Bat Echolocation Monitoring of the Phoenix Bat Cave in 2021

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Introduction

271 nights of bat echolocation recordings were made in 2021 at the Phoenix Bat Cave located at 43rd AVE and Camelback Rd in Phoenix, AZ. The Bat Cave is a large flood control tunnel in downtown Phoenix that has become an important year round roosting site for bats in the urban environment. No known previous surveys have been carried out of this bat population. Being bats are nocturnal and elusive, relatively little is known about them in general and there has been a minimal amount of information known about bats in urban Phoenix. Specifically, it is not known what species are present and use the cave, and what the seasonal use of the cave is. It was expected that Mexican free-tailed bats were the primary species occupying the cave from spring through fall, with very few bats present during winter months. It was the goal of this study to answer these unknowns about bats utilizing the Phoenix Bat Cave.

Habitat

The Phoenix Bat Cave is a concrete flood control tunnel located in downtown urban Phoenix, AZ within the Sonoran Desert. For the majority of the year the cave remains dry and ephemeral run-off from large rainfall events only enters the cave for a few days per year. The cave is located adjacent to a perennial canal, with both cave and canal being surrounded by urban neighborhoods and businesses. No native vegetation is present in the immediate vicinity of the cave. Bats utilize the cave by occupying joints between concrete slabs for day roosts.

Data Collection

A Wildlife Acoustics Echometer Mini Bat recorder was deployed approximately 100 meters from the mouth of the cave and 5 meters above ground level in 2021. A total of 271 nights of echolocation recordings were collected over the course of the year starting December 2020 and ending December 2021. Recordings began at sunset and concluded at sunrise. Difficulties with batteries powering the echolocation recorder were encountered consistently during the recording period of 2021. This was due to the high number of bats being recorded resulting in the recorder running almost continuously throughout the night as well as the high temperatures encountered during the day time, both of which greatly diminished battery life. The number of bats appeared to be far greater than the capacity of the detector to record echolocation calls. Recordings were analyzed with Wildlife Acoustics Kaleidoscope Pro Software, with parameters set for a minimum of five echolocation pulses and on conservative identification of bat call recordings. Each species identified by the software was positively identified manually, but not all calls were manually identified. For this reason, counts should be viewed as estimates rather than absolute positive counts of bat detections.

Bat Species at the Phoenix Bat Cave

A total of 10 species were positively identified at the mouth of the Bat Cave (Table 1 below). Of these species Mexican free-tailed bats (TADBRA) were by far the most abundant, composing approximately 51.9% of positively identified calls. Silver haired (LASNOC) and big brown bats (EPTFUS) were of secondary importance composing approximately 7.1 to 7.8% respectively of positively identified calls. Hoary bats (LASCIN) were found to be approximately 2.6% of positively identified calls with all other species being under 1% of positively identified calls.

Species	Total detections 2021	% of total detections	% of nights detected
Total detections	462442.0	100.00	100.00
Mexican free-tailed	239797.0	51.85	100.00
No ID	132298.0	28.61	100.00
Silver haired	36193.0	7.83	99.63
Big brown	32991.0	7.13	98.15
Hoary	11880.0	2.57	98.52
Canyon	2714.0	0.59	65.68
Western yellow	2327.0	0.50	34.69
Yuma myotis	2220.0	0.48	85.98
Desert pallid	1256.0	0.27	26.57
Western red	429.0	0.09	45.76
California myotis	153.0	0.03	23.25

Table 1. Positively identified bats found at the Phoenix Bat Cave in 2021, total number of detections quantified over 2021, percent of total bat recordings, and percent of nights detected.

Seasonal activity

The Phoenix Bat Cave was found to have significant numbers of bats present during the entirety of 2021. Bats were detected during every night recording took place in 2021. The highest levels of activity were between April and October. The increase seen between April and mid-October does not properly represent the number of bats passing the detector due to the fact that the recorder would run nearly all night and often detect multiple individuals in a single recording. The peak number of detections taking place in October most likely is not accurate, but simply due to the longer nights in October providing more time to detect more bats. Number of detections dropped between mid-October and somewhat leveled off between December and March. In March detections began to increase dramatically. Number of species detected nightly was highest from spring through fall and lower during the winter months.

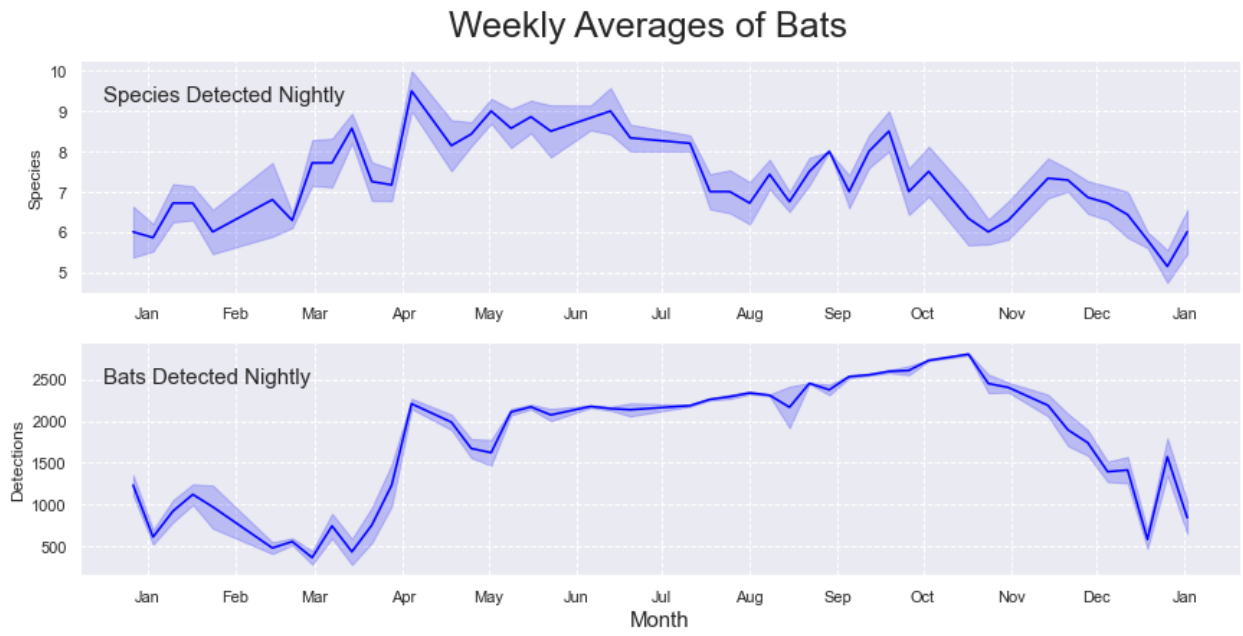

Figure 1. Weekly averages of species detected nightly top figure. Weekly averages of total bats detected nightly in bottom figure. Light blue bands are standard error bands.

The different species of bats followed different patterns of seasonal use of the Bat Cave. The vast majority of this activity year round was Mexican free-tailed bats. While it was estimated that approximately 52% of bats detected were Mexican free-tail bats, due to the fact that over 28% of detected bats were not identified, it is suspected that the number of Mexican free-tailed bats was significantly higher, possibly in the range of 80% of all bats detected. While the majority of bat activity for nearly all bat species was during the summer months, some bats such as the Hoary and the Silver haired bats were found to have bimodal patterns of annual activity, likely a result of migratory activity (see figures 2 and 3 below).

Significance of findings

The Phoenix Bat Cave provides important day roosting habitat for many thousands of bats year round in urban Phoenix, AZ. The majority of these bats are Mexican free-tailed bats but several other species likely utilize the Bat Cave as a day roost during the summer months as well as during seasonal migrations. Additionally, it is likely that the cave is an important habitat used in bat reproduction. Some of the species detected in this study possibly do not utilize the cave at all but were simply detected as they passed through the area. Additional bat research at the cave could focus on where these bats go to forage at night and what insects they are consuming. In all, the Phoenix Bat Cave is an extremely important habitat for bats that should be protected and likely provides a significant economic benefit in the form of insect pest control carried out by the bats.

To view GitHub repository for raw data, presentation, and Python code:
https://github.com/haberkornm/Bat-Cave-2021-Bats

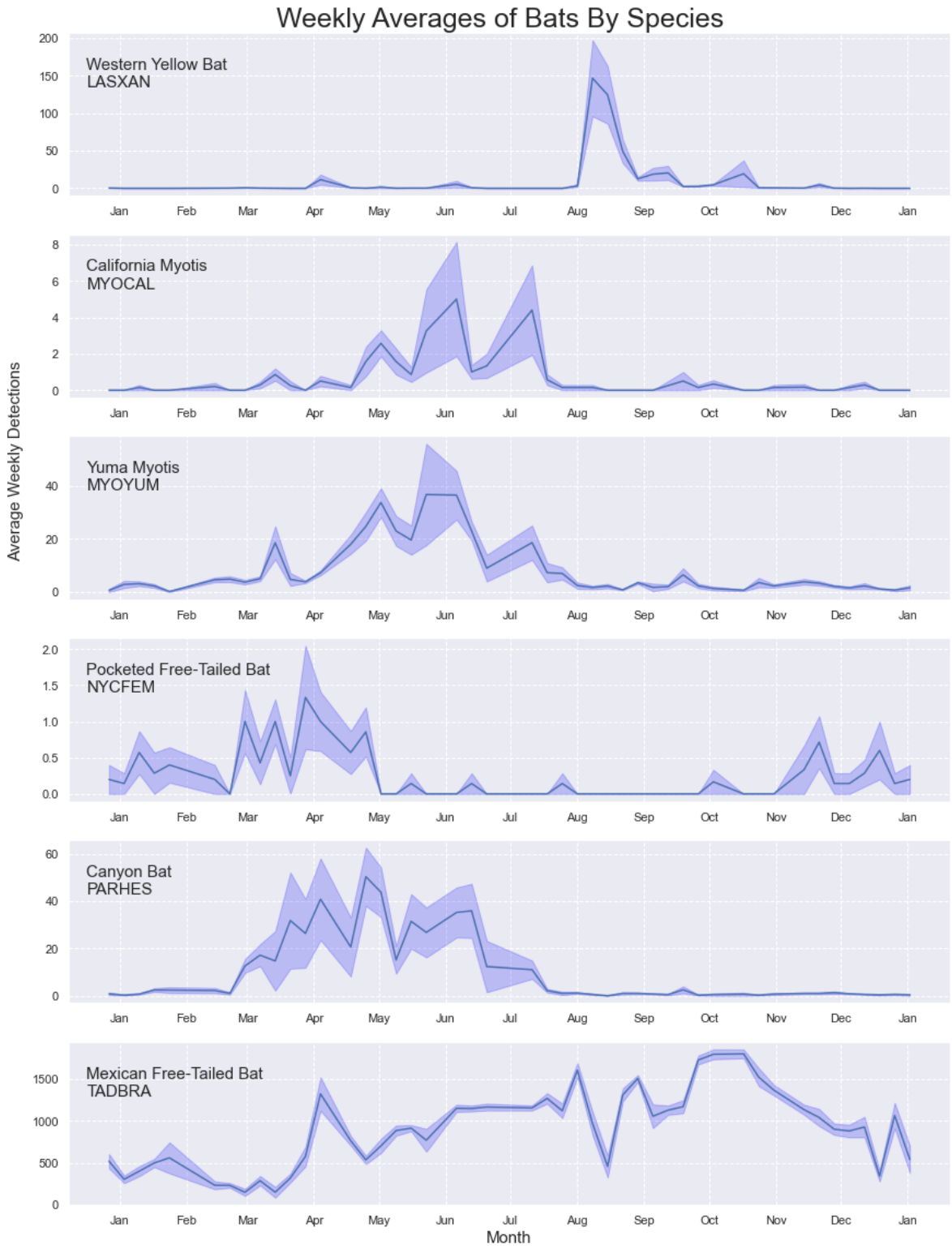

Figure 2. Weekly averages of nightly detections of species at the Phoenix Bat Cave. The pocketed free-tailed bat was not confirmed but was detected by the Kaleidoscope Pro Software. Light blue bands are standard error bands.

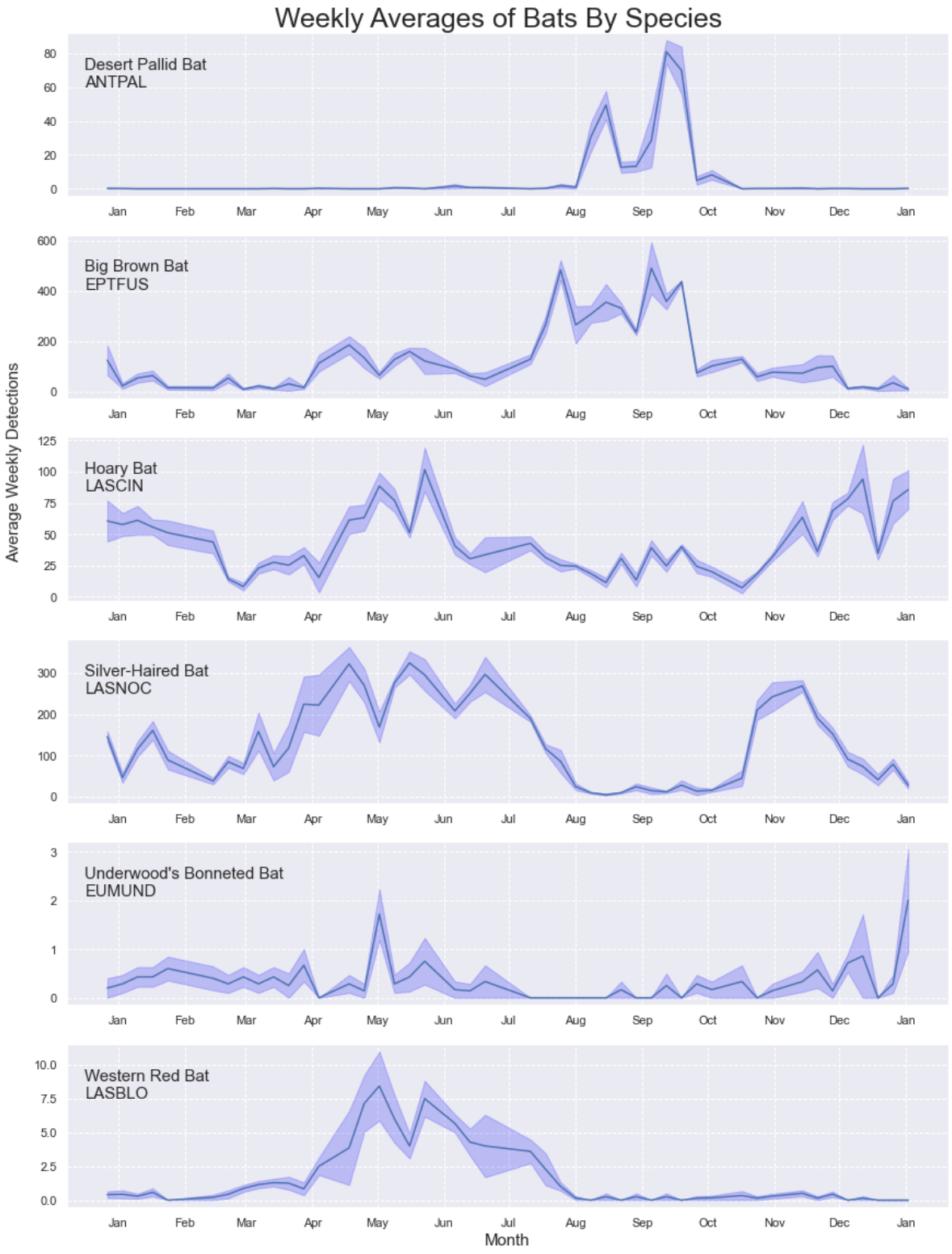

Figure 3. Weekly averages of nightly detections of species at the Phoenix Bat Cave. The Underwood's bonneted bat was not confirmed but was detected by the Kaleidoscope Pro Software. Light blue bands are standard error bands.