2025

BAT ACTIVIVTY IN THE LES CHENEAUX ISLANDS COASTAL AREA – FINAL REPORT

S MYERS – LES CHENEAUX WATERSHED COUNCIL JANUARY 17, 2025

ABSTRACT: During the period 2019 through 2023, acoustic recorders were used to monitor bat echolocation signals in six locations within the Les Cheneaux Islands (App. 1). The monitoring was conducted to identify trends in bat activity as an indicator of population trends. Five of the locations were monitored at specific time frames during the season. A second monitor remained in place at a fixed location throughout the season, roughly April 29th through September 19th. Results were normalized as detections per night for comparison of activity levels at the different locations and comparison of overall activity from year to year. Overall bat activity has increased in the Les Cheneaux area over the five years, suggesting that there is at least a short-term, two-fold upward trend in bat activity. Average detections per night increased from 276 to 673 across the area during the study period.

Eight of nine bat species native to Michigan were identified using Kaleidoscope software to interpret recorded signals. Little Brown bat (*Myotis lucifugus*) signals were recorded most frequently, followed by the Silver Hair Bat (*Lasionycteris noctivagans*) and the Big Brown Bat (*Eptesicus fuscus*). The number of signals recorded for a given species did not accurately reflect a specific number of individuals. Rather, the number of signals reflected the relative activity of each species. Kaleidoscope software identified some signals, such as the Tri-color (*Perimyotis subflavus*) but the probability of this species presence was questionable due to an extremely small number of detections. Signal numbers were analyzed as an indicator of the relative activity over time.

Recorded bat activity of the Les Cheneaux watershed coastal area varied depending on location. This was perhaps related to human disturbance at the sites and/or the availability of manmade habitat. Weather conditions also affected the degree of activity. Signal numbers peaked during the pup birthing and weaning period between Julian calendar days 160 and 190. Species distribution was not homogenous throughout the entire Les Cheneaux area. Availability of preferred habitat and food sources were likely factors in the observed variations.

There are no known published studies linking acoustic bat detections to population numbers, nor is there a verified method to determine if a positive trend in acoustic detections indicates an increase in population. It is, however, a favorable indicator that bat populations, particularly the Little Brown (*Myotis lucifugus*) numbers are increasing in the Les Cheneaux Islands area.

Introduction: Insectivore bat populations across the country have plummeted in recent years due in large part to White-nose Syndrome, a lethal fungal disease caused by *Pseudogymnoascus destructans*[1]. Historically, Little Brown Bats (*Myotis lucifugus*) were reported to be the most common bat in the Les Cheneaux area prior to the population crash.

The Les Cheneaux Watershed Council (LCWC) began monitoring local bat activity in 2017 to assess the relative numbers of surviving bats. In 2019 the LCWC purchased a Wildlife Acoustics SM4BAT-FS as a monitoring tool to record ultrasonic bat signals. A second SM4BAT-FS was added in 2020 to monitor a fixed location for the entire season. Wildlife Acoustics Kaleidoscope software was used to sort and identify the recordings. Since the original purpose of the project was to monitor bat activity over a given time span, the presence of the various species reported in this paper were verified using only the automatic identification assigned by the Kaleidoscope software.

METHODS

One Wildlife Acoustics SM4BAT-FS ultrasonic detection meter was positioned in five different areas of the Les Cheneaux Islands starting in May and continuing through August. A second recorder was placed at a fixed location. Monitoring locations were chosen to provide a sampling of activity across the coastal area of the Les Cheneaux watershed. The SM4BAT-FS equipment recorded full spectrum signals using Wildlife Acoustics U2 microphones that were separate from the recording units. Microphones of the SM4BAT systems were elevated between 12 and 15 feet. Microphone orientation placed the primary recording direction toward an open area, away from buildings and foliage wherever possible. An acoustically transparent reticulated foam cover was placed over microphones to prevent moisture collection during rain events and associated signal loss. Each distributed location was monitored for 7 to 31 days. When possible, each of these five sites was monitored on the same dates each year. Monitoring time was based on logistics and time available. The fixed location was monitored continuously throughout the season.

The SM4BAT-FS equipment recorded bat ultrasonic echolocation signals from 30 minutes before civil sunset to 30 minutes after sunrise per the North American Bat Monitoring Program (NABat) protocol. Other recording parameters also met the NABat protocol as specified for the SM4BAT-FS.

The SM4BAT-FS recorded ultrasonic echo location signals as ".wav files". The .wav files from each year at each location were processed using the Wildlife Acoustics Kaleidoscope software version 5.4.2. as a baseline. Analysis using later versions had no statistically significant effect on the total numbers detected or the species detected. Software parameters were set in the Bat Analysis mode using the recommended settings for frequency and duration. Auto ID classifiers were set to the North American 5.4.0 data base and the conservative (+1) setting. Michigan was used as the selected region. Data from each of the six monitoring sites was processed individually to obtain species distribution data.

The total number of bat detections at each location included both signals assigned an auto ID by the Kaleidoscope software and those without an assigned ID. The total number of signals recorded was divided by the total number of nights the monitor was active during deployment at specific sites to obtain a normalized value of bat detections per night for the coastal areas of the watershed. Normalized values for each site and the combined overall value were determined for each year as an indicator of activity trends.

Wildlife Acoustics Kaleidoscope software provides statistical data for the signals recorded. In general, the software performs multiple comparisons on each signal. Each signal consists of a series of pulses. Each pulse typically starts at a high frequency that decreases over a period of milliseconds. Each species of bat produces signals with characteristic frequency shifts and time duration. The frequency characteristics and time duration of recorded pulses are compared to several recorded pulses from known sources. Each signal, then, has pulses that match known pulses to a certain degree. When the match ratio to pulses from a particular species is high, the signal is identified as coming from that species. The statistics provided include the number of matching signals, the match ratio, and the margin of error in the ratio. Frequency characteristics and time data for each pulse are also provided. The software uses the available data to calculate an estimated probability of a null hypothesis being true, i.e., the species not being present, for each species identified in each recording period (each night). When no recorded

signals match any of the baseline signals within certain parameters for a given species, the resulting estimated probability is 1[(2)].

RESULTS

Bat activity in the Les Cheneaux Island area appeared to increase from 2019 through 2023. While detection rates at each site varied from year to year, the average number of calls per night increased each year for the combined data of the five distributed monitoring sites in the island area (Fig. 1). The Birge Preserve and Coryell sites exhibited peak activity in 2020 with a reduction in 2021 whereas activity at the remaining three sites resulted in an overall year to year increase in average nightly detections.

Data from the Woodland Park fixed monitoring site exhibited a similar increase in average detections per night between 2020 and 2022. Average detections dipped slightly in 2023. This site was monitored from late April through mid-September. The site was not a designated seasonal monitoring site in 2019. Monitoring at this site continued into 2024 in order to provide a five-year data set. Data from 2019 were not included in Fig. 2.

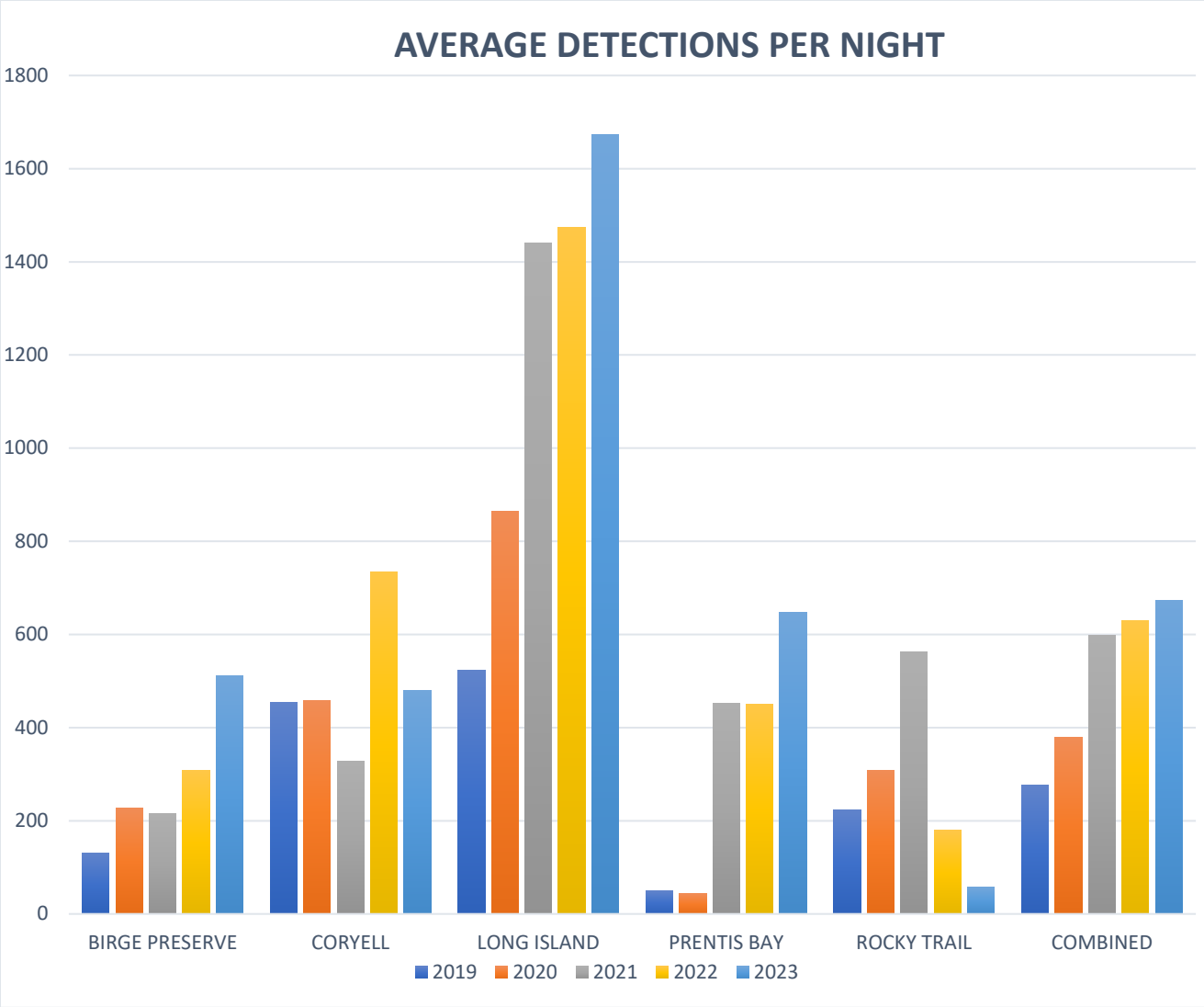
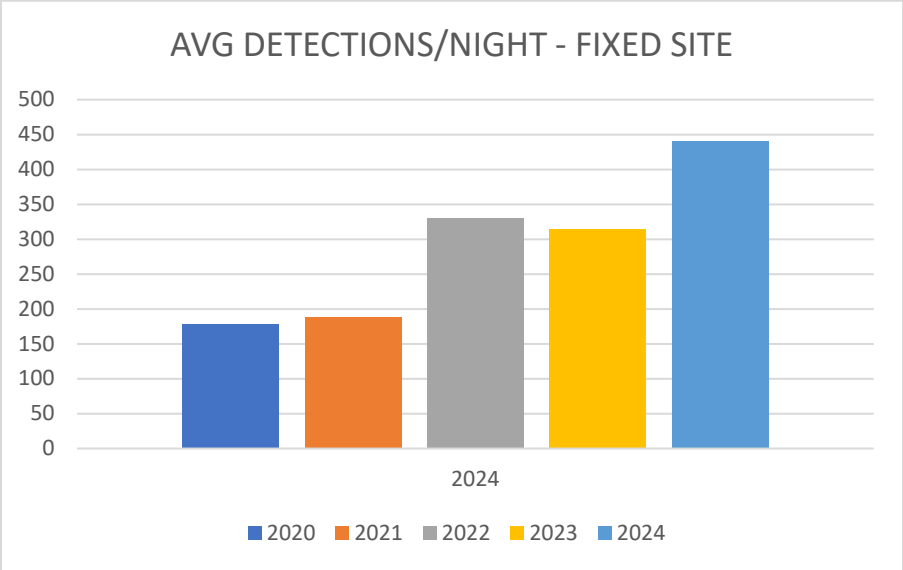


Fig. 1 – Distributed sites average detections per night

Fig. 2 – Fixed monitoring site average detections per night



Species Distribution

Species distribution was based on the Kaleidoscope software Auto ID function. Unidentified signals were not vetted as the focus was on activity trends and not definitive species identification. Experience indicated that unidentified signals were a mix of signals from the most prevalent species and other species with a minor presence. The percentage of Little Brown signals exceeded that of all other species and the unidentified signals. It was assumed that vetting of the unidentified would result in increasing the percentage of little browns without significantly changing the remaining species ratios.

While bat detections per night increased over the period 2019-2023, the activity of each species identified did not increase proportionally. The species signal numbers as identified by the Kaleidoscope software version 5.4.2 are not consistent year to year. Some variation is expected due to several factors such as weather, food sources and change in habitat. Some species activity numbers remain remarkably consistent while others, notably the Little Brown and Silver Haired detections varied considerably. It is not presently known if a causal relationship exists between the two species overall activity.

Figures 3 and 4 show the number of each auto identified species detection as a percentage of the total number of detected signals in 2020 and 2023 respectively. Unidentified signals are included in the totals when calculating percentages. The percentage of unidentified detections ranges between 22% and 36%. Species with “zero” percentages have small numbers of detections in comparison to the other species.

In 2021 the little brown bat detections increased significantly while the detection levels of other species decreased. The change in percentages was a result of the *Myotis lucifugus* detections increasing to a greater degree than those of the other species. This indicates that there was a possible population increase in Little Browns or an increase in foraging activity compared to that of the other species.

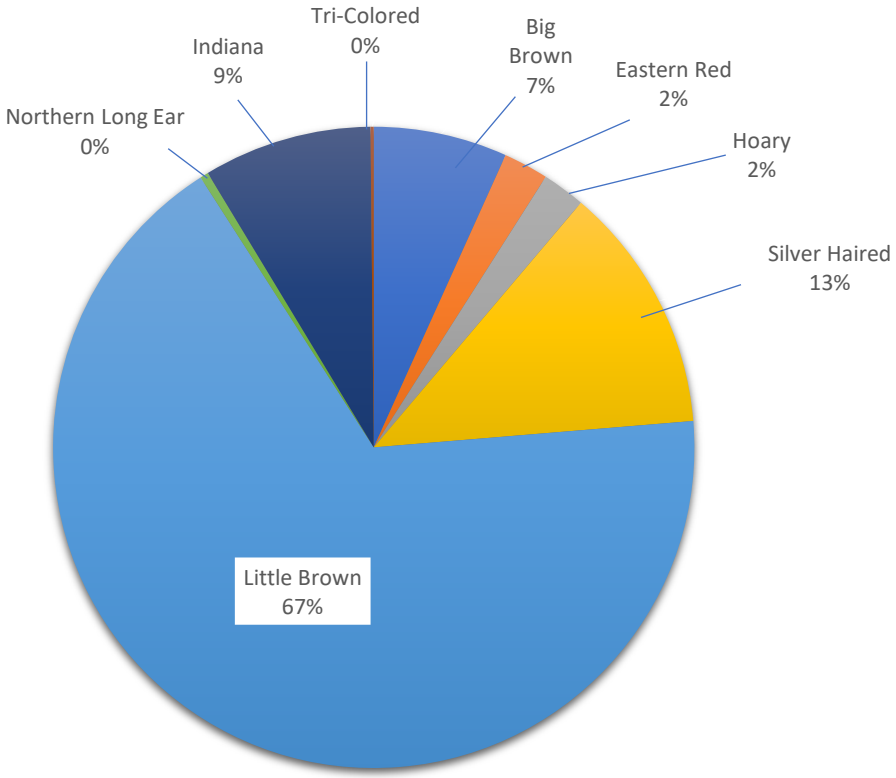


Fig. 3 – 2020 Species mix as a percentage of total identified signals at the distributed sites in the Les Cheneaux Islands

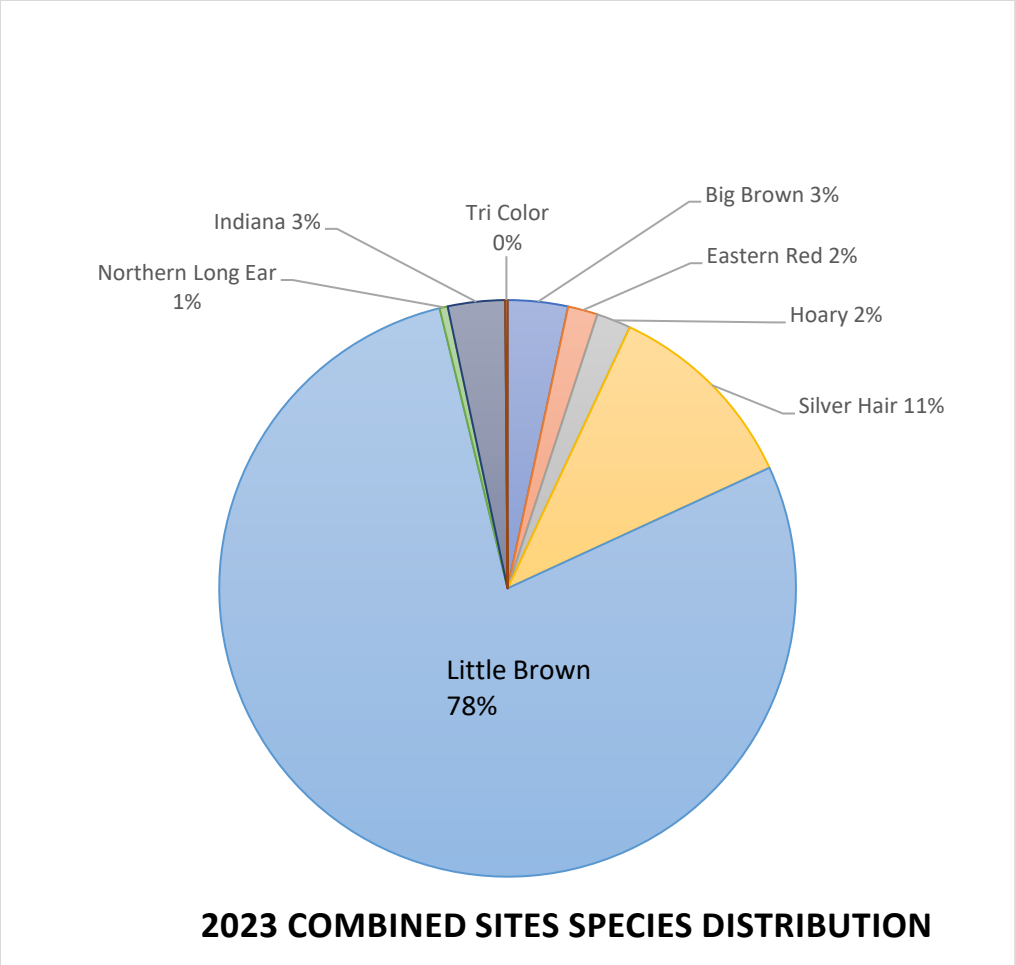


Fig. 4 – 2023 Species mix as a percentage of total identified signals at the distributed sites in the Les Cheneaux Islands

Figure 5 provides a more detailed picture of the species detections year to year at the distributed sites and the calculated trends of the overall activity and that of the Little Brown, Silver Hair and Indiana. These data are presented in a log plot to provide adequate visualization of the lower detection rates of most species compared to the large number of Little Brown detections. The trend lines for the overall and the Little Brown activity reflect the year-to-year increases in recorded activity. Note that the ratio of Indiana (red) to Little Brown (Light Blue) detections is not consistent, suggesting that the Indiana numbers are real and not falsely identified Little Brown calls. The ratio varies from a high of 0.126 Indiana to Little Brown in 2020 to a low of .026 in 2021. This causes the slopes of the associated trend lines to diverge.

Figure 5 also includes the number of detections that are not identified by the Kaleidoscope software. These detections are a mix of individual signals that do not meet the specific requirements for any one species. They are included as they reflect the overall activity levels. Note that the number of detections in this category is higher in 2023 than in any of the previous years. This indicates that the increase in overall activity is quite likely due to an increase in the activity of all species.

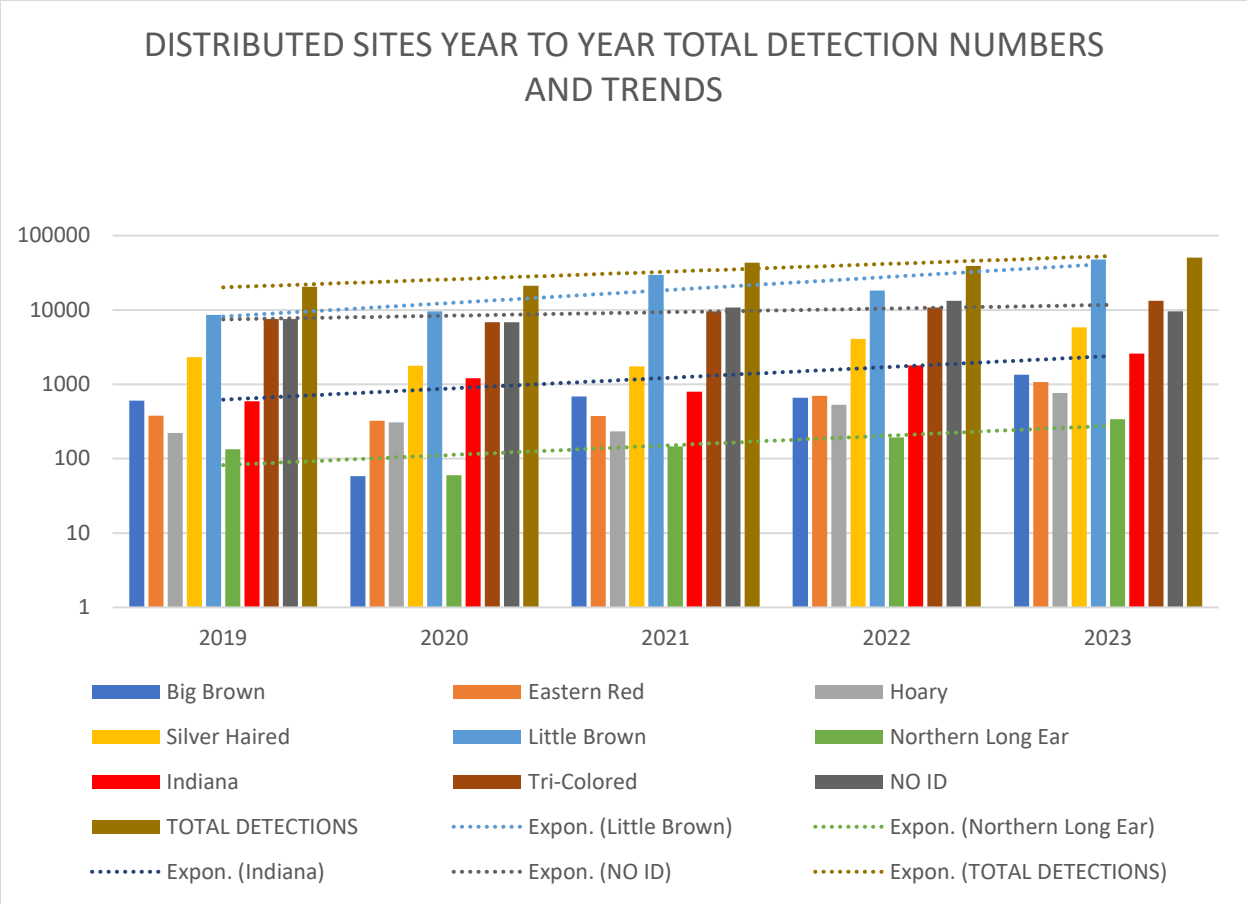


Fig. 5 – detection numbers and trends distributed sites 2019-2023

Fixed Site Species Detections

Fig. 6 shows the number of detections for 2020 through 2023 for each species, the total number of detections, and the trend line for the total number. The mix of identified species signals at the fixed monitoring site changed from 2020 to 2024 while the average calls per night remained consistent with an increase in 2024. This is an indication that approximately the same number of animals return to the fixed site every year with a possible increase in 2024.

Little Brown activity at the fixed control site remained remarkably consistent over five years. There was a slight dip in recorded signals in 2022, with an 11% increase in counts from 2020 to 2025. Indiana Bat recordings saw a 3.7% increase in 2022 over 2020 while Little Brown recordings were down 3.4%.

Overall recordings per night show an increasing trend at the fixed control site. This trend is mirrored in the trend of the other species and the un-identified recording numbers. The numbers of all species exhibit at least a slight upward trend from 2020 to 2024.

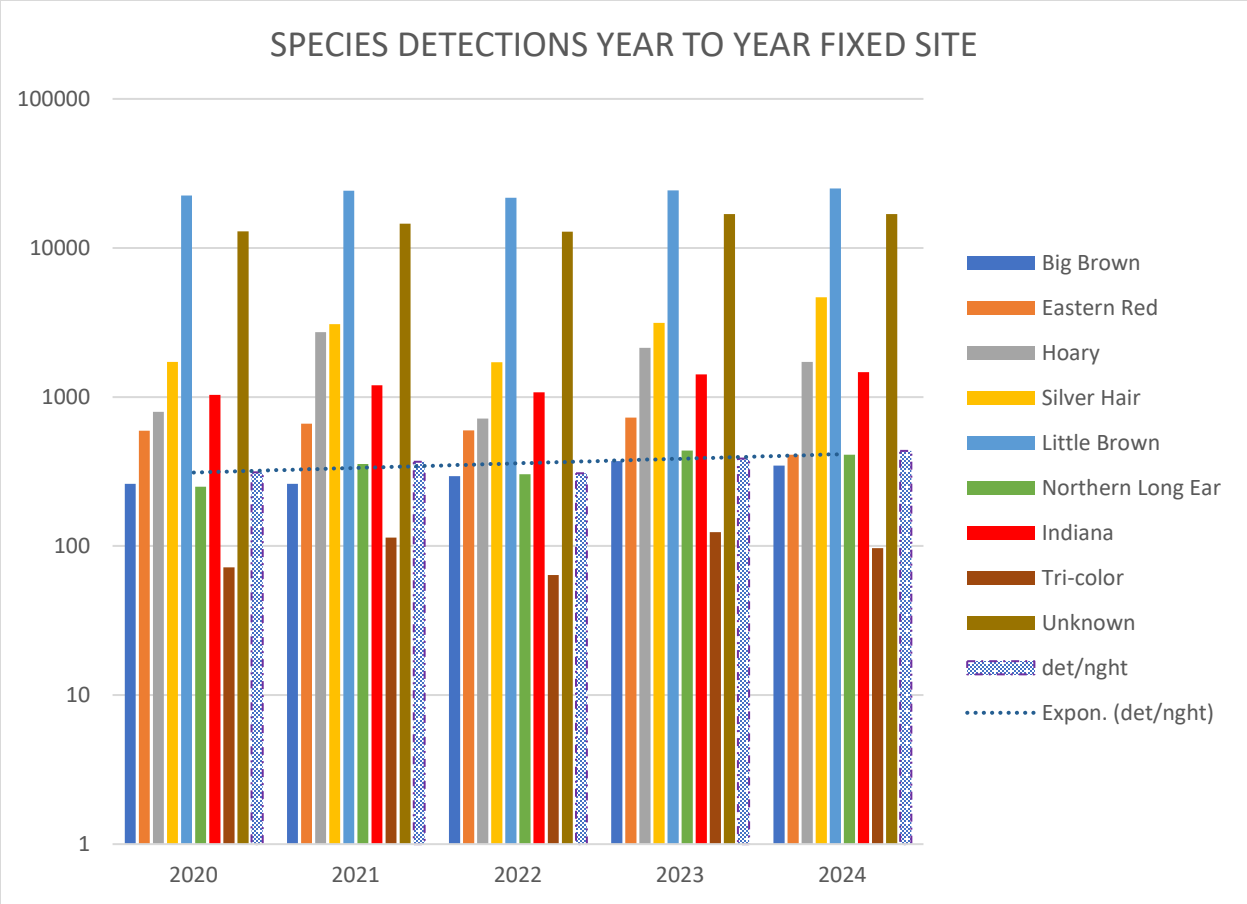


Fig. 6 – Comparison of species activity at fixed monitoring site 2020 and 2021

Seasonal Variations in Activity

The addition of a fixed monitor in 2020 made it possible to determine seasonal variations in bat activity. This information was key in determining if the differences in activity levels observed at the five distributed sites was due to location or seasonal changes.

Data collected at the fixed site in 2020 through 2024 indicate that much of the difference in bat activity observed at the 5 scattered sites is a result of seasonal variations. Plotting date verses activity level at the fixed site (Figure 7) shows activity increases through May, then levels off until late June, and peaks in early July. This is consistent with animals arriving at maternity sites followed by birthing and emergence of young.[3] Mid to late June coincides with the Long Island monitoring period, implying that the emergence of young accounts for some of the higher activity at this site.

The curves of total calls recorded verses date for 2020 through 2024 are similar (Fig. 7). Activity seemed to peak at the same times and levels, declining in a like fashion with 2024 numbers being slightly higher, indicating a possible slow increase in population year-to-year.

The dramatic decline in activity on or around day 119 of 2020, 2021 and 2023 is unusual in that it occurs three different years. This decline is a result of temperatures dropping below 40F

(4.4C) in the same week in all three years. Bat activity decreases rapidly at temperatures below 50F (10C) accounting for the observed drop in activity in all three years. [4]

Other drops in activity depicted in Fig.7 may be a result of other factors as noted later in this paper.

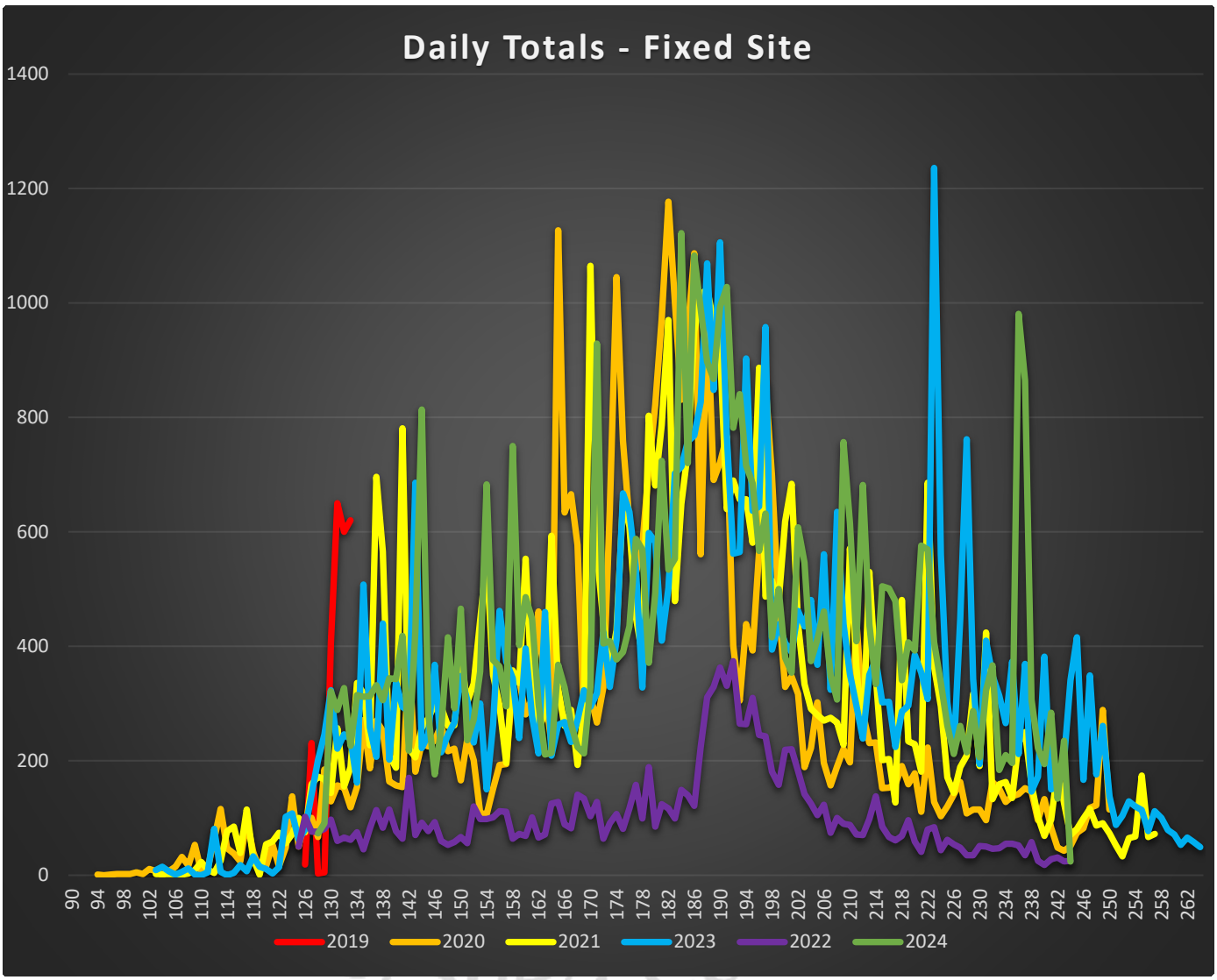


Fig. 7 – Fixed site activity levels by day

Endangered Species Presence (*Myotis sodalist*)

The fixed site 2021 activity data provides some insight into the presence of the *Myotis sodalist* or Indiana Bat (figure 8). Note that the data curve for the number of detected Little Brown and Indiana bats by date have the same general shape over the season. Detection levels on individual dates, however, do not peak on the same days and some days the activity peaks for the Indiana where the detections for the Little Brown dip. Trend lines for the two species detection numbers diverge, Little Brown counts continue to trend upward while Indiana counts

trend lower. This indicates further that the detection levels of the Indiana bat are not a function of Little Brown signal numbers, and that the Indiana (*Myotis sodalist*) is present at some level.

The statistical data provided by the Kaleidoscope software show the probability of a null occurrence for the Indiana bat, i.e., species signal correctly identified, is very close to zero on several days in different years (Table 1)

DATE	NULL PROBABILITY OF MYOSOD (Indiana)
05/5/21	0.0001
05/9/21	0.0002
05/26/21	0.0017
06/30/21	0.0004
07/03/21	0.00002
07/04/21	0.0003
05/21/22	0.00000
05/22/22	0.000121
06/17/22	0.0000241
06/27/22	0.000521
06/23/23	0.000356
06/28/23	0.000026
07/01/23	0.000827
07/06/23	0.00164

Table 1 – Probability of Indiana bat *not* being present on given dates

These dates correspond with peaks in *Myotis sodalist* (Indiana) activity and in some cases, dips in *Myotis lucifugus* (Little Brown) activity. The distributed sites also had time periods where the null probability of the Indiana bat presence was close to zero. While these data do not provide absolute proof of the presence of the endangered Indiana bat in the Les Cheneaux area, they are a strong indication of the positive.

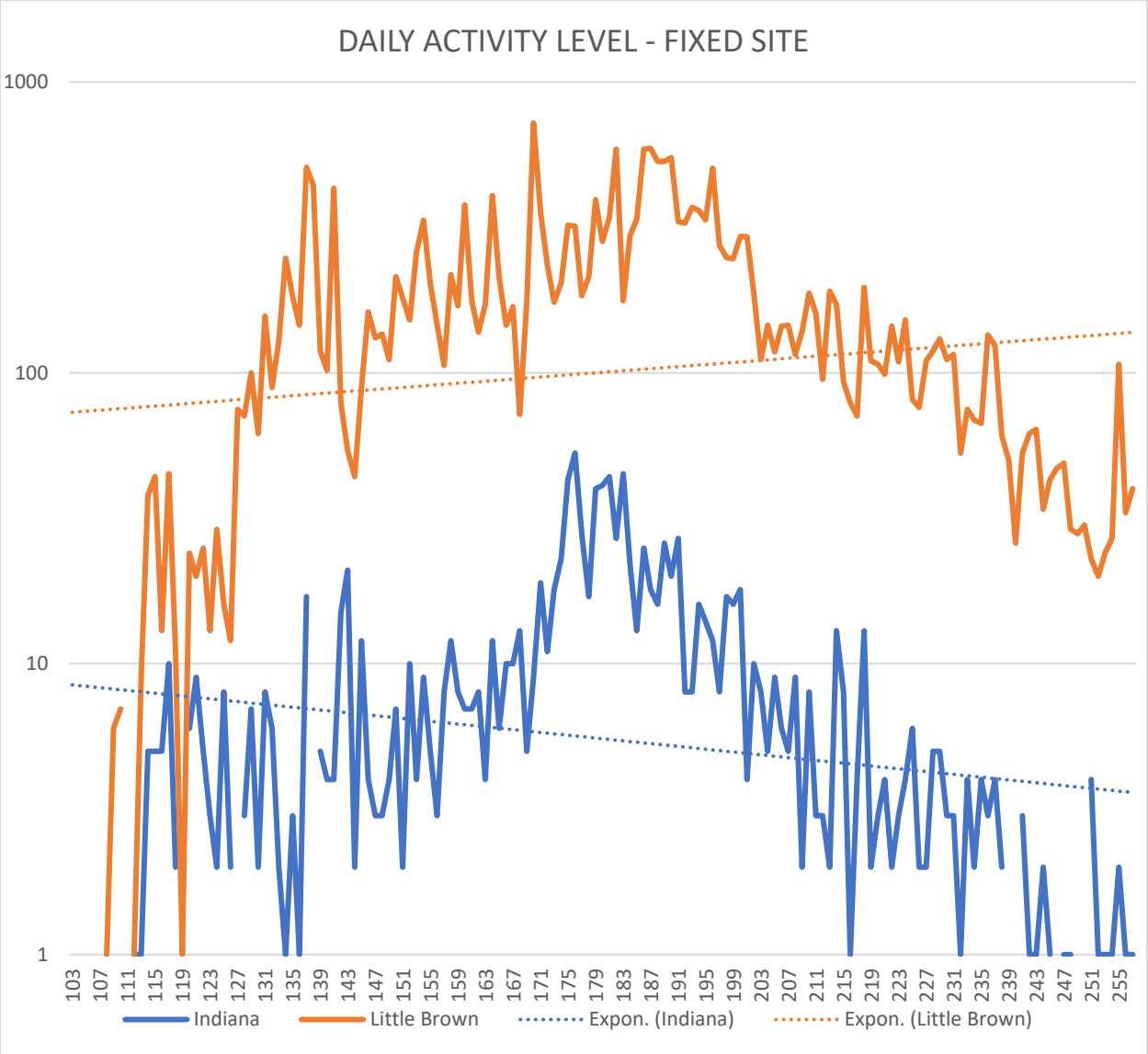


Fig. 8 – Daily activity levels of Little Brown (*Myotis lucifugus*) and Indiana (*Myotis sodalist*) Bats at fixed monitoring site

Discussion

Increasing bat ultrasonic signal numbers over the last 5 seasons in the Les Cheneaux area are encouraging. It is important to point out, however, that the recorded signals are only indications of increased activity. Whereas a population increase could account for the observed increase in signals, other factors such as food supply, temperature, precipitation, and habitat availability may also influence signal counts.

Bat population densities cannot be determined reliably without physical capture and sampling over a period of several years. The Wildlife Acoustics monitors and software, however, provide

a fair indicator. As activity increases the number of detections increase. This is evident in the increases observed during pup emergence between days 174 and 194 as depicted in figure 7.

Published information on bat activity relates that most species do not fly in heavy rain or in temperatures below 50F (10C).[4] These conditions result in very low numbers of detected signals. A wet, cool season then, potentially produces a lower number of detected signals. A review of weather data for the years 2019 through 2024 (App. 2) shows that measured precipitation at the Rocky Trail site decreased from 18.75 inches to 12.50 inches for the time period of May through September in the years 2019 through 2024. The average high temperature over the monitoring season (May through September) however, ranged from 59^{0} F in 2019, 60^{0}F in 2020, to 61^{0}F for the years 21 through 2024 (see appendices).

The warmer, drier seasons in 2021 through 2024 may account for more bat activity. Drier years reduce the insect hatches requiring more foraging to obtain adequate food. Increased foraging results in more signals and hence more recorded activity. Other studies find, however, that bat activity increases during times when insects are plentiful and not inversely. The increase noted in detections between 2019 and 2024, therefore, is likely related to population increase.

The effect of habitat availability on bat activity is most apparent at the Long Island site. This site contains several older structures that are used infrequently. The fields and forest around the structures remain untouched for the most part. The island itself is located some distance from most human activity with few boaters. It is at this site that signal detections are at the highest levels each year. Some of this activity is due to the scheduled monitoring time encompassing the typical time for birthing and emergence of pups. The detections for all species at the Long Island site, however, are much higher than at any of the other sites.

The same conditions that affect overall activity also contribute to variations in species distribution. Food source and habitat likely have the strongest influence.

Most species of bat are opportunistic insectivores, but many species have a preferred food source. [5] Where insects with aquatic larvae are numerous Little Brown detections are predominant. The early warm weather in the 2021 season contributed to several early aquatic insect hatches possibly resulting in the greater number of *Myotis lucifugus* detections. The Big Brown, Hoary and silver Hair prefer larger moths and beetles [5] so are detected more often where that food source is available. The Hoary bat feeds above tree canopies and so may not be detected as readily as other species. The Silver hair avoids foraging in areas where the Big Brown is present[6] so where the detection rate for Big Browns is high there may be little evidence of the Silver Hair. The converse is also true. The Active Times chart in the appendices illustrates this phenomenon. When the density of Big Brown detection is high, the density of Silver Hair detection is low.

Available habitat is most likely a strong determinant of species distribution. Little Brown females prefer dwellings where temperatures may exceed 100^{o}F such as attics. The females also congregate in large maternity colonies. This causes the detected signal number to exceed that of any other species at monitoring sites with little used structures. Other species roost primarily in forests under loose bark, in tree hollows, or in higher branches. The associated detection numbers, therefore, are higher in these areas. Little Browns typically return to the same preferred habitat each season whereas other species may choose the same area or even the same tree but periodically re-locate during the season affecting the total detected signals at any one site. [7]

Vegetation growth and expansion may also affect detected signal numbers. Some species prefer to forage over open ground. Where vegetation is expanding in the monitoring corridors detection numbers may decrease due to animals moving to more open areas to feed.

Seasonal variations in activity and the effect on detected signals are discussed earlier in this paper. As noted, the number of signals detected at any one particular site is affected by the timing of the monitor placement. More signals are obtained during the birthing and emergence of young in mid-June to early July. Sites monitored later in the season may show a decline in activity particularly later in August as migration time approaches.

Electronic signal monitoring for bats in the Les Cheneaux area indicates the presences of both the Indiana bat and the Northern Long ear. While electronic monitoring is not definitive, the Kaleidoscope software puts the probabilities of these species being present at over 99% on certain days at certain sites. The number of Indiana bat detections varies but remains over 500 as identified by the Kaleidoscope software over a five year time period reaching a total of over 2600 in 2023. Comparing the times of the detections with those of other species reveals that the majority of Indiana bat signals are not mis-identified Little Brown calls. It is known that as conditions continue to warm, that species ranges continue to expand. The last National Forest Service Range and Recovery Unit map of 2019 extended the Mid-west unit to within 100 miles of the Les Cheneaux area. [8] National Weather Service data show an increase and stabilization in the average seasonal temperatures in the Les Cheneaux area over the last five years making further habitat expansion likely (see appendices). Similarly, an early May monitoring detected Northern Long Ear bats within 30 miles of the distributed monitoring sites. This is also well within approximately 60 miles of a known Northern Long Ear habitat at the Fibron Karst preserve.

Evidence of the presence of the Tri-color bat in the Les Cheneaux area is weak. There are signals identified as Tri-color but the software calculated probabilities for a confirmed presence are below 20% on most days in all locations with one day increasing to 94% at the fixed site in mid-June 2021.

Reference signals for the Eastern Small Footed bat are included in the 2024 analysis of the total distributed site and control site data. Software probability calculations determined that this species may have a very limited presence in the area. There are known colonies of the Small Footed bat in the regions of Ontario within 50 miles of the Cheneaux Islands. Expansion of the range for the species is possible.

Conclusions

Overall bat activity has increased in the Les Cheneaux area over the last 5 years. This confirms that there is at least a short-term upward trend in bat activity.

Signals from eight of the nine species found in Michigan were reported.

Little Brown Bat signals constitute the majority of the activity in the Les Cheneaux area. This is followed by the Silver Hair and the Big Brown. The high number of Little Brown signals is a positive sign of recovery for the population.

Bat activity in the area peaks in mid-June, early July during pup emergence and declines thereafter. Weather, insect population and habitat affect the day-to-day activity of the species detected. This reinforces that seasonal variations influence detection levels at the distributed sites.

The presence of the Indiana Bat and Northern Long Ear in the Les Cheneaux area is probable as reported by the Kaleidoscope analysis of recorded bat calls.

Literature Cited:

1) https://www.whitenosesyndrome.org/static-page/the-fungus
2) Wildlife Acoustics; Inc., Kaleidoscope Pro 5 Users Guide, December 4, 2020, Pgs 111-112
3) Kurta, Allen; Mammals of the Great Lakes Region, Third Edition; University of Michigan Press, 2017, pg. 68
4) Kurta, Allen; Mammals of the Great Lakes Region, Third Edition; University of Michigan Press, 2017, pg. 91
5) www.animaldiversity.org/accounts/genus_species/#food_habits
6) Kurta, Allen; Mammals of the Great Lakes Region, Third Edition; University of Michigan Press, 2017, pg. 82
7) Kurta, Allen; Mammals of the Great Lakes Region, Third Edition; University of Michigan Press, 2017, pg. 70, 79
8) www.fws.gov/midwest/endangered/mammals/inba/RangeMapINBA.html

APPENDICES

1) Map of monitoring locations
2) Season precipitation and temperature data 2019 through 2024
3) Coryell Island active times - Big Brown (*Eptesicus fuscus*) and Silver Hair (*Lasionycteris noctivagans*)

Les Cheneaux
Watershed Council

App.1 - MAP OF MONITORING LOCATIONS

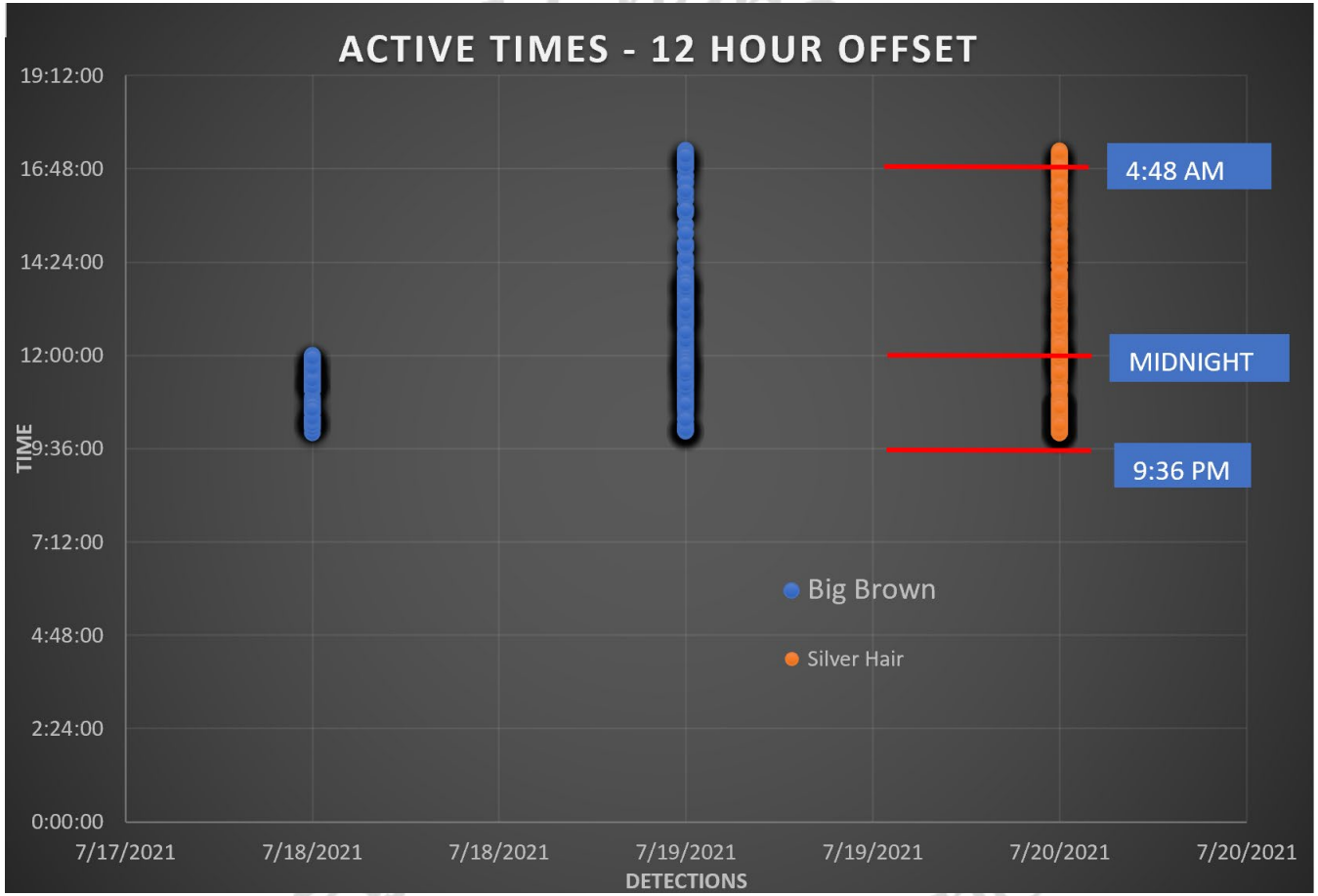
YEAR	TOTAL SEASON (5/1-10/01) PRECIPITATION (Inch)
2019	18.75
2020	14.31
2021	12.12
2022	12.02
2023	12.43
2024	12.5

TOTAL SEASON PRECIPITATION

Cocorahs data station MI-MC-3

AVERAGE DAILY TEMPERATURE DEGREES F						SEASON AVG
YEAR	MAY	JUNE	JULY	AUGUST	SEPT	(rounded)
2019	46.64	58.24	66.86	63.43	57.66	59
2020	49.09	62.07	68.38	64.96	54.47	60
2021	51.84	63.46	65.54	67.36	57.4	61
2022	53.75	59.02	64.74	65.58	58.13	61
2023	53.12	63.31	64.34	63.18	59.96	61
2024	53.93	60.87	66.56	66.08	61.86	61

MONTHLY SEASONAL TEMPERATURE
(NWS Data Chippewa County International Airport KCIU)



App. 3 - Coryell Island Active Times Big Brown (*Eptesicus fuscus*) and Silver Hair (*Lasionycteris noctivagans*)