

Echolocation Survey of Hassayampa River Preserve Bats September 2019 to July 2021

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Introduction

Bat echolocation recordings were made at the Hassayampa River Preserve between September 1st 2019 and July 20th 2021. Recording ended due to equipment failure. It was the goal of this study to determine the year to year and seasonal bat usage of the Hassayampa River Preserve.

Habitat

The preserve is located near Wickenburg, AZ in a perennial riparian habitat in the Upper Sonoran Desert. This habitat is one of the larger intact riparian areas in the Sonoran Desert with major plant communities being composed of *Populus fremontii*, *Salix gooddingii*, and *Prosopis velutina*. The surrounding Sonoran Desert Uplands are rocky and semi-mountainous with *Carnegie gigantea*, *Ambrosia deltoidea*, *Encelia farinosa*, and *Parkinsonia microphylla* plant associations. Development in the area has to this point been minimal. It is hypothesized that this relatively large and intact habitat is ideal for bats.

Data collection

The ultrasonic recorder was placed in the southeastern portion of the preserve in a *Populus fremontii* and *Prosopis velutina* open woodland (Refer to Figure 4 located on page 5). Open water was located approximately 50 meters to the south and 100 meters to the northwest (GPS location of recorder: 33.929567,-112.6901606). The Anabat Express zero cross recorder used was set to record nightly from sunset to sunrise. The area selected for recording was free of clutter that may disrupt echolocation recordings for 30 or more meters. The recording site was a transitory area for bats between major roosting areas, water sources, and feeding areas. By avoiding roosting, feeding, and water areas, an unmanageable number of calls were avoided and there was an increased chance that a single bat detection represented a single bat, rather than a single bat's continued use of the area repeatedly triggering recordings. All data was analyzed with Wildlife Acoustics Kaleidoscope Pro software to identify each call to the species level. All species were then verified manually but not all individual calls were verified to species manually. Three species, *Myotis evotis*, *Myotis occultus*, and *Myotis thysanodes* were identified by Kaleidoscope Pro but could not be verified manually. Overall, counts of species identified from echolocation recordings should be viewed as estimates due to potential software misclassification.

Bat species of the Hassayampa River Preserve

A total of 17 species of bats were detected during the recording period (refer to Table 1 below). Species richness increased from February until peaking at the end of August. Species richness then decreased during the month of September until only a few species were detected nightly starting in the middle of October, returning to levels seen prior to February. Both years followed a similar pattern of activity. The most common species detected over the course of the entire detection period were MYOVEL, TADBRA, EPTFUS, LASNOC, LASCIN, and MYOVOL.

Table 1. Total detections of bats for each year sampled

		Year 2019-20		Year 2020-21	
Bat Species	Species Abbreviation	Total detections	% of nights detected	Total detections	% of nights detected
All Species and No ID		36861	91.1	29241	93.7
Big Brown	EPTFUS	4309	57.6	4731	52.3
Mexican Free-Tailed	TADBRA	4378	68.5	3284	61.3
Cave Myotis	MYOVEL	6607	51.0	2764	51.7
Western Small-Footed	MYOCIL	1866	46.4	2160	43.7
Desert Pallid	ANTPAL	456	28.1	1925	26.8
Hoary	LASCIN	1015	55.6	1555	40.7
Silver Haired	LASNOC	2156	62.3	1479	65.9
Long-Legged Myotis	MYOVOL	835	38.4	477	28.8
Canyon Bat	PARHES	456	38.7	408	31.5
Western Yellow	LASXAN	198	23.2	198	20.5
California Myotis	MYOCAL	131	20.5	191	24.5
Pocketed Free Tailed	NYCFEM	128	20.9	162	19.5
Yuma Myotis	MYOYUM	46	9.6	100	21.9
Western Red	LASBLO	225	22.2	46	9.6
Big Free Tailed	NYCMAC	19	4.6	12	3.6
Townsend's Big Eared	CORTOW	23	5.3	11	3.0
Underwood's Mastiff	EUMUND	18	5.0	10	3.3

Several less common species of interest were also detected both years during the sampling period. Species of interest were CORTOW, a federally listed Vulnerable species; LASXAN, which has been a US Forest Service listed Sensitive species; and LASBLO, which also has been a US Forest Service listed Sensitive species. All three of these species' sonograms were manually verified and found in both years of recording.

Seasonal activity levels

Overall activity levels increased from winter levels starting in late March and leveling off through the middle of June (refer to Figure 1 below). The end of June and into July had an extremely high level of activity that decreased into August, with low levels of activity taking place after the middle of September. The majority of activity taking place in between the end of June and August can be attributed to TABRA, EPTFUS, and MYOVEL, and is likely a result of young fledgling bats that were born in prior months. Both years were found to have similar patterns of activity.

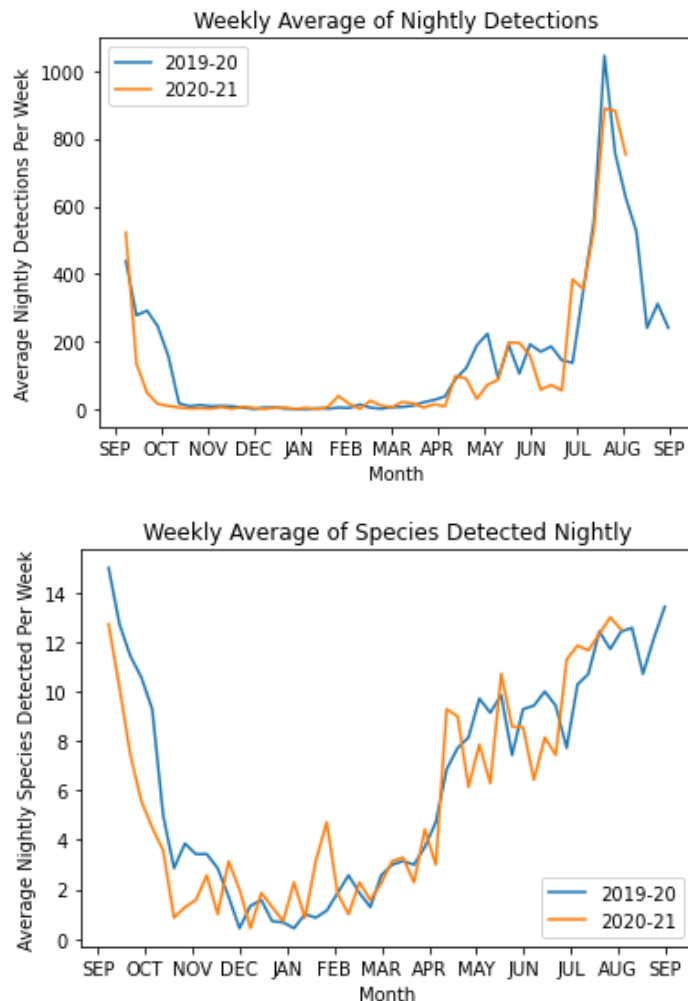


Figure 1. Weekly average of total bat detections (top) and bat species (lower) detected nightly.

Year to Year Comparison

To determine if different numbers of detections took place from one year to the next (See Figure 3 below and figures 5 and 6 after the conclusion on pages 6 and 7) the Mann Whitney U test was carried out on the weekly average detections for the 13 most common species, as well as total bat detections and total species detected. This nonparametric hypothesis test was used as a result of the strongly left skewed distributions of all the data. No statistically significant differences ($p>0.05$) were found between weekly detections for the first and second year for MYOVEL, ANTPAL, EPTFUS, LASCIN, LASNOC, MYOCIL, TADBRA, MYOVOL, LASXAN, or PARHES. Statistically significant differences between the years were found for MYOYUM ($p=0.02017$), LASBLO ($p=0.00576$), and LASCIN ($p=0.02103$). Due to the relatively low number of detections of these last three species and the high variability of the data, the actual statistical significance of this data should be questioned.

Spearman Rank Correlation was also carried out for the 13 most common species. Number of species, total number of bats detected, MYOVOL, MYOVEL, MYOCIL, EPTFUS, and ANTPAL were found to have a high Spearman Rank Correlation (>0.7) in detections between the two years. This indicated that seasonal patterns of detections were similar between the two years. MYOYUM, LASBLO, LASCIN, LASNOC, LASXAN, and TADBRA had weaker Spearman Rank Correlation (between 0.2 and 0.7) indicating some correlation in seasonal patterns of detection between the two years. CORTOW and PARHES had very weak Spearman Rank Correlation (<0.2) indicating weak to no correlation between the two years. However, due to a low number of overall detections for these last two species, strong conclusions cannot be drawn. As mentioned previously, due to the highly variable nature of echolocation data, this data cannot indicate any strong conclusions. However, with the majority of species having some level of correlation between year one and year two it could potentially be concluded that the overall seasonal patterns of bat detections were very similar for both years.

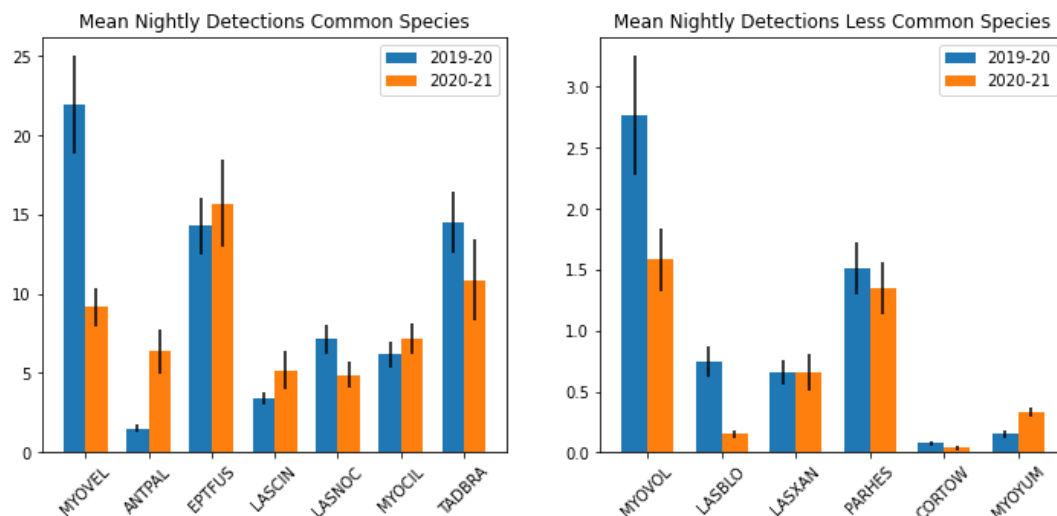


Figure 3. Mean nightly detections for the 13 most common species

Conclusion

The Hassayampa River Preserve has a very high level of bat species and activity with 17 confirmed species. This diversity is likely owed to the combination of intact desert and riparian habitat, as well as the presence of perennial water and undisturbed mines in the surrounding desert. It is likely that additional species also utilize the preserve and additional monitoring with a full spectrum ultrasonic recorder would likely verify additional species. During 2021, full spectrum monitoring was carried out at the pond for this purpose. A number of very important species were found to have utilized the preserve during both of the years monitored. Bat detections and seasonal patterns of use were found to be similar between the two years of monitoring. Additional years of monitoring would have to take place in order to identify trends in bat detections that potentially correspond to changes in bat populations. Additionally, searches for roosts could be carried out so they can be protected, thus protecting the bat diversity of the area. For example, mines in the area could be mapped and surveyed as roosts, and entrances to the mines gated off with bat safe gates.

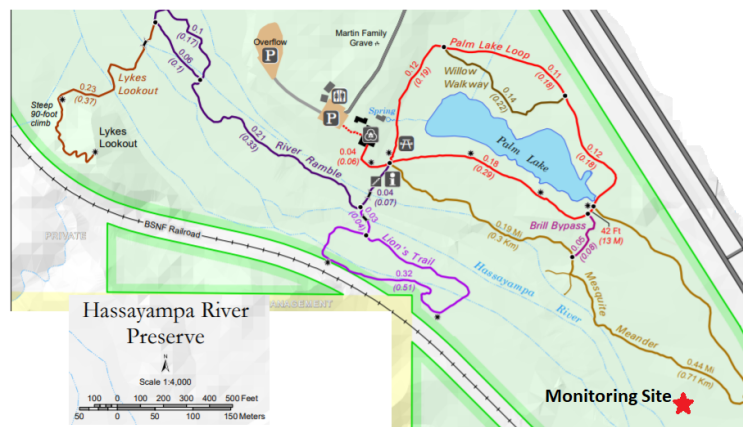


Figure 4. Map of Hassayampa River Preserve and location of echolocation recorder
Recorder located at GPS coordinates GPS location 33.929567,-112.6901606

Github repository for data and analysis:

<https://github.com/haberkornm/Hassayampa-Bats-2019-2021>

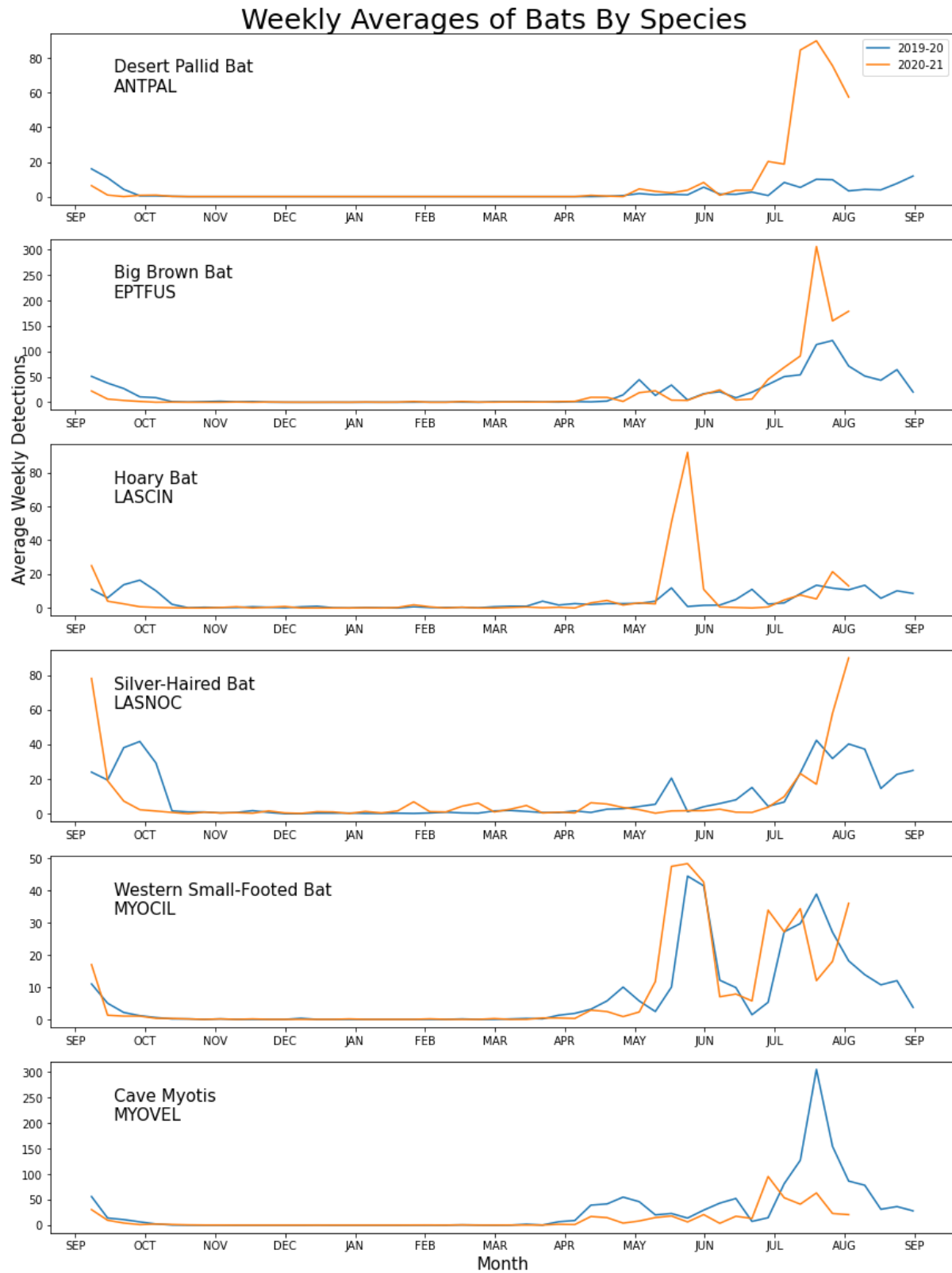


Figure 5. Weekly averages of bat detections by species for September 2019 to August 2020 for year one (2019-20) and September 2020 to July 2021 (2020-21).

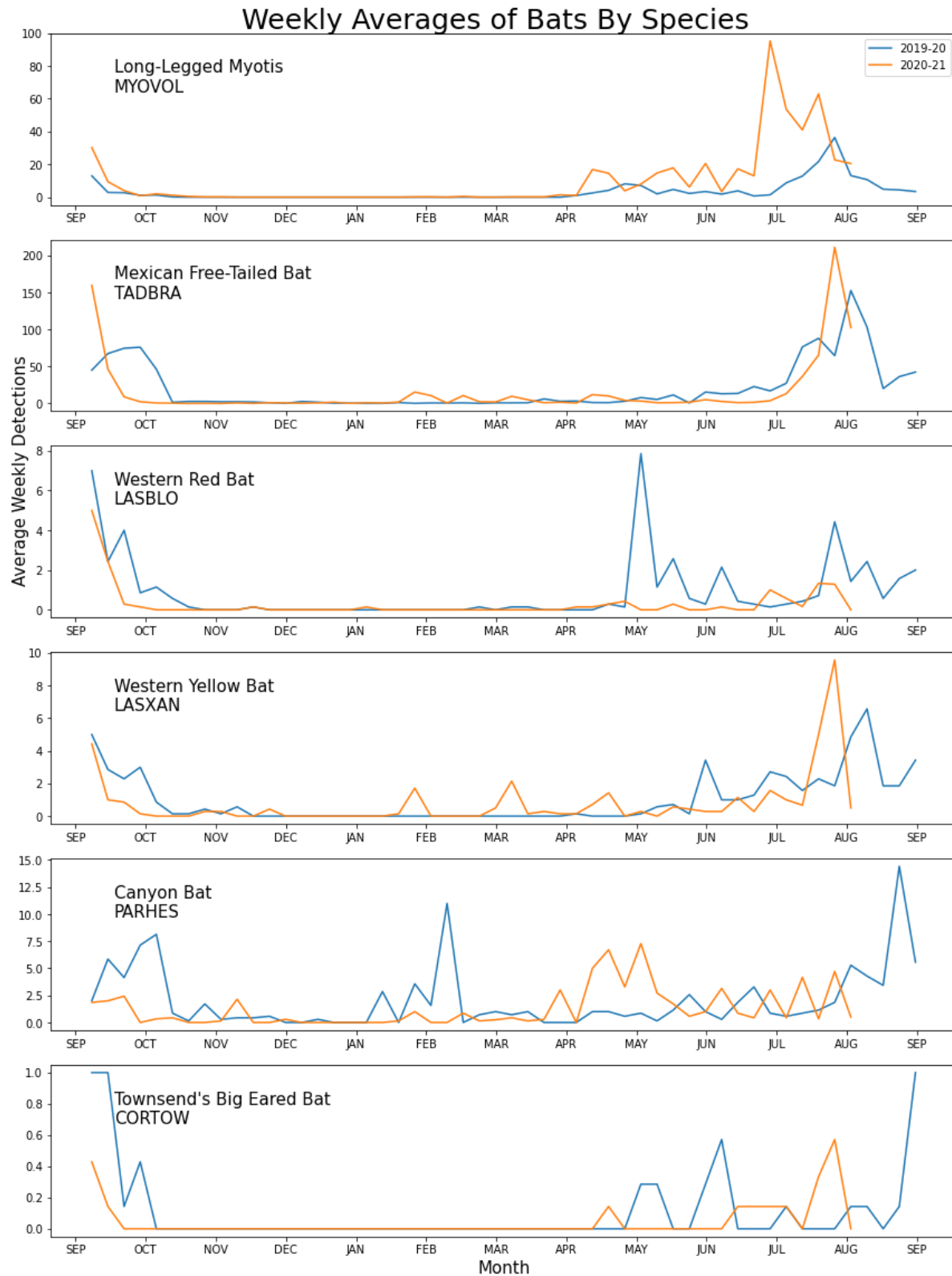


Figure 6. Weekly averages of bat detections by species for September 2019 to August 2020 for year one (2019-20) and September 2020 to July 2021 (2020-21).