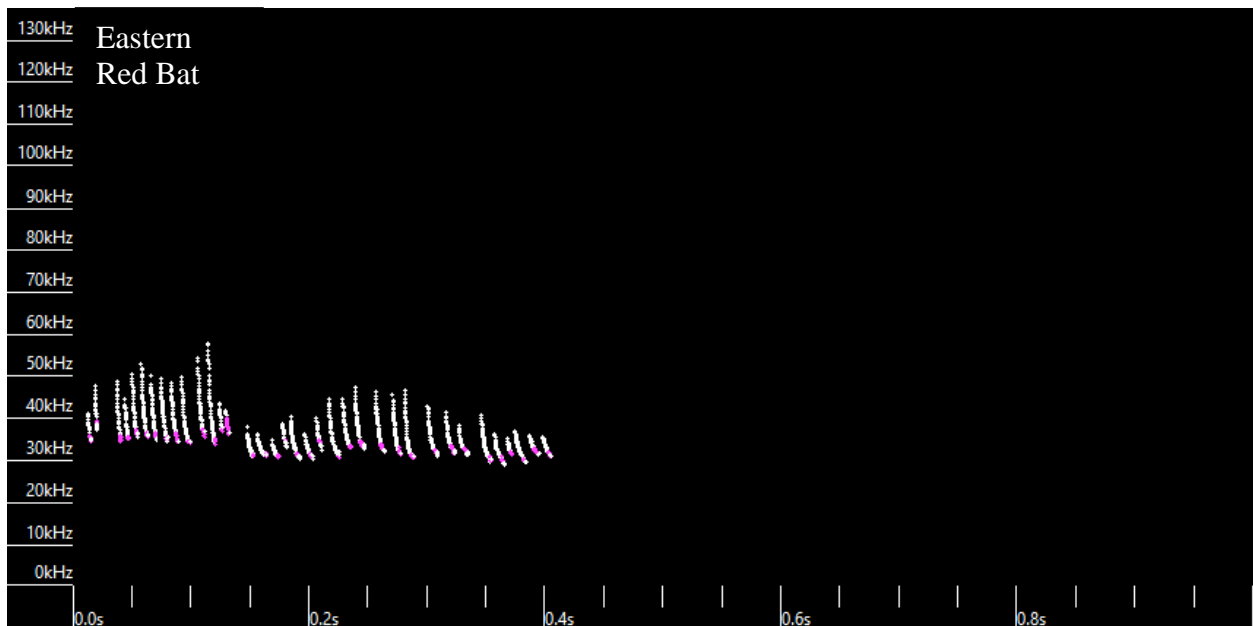
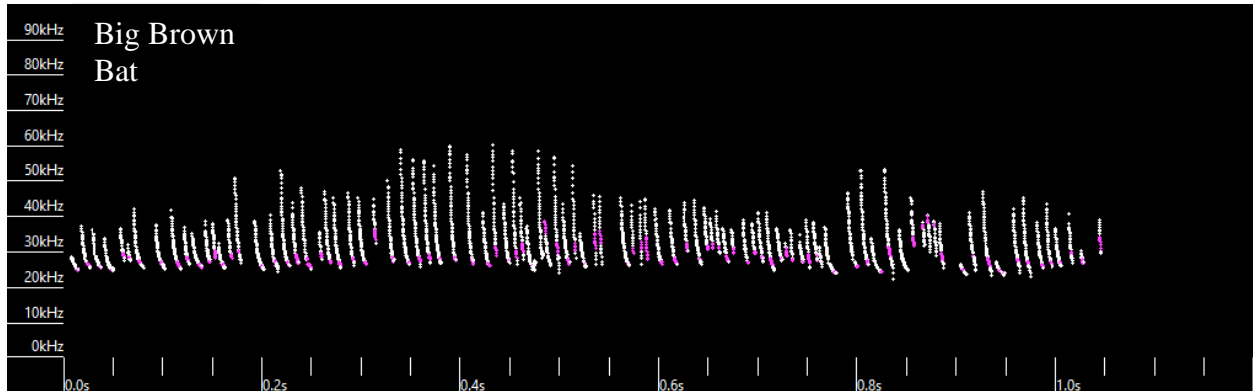
Silver-haired Bat, a State Special Concern Species, was uncommon during the breeding season at the Crossroads Preserve in 2021.

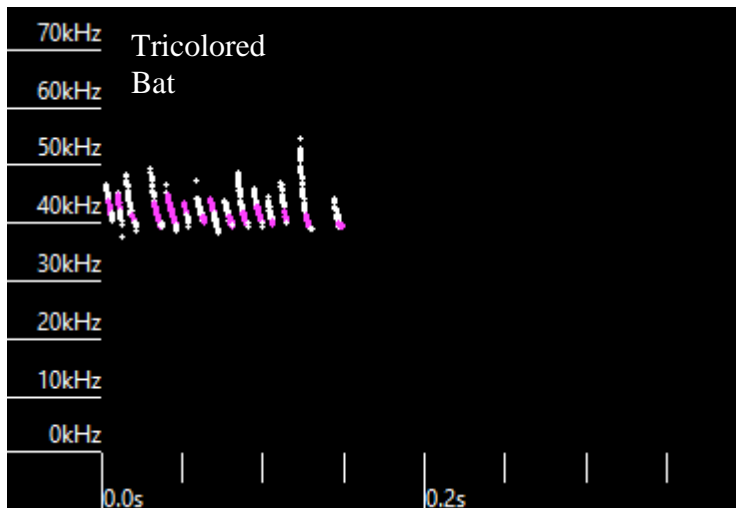
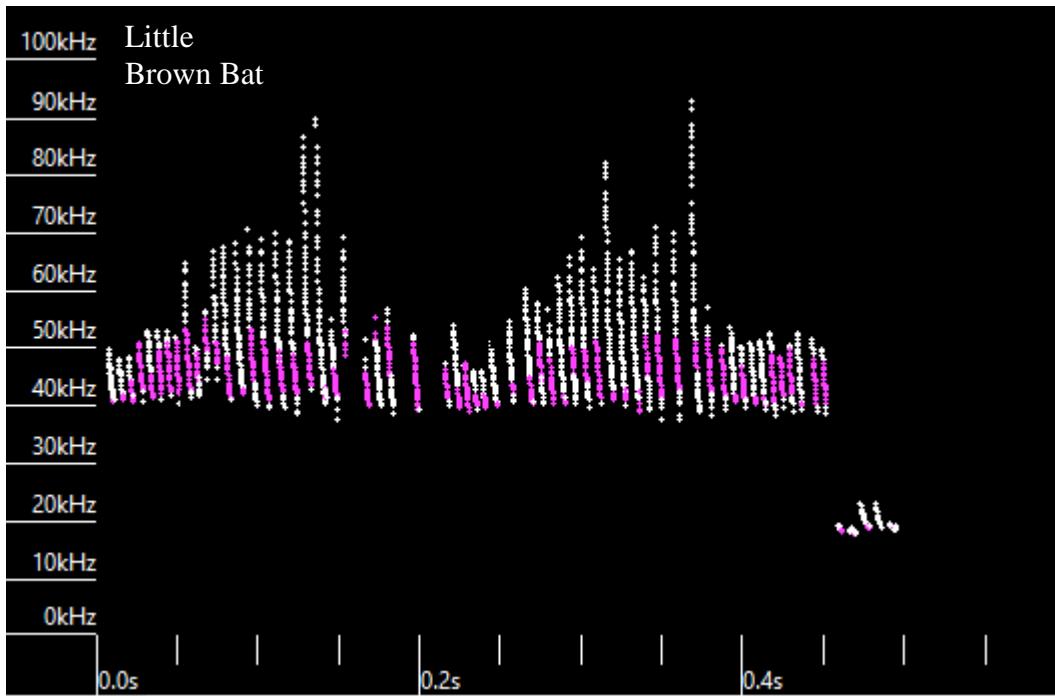
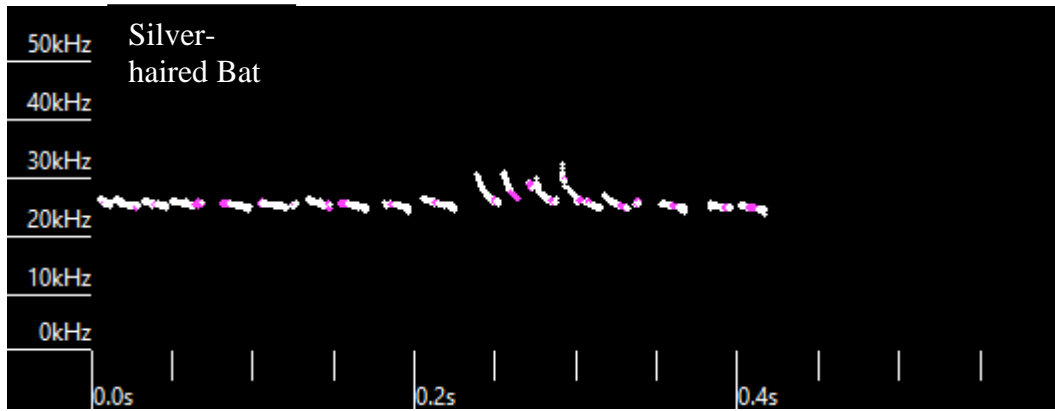


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APPENDIX A1

Images in Sonobat of manual review of species for data collected in 2021.





APPENDIX A2

2021 maximum likelihood estimation (MLE) values from Kaleidoscope. **Bold** denotes values <0.10 indicating likely presence. Species codes: EPFU (Big Brown bat), LABO (Eastern Red bat), LACI (Hoary bat), LANO (Silver-haired bat), MYLU (Little Brown bat), MYSE (Northern Long-eared bat), NYHU (Evening bat), PESU (Tricolored bat).

Site	Date	EPFU	LABO	LACI	LANO	MYLU	MYSE	NYHU	PESU
Site1	5/31/2021	0.28	1.00	0.00	0.78	1.00	1.00	1.00	1.00
Site1	6/1/2021	0.18	1.00	0.00	0.97	0.00	1.00	0.10	1.00
Site1	6/2/2021	0.00	0.35	0.00	1.00	0.07	1.00	0.80	1.00
Site1	6/3/2021	0.00	1.00	0.00	0.94	0.13	1.00	0.30	1.00
Site1	6/4/2021	0.00	1.00	0.00	1.00	0.00	1.00	0.01	0.92
Site1	6/5/2021	0.00	0.29	0.00	1.00	0.46	1.00	0.86	0.09
Site1	6/6/2021	0.09	1.00	0.00	1.00	0.00	1.00	0.32	1.00
Site1	6/7/2021	0.00	0.08	0.00	1.00	0.00	1.00	0.98	1.00
Site1	6/8/2021	0.00	0.03	0.00	1.00	0.59	1.00	0.98	1.00
Site1	6/9/2021	0.00	0.41	0.00	1.00	0.01	1.00	0.80	1.00
Site1	6/10/2021	0.00	1.00	0.00	0.99	0.02	1.00	0.03	1.00
Site1	6/11/2021	0.00	0.85	0.00	1.00	0.00	1.00	0.01	1.00
Site1	6/12/2021	0.00	1.00	0.00	1.00	0.09	1.00	1.00	1.00
Site1	6/13/2021	0.13	0.26	0.00	1.00	1.00	1.00	0.76	1.00
Site1	6/14/2021	0.00	1.00	0.00	1.00	1.00	1.00	0.08	1.00
Site1	6/15/2021	0.00	1.00	0.00	1.00	0.09	1.00	1.00	1.00
Site1	6/16/2021	0.00	0.40	0.00	1.00	1.00	1.00	0.33	1.00
Site1	6/17/2021	0.00	0.05	0.00	1.00	0.01	1.00	1.00	1.00
Site1	6/18/2021	0.00	0.47	0.00	1.00	0.08	1.00	0.37	1.00
Site1	6/19/2021	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site1	6/20/2021	0.00	0.27	0.00	1.00	0.04	1.00	1.00	1.00
Site1	6/21/2021	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site1	6/22/2021	0.00	1.00	0.00	1.00	0.09	1.00	1.00	1.00
Site2	6/23/2021	0.05	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site2	6/24/2021	0.04	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site2	6/25/2021	0.00	0.09	0.00	1.00	1.00	1.00	1.00	1.00
Site2	6/26/2021	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site2	6/27/2021	0.00	1.00	0.00	1.00	0.09	1.00	1.00	1.00
Site2	6/28/2021	0.00	1.00	0.00	1.00	0.09	1.00	1.00	1.00
Site2	6/29/2021	1.00	1.00	0.05	1.00	1.00	1.00	1.00	1.00
Site2	6/30/2021	0.03	1.00	0.28	1.00	1.00	1.00	1.00	1.00
Site2	7/1/2021	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Site2	7/2/2021	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Site2	7/3/2021	0.13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Site2	7/4/2021	0.00	1.00	1.00	0.28	1.00	1.00	1.00	1.00
Site3	7/20/2021	0.74	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Site3	7/21/2021	0.67	1.00	0.00	1.00	0.00	0.46	1.00	1.00
Site3	7/22/2021	0.03	1.00	0.00	1.00	0.00	1.00	1.00	1.00
Site3	7/23/2021	0.03	1.00	0.00	1.00	1.00	1.00	1.00	1.00

Site	Date	EPFU	LABO	LACI	LANO	MYLU	MYSE	NYHU	PESU
Site3	7/24/2021	0.13	1.00	0.00	1.00	0.01	1.00	1.00	1.00
Site3	7/25/2021	0.09	0.36	0.00	0.68	0.00	1.00	1.00	1.00
Site3	7/26/2021	0.06	1.00	0.03	1.00	0.08	0.11	1.00	1.00



Eastern Red Bat was rare during the breeding season at the Crossroads Preserve.

Appendix B. Bat Checklist for the Crossroads at Big Creek Preserve, Door County, Wisconsin (current 2021).

Common Name	Scientific Name	Acronym	Preserve Status	Wisconsin Status	Federal Status	Habitat
Big Brown Bat	<i>Eptesicus fuscus</i>	EPFU	Common breeder	Threatened, but common statewide		Cave bat. Deciduous woodlands and urban areas. Forages in forest gaps, along edge habitat and in riparian habitat. Forms maternity colonies in buildings, bat houses and rock crevices. Hibernates in buildings, culverts, basements, caves or abandoned mines. Resident June-July rearing young, otherwise migrant to/from wintering sites.
Eastern Red Bat	<i>Lasiurus borealis</i>	LABO	Rare, possible breeder	Locally common		Tree bat. Hibernates in foliage of deciduous and coniferous forest on the south side of trees, sometimes in leaf litter when temperatures drop. Rarely enters caves or buildings. Roosts alone in mature riparian forests close to edge habitat, open water, or fields; typically 1-6 meters off the ground in tall, large-diameter deciduous trees on south facing branches. Forages along forest-field edges, forest gaps, riparian areas, and near artificial light sources. Resident June-July rearing young, otherwise migrant to/from wintering sites.
Hoary Bat	<i>Lasiurus cinereus</i>	LACI	Common breeder	Considered uncommon		Tree bat. Solitary species; roosts alone in both hardwood and coniferous forests and prefers large, mature trees, typically 10-15 feet above the ground on branches among foliage oriented to the south for warmth. Rarely forms maternity colonies. Migrates south of Wisconsin to overwinter. Resident June-July rearing young, otherwise migrant to/from wintering sites.

Appendix B. Bat Checklist for the Crossroads at Big Creek Preserve, Door County, Wisconsin (current 2021).

Common Name	Scientific Name	Acronym	Preserve Status	Wisconsin Status	Federal Status	Habitat
Silver-Haired Bat	<i>Lasionycteris noctivagans</i>	LANO	Uncommon, probable breeder	State Special Concern, uncommon statewide		Tree bat. Prefers, riparian areas along fast-moving brooks or streams in summer, hanging up to rest in woodpiles, loose bark of trees or in tree cavities. Summer roosts in deciduous or coniferous forest, especially near water. Forages in forest clearings, clear cuts and along ponds and streams. Migrates south of Wisconsin to overwinter. Resident June-July rearing young, otherwise migrant to/from wintering sites.
Little Brown Bat	<i>Myotis lucifugus</i>	MYLU	Common breeder	Threatened, considered uncommon but status uncertain	Under review	Cave bat. Frequents woodlands, often foraging in riparian habitats or near the mouths of caves. Usually roosts solitarily or with a few other bats in buildings, trees and rock crevices. Highly associated with water commonly foraging along shorelines, as well as along field and wood edges. Forms maternity colonies of up to 1000 bats in old barns, attics and bat houses. In migration can turn up almost anywhere, even entering buildings or hanging onto the exteriors. Hibernates in caves and abandoned mines. Resident June-July rearing young, otherwise migrant to/from wintering sites.
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	MYSE	Absent as breeder, probably present as migrant.	Threatened	Threatened, proposed for Endangered	Cave bat. Summer habitat may include day roosts in buildings, under tree bark or shutters, or caves during the night. May form small maternity colonies in tree crevices and rarely under shingles and in buildings. Hibernation sites are often in mines or caves. Prefers to roost in tall trees with a dynamic forest structure that are in close proximity to wetlands or other riparian habitat. Commonly forages within the forest interior, but also uses corridors and edge habitat. Resident June-July rearing young, otherwise migrant to/from wintering sites.

Appendix B. Bat Checklist for the Crossroads at Big Creek Preserve, Door County, Wisconsin (current 2021).

Common Name	Scientific Name	Acronym	Preserve Status	Wisconsin Status	Federal Status	Habitat
Evening Bat	<i>Nycticeius humeralis</i>	NYHU	Absent as breeder, possibly present as migrant.	Under evaluation, only recently discovered as resident in Wisconsin, possibly moving northward with climate change		Tree bat. Occurs in deciduous, mixed deciduous-coniferous and pine-dominated forests, commonly along waterways. Forages in open areas and around tree canopies. Males tend to roost solitarily; females form nursery colonies in summer, usually in trees or buildings. Roosts include cavities in live or dead trees, spaces behind loose tree bark, tree foliage, Spanish moss, leaf litter, rock crevices, abandoned burrows in the ground, and nooks, spaces, and crevices in many types of human-made structures; rarely caves. Individuals roosting in trees frequently change roosts. Maternity colonies may be found under loose bark, in tree cavities, in Spanish-moss, or in buildings. Diet includes beetles and other night-flying insects. Resident June-July rearing young, otherwise migrant to/from wintering sites.
Tricolored Bat or Eastern Pipistrelle	<i>Perimyotis subflavus</i>	PESU	Rare, possible breeder	Threatened, considered uncommon		Cave bat. Solitary, roost in the foliage of deciduous trees. Occasionally use structures such as barns for maternity colonies, but normally roost in clusters of oak and maple leaves. Edge habitat is important as they migrate and forage. Resident June-July rearing young, otherwise migrant to/from wintering sites.