Bat Detections in Les Cheneaux Islands

2019 Summary

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ABSTRACT: Echolocation signals were recorded in six locations in the Les Cheneaux Islands to monitor local bat activity using a Wildlife Acoustics detection meter. 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 activity was calculated at 221 detections per night.

Eight of nine bat species native to Michigan were identified using Kaleidoscope software to interpret recorded signals. The Little Brown bat (*Myotis lucifugus*) signals were recorded most frequently, followed by 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. 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 at the island sites than the mainland sites. This may be related to the infrequent human activity at these sites. Species distribution is not homogenous throughout the area. Availability of preferred habitat is a likely factor in the observed variations.

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*. 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. 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 was verified using only the automatic identification assigned by the Kaleidoscope software.

METHODS

A Wildlife Acoustics SM4BAT-FS ultrasonic detection meter was positioned in six areas of the Les Cheneaux Islands. Monitoring locations were chosen to provide a sampling of activity across the coastal area of the Les Cheneaux watershed. The SM4BAT-FS recorded full spectrum signals using a microphone that was separate from the recording unit. The microphone of the SM4BAT system was 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. Each location was monitored for 7 to 31 days. Monitoring time was based on logistics and time available.

Figure 1 is a map depicting the various monitoring locations used for this paper. **Figure 2** illustrates a typical microphone setup.

The SM4BAT-FS 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. These files were processed using the Wildlife Acoustics Kaleidoscope software version 5.1.9. 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 5.1.0 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 includes 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 the season to obtain a normalized value of bat detections per night for the coastal area of the watershed.

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[(1)].

RESULTS

Overall - The SM4BAT-FS registered a total of 20526 detections of bat echo location signals while recording from 30 minutes prior to sunset to 30 minutes after sunrise for 93 nights over the 2019 season. A Wildlife Acoustics Kaleidoscope software analysis of the signals assigned an auto species identification (auto ID) to a total of 12,916 of the signals. The remaining 7,610 signals did not exhibit statistically significant conformity to any of the signals in the Kaleidoscope library of baseline signals and were, therefore, not assigned an ID. In addition to the 20526 detections, the software classified an additional 4885 signals as noise as they did not meet the requirements for bat echo location calls.

Normalized bat activity for the Les Cheneaux area was calculated by dividing the total number of detections (20,526) by the total number of nights monitored from Table 1 (93). The resulting average was rounded up to 221 detections per night.

Table 1 lists the locations monitored, the average number of signal detections per night, and the time period monitored.

TABLE 1. - Location Average Detections

LOCATION	AVG DETECTIONS/NIGHT	DATES COLLECTED	TOTAL NIGHTS
BIRGE PRESERVE	165.9	8/9 - 8/20	11
PRENTISS BAY	46.6	6/30 - 7/12	13
ROCKY TRAIL	24.65	VARIOUS 4/21-7/30	31
WOODLAND PARK	362	5/5 - 5/13	9
CORYELL	583.85	7/16 - 7/23	8
LONG ISLAND	578.73	6/6 - 6/27	21
TOTAL NIGHTS MONITORED			**93**

Species Diversity

Table 2 breaks down the automatic species identification by location and number detected. The abbreviations used in table 2 and elsewhere in this paper are as follows:

SM4BAT-FS Identifier	Scientific Name	Common Name
EPTFUS	*Eptesicus fuscus*	Big Brown
LASBOR	*Lasiurus borealis*	Eastern Red
LASCIN	*Lasiurus cinereus*	Hoary
LASNOC	*Lasionycteris noctivagans*	Silver Haired
MYOLUC	*Myotis lucifugus*	Little Brown
MYOSEP	*Myotis septentrionalis*	Northern Long Ear
MYOSOD	*Myotis sodalist*	Indiana
PERSUB	*Pipistrellus subflavus*	Eastern Pipestrelle or Tri-Colored

TABLE 2. Detections by Species and Probability Data

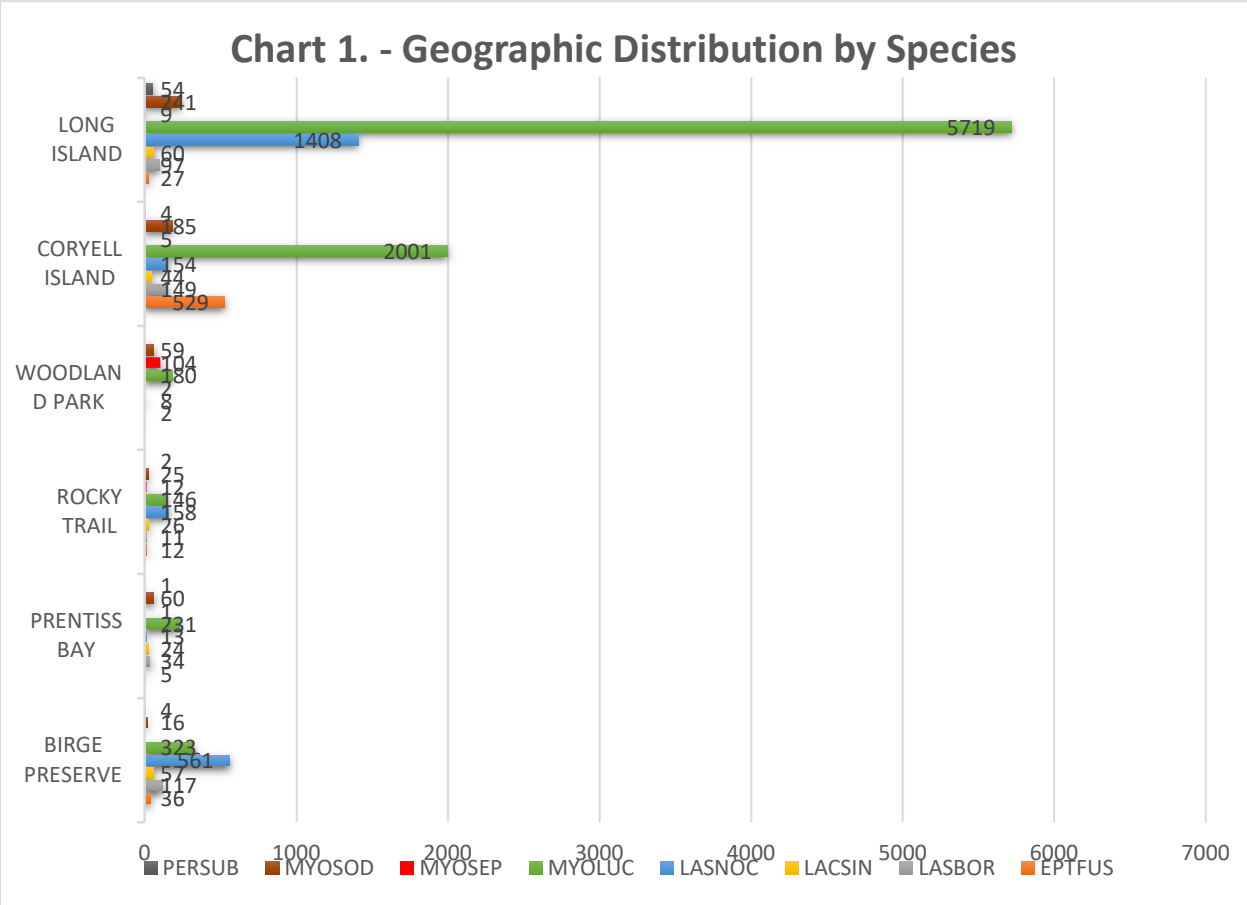
LOCATION	EPTFUS	LASBOR	LACSIN	LASNOC	MYOLUC	MYOSEP	MYOSOD	PERSUB	NO ID	**TOTALS**
BIRGE PRESERVE	36	117	57	561	323		16	4	548	**1662**
AVG PROBABILITY OF NO PRESENCE	0.998	0.109	0.516	0	0	1	0.80156	0.897		
PRENTISS BAY	5	34	24	13	231	1	60	1	237	**606**
AVG PROBABILITY OF NO PRESENCE	0.791	0.433	0.334	0.765	0.080	0.985	0.538	0.949		
ROCKY TRAIL	12	11	26	158	146	12	25	2	249	**641**
AVG PROBABILITY OF NO PRESENCE	0.925	0.863	0.728	0.426	0.316	0.747	0.665	0.934		
WOODLAND PARK		2	8	2	180	104	59		2179	**2534**
AVG PROBABILITY OF NO PRESENCE	1	1	0.434	0.90	0.14	0.38	0.42	1		
CORYELL ISLAND	529	149	44	154	2001	5	185	4	1016	**4087**
AVG PROBABILITY OF NO PRESENCE	0.00	0.12	0.36	0.19	0.00	1.00	0.46	1.00		
LONG ISLAND	27	97	60	1408	5719	9	241	54	3381	**10996**
AVG PROBABILITY OF NO PRESENCE	0.975	0.932	0.797	0.061	0.151	0.921	0.765	0.492		
TOTALS	**609**	**410**	**219**	**2296**	**8600**	**131**	**586**	**65**	**7610**	**20526**

Table 2 values identified as the “average probability of no presence” are derived from a statistic provided by the Kaleidoscope software[(1)]. The lower the number, the more recorded signals match the baseline signal parameters. These probabilities are averaged over the recording time period for each location.

Using the auto ID function of the Wildlife Acoustics BATSM4 as an indicator, eight of the nine species of bats found in Michigan were identified as likely present in the Les Cheneaux area. As expected, the most common species signal identified was *Myotis lucifugus* or the Little Brown bat. Prior to the emergence of White Nose Syndrome, the little brown was known to frequent the area in large numbers. Anecdotal reports of sightings have declined drastically since about 2010. The next most sonically active species was identified as the Silver Haired (*Lasionycteris noctivagans*), a widespread species known to inhabit forested areass. Big Browns (*Eptesicus fuscus*) and Eastern Reds (*Lasiurus borealis*), both common in Michigan, were next in numbers of signals identified. Northern Long Ear (*Myotis septentrionalis*), Hoary (*Lasiurus cinereus*), and Tri-color (*Pipistrellus subflavus*) bat signals were identified in much lower numbers. Additional data analysis to verify the actual presence of species with low detection rates was not performed or required.

Geographic Species Distribution

Chart 1 is a graphic representation of bat activity data presented in Table 2. Here the species distribution among the six recording sites is more apparent. As expected, the island locations exhibit the highest activity in all species identified. The proportion of Silver Hair (LASNOC) activity is higher in the two mainland sites, Rocky Trail and Birge Preserve. LASNOC activity is recorded in very low numbers at two other mainland sites, Woodland Park and Prentis Bay. Significant Big Brown (EPTFUS) activity is noted in only one island location, Coryell, and no other site. Indiana bat (MYOSOD) activity appears in all six recording locations. Apparent significant Northern Long Ear (MYOSEP) activity is noted at the Woodland Park site



Variations in Activity During Recording Periods

The number of bat signals recorded at any one sight varied from night to night. While not unexpected, some of the variations were quite drastic. Also of interest were the differences in recorded activity from species to species. Not all species detected exhibited peak activity during the same time period. Some attempt was made to explain these variations using environmental factors such as temperature and wind speed. These factors correlated well at some sites but not at other sites. The most likely cause for this was the variation in other factors such as recording distance, foliage density and surrounding clutter differences.

Figure 3 illustrates the variability encountered in the activity in the Birge Nature Preserve. **Figure 4** illustrates the number of detections of the 3 most common species over the recording period on Long Island.

DISCUSSION

Ultrasonic detection of bat signals is subject to many environmental factors. These factors include microphone placement in relation to activity, temperature, humidity, and foliage present. Signals detected represent individual calls rather than individual animals. One bat can produce several signals during one pass over the stationary microphone and several passes might be made in one hour. The number of signals recorded, therefore, represents only a measure of bat activity and not population. One can infer from the recorded data that higher activity is an indicator of higher number of individuals but physical counts are required to validate this inference.

The current study is an attempt to track bat activity in the Les Cheneaux area over time to ascertain if any trends exist. The hypothesis is that bat activity relates to the overall health of the bat population. A precedent for this exists in that some researchers use songbird activity to assess wetlands ecosystem health[(2)]. In this case population estimates are not required. Whereas a parameter of signals per hour to compare year to year activity levels is used as an indicator.

Kaleidoscope software Auto Identification is based on comparing recorded signals with reference signals obtained from each species known to inhabit a recording region. Reference signals are obtained from bats in free flight in non-cluttered areas and do not represent all possible signals produced by each species. Signals produced by a single individual may vary greatly depending on the type of activity. Environmental factors may result in auto identification errors. Omission errors may also exist due to the lack of data concerning the reported ranges of individual species. Auto identification is used in this report only as an indicator of the species diversity present. Additional signal vetting and possible physical counts are needed to verify the presence of species with low signal counts. The signals with no auto identification are included in the overall total as they represent detections of bat activity. The software could not classify noise signals as bat calls and are not included in the overall activity.

An apparent anomaly occurred in the identification of several signals at the Woodland Park, Coryell Island, and Long Island sites (Table 2). At these sites the BATSM4-FS identified many of the detected signals as the Indiana Bat (*Myotis sodalist* identified as MYOSOD). The average estimated probability of null hypothesis in these cases was below 0.5. Woodland Park site had 3 periods where null hypothesis probability was at or very near zero. The Coryell and long Island sites each had two periods of at or near zero.

Little Brown (*Myotis lucifugus* identified as MYOLUC) signals are very similar to those of the Indiana so there is still some question of accuracy. While the Indiana is in Michigan, its currently known range only extends as far north as Leelanau county (NFWS map, **Figure 5**). Numerous articles, however, indicate that species of flora and fauna are expanding northward as a result of climate change(3). The existence of the Indiana bat in the Les Cheneaux area remains an open question.

There are many factors affecting bat activity from night to night at the same location. These could include the microphone to activity location distance, weather, migration, emergence of young, and feeding and social habits. The little Brown (MYOLUC) activity variation on Long Island in early June could correlate to insect hatches as the peak activity numbers are at roughly the same level. Starting about June 15, however, the peak activity numbers trend upward indicating a possible increase in source numbers. Little Brown pups are born in late May and early June and become independent within 4 weeks[(4)]. This loosely corresponds to the time frame of the upward trend in activity.

Another factor that may influence species activity at different times is the preferred diet. Little Browns (MYOLUC) are opportunist insectivores but prefer to feed on swarms of smaller insects in the range of 3mm to 10mm[5]. Silver haired bats (*Lasionycteris noctivagans* identified as LASNOC), however, prefer moths, flies, and beetles which can be outside of this size range. The smaller insects may appear at different times than the larger moths and flies.

The variable that has the strongest effect on the number of signals recorded each night is the distance and orientation of the microphone to the areas of activity.[5] Feeding activity that takes place at 20 meters from the microphone at an oblique angle to the primary recording direction results in fewer detections than activity that is on the axis at 10 meters. Since insect hatches are seldom geographically static, bat feeding activity locations and thus detections also vary. Averaging the number of detections over a longer time period helps to reduce this variability but does not eliminate its affects.

Geographic Distribution

Bat activity and species distribution in the Les Cheneaux coastal area is most likely dependent on the available habitat predominant characteristics. The island sites have much less human activity and an abundance of low use unused structures. Structures are considered preferred summer habitats for species such as the Big Brown and Little Brown bats (EPTFUS and MYOLUC). Long Island, for instance, has very few structures that see little use and large areas of untouched forest with small wildflower meadows all surrounded by water and wetlands. This type of environment is ideal for Michigan bat species. The inland areas such as the Birge Preserve have forest with no nearby structures. This may explain why the Brown Bat activity is lower while the Silver Hair (LASNOC) activity is predominant.

Conclusions

- Bat activity in the Les Cheneaux coastal area appears to be higher at the island locations where human activity is seasonal.
- Ultrasonic signal recording and automatic identification indicates that several species of bats are present in the Les Cheneaux coastal area. The species exhibiting the most activity is the Little Brown (Myotis lucifugus, MYOLUC). The two other species exhibiting the highest activity rates in the area are the Silver Hair Bat (*Lasionycteris noctivagans,* LASNOC) and the Big Brown Bat (*Eptesicus fuscus,* EPTFUS). Other species whose presence is indicated include the following:

Common Name	**Scientific Name**	**SM4BAT-FS Identifier**
Eastern Red	*Lasiurus borealis*	LASBOR
Hoary	*Lasiurus cinereus*	LASCIN
Northern Long Ear	*Myotis septentrionalis*	MYOSEP
Indiana	*Myotis sodalist*	MYOSOD
Eastern Pipestrelle or Tri-Colored	*Pipistrellus subflavus*	PERSUB

FIGURE 1

Monitoring locations

FIGURE 2

Typical microphone placement

FIGURE 3

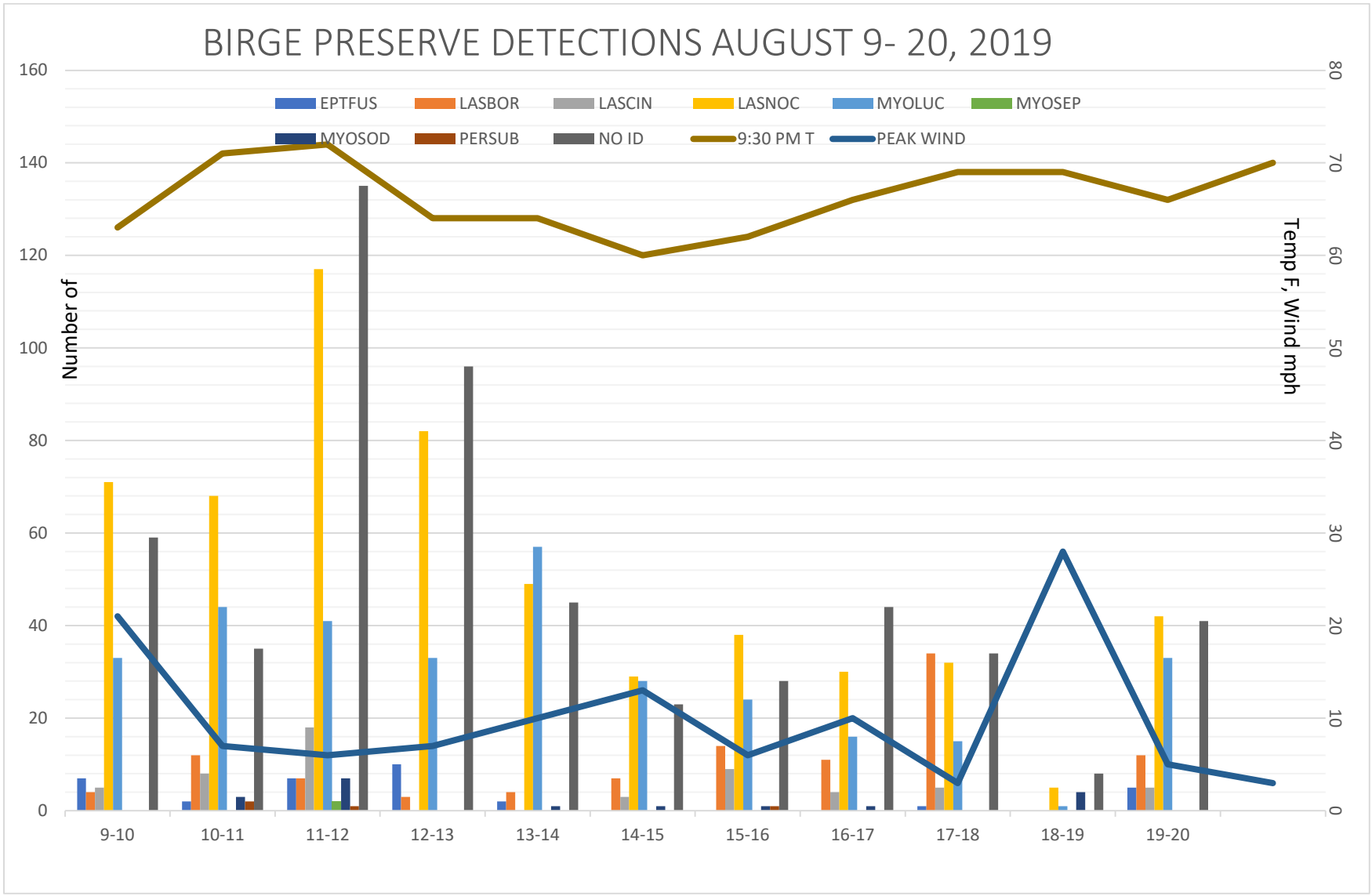
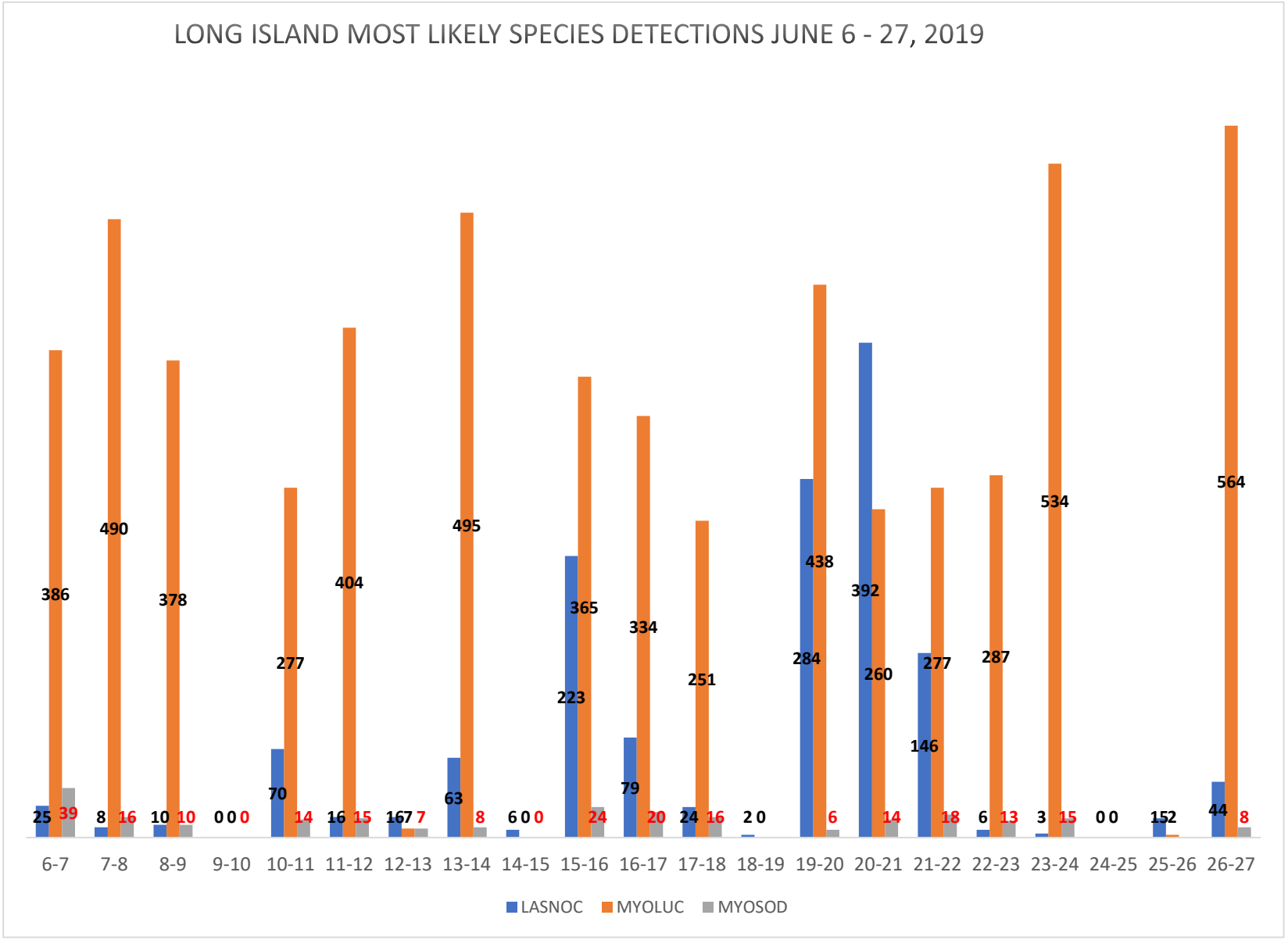

BIRGE PRESERVE DETECTIONS AUGUST 9- 20, 2019
EPTFUS
LASBOR
LASCIN
LASNOC
MYOLUC
MYOSEP
MYOSOD
PERSUB
NO ID
9:30 PM T
PEAK WIND
Number of
Temp F, Wind mph
160
140
120
100
80
60
40
20
0
80
70
60
50
40
30
20
10
0
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20

FIGURE 4


LONG ISLAND MOST LIKELY SPECIES DETECTIONS JUNE 6 - 27, 2019
6-7 25 386 39
7-8 8 490 16
8-9 10 378 10
9-10 0 0 0
10-11 70 277 14
11-12 16 404 15
12-13 16 7 7
13-14 63 495 8
14-15 6 0 0
15-16 223 365 24
16-17 79 334 20
17-18 24 251 16
18-19 2 0
19-20 284 438 6
20-21 392 260 14
21-22 146 277 18
22-23 6 287 13
23-24 3 534 15
24-25 0 0
25-26 15 2
26-27 44 564 8
LASNOC
MYOLUC
MYOSOD

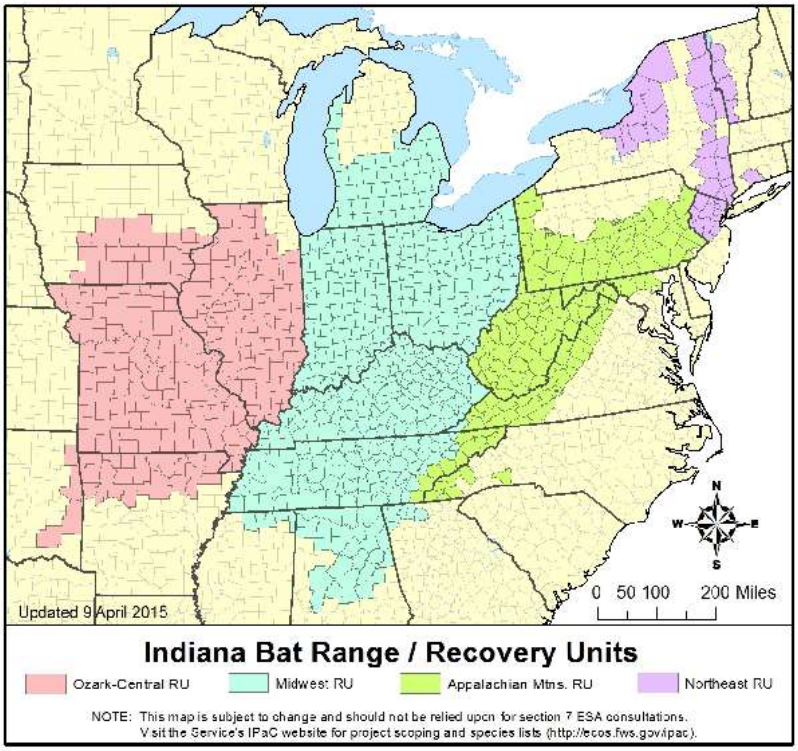


FIGURE 5

Indiana Bat Range

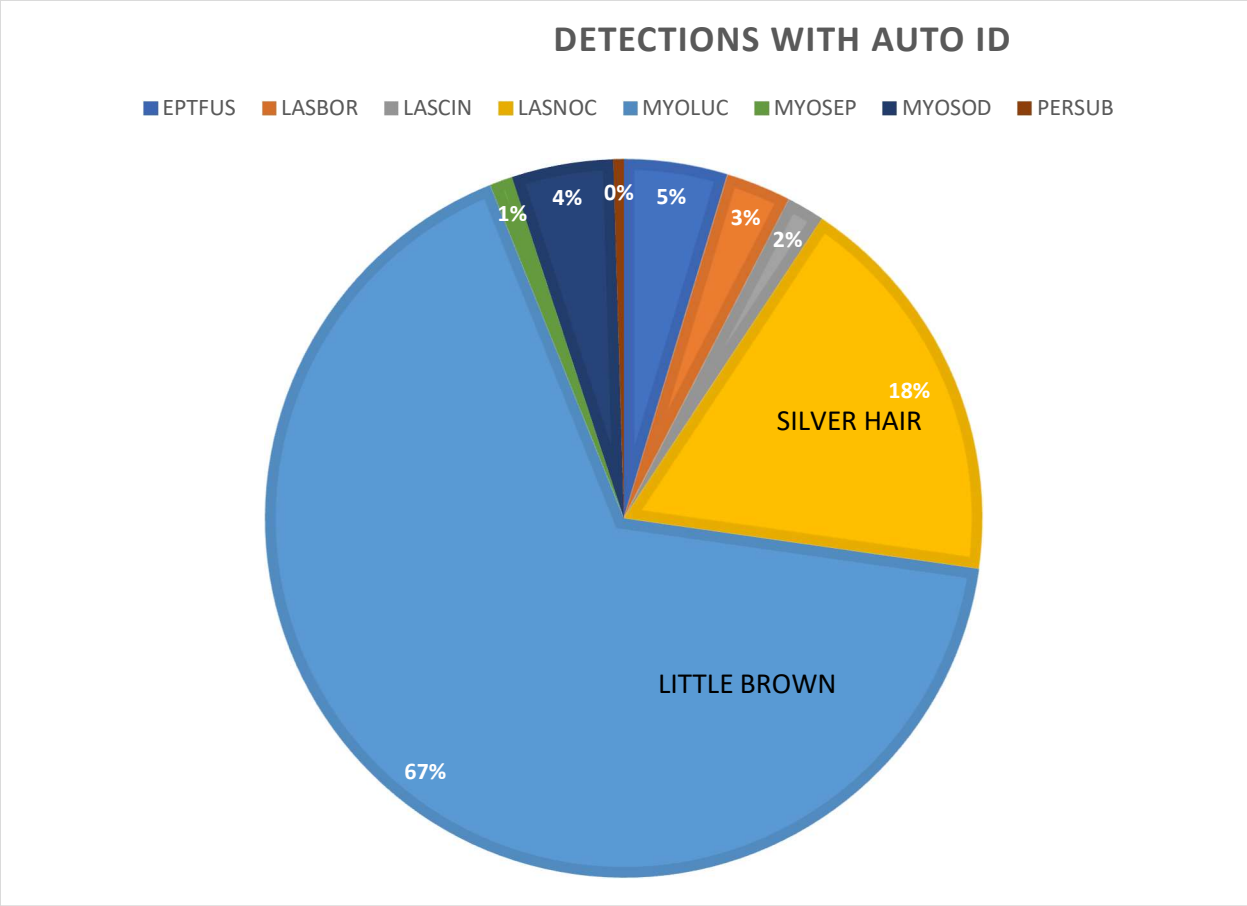
Cited:

1) Kaleidoscope Pro 5 User Guide. Wildlife Acoustics ©1998-2005; Smart, Julian; Roebling, Robert; et.al.; Pg. 98
2) Linking Land and Lakes; Central Michigan University documentary, October 2019
3) Global Climate Change and Mammalian Species Diversity in U.S. National Parks. Catherine E. Burns, Kevin M. Johnston, and Oswald J. Schmitz. Proc Natl Acad Sci U S A. 2003 Sep 30; 100(20): 11474–11477. Published online 2003 Sep 19. Pg. 1
4) Little Brown Bat. Animal Diversity Web. Fenton, M., R. Barclay. 1980. *Myotis lucifugus*. Mammalian Species, 142: 1-8.
5) Patriquin, K., R. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. *Journal of Applied Ecology*, 40/4: 646-657.
6) Detecting Bats with Ultrasonic Microphones, Understanding the effects of microphone variance and placement on detection rates. *Ian Agranat, Wildlife Acoustics, Inc. November 10, 2014.*Pg. 5

APPENDIX

Possible Species – Estimated Ratios

Activity Time Plot – 2 Species



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MYOLUC	*Myotis lucifugus*	Little Brown
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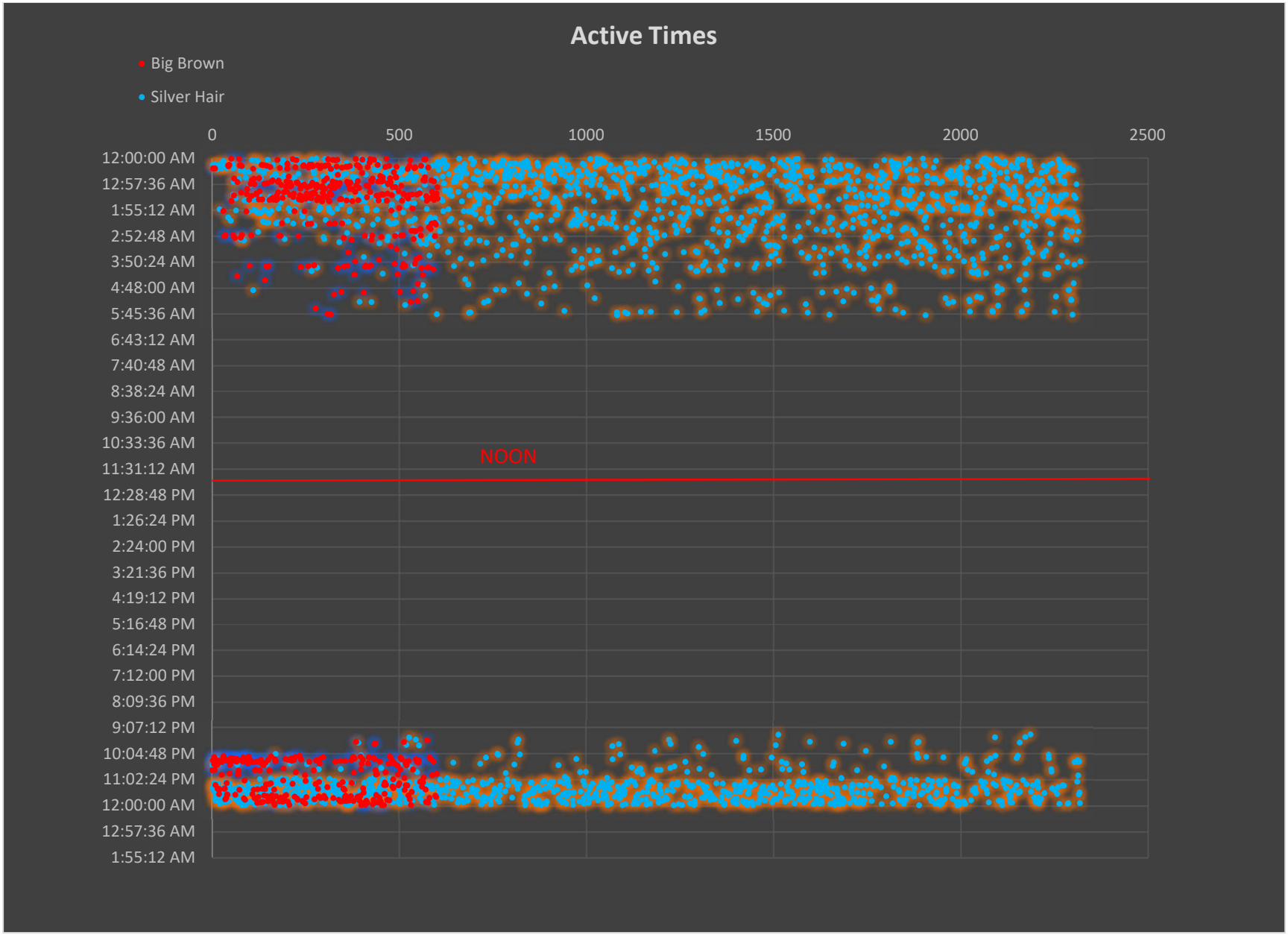
Active Times
Big Brown
Silver Hair
0
500
1000
1500
2000
2500
12:00:00 AM
12:57:36 AM
1:55:12 AM
2:52:48 AM
3:50:24 AM
4:48:00 AM
5:45:36 AM
6:43:12 AM
7:40:48 AM
8:38:24 AM
9:36:00 AM
10:33:36 AM
11:31:12 AM
12:28:48 PM
1:26:24 PM
2:24:00 PM
3:21:36 PM
4:19:12 PM
5:16:48 PM
6:14:24 PM
7:12:00 PM
8:09:36 PM
9:07:12 PM
10:04:48 PM
11:02:24 PM
12:00:00 AM
12:57:36 AM
1:55:12 AM
NOON