



# Acoustic Monitoring for Bats at Grand Portage National Monument

## *Data Summary Report for 2016–2019*

Natural Resource Data Series NPS/GLKN/NRDS—2021/1314



**ON THE COVER**

Bat acoustic monitoring equipment at Grand Portage National Monument.  
NPS photo.

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# **Acoustic Monitoring for Bats at Grand Portage National Monument**

## *Data Summary Report for 2016–2019*

Natural Resource Data Series NPS/GLKN/NRDS—2021/1314

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## **Abstract**

The Great Lakes Inventory and Monitoring Network initiated acoustic bat monitoring at Grand Portage National Monument in 2016. This report presents results for the 2016–2019 surveys. Acoustic recordings were analyzed using the software program Kaleidoscope Pro, and a subset of files were manually reviewed to confirm species identifications. The six bat species previously documented at the park were reconfirmed. These include big brown bat, eastern red bat, hoary bat, silver-haired bat, little brown bat, and northern long-eared bat. A seventh species, the tricolored bat, was also documented. Tricolored bats have not been physically captured in the park, but our acoustic data suggest this species is present. Activity levels for big brown bat, hoary bat, and silver-haired bat appear to be stable. Activity levels for little brown bat, northern long-eared bat, eastern red bat, and tricolored bat show decreasing trends.

## **Acknowledgments**

This work would not have been possible without all the National Park Service and Grand Portage Band employees, partners, and volunteers who completed field surveys and provided logistical support, including B. Seitz, S. Young, K. Gallup, I. Bernard, J. VanDyne, T. Slinkard, and L. York. We thank K. Gilland and others at Normandeau Associates for data processing and manual vetting, and R. Key for database development and assistance with data management. B. Seitz and T. Gostomski reviewed earlier drafts of this report. Funding for this monitoring effort was provided by the National Park Service's Natural Resource Stewardship and Science Directorate White-Nose Syndrome program.



## Introduction

North American bat populations are threatened by a number of environmental pressures including the fungal disease white-nose syndrome (WNS), mortality from wind turbines, and changing land use and climatic conditions. Due to these conservation concerns, the National Park Service (NPS) and other federal agencies have begun implementing or expanding bat research and monitoring programs (Loeb et al. 2015, Rodhouse et al. 2016, Rodriguez et al. 2019). The NPS has funded over 150 bat-focused research, conservation, and education projects at 78 parks since 2013 (National Park Service 2016).

In 2015, the Great Lakes Inventory and Monitoring Network (GLKN) and the network parks established a bat acoustic monitoring program with a particular focus on documenting the impacts of WNS. When the project was initiated, the Great Lakes region was at the leading edge of the disease's spread, with WNS documented within 50 miles of most parks (U. S. Geological Survey 2019). GLKN's monitoring program is helping parks to document baseline data on their bat populations and assess changes over time. Grand Portage National Monument (GRPO) has participated in this monitoring program since 2016.

Nine species of bats are found in the Great Lakes region (Kurta 2017), detailed in Appendix A. All are insectivores belonging to the Family Vespertilionidae, the largest and most common group of bats in North America. Great Lakes bat species can be divided into two groups: tree-roosting, migratory bats and cavity-roosting, hibernating bats. The hibernating species are highly susceptible to WNS, except for big brown bats (*Eptesicus fuscus*) which show greater resilience (Frank et al. 2014, Moore et al. 2018).

The U.S. Fish and Wildlife Service lists the Indiana bat (*Myotis sodalis*) as federally endangered and the northern long-eared bat (*Myotis septentrionalis*) as federally threatened under the Endangered Species Act (U.S. Fish and Wildlife Service 1967, 2016). Furthermore, all nine Great Lakes bat species are listed by one or more states as endangered, threatened, or of special concern (Michigan Natural Features Inventory 2009, Minnesota Department of Natural Resources 2013, Wisconsin Department of Natural Resources 2016, Indiana Division of Fish and Wildlife 2020) (Appendix A).

Prior to the initiation of the GLKN bat acoustic monitoring program, a total of six species had been documented at GRPO (Table 1). Only two species were detected during general faunal surveys in 1992–1994: the little brown bat (*Myotis lucifugus*) and hoary bat (*Lasiurus cinereus*) (Graetz et al. 1995). Four additional species were recorded during a survey effort specifically targeting bats, completed at GRPO in 2003 (Kruger and Peterson 2008, Miller 2010). This effort included acoustic recording, mist-netting, and roost surveys.

Although the tricolored bat (*Perimyotis subflavus*) has not been documented at GRPO, there are nearby records from Palisade Head near Silver Bay, Minnesota (Knowles 1992), and from the Hovland, Minnesota, area (Abel and Moen 2011). Recent acoustic surveys conducted in 2015–2017 by the Minnesota Department of Natural Resources and the University of Minnesota-Duluth's Natural Resources Research Institute also detected possible tricolored bats at numerous Cook County

locations (Moen et al. 2018). GRPO lies near the edge of the tricolored bat’s range, and this species may potentially be present in the park. The ranges of the Indiana bat (*Myotis sodalis*) and evening bat (*Nycticeius humeralis*) lie further south, therefore these species are not expected to be present at GRPO.

**Table 1.** Bat species occurrences recorded at Grand Portage National Monument prior to the initiation of the GLKN acoustic monitoring program in 2016, and method(s) by which the species were documented. Data sources include Graetz et al. (1995), Kruger and Peterson (2008), and Miller (2010). Ranges are as shown in Kurta (2017).

Species Name	Prior Records	Methods Used
Big Brown Bat <i>Eptesicus fuscus</i>	Yes	Acoustic
Eastern Red Bat <i>Lasiurus borealis</i>	Yes	Acoustic, Capture
Hoary Bat <i>Lasiurus cinereus</i>	Yes	Acoustic, Capture
Silver-haired Bat <i>Lasionycteris noctivagans</i>	Yes	Acoustic, Capture, Genetic Voucher
Little Brown Bat <i>Myotis lucifugus</i>	Yes	Acoustic, Capture, Genetic Voucher
Northern Long-eared Bat <i>Myotis septentrionalis</i>	Yes	Acoustic, Capture, Genetic Voucher
Indiana Bat <i>Myotis sodalist</i>	No, well outside of range	n/a
Evening Bat <i>Nycticeius humeralis</i>	No, well outside of range	n/a
Tricolored Bat <i>Perimyotis subflavus</i>	No, close to edge of range	n/a

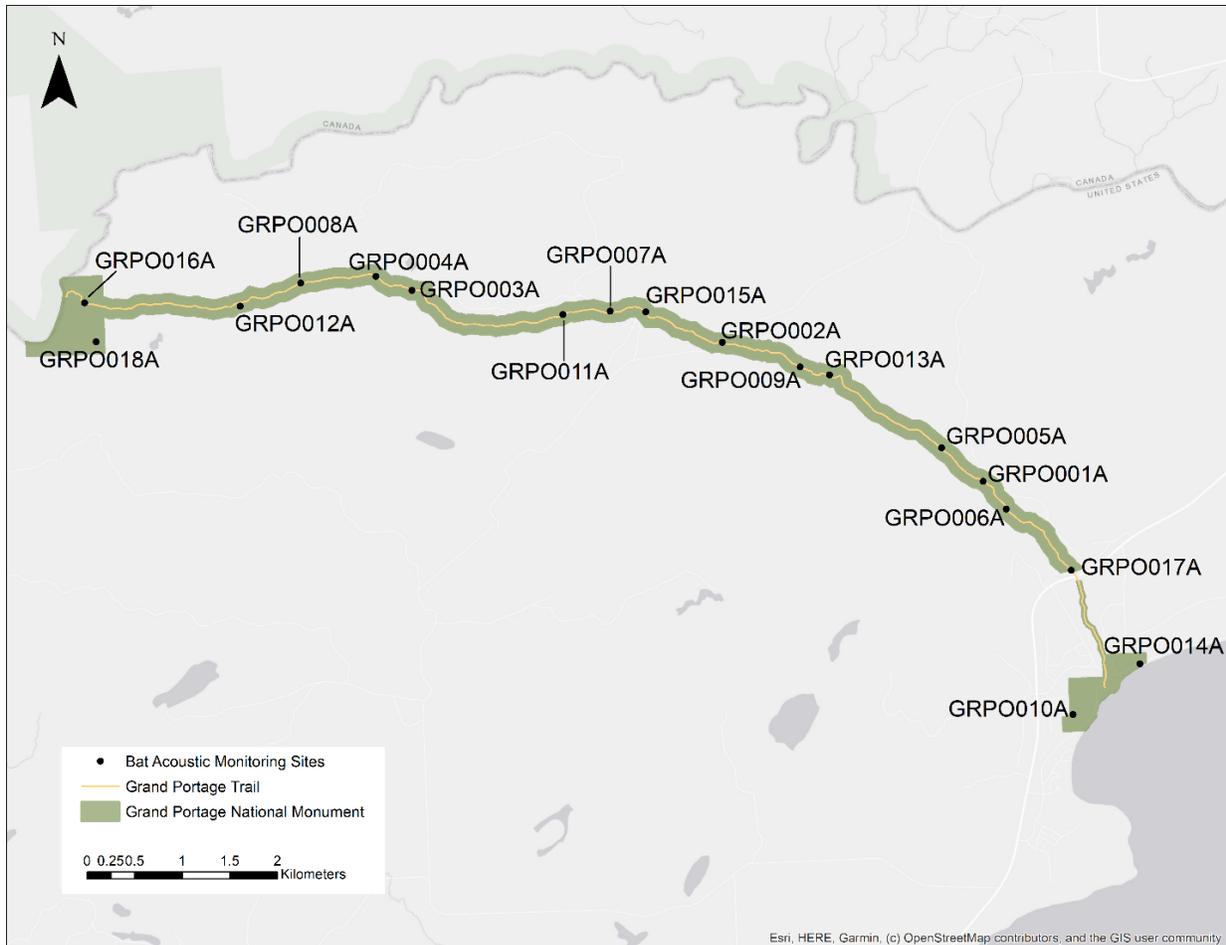
## Methods

Bat acoustic monitoring at GRPO was conducted according to the protocol and standard operating procedures developed by GLKN (Goodwin et al. 2020). Initial protocol development was done in coordination with an outside consultant, Western EcoSystems Technology, Inc. (Gruver et al. 2016). Although methods were revised by GLKN after the 2015 season of monitoring, the majority of the sampling procedures were consistent across all years.

### Site Selection

GLKN utilizes a probabilistic sample design based on the creation of a master sample, as described by Larsen et al. (2008). The sampling frame for each park consists of a finite grid of 1-km<sup>2</sup> cells. For some parks certain areas were excluded from the sampling frame *a priori* based on inaccessibility from roads, trails, or shorelines. Using the Generalized Random Tessellation Stratified (GRTS) algorithm, cells within the sampling frame were arranged into an ordered list, referred to as the “master sample”; this list is both randomized and spatially balanced (Stevens and Olsen 2004). Cells to be sampled were identified by working through the master sample list in numerical order, starting with Cell #001. Each cell was evaluated for accessibility and safety to determine if it should be included. Omitted cells were documented to justify the reason for exclusion. At GRPO, a total of 18 cells were selected for sampling, equivalent to 100% of the park’s sampling frame. The selected cells have been used from 2016 onward.

The *cell* is defined as the 1-km<sup>2</sup> area that is selected for sampling. The *site* is defined as the exact location within the cell where the acoustic recording equipment is placed. Sites were chosen by identifying locations that were reasonably accessible and had suitable bat habitat such as travel corridors (e.g., cut line, road, trail, or forest edge) or foraging areas (e.g., wetland). As much as possible, sites were located away from dense vegetative clutter, buildings, or open water to optimize recording quality. Each site was assigned a Site ID based on the cell’s GRTS order number, in the format GRPO001A. A map of GRPO sample sites is provided in Figure 1.



**Figure 1.** Bat monitoring sites at Grand Portage National Monument. Sites shown were established in 2016 and used each year since.

## Data Collection

Acoustic monitoring is conducted during the summer, from 1 June–15 August. The same sites are monitored each year in approximately the same order and at approximately the same time of year to facilitate estimation of long-term trends. Each site is sampled once per year, for a period of 7–14 consecutive nights. Detectors are programmed to record every night from 6:00 p.m. to 8:00 a.m.

One acoustic detector with an external ultrasonic microphone is deployed at each survey site to passively record bat echolocation calls. Equipment used at GRPO includes Wildlife Acoustics Song Meter SM3BAT and Song Meter SM4BAT-FS detectors and Wildlife Acoustics SMM-U1 microphones. Recordings are collected in full-spectrum format and stored as WAV files on SD cards mounted in the detector. Field technicians complete a datasheet for each deployment and collect site photographs and GPS coordinates. After retrieving equipment, the WAV files and detector program/status files are downloaded.

## Data Management and Analysis

Field technicians are responsible for data organization and securely storing data at the GRPO office. At the conclusion of the field season, all data are submitted to GLKN for quality assurance/quality control, entry into the bat monitoring database, data analysis, and data archiving.

For 2016–2019 data, GLKN contracted with an outside consultant (Normandeau Associates) to process acoustic files and obtain species classifications. Each deployment was categorized as valid or not valid. Valid deployments were those that had at least four nights of successful recording during the protocol sampling period (1 June–15 August). In some cases, there was more than one valid deployment per year at a particular site. When this occurred, the first valid deployment was categorized as “valid” and the remaining were categorized as “valid (duplicate)”. A deployment categorized as “failed” indicates it was unsuccessful due to equipment malfunction, improper programming, and/or vandalism. “Failed (short)” indicates the deployment was unsuccessful only because the minimum required four nights of recording were not completed. “Early” and “late” categories designate deployments that occurred either before 1 June or after 15 August, and thus were outside the protocol sampling period. Finally, “nonprotocol” indicates deployments that were completed for park-specific monitoring goals at locations that were intentionally selected rather than following the GRTS sample design. Non-valid deployments (including those categorized as “valid (duplicate)”) were excluded from all further analyses.

Normandeau Associates used an automated acoustic analysis software program to filter out noise and assign species classifications to audio files. The specific program used was Wildlife Acoustics Kaleidoscope Pro Version 4.0.0 (2016–2018) or Version 5.0.3 (2019), with the Bats of North America Classifier Version 3.1.0 and the “–1 More Sensitive” setting. During Kaleidoscope processing, the software assigned each audio file a species-level classification where possible. Files not classified to a particular species were labeled “No ID” if they contained unknown bat calls, otherwise they were labeled “Noise”. The software did not process files that were corrupt or unreadable. Kaleidoscope Pro allows the user to customize a list of possible bat species that will be considered during the classification process. This allows for the exclusion of any species not found in the study area, reducing the chance of obtaining false positive results. GLKN determined which species have known ranges within the boundaries of GRPO based on published range maps (Harvey et al. 2011, Rodhouse et al. 2016, Kurta 2017). These species were considered the “baseline” species list. We also created an “expanded” list, adding species that are documented relatively close to the park and may possibly be present. All audio files were run through Kaleidoscope Pro twice, once using the baseline list and once using the expanded list. The baseline and expanded species lists for GRPO are provided in Appendix B. Analysis settings used in Kaleidoscope Pro are provided in Appendix C.

Kaleidoscope Pro and other similar acoustic analysis programs are not 100% accurate. Software classification results are expected to include some errors due to the similarity of echolocation calls among different species, variation of calls within the same species, poor quality or truncated calls, clutter effects, or multiple bats recorded simultaneously (Britzke et al. 2013, Reichert et al. 2018).

Therefore, manual review (manual vetting) of call files by a qualified biologist is an important secondary step to verify the results produced by the software.

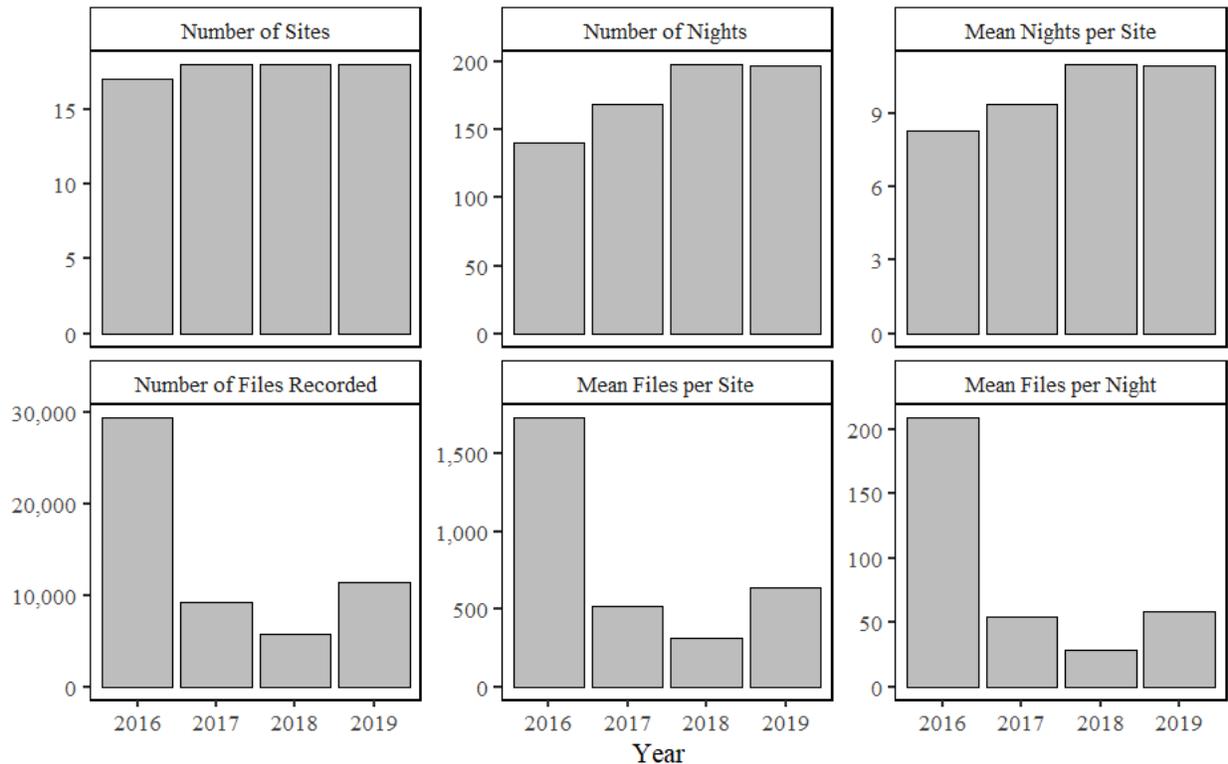
Due to the enormous quantity of data collected by the GLKN monitoring program, it is not feasible to manually review all files. From each year's dataset, Normandeau Associates randomly selected approximately 1% of the files that Kaleidoscope Pro identified to the species level (i.e., excluding noise and unknown bats). To ensure all species were proportionally represented, this consisted of 1% of the files identified to each species, with a required minimum of 10 files per species unless there were fewer than 10 files available. This procedure was used for the baseline analysis; for the expanded analysis, additional files were selected only for the new species not already represented by the baseline analysis. Files selected for manual vetting were chosen and prepared by a different individual than the biologist doing the reviewing. Potentially identifying information such as site location and date were removed from the file name. Manual vetting was performed by a qualified biologist from Normandeau Associates, who was provided with a list of possible species to consider. However, to ensure an independent assessment, the manual reviewer did not know how the Kaleidoscope software had identified each file. Manual identifications were based on call characteristics such as shape, frequency, and duration, using published reference materials and call libraries. The manual reviewer assigned a species or species group (e.g., unknown high frequency or unknown low frequency) to each audio file, assuming it contained bat calls of sufficient quality. The reviewer could also determine that a file did not contain bat echolocation calls and contained only noise. Following processing, results of both automated software classification and manual vetting were incorporated into GLKN's bat monitoring database.

# Results

## Survey Effort

Acoustic monitoring took place at GRPO during the years 2016 to 2019. There were 17 to 18 valid deployments per year. This report provides results only for the sites that had valid deployments.

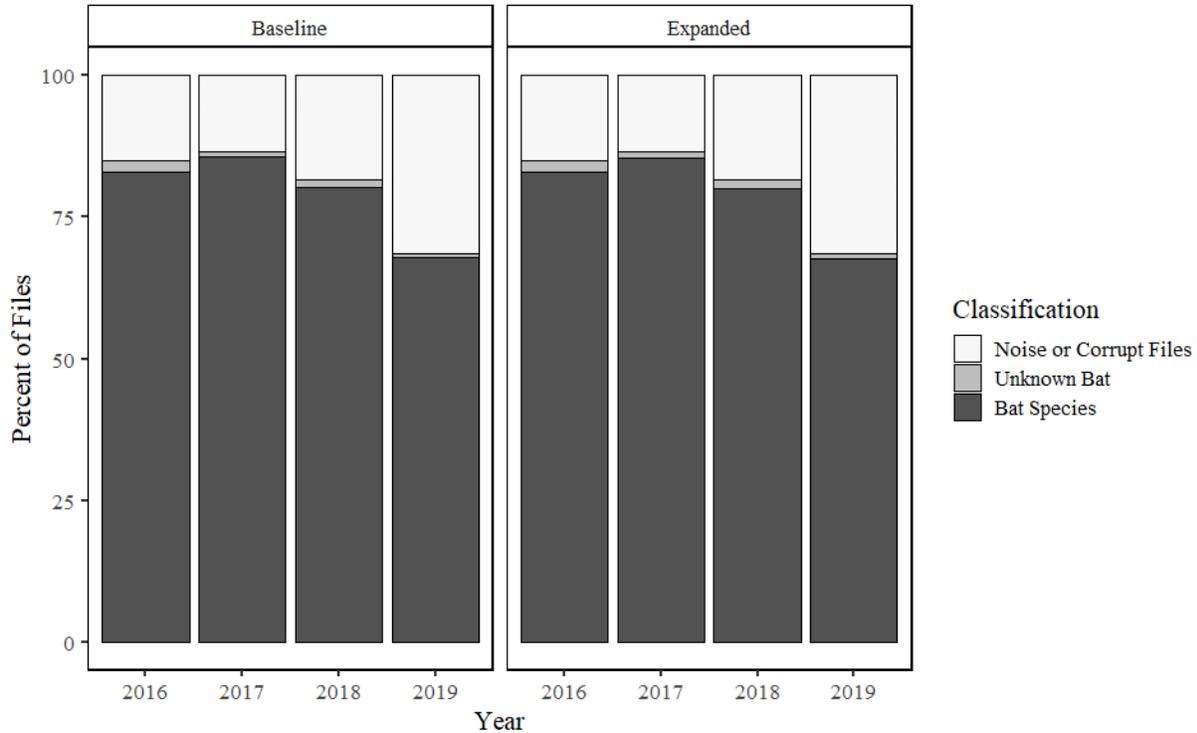
Monitoring occurred over a total of 141 to 198 nights of recording. The number of audio files collected per year ranged from 5,748 to 29,413, with 2016 significantly higher than all other years. Yearly survey effort and deployment information are summarized in Figure 2 and Appendix D.



**Figure 2.** Yearly survey effort at Grand Portage National Monument (2016–2019). *Top, left to right:* Number of sites, number of nights, and mean nights per site; *bottom, left to right:* total number of audio files recorded, mean files per site, and mean files per night. Number of files is prior to classification (i.e., includes noise).

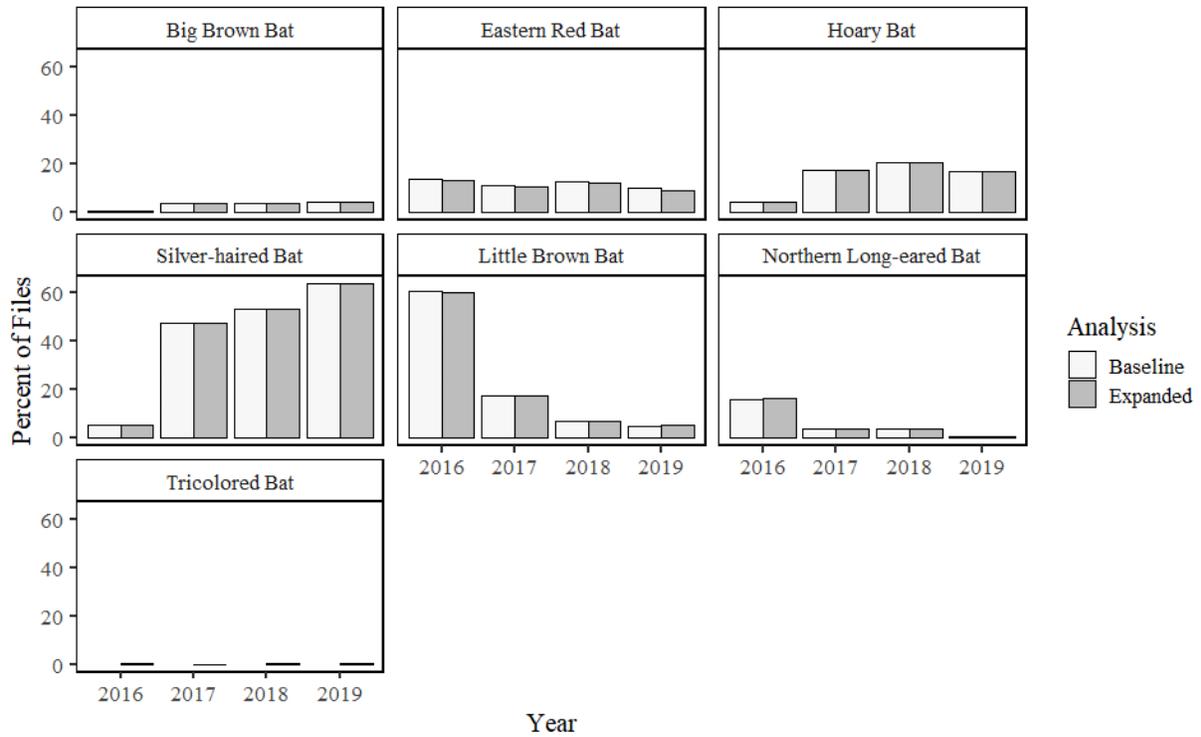
## Automated Classification

A majority of files (68–86% per year) were identified to the species level by Kaleidoscope Pro (Figure 3, Appendix E). . The proportion of files assigned to a species versus noise or unknown was similar for the baseline and expanded analyses.

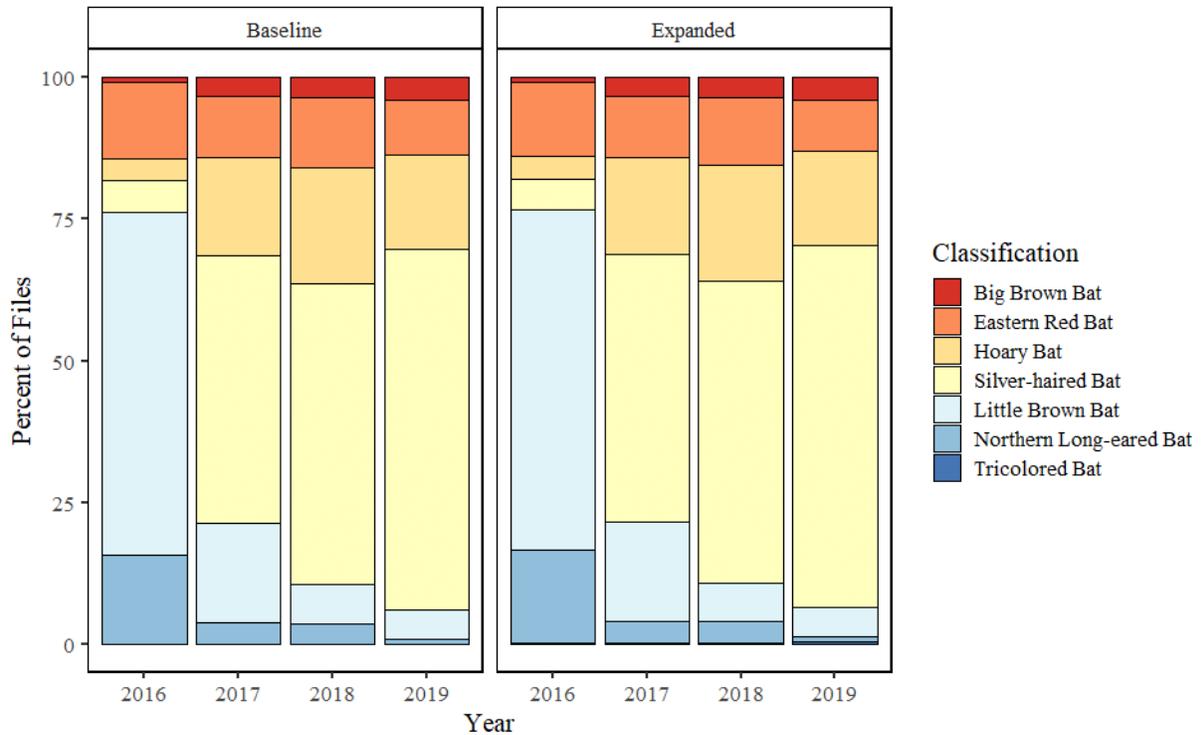


**Figure 3.** Percent of audio files classified by Kaleidoscope Pro as bat species vs. unknown bats vs. noise or corrupt files for each year and analysis type, Grand Portage National Monument (2016–2019).

Kaleidoscope Pro automated classification resulted in a total of six species documented in the baseline analysis and seven species documented in the expanded analysis. For the subset of files that were successfully assigned a species-level classification, the percent classified to each species was similar between the baseline and expanded analyses but varied from year to year (Figure 4). In general, 2016 results were quite different from 2017–2019. In both the baseline and expanded analyses, the largest proportion of files was classified as little brown bat in the first year, then silver-haired bat in the later three years. After 2016, the proportion of files attributed to the three most WNS-susceptible species (little brown, northern long-eared, and tricolored bats) showed a strong decrease relative to the proportion attributed to the other species (Figure 5). The most notable changes for individual species were an increase in the percentage of hoary and silver-haired bat files and a decrease in the percentage of little brown and northern long-eared bat files. File counts and percentages are provided in Appendix E.

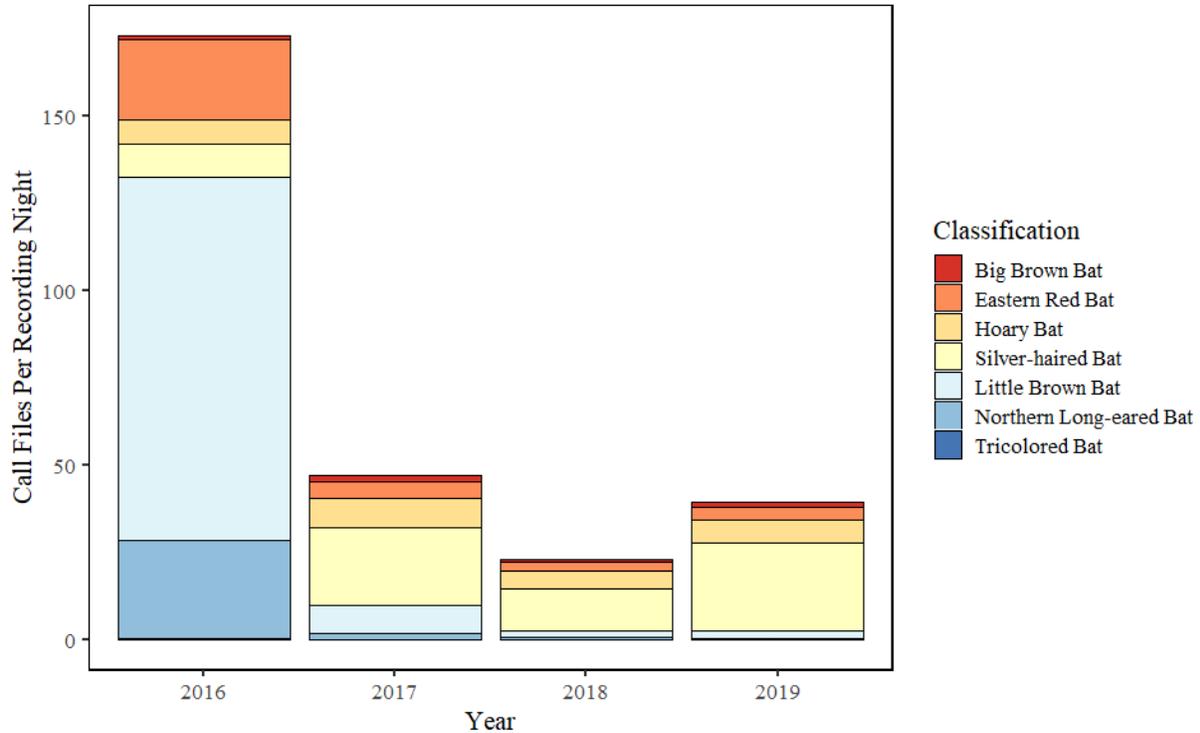


**Figure 4.** Proportion of files classified to each species each year in the baseline versus expanded analysis, Grand Portage National Monument (2016–2019). Tricolored bat was only allowed as a possible species in the expanded analysis. Includes only the subset of files successfully assigned a species-level classification by Kaleidoscope Pro.



**Figure 5.** Proportion of files classified to each species each year relative to all other species, Grand Portage National Monument (2016–2019). The three most WNS-susceptible species (little brown, northern long-eared, and tricolored bats) are shown in shades of blue while less susceptible species are shown in red, orange, and yellow. Tricolored bat was only allowed as a possible species in the expanded analysis. Includes only the subset of files successfully assigned a species-level classification by Kaleidoscope Pro.

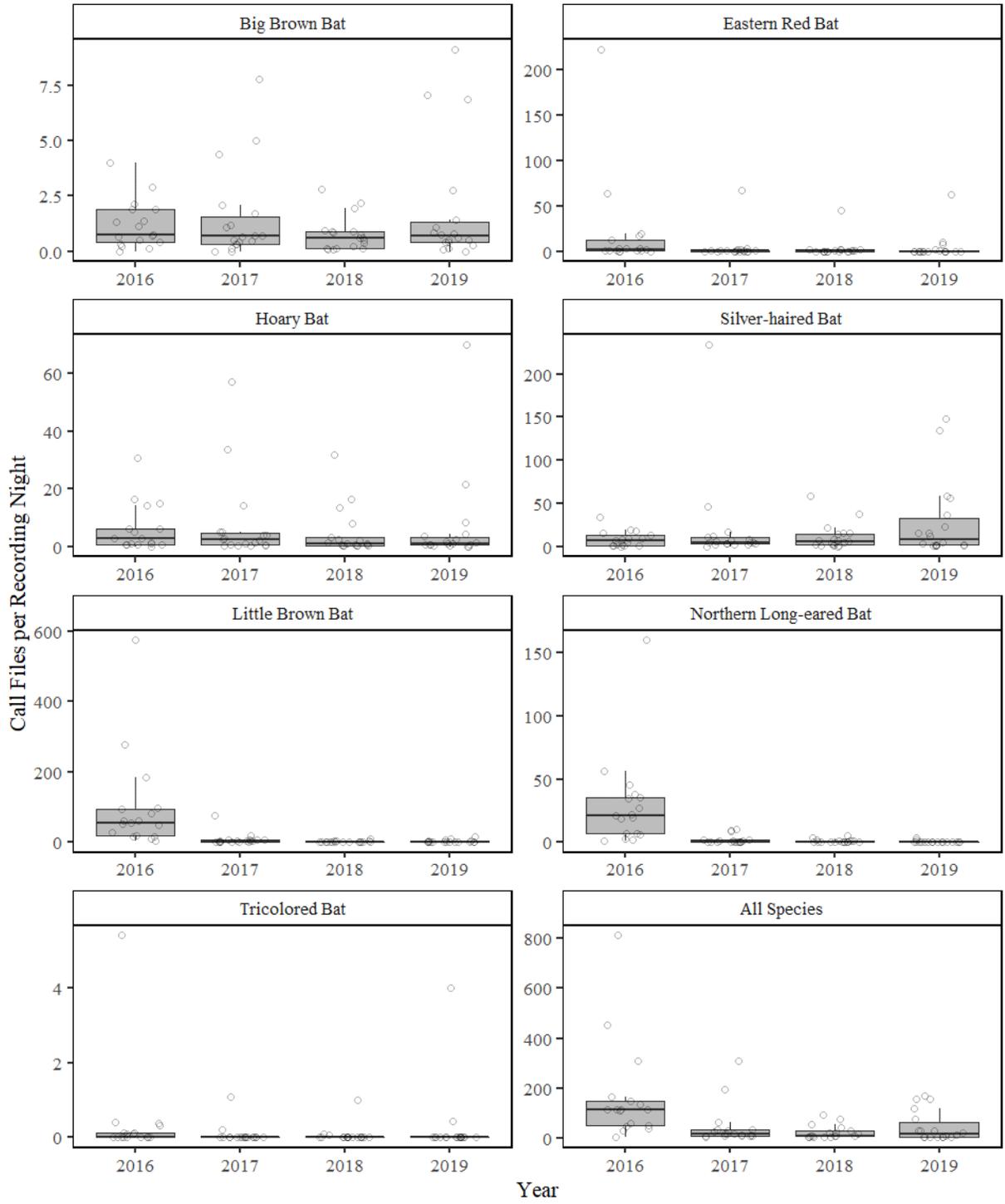
Call files per recording night were calculated on both the park level and individual site level using the results of the automated classification by Kaleidoscope. Parkwide, total call files per recording night were much higher in 2016 than in any of the later years and call files per recording night declined sharply for the WNS-susceptible species, especially little brown bat (Figure 6).



**Figure 6.** Parkwide call files per recording night by species and year for the expanded analysis, Grand Portage National Monument (2016–2019). The three most WNS-susceptible species (little brown, northern long-eared, and tricolored bats) are shown in shades of blue while less susceptible species are shown in red, orange, and yellow. Results were similar for baseline and expanded analysis so only the expanded analysis is shown.

At the site level, when looking at all species combined, call files per recording night were much higher in 2016 than in the other years and results from 2017–2019 were all similar (Figure 7, lower right panel). Looking at individual species, we observed a substantial drop in median call files per recording night after 2016 for three species (little brown, northern long-eared, and eastern red bats), while the median values for big brown, hoary, and silver-haired bats were more stable across all four years (Figure 7).

The median call files per recording night for tricolored bat was very low in all four years. Adding the tricolored bat as a possible species in the expanded analysis did not substantially change the call files per recording night values for other species because only a small number of files were reassigned to tricolored bat.

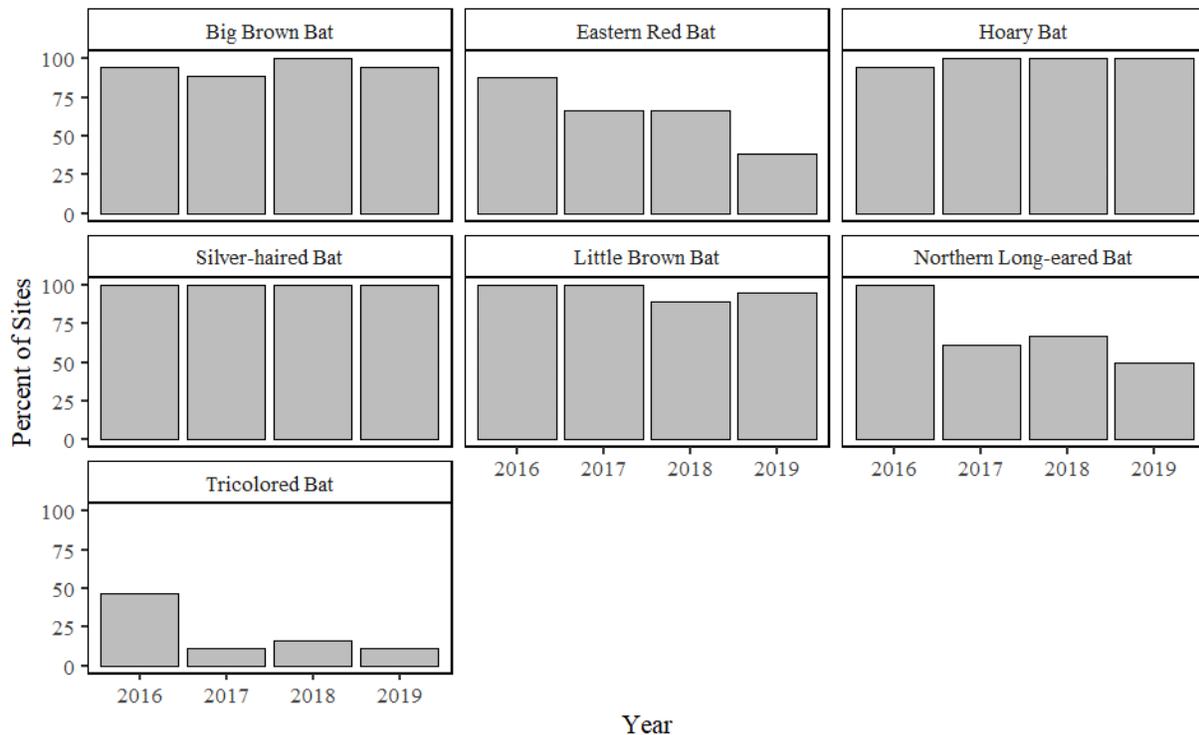


**Figure 7.** Call files per recording night for each species and for all species combined, by year, for the expanded analysis, Grand Portage National Monument (2016–2019). Each point represents call files per recording night at a particular survey site. The dark line across the boxplot represents the median. Note that the y-axis scale is different for each species. Results were similar for baseline and expanded analysis so only expanded is shown.

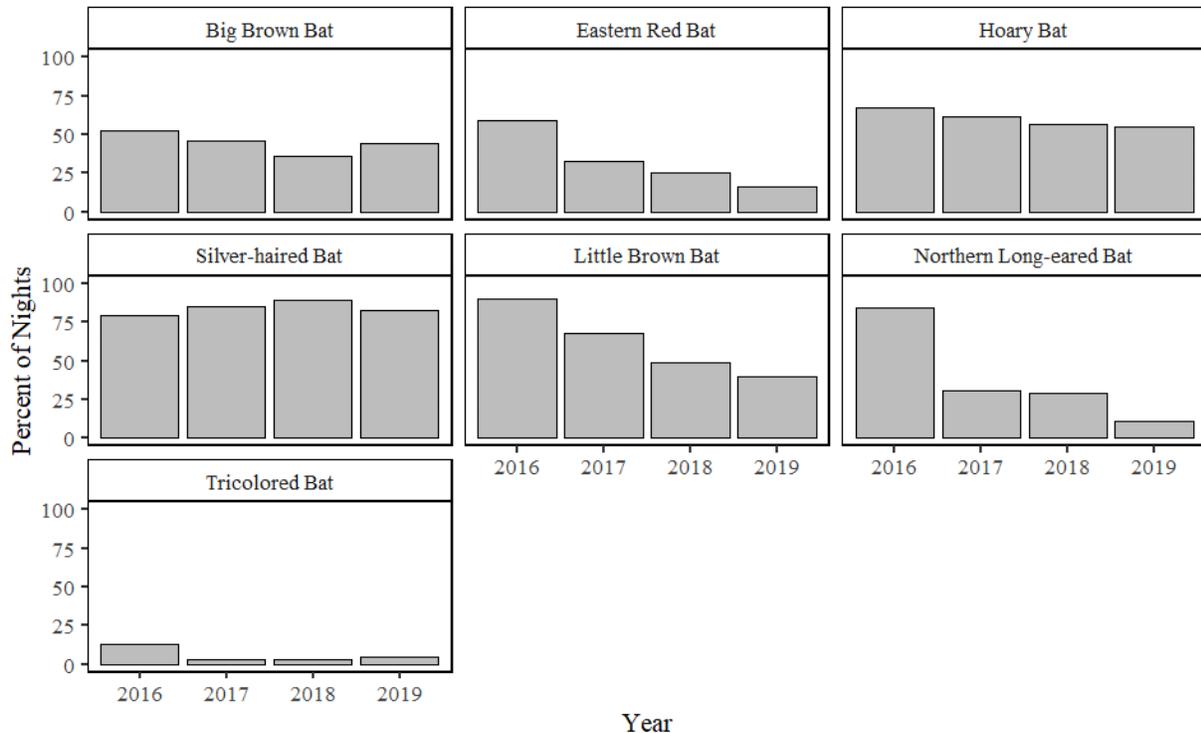
## Spatial and Temporal Distribution

Spatial and temporal species distributions were assessed using the results of the automated classification. A species was considered to be detected at a site if at least one audio file was classified as that species by Kaleidoscope Pro.

Four species (big brown, hoary, silver-haired, and little brown bats) were widely distributed across the park, with detections at greater than 85% of monitoring sites in every year (Figure 8, Appendix E). Eastern red bats and northern long-eared bats were detected at a high percentage of sites in 2016, but this declined in 2017–2019. Hoary and silver-haired bats were detected on greater than 50% of recording nights each year, while the other species were detected less frequently and showed a declining percentage of nights after 2016 (Figure 9, Appendix E). On average, the silver-haired bat was detected at the highest percentage of sites and on the highest percentage of nights. When included in the expanded analysis, the tricolored bat was detected at 11%–47% of sites and on 3%–13% of nights.



**Figure 8.** Proportion of monitoring sites where each species was detected, for each year and analysis type, Grand Portage National Monument (2016–2019). Results were similar for baseline and expanded analysis so only expanded is shown. A species was considered to be detected at a site if at least one audio file was classified as that species by Kaleidoscope Pro.



**Figure 9.** Proportion of recording nights on which each species was detected, for each year and analysis type, Grand Portage National Monument (2016–2019). Results were similar for baseline and expanded analysis so only expanded is shown. A species was considered to be detected on a night if at least one audio file was classified as that species by Kaleidoscope Pro.

### Manual Vetting

A small subset of audio files was manually vetted, approximately 1% of files identified to each species. Because the 1% sometimes equated to only a few files, we required a minimum of 10 files per species to be vetted unless there were fewer than 10 files available (see Methods). Manual vetting resulted in a total of seven species being verified between 2016 and 2019. Detailed manual vetting results for the park as a whole are provided in Appendix F and for each monitoring site in Appendix G.

The percentage of files that were verified by manual vetting varied widely by species. The mean percentage verified (calculated parkwide, across all survey years) ranged from 2% for the tricolored bat to 79% for the hoary bat (Appendix F). The variation in percentage verified is related to how difficult the calls are to identify. Ease of identification can depend on both call structure and recording environment. For example, the hoary bat consistently vocalizes at a much lower frequency than any other bat in the region, making its call signature unique and relatively easy to distinguish. On the other hand, the three *Myotis* species (little brown bat, northern long-eared bat, and Indiana bat) all produce very similar calls with highly overlapping call characteristics. Northern long-eared and little brown bat calls tend to be more distinctive from each other in cluttered environments, such as under a closed forest canopy, than in open environments (Broders et al. 2004) and can therefore sometimes be identified.

## Summary and Conclusions

The six bat species previously documented at GRPO (see Table 1) were reconfirmed through this monitoring effort: big brown bat, eastern red bat, hoary bat, silver-haired bat, little brown bat, and northern long-eared bat. A seventh species, the tricolored bat, was also documented. Tricolored bats have not been confirmed at GRPO through physical captures, but our acoustic surveys suggest this species is present, as evidenced by one tricolored bat recording that was manually verified. The manually verified recording came from site GRPO014A (Boneyard Road/Lake Superior shoreline) and was collected in 2017. This particular location had a greater number of tricolored bat calls identified by the software than any other sample site in all four years. It is important to note that only about one-third of the call files (40 files) identified by the software as tricolored bats have so far been manually reviewed. Conducting additional manual review on the remaining files could increase the number of locations or years with positive records of this species.

Activity levels for three of the seven species (big brown bat, hoary bat, and silver-haired bat) appeared to be stable. The remaining four species appeared to have decreasing trends in activity levels. Three of these (little brown bat, northern long-eared bat, and tricolored bat) are highly susceptible to WNS, and the disease is mostly likely causing the observed declines. The fourth species (eastern red bat) is not susceptible to WNS but is one of the most frequently killed at wind energy facilities (Arnett et al. 2015). Although there are many wind energy facilities in Minnesota, they are located primarily in the southwestern part of the state, not near GRPO. Migration routes of migratory bats are not well understood, but red bats are thought to move south and east, concentrating on the Atlantic and Gulf coasts for the winter (Cryan 2003). Hoary and silver-haired bats also have high fatality rates at wind facilities but do not seem to be declining at GRPO. The decrease in red bat activity may, therefore, be due to other unknown factors.

Results for each species are summarized below and in Table 2. For comparison purposes, species composition over time across all GLKN parks is provided in Appendix H.

### Big Brown Bat

- Documented in every year of surveys via automated identification and verified manually in 2016 and 2017.
- Widely distributed: Present at over 85% of survey sites each year.
- Recorded relatively rarely compared to other species: Less than 4% of total files each year.
- Recorded on 36%–52% of nights each year.
- Median call files per recording night consistently low in all four years.

### Eastern Red Bat

- Documented in every year of surveys (both automated and manual identification).
- Present at 39%–94% of survey sites each year, with a decreasing trend since 2016.
- Percent of total files ranged from 9%–14%, with little variation from year to year.
- Recorded on about 60% of nights in 2016, but only 17%–33% of nights in 2017–2019.

- Median call files per recording night higher in 2016 than in other three years. One site (GRPO014A, Boneyard Road/Lake Superior shoreline) had the highest red bat calls per recording night of all sites in all four years.

### **Hoary Bat**

- Documented in every year of surveys (both automated and manual identification).
- Widely distributed: Present at over 90% of survey sites each year.
- Percent of total files ranged from 4%–21%. Made up a much larger proportion of files in the last three years than in 2016.
- Recorded on 55%–67% of nights each year.
- Median call files per recording night generally similar across all years but slightly lower in 2018–2019 than in 2016–2017.

### **Silver-haired Bat**

- Documented in every year of surveys (both automated and manual identification).
- Widely distributed: Present at 100% of survey sites each year.
- Percent of total files ranged from 5%–64%. Made up a much larger proportion of files in the last three years than in 2016.
- Recorded on a high percentage of nights each year (79%–89%).
- Median call files per recording night similar across 2016–2019. One site (GRPO018A) had a very high number of calls per recording night in 2017 (over 200). This site also had the most silver-haired bat calls per recording night of all sites in 2016 and 2018, and the second highest in 2019.

### **Little Brown Bat**

- Documented in every year of surveys (both automated and manual identification).
- Widely distributed: Present at over 85% of survey sites each year.
- Most commonly recorded species by far in 2016, with 60% of the total files, but only 5%–17% of total files in the last three years.
- Recorded on 40%–90% of nights each year, with a decreasing trend after 2016.
- Median call files per recording night much higher in 2016 (approximately 60) than in 2017–2019 (less than 10).

### **Northern Long-eared Bat**

- Documented in every year of surveys (both automated and manual identification).
- Present at 100% of survey sites in 2016, but only 44%–67% of sites in 2017–2019.
- Second most commonly recorded species in 2016, with 16% of the total files, but less than 4% of total files in the last three years.
- Recorded on 84% of nights in 2016, but only 10%–30% of nights in 2017–2019.

- Median call files per recording night much higher in 2016 (approximately 20) than in 2017–2019 (less than two).

**Tricolored Bat**

- Documented in every year of surveys via automated identification (expanded analysis only) and verified manually in 2017.
- Present at 47% of survey sites in 2016, but only 11%–17% of sites in 2017–2019.
- Rarely recorded compared to other species: Less than 1% of total files each year and little change from year to year.
- Recorded infrequently, on only 3%–13% of nights each year.
- Median call files per recording night very low (approximately zero) in all four years.

**Table 2.** Summary of bat species documented at Grand Portage National Monument through automated classification and manual vetting of acoustic files.

Species	Year	Detected	
		Automated	Manual
Big Brown Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	No
	2019	Yes	No
Eastern Red Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	Yes
	2019	Yes	Yes
Hoary Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	Yes
	2019	Yes	Yes
Silver-haired Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	Yes
	2019	Yes	Yes

**Table 2 (continued).** Summary of bat species documented at Grand Portage National Monument through automated classification and manual vetting of acoustic files.

<b>Species</b>	<b>Year</b>	<b>Detected</b>	
		<b><i>Automated</i></b>	<b><i>Manual</i></b>
Little Brown Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	Yes
	2019	Yes	Yes
Northern Long-eared Bat	2016	Yes	Yes
	2017	Yes	Yes
	2018	Yes	Yes
	2019	Yes	Yes
Tricolored Bat	2016	Yes	No
	2017	Yes	Yes
	2018	Yes	No
	2019	Yes	No

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## Appendix A: Bat Species of the Great Lakes Region.

**Table A1.** Nine bat species are found in the Great Lakes region. Species affected by white-nose syndrome (WNS) are listed as “Confirmed” if they have been identified with diagnostic symptoms of the disease, or “Pd Positive” if the causative fungus *Pseudogymnoascus destructans* has been detected but without diagnostic symptoms of the disease. Federal/state status is indicated as E (Endangered), T (Threatened), or SC (Special Concern).

Species Name	Roosting/Wintering Behavior	WNS Affected? <sup>a</sup>	Federal Status <sup>b</sup>	State Status <sup>c</sup>
Big Brown Bat <i>Eptesicus fuscus</i>	Cavity-roosting/ Hibernating	Confirmed WNS	–	T (WI) SC (MN)
Eastern Red Bat <i>Lasiurus borealis</i>	Tree-roosting/ Migratory	Pd Positive	–	SC (IN)
Hoary Bat <i>Lasiurus cinereus</i>	Tree-roosting/ Migratory	–	–	SC (IN)
Silver-haired Bat <i>Lasionycteris noctivagans</i>	Tree-roosting/ Migratory	Pd Positive	–	SC (IN, WI)
Little Brown Bat <i>Myotis lucifugus</i>	Cavity-roosting/ Hibernating	Confirmed WNS	–	E (IN) T (WI) SC (MI, MN)
Northern Long-eared Bat <i>Myotis septentrionalis</i>	Cavity-roosting/ Hibernating	Confirmed WNS	T	E (IN) T (WI) SC (MI, MN)
Indiana Bat <i>Myotis sodalis</i>	Cavity-roosting/ Hibernating	Confirmed WNS	E	E (IN, MI)
Evening Bat <i>Nycticeius humeralis</i>	Tree-roosting/ Migratory	–	–	E (IN) T (MI)
Tricolored Bat <i>Perimyotis subflavus</i>	Cavity-roosting/ Hibernating	Confirmed WNS	–	E (IN) T (WI) SC (MI, MN)

<sup>a</sup> White-nose Syndrome Response Team, [www.whitenosesyndrome.org](http://www.whitenosesyndrome.org)

<sup>b</sup> U. S. Fish and Wildlife Service (1967, 2016)

<sup>c</sup> Indiana Division of Fish and Wildlife (2020), Michigan Natural Features Inventory (2009), Minnesota Department of Natural Resources (2013), Wisconsin Department of Natural Resources (2016)



## Appendix B: Baseline and Expanded Species Lists.

**Table B1.** Bat species included as possible candidates during Kaleidoscope Pro species classification. The first column shows the “baseline” species group (known ranges within the boundaries of the park). The second column shows the “expanded” species group (documented near the park, possibly present).

<b>Species Name</b>	<b>Baseline Analysis</b>	<b>Expanded Analysis</b>
Big Brown Bat <i>Eptesicus fuscus</i>	X	X
Eastern Red Bat <i>Lasiurus borealis</i>	X	X
Hoary Bat <i>Lasiurus cinereus</i>	X	X
Silver-haired Bat <i>Lasionycteris noctivagans</i>	X	X
Little Brown Bat <i>Myotis lucifugus</i>	X	X
Northern Long-eared Bat <i>Myotis septentrionalis</i>	X	X
Tricolored Bat <i>Perimyotis subflavus</i>	–	X



## **Appendix C: Analysis Settings for Kaleidoscope Pro.**

The following software settings were used during Kaleidoscope Pro analysis for species classification. Although two different software versions were used, the classifier did not change, so results are still comparable.

Software Version: Kaleidoscope Pro 4.0.0 (2015–2018 data) and Kaleidoscope Pro 5.0.3 (2019 data)

Classifier: Bats of North America 3.1.0

Classifier Sensitivity: -1 More Sensitive/Liberal

Signal Parameters:

Frequency: 8–120 kHz

Duration: 2–500 ms

Maximum inter-syllable gap: 500 ms

Minimum Number of Pulses: 2

Full spectrum WAV files were converted to zero crossing format before analysis.

Zero crossing conversion/analysis was enhanced with advanced signal processing option.



## Appendix D: Yearly Deployment Data.

**Table D1.** Earliest and latest dates equipment was deployed, number of deployments in each category, and total number of files recorded for each survey year at Grand Portage National Monument, 2016–2019.

Year	Earliest	Latest	Deployment Category <sup>1</sup>							Total Files
			Early	Failed	Failed (short)	Late	Non-protocol	Valid	Valid (dupl.)	
2016	8 June	18 August	0	0	1	0	1	17	0	31,119
2017	1 June	3 August	0	0	0	0	0	18	0	9,294
2018	1 June	6 August	0	0	0	0	0	18	0	5,748
2019	30 May	12 August	0	0	0	0	0	18	0	11,534

<sup>1</sup> “Early” = deployment occurred before 1 June, outside the protocol sampling period.

“Failed” = deployment was unsuccessful due to equipment malfunction, improper programming, and/or vandalism.

“Failed (short)” = deployment was unsuccessful because the minimum required four nights of recording were not completed.

“Late” = deployment occurred after 15 August, outside the protocol sampling period.

“Non-protocol” = deployments completed for park-specific monitoring goals at locations intentionally selected rather than following the GRTS sample design.

“Valid” = deployment with at least four nights of successful recording during the protocol sampling period (1 June–15 August).

“Valid (dupl.)” = valid deployment at a particular site in addition to the first valid deployment.

**Table D2.** Total number of sites, recording nights, files recorded, and mean recording nights per site, mean files per site, and mean files per recording night for each survey year’s valid deployments only, Grand Portage National Monument, 2016–2019. This table corresponds to Figure 2 in the main text.

Year	Total Sites	Total Nights	Mean Nights Per Site	Total Files	Mean Files Per Site	Mean Files Per Night
2016	17	141	8.29	29,413	1,730	209
2017	18	169	9.39	9,294	516	55
2018	18	198	11.00	5,748	319	29
2019	18	197	10.94	11,534	641	59



## Appendix E: Automated Classification Results.

**Table E1.** Total number of audio files recorded, and number and percent classified by Kaleidoscope Pro as bat species vs. unknown bats vs. noise or corrupt files for each year and analysis type, Grand Portage National Monument, 2016–2019. Only data from valid deployments are shown. This table corresponds to Figure 3 in the main text.

Year	Analysis	Total Files	# Bat Species	# Bat Unknown	# Noise	% Bat Species	% Bat Unknown	% Noise
2016	baseline	29,413	24,432	568	4,413	83.07	1.93	15.00
2016	expanded	29,413	24,423	577	4,413	83.03	1.96	15.00
2017	baseline	9,294	7,953	101	1,240	85.57	1.09	13.34
2017	expanded	9,294	7,948	106	1,240	85.52	1.14	13.34
2018	baseline	5,748	4,609	79	1,060	80.18	1.37	18.44
2018	expanded	5,748	4,598	90	1,060	79.99	1.57	18.44
2019	baseline	11,534	7,824	92	3,618	67.83	0.80	31.37
2019	expanded	11,534	7,809	107	3,618	67.70	0.93	31.37

**Table E2.** Total number of audio files classified as each bat species by Kaleidoscope Pro for each year and analysis type at Grand Portage National Monument, 2016–2019. Tricolored bat was allowed as a possible species only in the expanded analysis. Only data from valid deployments are shown.

Year	Analysis	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
2016	baseline	175	3,312	963	1,342	14,795	3,845	n/a
2016	expanded	178	3,220	965	1,341	14,670	3,983	66
2017	baseline	269	860	1,365	3,767	1,391	301	n/a
2017	expanded	269	842	1,365	3,768	1,386	304	14
2018	baseline	159	572	949	2,448	313	168	n/a
2018	expanded	158	549	949	2,450	312	168	12
2019	baseline	306	764	1,299	4,992	405	58	n/a
2019	expanded	306	706	1,296	4,995	408	63	35

**Table E3.** Percent of audio files classified as each bat species by Kaleidoscope Pro for each year and analysis type at Grand Portage National Monument, 2016–2019. Tricolored bat was allowed as a possible species only in the expanded analysis. Only data from valid deployments are shown. This table corresponds to Figures 4 and 5 in the main text.

Year	Analysis	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
2016	baseline	0.72	13.56	3.94	5.49	60.56	15.74	n/a
2016	expanded	0.73	13.18	3.95	5.49	60.07	16.31	0.27
2017	baseline	3.38	10.81	17.16	47.37	17.49	3.78	n/a
2017	expanded	3.38	10.59	17.17	47.41	17.44	3.82	0.18
2018	baseline	3.45	12.41	20.59	53.11	6.79	3.65	n/a
2018	expanded	3.44	11.94	20.64	53.28	6.79	3.65	0.26
2019	baseline	3.91	9.76	16.60	63.80	5.18	0.74	n/a
2019	expanded	3.92	9.04	16.60	63.96	5.22	0.81	0.45

**Table E4.** Total number of monitoring sites, and count of sites where each species was detected for each year and analysis type at Grand Portage National Monument, 2016–2019. A species was considered to be detected at a site if at least one audio file was classified by Kaleidoscope Pro to that species. Tricolored bat was allowed as a possible species only during the expanded analysis.

Year	Analysis	Total Sites	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
2016	baseline	17	16	16	16	17	17	17	n/a
2016	expanded	17	16	15	16	17	17	17	8
2017	baseline	18	16	12	18	18	18	10	n/a
2017	expanded	18	16	12	18	18	18	11	2
2018	baseline	18	18	12	18	18	16	12	n/a
2018	expanded	18	18	12	18	18	16	12	3
2019	baseline	18	17	8	18	18	17	8	n/a
2019	expanded	18	17	7	18	18	17	9	2

**Table E5.** Total number of monitoring sites, and percent of sites where each species was detected for each year and analysis type at Grand Portage National Monument, 2016–2019. A species was considered to be detected at a site if at least one audio file was classified by Kaleidoscope Pro to that species. Tricolored bat was allowed as a possible species only during the expanded analysis. This table corresponds to Figure 8 in the main text.

Year	Analysis	Total Sites	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
2016	baseline	17	94.12	94.12	94.12	100.00	100.00	100.00	n/a
2016	expanded	17	94.12	88.24	94.12	100.00	100.00	100.00	47.06
2017	baseline	18	88.89	66.67	100.00	100.00	100.00	55.56	n/a
2017	expanded	18	88.89	66.67	100.00	100.00	100.00	61.11	11.11
2018	baseline	18	100.00	66.67	100.00	100.00	88.89	66.67	n/a
2018	expanded	18	100.00	66.67	100.00	100.00	88.89	66.67	16.67
2019	baseline	18	94.44	44.44	100.00	100.00	94.44	44.44	n/a
2019	expanded	18	94.44	38.89	100.00	100.00	94.44	50.00	11.11

**Table E6.** Total number of recording nights, and count of recording nights on which each species was detected for each year and analysis type at Grand Portage National Monument, 2016–2019. A species was considered to be detected on a night if at least one audio file was classified by Kaleidoscope Pro to that species. Tricolored bat was allowed as a possible species only during the expanded analysis.

Year	Analysis	Total Nights	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Bat	Northern Long-eared Bat	Tricolored Bat
2016	baseline	141	72	88	95	112	127	119	n/a
2016	expanded	141	74	83	95	112	127	119	19
2017	baseline	169	78	55	104	144	115	51	n/a
2017	expanded	169	78	55	104	144	115	52	6
2018	baseline	198	73	50	112	176	97	56	n/a
2018	expanded	198	72	50	112	176	97	57	6
2019	baseline	197	87	36	109	163	80	19	n/a
2019	expanded	197	87	33	108	163	79	21	9

**Table E7.** Total number of recording nights, and percent of recording nights on which each species was detected for each year and analysis type at Grand Portage National Monument, 2016–2019. A species was considered to be detected on a night if at least one audio file was classified by Kaleidoscope Pro to that species. Tricolored bat was allowed as a possible species only during the expanded analysis. This table corresponds to Figure 9 in the main text.

<b>Year</b>	<b>Analysis</b>	<b>Total Nights</b>	<b>Big Brown Bat</b>	<b>Eastern Red Bat</b>	<b>Hoary Bat</b>	<b>Silver- haired Bat</b>	<b>Little Brown Bat</b>	<b>Northern Long- eared Bat</b>	<b>Tricolored Bat</b>
2016	baseline	141	51.06	62.41	67.38	79.43	90.07	84.40	n/a
2016	expanded	141	52.48	58.87	67.38	79.43	90.07	84.40	13.48
2017	baseline	169	46.15	32.54	61.54	85.21	68.05	30.18	n/a
2017	expanded	169	46.15	32.54	61.54	85.21	68.05	30.77	3.55
2018	baseline	198	36.87	25.25	56.57	88.89	48.99	28.28	n/a
2018	expanded	198	36.36	25.25	56.57	88.89	48.99	28.79	3.03
2019	baseline	197	44.16	18.27	55.33	82.74	40.61	9.64	n/a
2019	expanded	197	44.16	16.75	54.82	82.74	40.10	10.66	4.57

## Appendix F: Manual Vetting Results for Entire Park.

Manual vetting was performed on approximately 1% of call files classified to each species by Kaleidoscope Pro (or minimum of 10 files).

**Table F1.** Total number of files manually vetted, and the results of manual vetting for each year, analysis type, and species at Grand Portage National Monument, 2016–2019. “Verified” indicates that the manual identification matched, and thus verified, the automated identification.

Year	Analysis	Kaleidoscope Classification	Total Files Vetted	Number Files Verified	Percent Files Verified
2016	baseline	Big Brown Bat	5	1	20.00
2016	baseline	Eastern Red Bat	34	22	64.71
2016	baseline	Hoary Bat	10	7	70.00
2016	baseline	Silver-haired Bat	14	11	78.57
2016	baseline	Little Brown Bat	149	99	66.44
2016	baseline	Northern Long-eared Bat	39	23	58.97
2016	expanded	Tricolored Bat	10	0	0.00
<hr/>					
2017	baseline	Big Brown Bat	10	2	20.00
2017	baseline	Eastern Red Bat	10	7	70.00
2017	baseline	Hoary Bat	14	13	92.86
2017	baseline	Silver-haired Bat	38	26	68.42
2017	baseline	Little Brown Bat	14	11	78.57
2017	baseline	Northern Long-eared Bat	10	9	90.00
2017	expanded	Tricolored Bat	10	1	10.00
<hr/>					
2018	baseline	Big Brown Bat	10	0	0.00
2018	baseline	Eastern Red Bat	10	8	80.00
2018	baseline	Hoary Bat	10	6	60.00
2018	baseline	Silver-haired Bat	24	15	62.50
2018	baseline	Little Brown Bat	10	6	60.00
2018	baseline	Northern Long-eared Bat	10	7	70.00
2018	expanded	Tricolored Bat	10	0	0.00
<hr/>					
2019	baseline	Big Brown Bat	10	0	0.00
2019	baseline	Eastern Red Bat	10	10	100.00
2019	baseline	Hoary Bat	13	12	92.31

<b>Year</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2019	baseline	Silver-haired Bat	50	10	20.00
2019	baseline	Little Brown Bat	10	7	70.00
2019	baseline	Northern Long-eared Bat	10	1	10.00
2019	expanded	Tricolored Bat	10	0	0.00

## Appendix G: Manual Vetting Results by Site.

Manual vetting was performed on approximately 1% of call files classified to each species by Kaleidoscope Pro (or minimum of 10 files). This was 1% parkwide, so not every combination of monitoring site/species had files vetted.

**Table G1.** Total number of files manually vetted, and the results of manual vetting for each year, site, analysis type, and species at Grand Portage National Monument, 2016–2019. “Verified” indicates that the manual identification matched, and thus verified, the automated identification.

Year	Site ID	Analysis	Kaleidoscope Classification	Total Files Vetted	Number Files Verified	Percent Files Verified
2016	GRPO001A_2016	baseline	Little Brown Bat	5	3	60.00
2016	GRPO001A_2016	baseline	Northern Long-eared Bat	1	1	100.00
2016	GRPO002A_2016	baseline	Eastern Red Bat	1	0	0.00
2016	GRPO002A_2016	baseline	Little Brown Bat	4	1	25.00
2016	GRPO002A_2016	baseline	Northern Long-eared Bat	7	5	71.43
2016	GRPO003A_2016	baseline	Eastern Red Bat	1	1	100.00
2016	GRPO003A_2016	baseline	Silver-haired Bat	1	1	100.00
2016	GRPO003A_2016	baseline	Little Brown Bat	7	3	42.86
2016	GRPO004A_2016	baseline	Silver-haired Bat	1	1	100.00
2016	GRPO004A_2016	baseline	Little Brown Bat	1	0	0.00
2016	GRPO004A_2016	baseline	Northern Long-eared Bat	1	0	0.00
2016	GRPO005A_2016	baseline	Little Brown Bat	16	3	18.75
2016	GRPO005A_2016	baseline	Northern Long-eared Bat	3	3	100.00
2016	GRPO006A_2016	baseline	Silver-haired Bat	1	1	100.00
2016	GRPO006A_2016	baseline	Little Brown Bat	5	4	80.00
2016	GRPO006A_2016	baseline	Northern Long-eared Bat	5	2	40.00
2016	GRPO007A_2016	baseline	Little Brown Bat	1	0	0.00
2016	GRPO008A_2016	baseline	Hoary Bat	3	1	33.33
2016	GRPO008A_2016	baseline	Silver-haired Bat	4	3	75.00
2016	GRPO008A_2016	baseline	Little Brown Bat	1	0	0.00
2016	GRPO008A_2016	baseline	Northern Long-eared Bat	4	2	50.00
2016	GRPO009A_2016	baseline	Big Brown Bat	2	0	0.00
2016	GRPO009A_2016	baseline	Hoary Bat	2	1	50.00

<b>Year</b>	<b>Site ID</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2016	GRPO009A_2016	baseline	Little Brown Bat	11	9	81.82
2016	GRPO009A_2016	baseline	Northern Long-eared Bat	4	4	100.00
2016	GRPO011A_2016	baseline	Silver-haired Bat	1	1	100.00
2016	GRPO011A_2016	baseline	Little Brown Bat	1	0	0.00
2016	GRPO011A_2016	baseline	Northern Long-eared Bat	1	1	100.00
2016	GRPO012A_2016	baseline	Little Brown Bat	3	1	33.33
2016	GRPO012A_2016	baseline	Northern Long-eared Bat	4	3	75.00
2016	GRPO013A_2016	baseline	Big Brown Bat	1	0	0.00
2016	GRPO013A_2016	baseline	Eastern Red Bat	5	0	0.00
2016	GRPO013A_2016	baseline	Silver-haired Bat	2	2	100.00
2016	GRPO013A_2016	baseline	Little Brown Bat	33	30	90.91
2016	GRPO013A_2016	baseline	Northern Long-eared Bat	7	2	28.57
2016	GRPO014A_2016	baseline	Eastern Red Bat	24	20	83.33
2016	GRPO014A_2016	baseline	Hoary Bat	4	4	100.00
2016	GRPO014A_2016	baseline	Silver-haired Bat	1	0	0.00
2016	GRPO014A_2016	baseline	Little Brown Bat	16	13	81.25
2016	GRPO014A_2016	expanded	Tricolored Bat	9	0	0.00
2016	GRPO015A_2016	baseline	Silver-haired Bat	1	0	0.00
2016	GRPO015A_2016	baseline	Little Brown Bat	28	19	67.86
2016	GRPO016A_2016	baseline	Big Brown Bat	1	1	100.00
2016	GRPO016A_2016	baseline	Little Brown Bat	8	6	75.00
2016	GRPO016A_2016	baseline	Northern Long-eared Bat	2	0	0.00
2016	GRPO017A_2016	baseline	Eastern Red Bat	2	0	0.00
2016	GRPO017A_2016	baseline	Little Brown Bat	8	6	75.00
2016	GRPO017A_2016	expanded	Tricolored Bat	1	0	0.00
2016	GRPO018A_2016	baseline	Big Brown Bat	1	0	0.00
2016	GRPO018A_2016	baseline	Eastern Red Bat	1	1	100.00
2016	GRPO018A_2016	baseline	Hoary Bat	1	1	100.00
2016	GRPO018A_2016	baseline	Silver-haired Bat	2	2	100.00
2016	GRPO018A_2016	baseline	Little Brown Bat	1	1	100.00

<b>Year</b>	<b>Site ID</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2017	GRPO002A_2017	baseline	Big Brown Bat	1	1	100.00
2017	GRPO002A_2017	baseline	Little Brown Bat	1	0	0.00
2017	GRPO002A_2017	baseline	Northern Long-eared Bat	1	1	100.00
2017	GRPO004A_2017	baseline	Silver-haired Bat	1	0	0.00
2017	GRPO005A_2017	baseline	Silver-haired Bat	1	0	0.00
2017	GRPO006A_2017	baseline	Hoary Bat	1	0	0.00
2017	GRPO006A_2017	baseline	Silver-haired Bat	1	0	0.00
2017	GRPO007A_2017	baseline	Big Brown Bat	1	0	0.00
2017	GRPO007A_2017	baseline	Silver-haired Bat	3	1	33.33
2017	GRPO007A_2017	baseline	Northern Long-eared Bat	1	1	100.00
2017	GRPO009A_2017	baseline	Northern Long-eared Bat	2	2	100.00
2017	GRPO010A_2017	baseline	Silver-haired Bat	1	1	100.00
2017	GRPO010A_2017	baseline	Little Brown Bat	1	1	100.00
2017	GRPO011A_2017	baseline	Northern Long-eared Bat	6	5	83.33
2017	GRPO013A_2017	baseline	Hoary Bat	1	1	100.00
2017	GRPO013A_2017	baseline	Silver-haired Bat	1	1	100.00
2017	GRPO013A_2017	baseline	Little Brown Bat	1	1	100.00
2017	GRPO014A_2017	baseline	Big Brown Bat	2	1	50.00
2017	GRPO014A_2017	baseline	Eastern Red Bat	10	7	70.00
2017	GRPO014A_2017	baseline	Hoary Bat	3	3	100.00
2017	GRPO014A_2017	baseline	Little Brown Bat	9	7	77.78
2017	GRPO014A_2017	expanded	Tricolored Bat	10	1	10.00
2017	GRPO016A_2017	baseline	Big Brown Bat	3	0	0.00
2017	GRPO016A_2017	baseline	Silver-haired Bat	2	1	50.00
2017	GRPO016A_2017	baseline	Little Brown Bat	1	1	100.00
2017	GRPO017A_2017	baseline	Big Brown Bat	1	0	0.00
2017	GRPO017A_2017	baseline	Hoary Bat	1	1	100.00
2017	GRPO017A_2017	baseline	Silver-haired Bat	4	1	25.00
2017	GRPO017A_2017	baseline	Little Brown Bat	1	1	100.00
2017	GRPO018A_2017	baseline	Hoary Bat	8	8	100.00

<b>Year</b>	<b>Site ID</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2017	GRPO018A_2017	baseline	Silver-haired Bat	24	21	87.50
2018	GRPO004A_2018	baseline	Hoary Bat	1	1	100.00
2018	GRPO004A_2018	baseline	Silver-haired Bat	1	1	100.00
2018	GRPO005A_2018	baseline	Eastern Red Bat	1	0	0.00
2018	GRPO005A_2018	baseline	Northern Long-eared Bat	1	0	0.00
2018	GRPO007A_2018	baseline	Silver-haired Bat	6	1	16.67
2018	GRPO008A_2018	baseline	Big Brown Bat	1	0	0.00
2018	GRPO008A_2018	baseline	Hoary Bat	1	1	100.00
2018	GRPO008A_2018	baseline	Northern Long-eared Bat	1	1	100.00
2018	GRPO009A_2018	baseline	Hoary Bat	4	1	25.00
2018	GRPO009A_2018	baseline	Silver-haired Bat	1	0	0.00
2018	GRPO009A_2018	baseline	Northern Long-eared Bat	3	1	33.33
2018	GRPO010A_2018	baseline	Big Brown Bat	1	0	0.00
2018	GRPO010A_2018	baseline	Hoary Bat	1	1	100.00
2018	GRPO010A_2018	baseline	Silver-haired Bat	2	2	100.00
2018	GRPO010A_2018	baseline	Little Brown Bat	1	1	100.00
2018	GRPO011A_2018	baseline	Silver-haired Bat	1	0	0.00
2018	GRPO011A_2018	baseline	Little Brown Bat	1	0	0.00
2018	GRPO011A_2018	baseline	Northern Long-eared Bat	5	5	100.00
2018	GRPO013A_2018	baseline	Silver-haired Bat	1	1	100.00
2018	GRPO013A_2018	baseline	Little Brown Bat	3	2	66.67
2018	GRPO014A_2018	baseline	Big Brown Bat	3	0	0.00
2018	GRPO014A_2018	baseline	Eastern Red Bat	9	8	88.89
2018	GRPO014A_2018	baseline	Hoary Bat	2	1	50.00
2018	GRPO014A_2018	baseline	Silver-haired Bat	2	1	50.00
2018	GRPO014A_2018	baseline	Little Brown Bat	2	1	50.00
2018	GRPO014A_2018	expanded	Tricolored Bat	8	0	0.00
2018	GRPO016A_2018	baseline	Silver-haired Bat	1	1	100.00
2018	GRPO016A_2018	baseline	Little Brown Bat	1	1	100.00
2018	GRPO017A_2018	baseline	Silver-haired Bat	2	1	50.00

<b>Year</b>	<b>Site ID</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2018	GRPO017A_2018	baseline	Little Brown Bat	1	1	100.00
2018	GRPO017A_2018	expanded	Tricolored Bat	1	0	0.00
2018	GRPO018A_2018	baseline	Big Brown Bat	5	0	0.00
2018	GRPO018A_2018	baseline	Hoary Bat	1	1	100.00
2018	GRPO018A_2018	baseline	Silver-haired Bat	7	7	100.00
2018	GRPO018A_2018	baseline	Little Brown Bat	1	0	0.00
2018	GRPO018A_2018	expanded	Tricolored Bat	1	0	0.00
2019	GRPO001A_2019	baseline	Silver-haired Bat	1	0	0.00
2019	GRPO003A_2019	baseline	Hoary Bat	1	1	100.00
2019	GRPO003A_2019	baseline	Silver-haired Bat	2	0	0.00
2019	GRPO003A_2019	baseline	Northern Long-eared Bat	1	0	0.00
2019	GRPO006A_2019	baseline	Big Brown Bat	1	0	0.00
2019	GRPO007A_2019	baseline	Big Brown Bat	4	0	0.00
2019	GRPO007A_2019	baseline	Silver-haired Bat	15	0	0.00
2019	GRPO008A_2019	baseline	Silver-haired Bat	2	2	100.00
2019	GRPO008A_2019	baseline	Northern Long-eared Bat	1	1	100.00
2019	GRPO009A_2019	baseline	Eastern Red Bat	2	2	100.00
2019	GRPO009A_2019	baseline	Hoary Bat	10	9	90.00
2019	GRPO009A_2019	baseline	Silver-haired Bat	7	4	57.14
2019	GRPO009A_2019	baseline	Little Brown Bat	1	1	100.00
2019	GRPO010A_2019	baseline	Eastern Red Bat	1	1	100.00
2019	GRPO010A_2019	baseline	Little Brown Bat	1	1	100.00
2019	GRPO011A_2019	baseline	Silver-haired Bat	1	0	0.00
2019	GRPO012B_2019	baseline	Hoary Bat	1	1	100.00
2019	GRPO012B_2019	baseline	Northern Long-eared Bat	6	0	0.00
2019	GRPO013A_2019	baseline	Big Brown Bat	2	0	0.00
2019	GRPO013A_2019	baseline	Eastern Red Bat	1	1	100.00
2019	GRPO013A_2019	baseline	Silver-haired Bat	3	0	0.00
2019	GRPO013A_2019	baseline	Little Brown Bat	1	1	100.00
2019	GRPO013A_2019	baseline	Northern Long-eared Bat	1	0	0.00

<b>Year</b>	<b>Site ID</b>	<b>Analysis</b>	<b>Kaleidoscope Classification</b>	<b>Total Files Vetted</b>	<b>Number Files Verified</b>	<b>Percent Files Verified</b>
2019	GRPO013A_2019	expanded	Tricolored Bat	2	0	0.00
2019	GRPO014A_2019	baseline	Big Brown Bat	2	0	0.00
2019	GRPO014A_2019	baseline	Eastern Red Bat	6	6	100.00
2019	GRPO014A_2019	baseline	Silver-haired Bat	1	1	100.00
2019	GRPO014A_2019	baseline	Little Brown Bat	5	2	40.00
2019	GRPO014A_2019	expanded	Tricolored Bat	8	0	0.00
2019	GRPO016A_2019	baseline	Hoary Bat	1	1	100.00
2019	GRPO016A_2019	baseline	Silver-haired Bat	1	1	100.00
2019	GRPO017A_2019	baseline	Silver-haired Bat	4	1	25.00
2019	GRPO018A_2019	baseline	Big Brown Bat	1	0	0.00
2019	GRPO018A_2019	baseline	Silver-haired Bat	13	1	7.69
2019	GRPO018A_2019	baseline	Little Brown Bat	2	2	100.00
2019	GRPO018A_2019	baseline	Northern Long-eared Bat	1	0	0.00

## Appendix H: Species Composition Across Parks.

Figure H1 is for the baseline analysis only, and it includes all Great Lakes Network parks in which bat monitoring occurred.

APIS Apostle Islands National Lakeshore (Wisconsin)

GRPO Grand Portage National Monument (Minnesota)

INDU Indiana Dunes National Park (Indiana)

ISRO Isle Royale National Park (Michigan)

MISS Mississippi National River and Recreation Area (Minnesota)

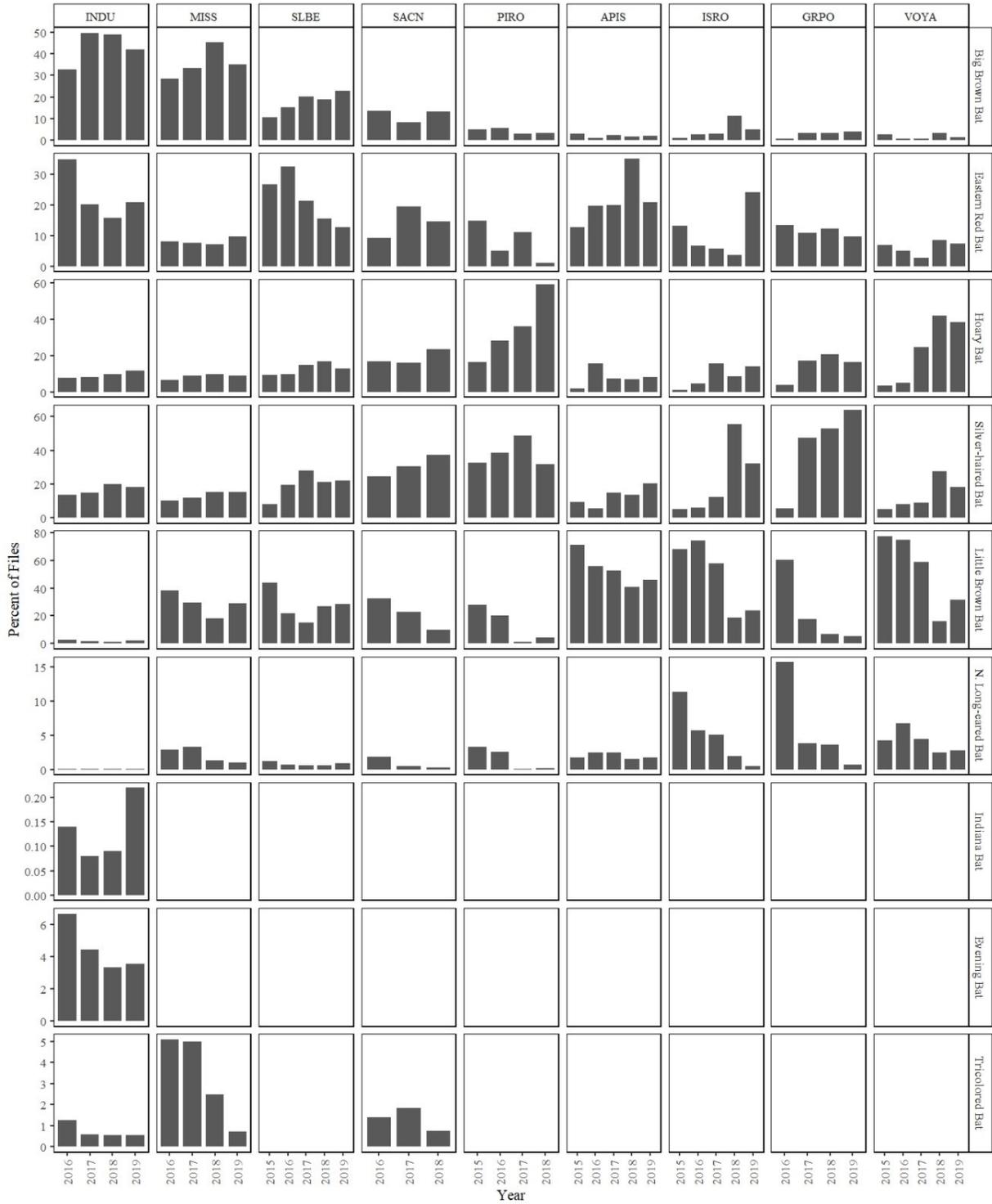
PIRO Pictured Rocks National Lakeshore (Michigan)

SACN St. Croix National Scenic Riverway (Wisconsin/Minnesota)

SLBE Sleeping Bear Dunes National Lakeshore (Michigan)

VOYA Voyageurs National Park (Minnesota)

The baseline analysis had Indiana bat and evening bat allowed as possible species only for INDU, and tricolored bat allowed as a possible species only for INDU, MISS, and SACN.



**Figure H1.** Percent of audio files classified as each bat species by Kaleidoscope Pro in the baseline analysis for each park and year. Note that the y-axis scale is different for each species and not all parks conducted surveys in all years. Only data from valid deployments are shown. Parks are ordered approximately by latitude, from INDU (southernmost) to VOYA (northernmost).

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