Bat Activity in the Les Cheneaux Islands Coastal Area 2019 Through 2021

Scott Myers- Les Cheneaux Watershed Council, Jan 7, 2022

ABSTRACT: In 2019, 2020, and 2021, Wildlife Acoustics detection meters were used to record echolocation signals in six locations in the Les Cheneaux Islands to monitor local bat activity. The monitoring was conducted in an attempt to identify trends in activity that might reflect on populations. 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. The 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 last 3 years implying that there is at least a short term trend in bat activity. Area activity rose from 279 detections per night in 2019 to 599 in 2021.

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. The high number of Little Brown signals was a positive sign for the population numbers, however. The software erroneously identified some signals, such as the Tri-color (*Perimyotis subflavus*) due to an extremely small number of detections. Signal numbers were recorded as an indicator of the relative activity over time.

Recorded bat activity in the coastal area of the Les Cheneaux watershed is higher on Long Island than at any of the other sites. This may be related to the infrequent human activity at this site and the availability of manmade habitat. Species distribution is not homogenous throughout the entire Les Cheneaux area. Availability of preferred habitat and food sources area likely factors in the observed variations.

There are no current studies linking acoustic bat detections to population numbers. There is no verified method to determine if a positive trend in detections indicates an increase in population numbers. It is, however, a favorable intimation 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)]. Little Brown Bats (*Myotis lucifugus*) have been 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. 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 microphones that were separate from the recording units. The microphones of the SM4BAT systems were elevated between 12 and 15 feet above the ground. 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 the 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. 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. The 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 a number of 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 a number of 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 appears to increase in the period 2019 – 2021. The average number of calls per night increased each year for the combined data of the five distributed monitoring sites in the island area. While the Birge Preserve and the Coryell sites exhibited peak activity in 2020 with a reduction in 2021 the activity at the remaining three sites resulted in an overall year to year increase in average nightly detections (figure 1).

Data from the fixed monitoring site in the Woodland Park area show a similar increase in average detections per night between 2020 and 2021. This site is monitored from late April through mid-September. The site was not a designated seasonal monitoring site in 2019. The 2019 data are not included in Figure 1.

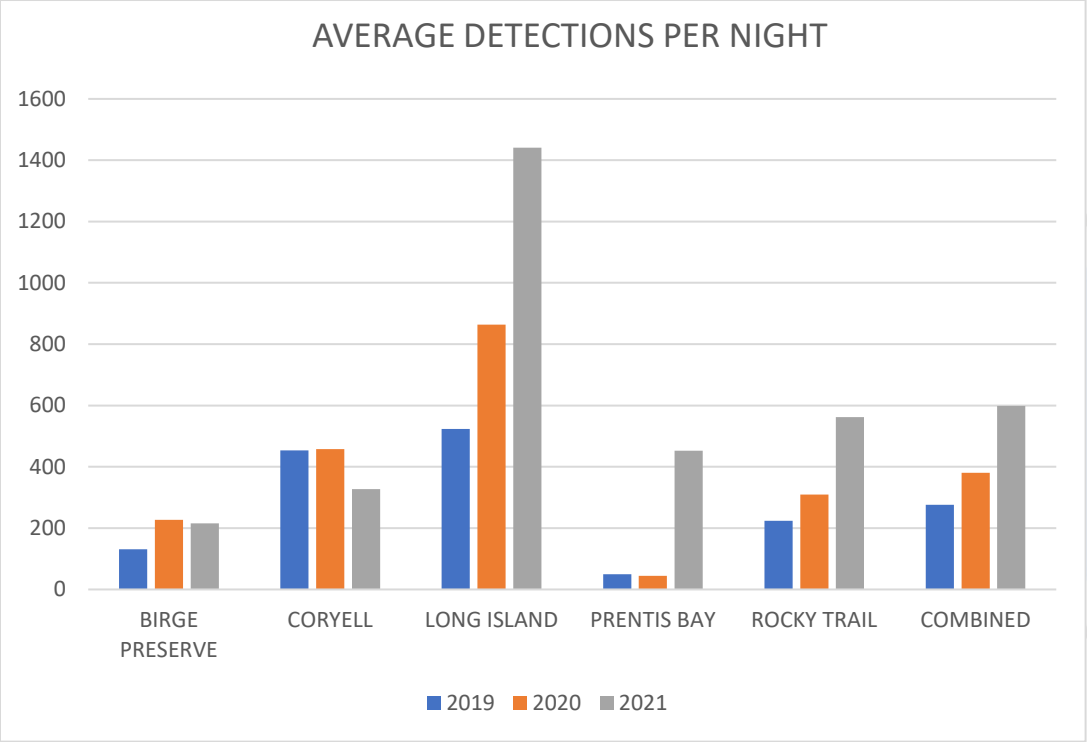

FIGURE 1 – distributed sites average detections per night

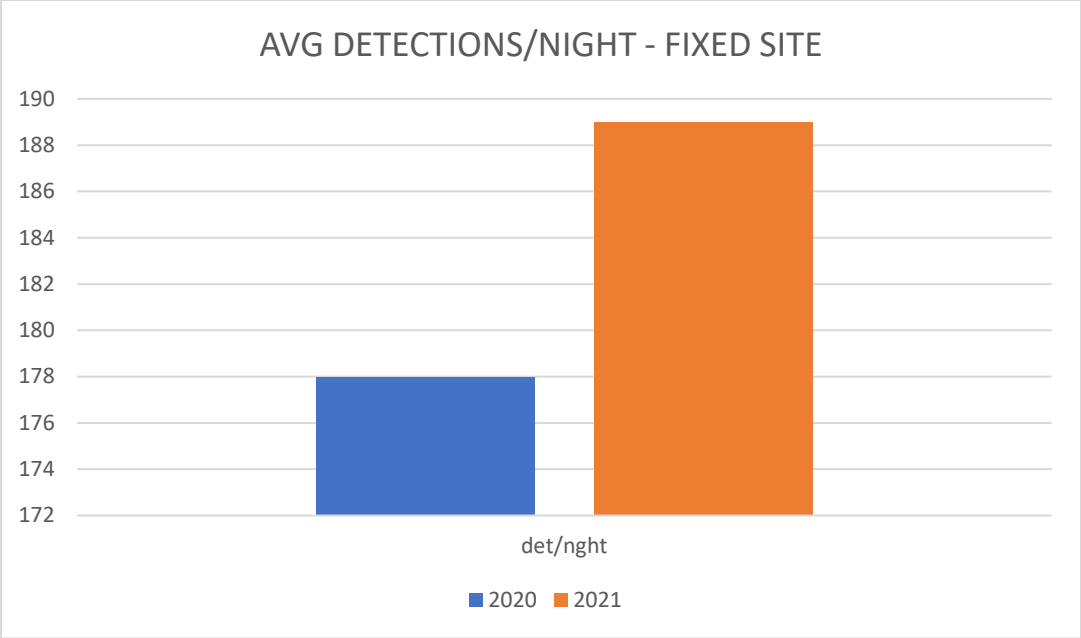

FIGURE 2 – Fixed monitoring site average detections per night

Species Distribution

While bat detections per night increased over the period 2020-2021, 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 vary considerably. It is not known at this time if there a causal relationship between the two species overall activity.

The following figures show the number of each species detection as a percentage of the total number of detected signals. 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 is a numerical result of the *Myotis lucifugus* detections increasing to a greater degree than those of the other species. This indicates that there is a possible population increase in Little Browns or an increase in foraging activity compared to that of the other species.

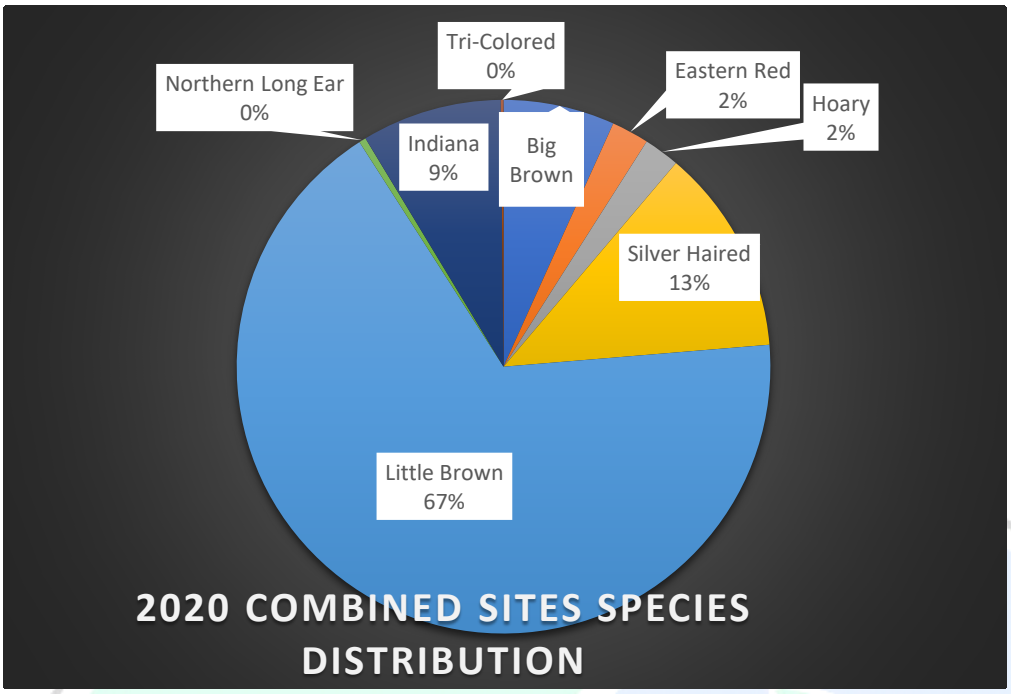

FIGURE 3 – Species mix as a percentage of total at the distributed sites in the Les Cheneaux Islands – 2020

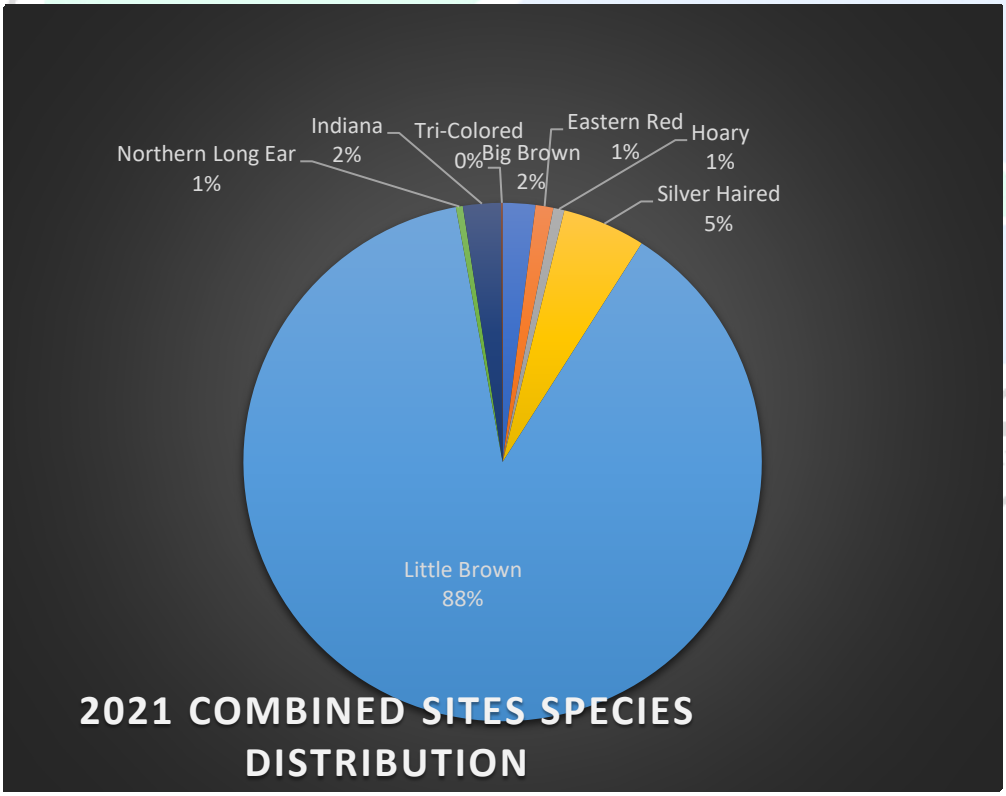

FIGURE 4 - Species mix as a percentage of total at the distributed sites in the Les Cheneaux Islands – 2021

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 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. These detections are included as they are a reflection of the overall activity levels. Note that the number of detections in this category increased in 2021 over previous years. This indicates that the increase in overall activity is quite likely due to an increase in the activity of all species.

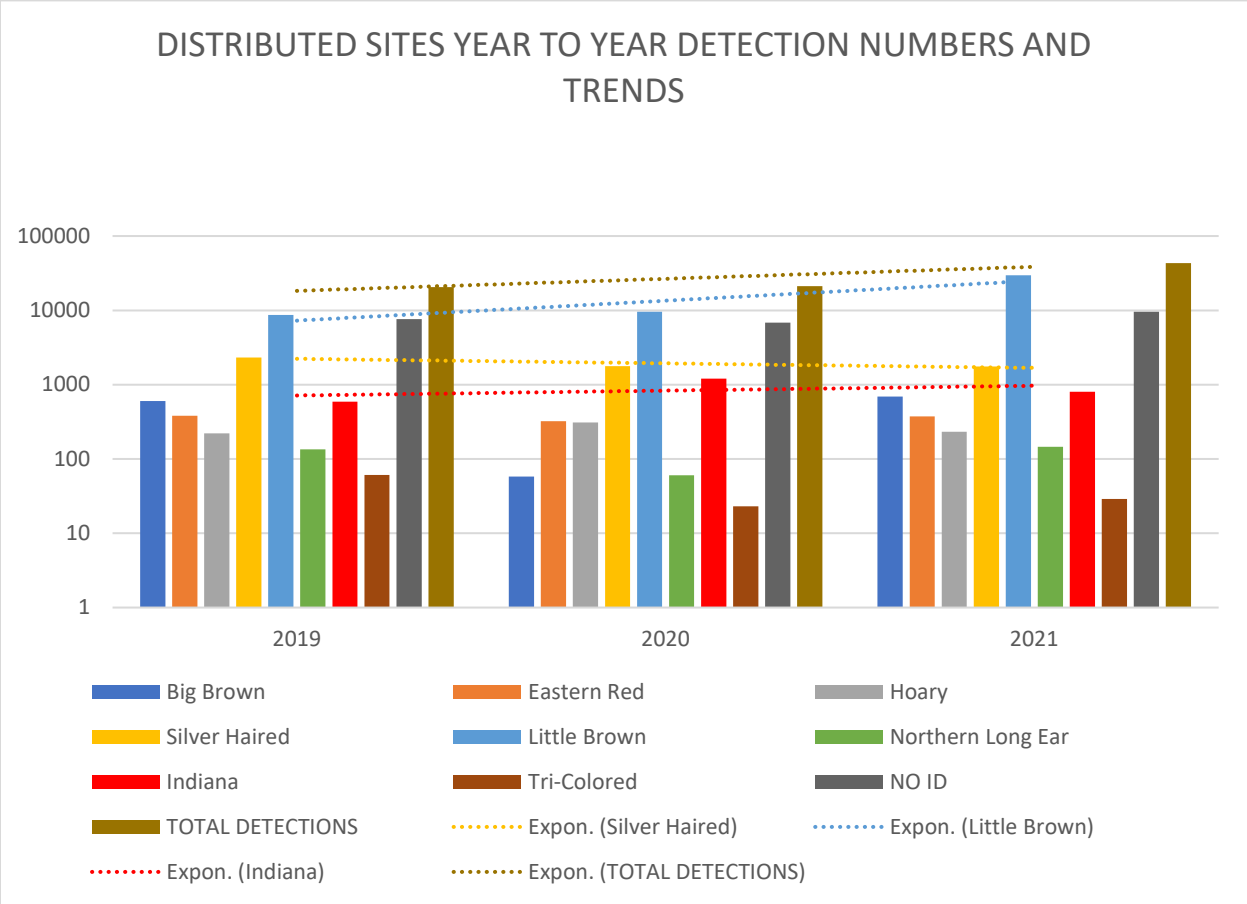

FIGURE 5 – detection numbers and trends distributed sites 2019-2020

Fixed Site Species Detections

The mix of identified species signals at the fixed monitoring site changes from 2020 to 2021. The total number of calls, however, remained consistent with a possible slight increase. This is an indication that approximately the same number of animals return to the fixed site every year. Figure 6 shows the number of detections for 2020 and 2021 for each species, the total number of detections and the trend line for the total number.

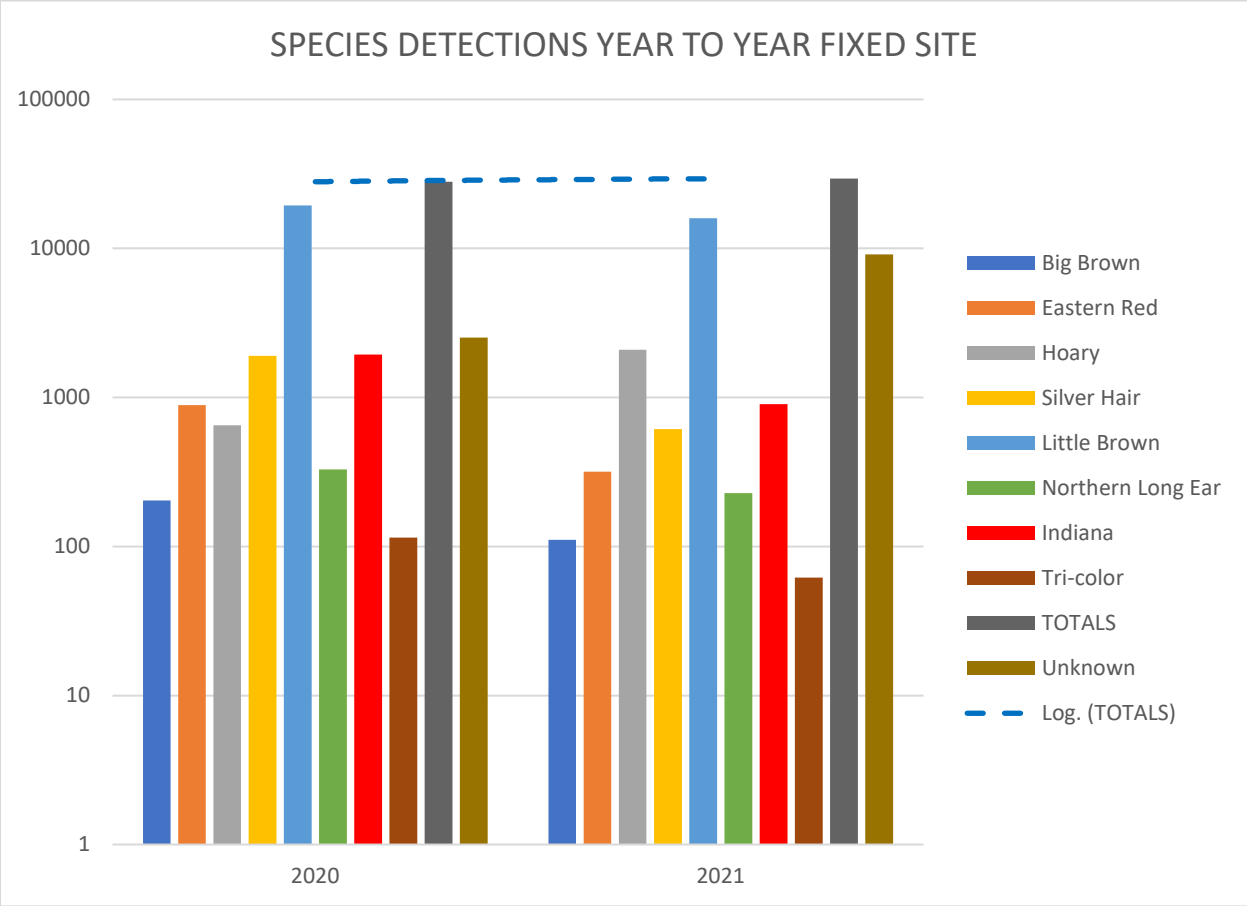

FIGURE 6 – Comparison of species activity at fixed monitoring site 2020 and 2021

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.

The data collected at the fixed site in 2020 and 2021 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, levels off until late

June, and peaks in early July. This is consistent with animals arriving at maternity sites and the 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 and 2021 are remarkably similar. Activity seems to peak at the same times and levels, declining in a like fashion with 2021 numbers being slightly higher, indicating a possible slow increase in population year to year.

The dramatic decline in activity on or around May 4 of both 2020 and 2021 is unusual in that it occurs two years in a row. This decline is a result of the temperatures dropping below 40 degrees Fahrenheit in the same week in both years. Bat activity decreases rapidly at temperatures below 50 degrees Fahrenheit accounting for the drop in both years. [4]

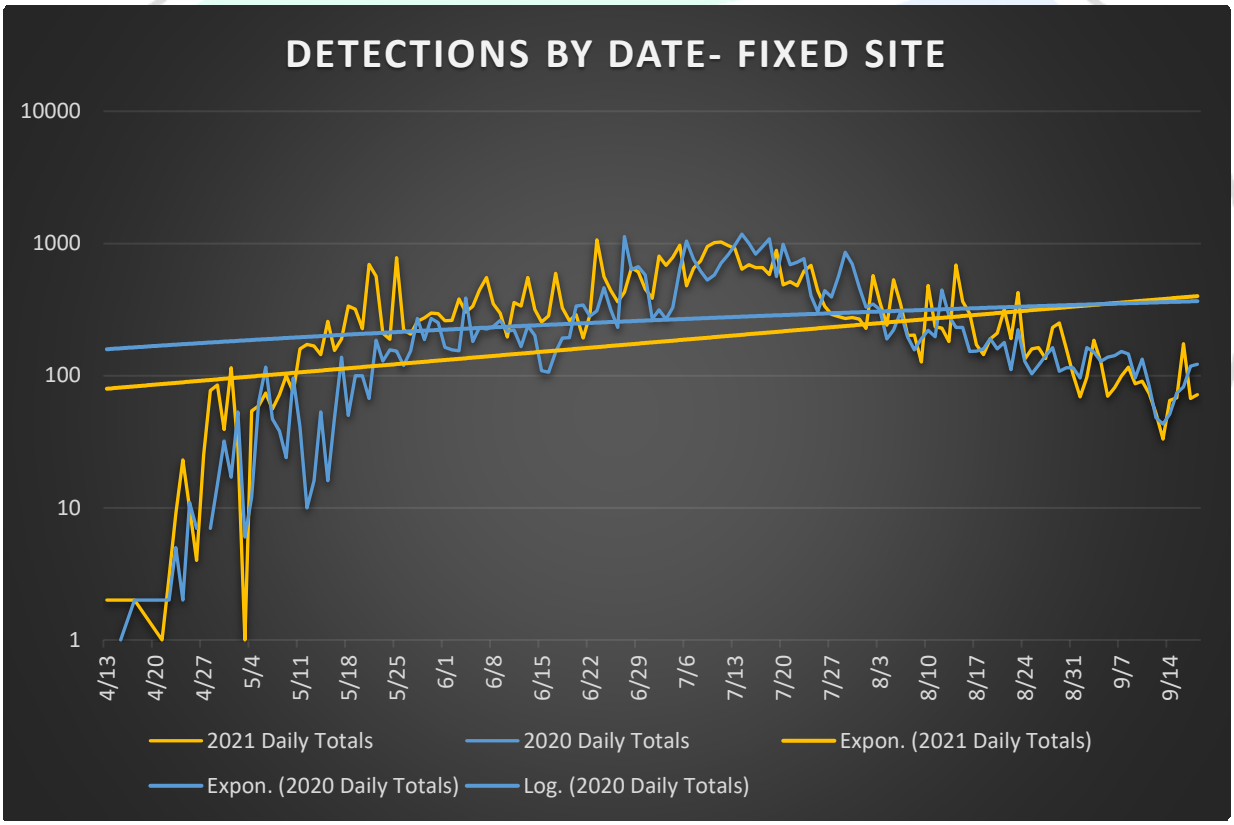

Figure 7 – Fixed site activity levels by day 2020 and 2021

Endangered Species Presence (*Myotis sodalist*)

The fixed site 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. 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:

DATE	NULL PROBABILITY OF MYOSOD (Indiana)
5/5/21	0.0001
5/9/21	0.0002
5/26/21	0.0017
6/30/21	0.0004
7/3/21	0.00002
7/4/21	0.0003

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.

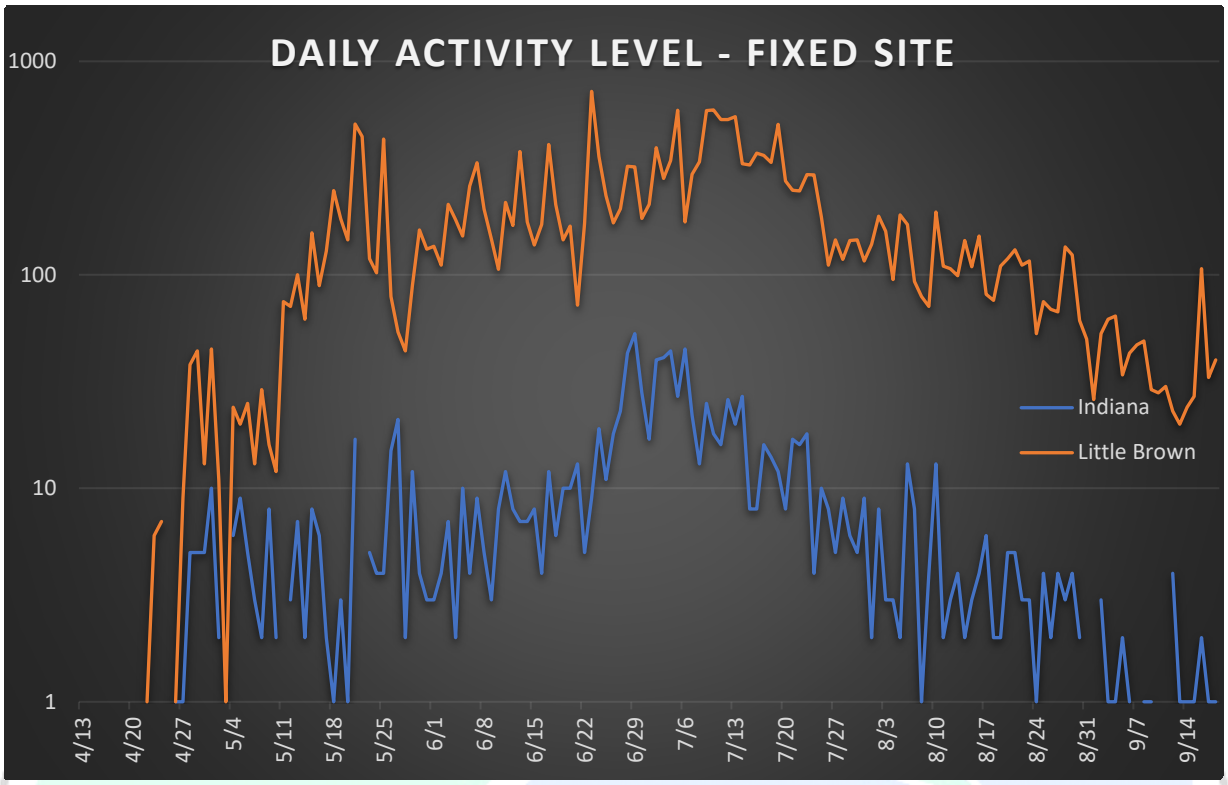

Figure 8 – Daily activity levels of Little Brown (*Myotis lucifugus*) and Indiana (*Myotis sodalist*) Bats at fixed monitoring site

Discussion

The increasing bat ultrasonic signal numbers over the last 3 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 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 in late June, early July. The daily detection counts represented in figure 7 show a faster and more sustained increase in activity in 2021 over 2020 as evidenced by the trend lines. Trend lines tend to even out the short- term effects of weather.

Published information on bat activity relates that most species do not fly in heavy rain or in temperatures below 50 degrees Fahrenheit.[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 2021 shows that measured precipitation at the Rocky Trail site decreased from 15.52 inches to 11.82 inches for the time period of May through September in the years 2019 through 2021. 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 in 2021 (see appendices).

The warmer, dryer seasons may account for more bat activity. Dryer years reduce the insect population requiring more foraging to obtain adequate food. Increased foraging results in more signals and hence more recorded activity.

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 at this site that activity is located some distance from most human activity with few boaters. It is at this site that signal detections are at the highest levels three years running. 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 over a three year time period. 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 in the average seasonal temperatures in the Les Cheneaux area over the last three 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.

Conclusions

Overall bat activity has increased in the Les Cheneaux area over the last 3 years. This confirms that there is at least a short term 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 for the population.

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

The Indiana Bat is present in the Les Cheneaux area as reported by the Kaleidoscope analysis of recorded bat calls.

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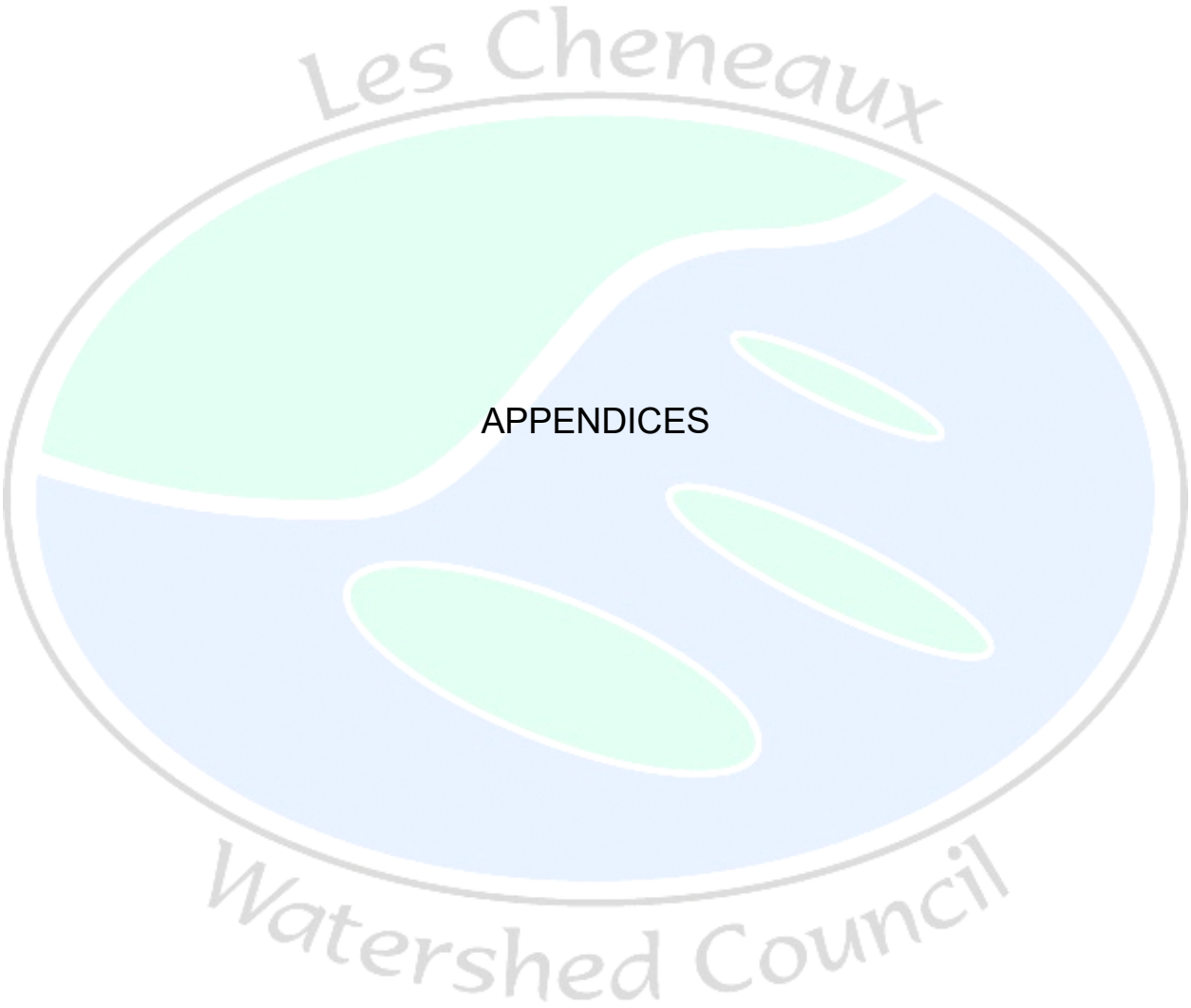
1) https://www.whitenosesyndrome.org/static-page/the-fungus
2) Wildlife Acoustics; Inc., Kaleidoscope Pro 5 Users Guide, December 4, 2020, Pgs 111-112
3) Kurta, Allen; Mammals of the Great Lakes Region, Third Edition; University of Michigan Press, 2017, pg. 68
4) Kurta, Allen; Mammals of the Great Lakes 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

Les Cheneaux
Watershed Council

MAP OF MONITORING LOCATIONS

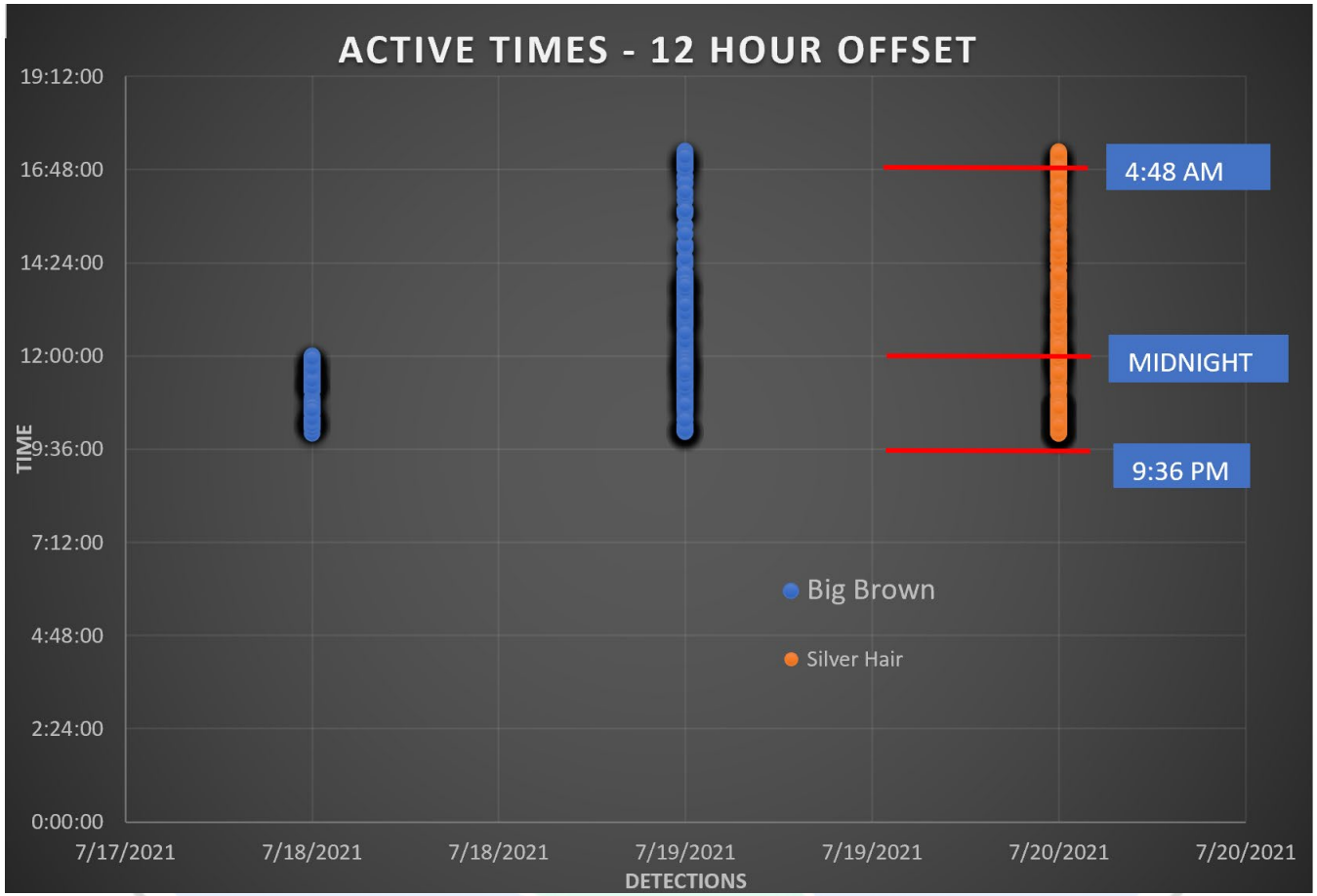
YEAR	TOTAL SEASON (5/1-9/17) PRECIPITATION (Inch)
2019	15.52
2020	13.51
2021	11.82

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

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



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