# Heber Dunes State Vehicular Recreation Area 2024 Acoustic Bat Survey Report

This page is left blank intentionally

# Contents

## Tables

## Figures

# 1   Introduction

The Heber Dunes State Vehicular Recreation Area (SVRA) is located in Holtville, California, in southern Imperial County. Since spring 2019, Heber Dunes SVRA has performed annual acoustic monitoring for bats. The purpose of the monitoring is to determine if bats, special-status species in particular, are using the site on a year-round or seasonal basis. Additionally, the Ocotillo Wells District Resources Department hope to increase their understanding of site use, species diversity, and changes year-to-year. This report presents the results of the 2024 annual monitoring period and comparison of results with the previous years' data.

Heber Dunes SVRA is composed of very low-rolling and inland (wind swept) dunes and is primarily used for off-highway vehicular recreational uses. There are five vegetation types present in the park: creosote scrub, saltbush scrub, arrowweed/saltbush scrub, arrowweed/coyote brush scrub, and tamarisk dune (AECOM 2011). There are a small number of fan palms (*Washingtonia* sp.) interspersed in the site. Elevation at Heber Dunes SVRA ranges from approximately 13 meters to over 35 meters. To our knowledge, there are currently no open water sources on the site; however, several irrigation canals surround the site in all directions, including the South Alamo canal, which flows adjacent to the eastern site boundary. These canals frequently or perennially maintain water. Some portions of the site include recreation infrastructure, buildings, roads, and others anthropogenic structures.

# 2   Methods

Acoustic detection sites monitored during previous surveys (2019–2023) were repeated at each of three locations – Channel-Structure (Lat: 32.70948, Long: -11539158), Channel-Open (Lat: 32.72812, Long: -11538718), and Residence (Lat: 32.72812, Long: -115.38593); (Figure 1). Fall monitoring was conducted at the Channel Structure site; however, no recordings were produced from this effort. The Channel Structure and Channel Open sites are located on the southern and northern portions of the site, respectively, adjacent to the South Alamo Canal. The Residence site is located adjacent to an existing residence structure. Spring deployments were from April 17 – May 13, 2024, and fall deployments were from September 30 – October 27, 2024 (Table 1). Monitoring was conducted with SongMeter SM4 Bat detectors (Wildlife Acoustics Inc., MA, USA).

Detectors were placed with microphones mounted on 3-meter-tall, galvanized steel poles that supported a microphone 3 meters or more above the ground surface. Detector settings were consistent with the North America Bat Monitoring Program's (NABat) suggested settings for SM3 or SM4 detectors (Reichert et al. 2017). Detectors were set to record from one hour before sunset and continue until one hour after sunrise. Data were analyzed using Sonobat 30. First, data were run through a noise scrubber (batch file scrubber) in the Sonobat Data Wizard as an initial round to remove non-bat recordings (e.g., insects) and poor-quality call files. Note that the scrubbing process removes some, but not all, non-bat sound files. Next, call files were processed through the Sonobat batch auto-classifier using the Southwest California Regional Classifier pack. A subset of auto-classified calls (i.e., calls with diagnostic call characteristics

that the auto-classifier can classify with 95% certainty) were manually vetted for verification purposes. All un-classified calls and calls of species with overlapping call characteristics that could not be auto-classified to the species level were manually-vetted and classified.

**Figure 1. Bat Detector Location Map**

Whenever possible during the vetting process, calls were classified to species based on known call characteristics (e.g., call shape, minimum frequency, duration, and call sequence pattern) of search phase calls (consistent calls emitted by bats when foraging or commuting). Calls that could not be identified to species due to lack of diagnostic features or poor call quality were labeled as unknown. Among the calls that were analyzed, some call variants of big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasiurus noctivagans*), and Mexican free-tailed bats (*Tadarida brasiliensis*) are difficult to distinguish because they have similar frequency, duration, and call shapes. Such call files were classified as EpfuLanoTabr, which denotes the first two letters of the species' scientific names. Thus, these species were considered during the analysis. Because of the paucity of verified library calls and metrics of their call characteristics, and potential similarity of their calls, we took a conservative approach and began reporting the calls of Pocketed free-tailed bat (*Nyctinomops femorosaccus*) and big free-tailed bat (*Nyctinomops macrotis*) as *Nyctinomops* sp. in 2022 and 2023. However, updated classifier algorithms and field-verified call libraries for these species are now available with the latest Sonobat software update (Sonobat 30). Based on this new information, Sonobat's classification performance has increased for these species, and we have a better understanding of the species' call characteristics for manually vetting call files. Thus, we were able to classify calls for these species with greater confidence.

Once call data were analyzed, the data were summarized as the number of call files and number of call minutes that were recorded. A call file is defined as a file containing two or more bat echolocation calls or pulses. A call minute is defined as a minute in which at least one bat call/pulse occurs. For this report, bat activity was measured as a function of the number of call minutes per season following Miller (2001). Call minutes were calculated by summing all minutes that a species was calling and then removing any duplicate time periods (i.e., two call files of the same species in the same one-minute period) from the dataset. Thus, the maximum number of call minutes for any one species in an hour is 60. The call minute is a commonly-used acoustic activity index. Activity indices such as this are preferable to counting call files because they provide an unbiased method for quantifying activity (Miller 2001). This activity index prevents overestimating bat activity of a single species if multiple call files of one individual are recorded in a short period of time, or underestimating activity if multiple bats of a single species are recorded in a single file.

After calculating call minutes, the data were then standardized to monitoring effort by dividing the total number of call minutes for each species detected each season by the total number of monitoring nights (the number of nights of active recording) each season. The resulting calculation is a relative index of activity (call minutes per night) by species each season. The index allows for within year seasonal comparisons, as well as year-to-year comparisons of bat activity by species while accounting for uneven sampling of active recording nights.

For annual comparisons, the seasonal presence/absence of each species at each site was generally compared since 2019. Additionally, call minutes per night was used to compare activity levels of bat species for the last three years (2022-2024), consistent with data reporting since 2022.

# 3  Results

Detectors were operational for a total of 106 monitoring nights during the spring and fall sampling periods. Sampling periods ranged from 18 nights to 27 nights in the spring, and from 14 nights to 28 nights in the fall. Bat detectors stopped recording before the end of the intended fall sampling period at each of the monitoring sites. It is unclear why they stopped recording. Additionally, no data was recorded at the Channel Open site. See Table 1 for dates of operation and number of monitoring nights for each site.

**Table 1. Dates of Operation and Number of Acoustic Monitoring Nights in 2024**

| Monitoring Site | Season | Dates of Operation | No. Monitoring Nights | Notes |
|---|---|---|---|---|
| Channel Structure | Spring | 4/17 – 5/4 | 18 | |
| | Fall | - | 0 | |
| Channel Open | Spring | 4/17 – 5/13 | 27 | |
| | Fall | 9/30 – 10/27 | 28 | The unit stopped recording on 10/27 and output several sm4dump files on 10/26 and 10/27.* |
| Residence | Spring | 4/17 – 5/5 | 19 | |
| | Fall | 9/30 – 10/13 | 14 | The unit stopped recording on 10/13 and output several sm4dump files on this date.* |
| | | **TOTAL** | **106** | |

*A sm4dump file is a text file that is produced when the detector detects an issue with the unit such as low battery power or the SD cards are filled.

Bat detectors recorded a total of 13,968 sound files at all three sites combined. After scrubbing/removing noise files from the dataset with the batch file scrubber, a total of 12,946 files remained, of which 6,007 call files were identifiable bat call files. The remaining files contained either non-bat files (e.g., insect call); or poor-quality bat call files, bat social calls, or feeding buzz calls that could not be identified to species; thus, these files were discarded from the analysis. Of the 6,007 identifiable bat call files that were recorded, 1,937 call files (1,752 call minutes) were recorded in the spring and 4,070 call files (3,281 call minutes) were recorded in the fall.

For all species, a summary of call files and call minutes of activity is listed in Table 2, and a summary of call minutes is illustrated in Figure 2. A summary of call minutes per night is listed in Table 3 and illustrated in Figure 3. Additionally, a summary of seasonal detections by monitoring site from 2019 to 2024 is included in Table 4 for a yearly comparison of presence/absence.

*Special-Status Species*

Five special-status bat species, including the California leaf-nosed bat (*Macrotus californicus*), pocketed free-tailed bat (*Nyctinomops femorosaccus*), western red bat (*Lasiurus frantzii*), western yellow bat (*Lasiurus xanthinus*), and western mastiff bat (*Eumops perotis*), were detected on the site (Table 2, Appendix A). In terms of overall call minutes per season, the western yellow bat and pocketed free-tailed bat were the most active special-status species. The western yellow bat was detected for 350 call minutes in the spring and 250 call minutes in the fall. The pocketed free-tailed bat was detected for 86 call minutes in the spring and 329 minutes in the fall. The remaining special-status bat species that were detected had relatively low activity levels during the spring and fall monitoring periods. The California leaf-nosed bat was detected for one call minute in the fall. The western red bat was detected for two call minutes in the spring and one call minute in the fall. The western mastiff bat was detected for 15 call minutes in the spring. After standardizing the data to call minutes per night, all of the special-status species' nightly activity levels (call minutes per night) by season paralleled their overall activity levels (call minutes) each season (Table 3, Figure 3).

*Non-special-Status Species*

Non-special-status species that were detected are the big brown bat, hoary bat (*Lasiurus cinereus*), California myotis (*Myotis californicus*), Yuma myotis (*Myotis yumanensis*), and Mexican free-tailed bat (Table 2, Appendix A). The Mexican free-tailed bat was the most active non-special-status species with 1,002 call minutes in the spring and 2,223 call minutes in the fall. The big brown bat was active for 86 call minutes in the spring and 103 call minutes in the fall. The Yuma myotis active for 41 call minutes in the spring and 137 call minutes in the fall. The California myotis was active for 30 call minutes in the spring and 119 call minutes in the fall. The hoary bat was active for 115 and 10 call minutes in the spring and fall, respectively. Calls with overlapping features that may be attributed to the big brown bat, silver-haired bat, or Mexican free-tailed bat (EpfuLanoTabr) were detected for 25 call minutes in the spring and 108 call minutes in the fall. All of the non-special-status species' nightly activity levels (call minutes per night) each season paralleled their overall activity levels (call minutes) each season (Table 3, Figure 3).

**Table 2. Number of Call Files and Call Minutes Recorded Per Season by Species in 2024.**

| Species | Call Files | | Call Minutes | |
|---|---|---|---|---|
| | **Spring** | **Fall** | **Spring** | **Fall** |
| Western red bat[1] | 2 | 1 | 2 | 1 |
| Western yellow bat[1] | 415 | 281 | 350 | 250 |
| Pocketed free-tailed bat[1] | 88 | 375 | 86 | 329 |
| California leaf-nosed bat[1] | 0 | 1 | 0 | 1 |
| Western mastiff bat[1] | 15 | 0 | 15 | 0 |
| Big brown bat | 91 | 115 | 86 | 103 |
| Hoary bat | 118 | 10 | 115 | 10 |
| California myotis | 32 | 125 | 30 | 119 |
| Yuma myotis | 42 | 141 | 41 | 137 |
| Mexican free-tailed bat | 1,109 | 2,901 | 1,002 | 2,223 |
| EpfuLanoTabr [2] | 25 | 120 | 25 | 108 |

[1]California species of special concern
[2]EpfuTabrLano = Calls with indistinguishable call characteristics of the big brown bat, silver-haired bat, and Mexican free-tailed bat.
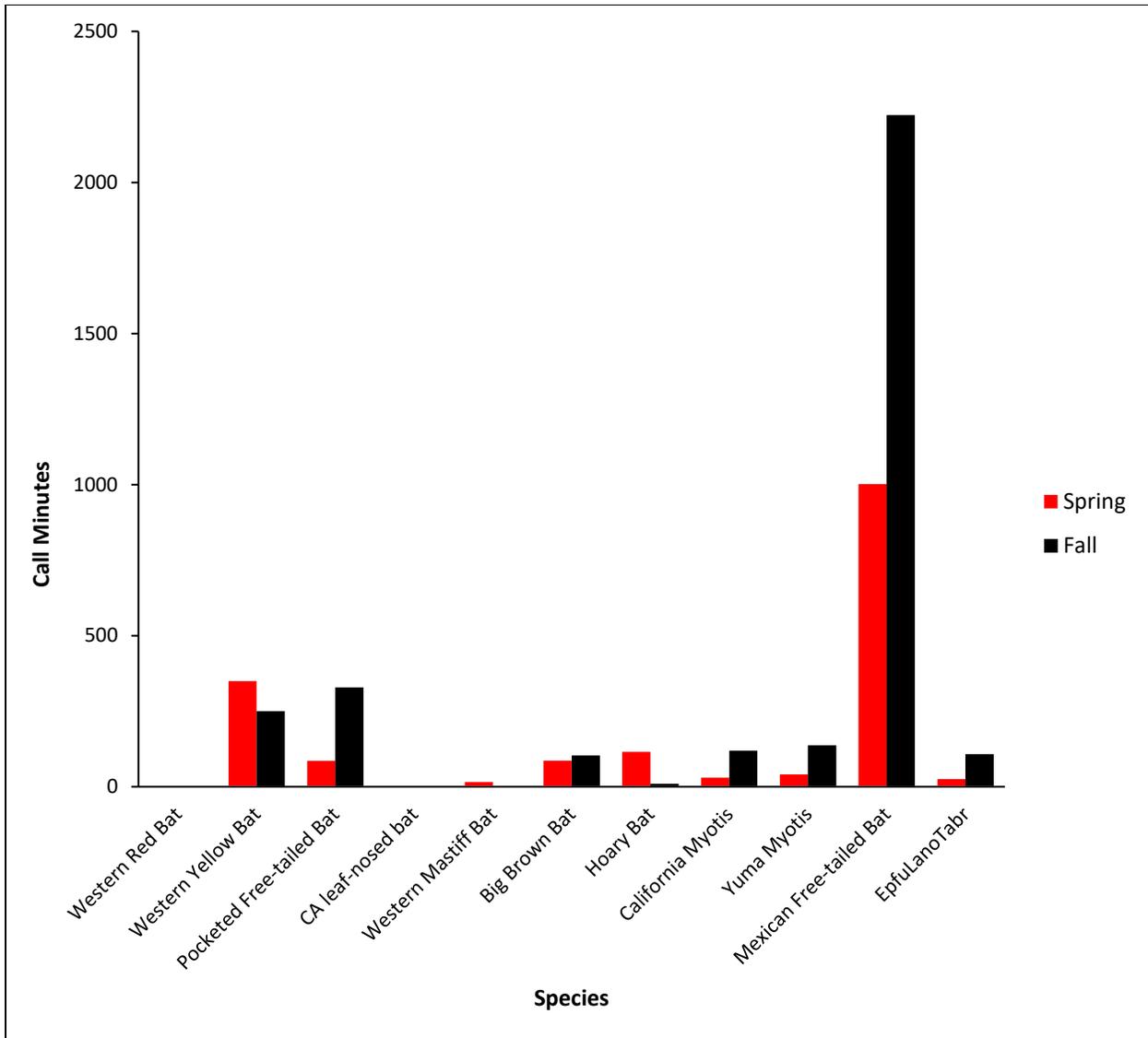
**Figure 2. Number of Call Minutes Recorded During Spring and Fall Acoustic Monitoring in 2024.**

EpfuLanoTabr = indistinguishable call variants that may be the big brown bat, silver-haired bat, or Mexican free-tailed bat.

**Table 3. Relative Activity (Call Minutes Per Night) by Species in 2024**

| Species | Spring | Fall |
|---|---|---|
| Western red bat[1] | 0.03 | 0.02 |
| Western yellow bat[1] | 5.47 | 5.95 |
| Pocketed free-tailed bat[1] | 1.34 | 7.83 |
| California leaf-nosed bat[1] | 0 | 0.02 |
| Western mastiff bat[1] | 0.23 | 0 |
| Big brown bat | 1.34 | 2.45 |
| Hoary bat | 1.80 | 0.24 |
| California myotis | 0.47 | 2.83 |
| Yuma myotis | 0.64 | 3.26 |
| Mexican free-tailed bat | 15.66 | 52.93 |
| EpfuLanoTabr[2] | 0.39 | 2.57 |

[1]California species of special concern

[2]EpfuLanoTabr = Calls with indistinguishable call characteristics of the big brown bat, silver-haired bat, and Mexican free-tailed bat.
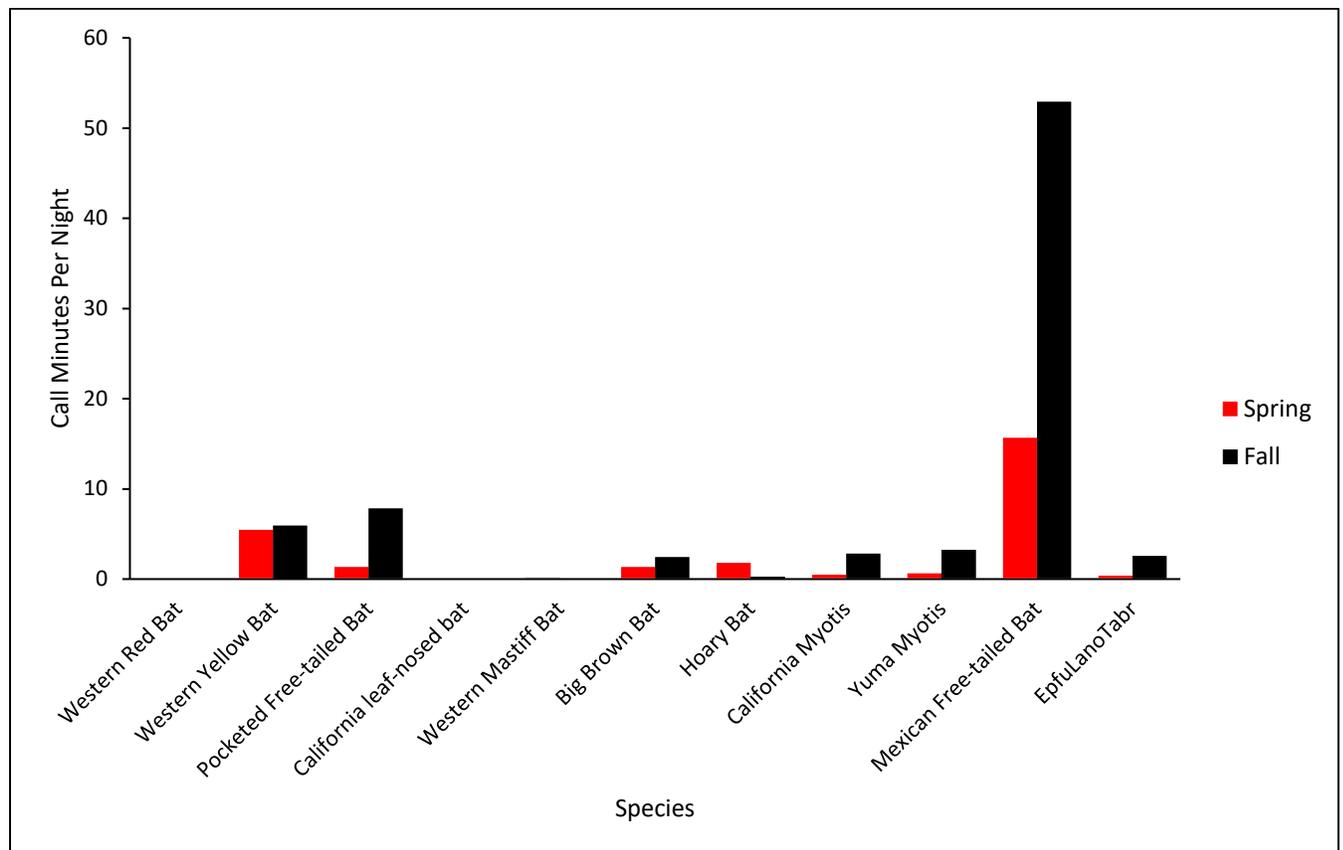


**Figure 3. Relative Activity of Bats (Call Minutes Per Night) Recorded During Spring and Fall Acoustic Monitoring in 2024.**
EpfuLanoTabr = indistinguishable call variants that may be the big brown bat, silver-haired bat, or Mexican free-tailed bat.

*Year to Year Seasonal Activity Comparisons*

*Special-Status Species*

In terms of call minutes per night, the western yellow bat and pocketed free-tailed bat were the most active special-status species during the spring and fall monitoring periods between 2022 and 2024 (Figure 4). During this time, the western yellow bat was most active during the spring 2022 monitoring period, whereas the pocketed free-tailed bat was most active during the fall 2024 monitoring period. The other three special-status species that were detected during the spring and fall monitoring periods over the last three years—the western mastiff bat, western red bat, and California leaf-nosed bat—all had relatively low nightly activity levels during the spring and fall monitoring periods between 2022 and 2024 (Figure 4).
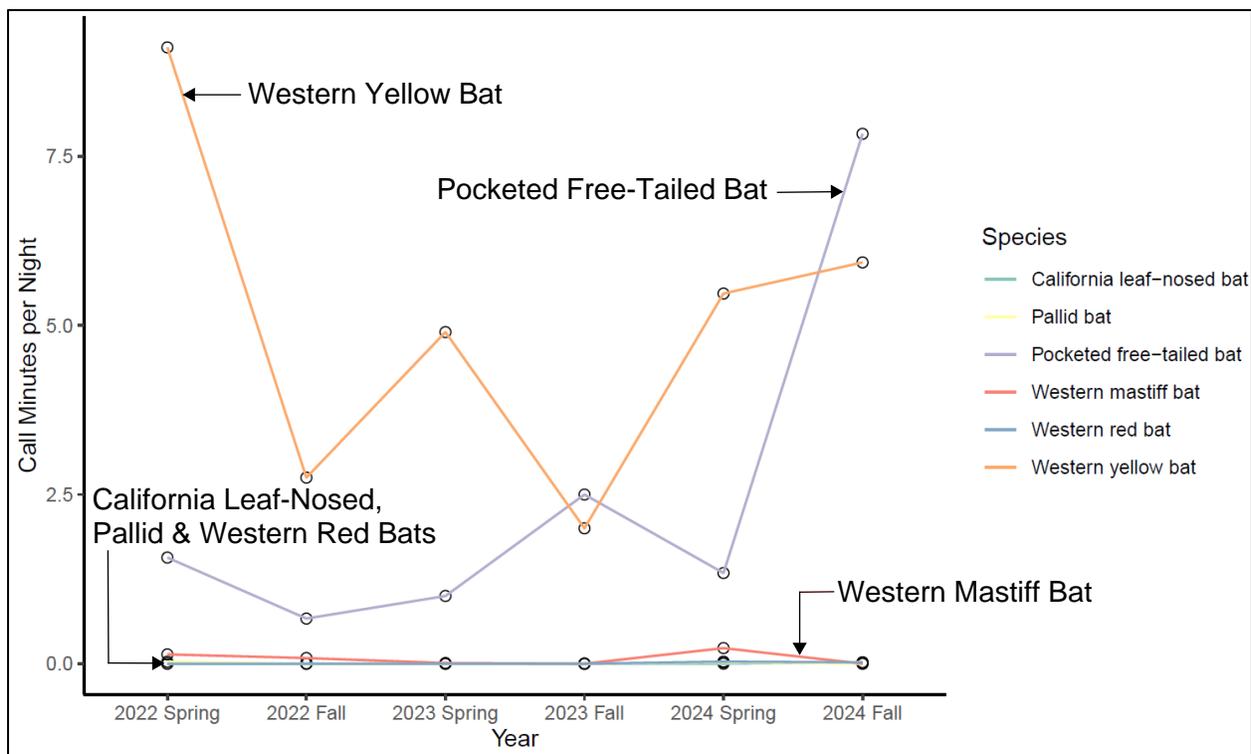


**Figure 4. Relative Activity of Bats (Call Minutes Per Night) Recorded During Spring and Fall Acoustic Monitoring from 2022 - 2024.**

*Non-Special-Status Species*

The Mexican free-tailed bat was the most active non-special-status species during the spring and fall monitoring periods between 2022 and 2024, and its 2024 fall activity exceeded its fall activity in the previous two monitoring years (Figure 5). The big brown bat, hoary bat, Yuma myotis and EpfuLanoTabr group had similarly low activity levels over the last three monitoring years (Figure 5).
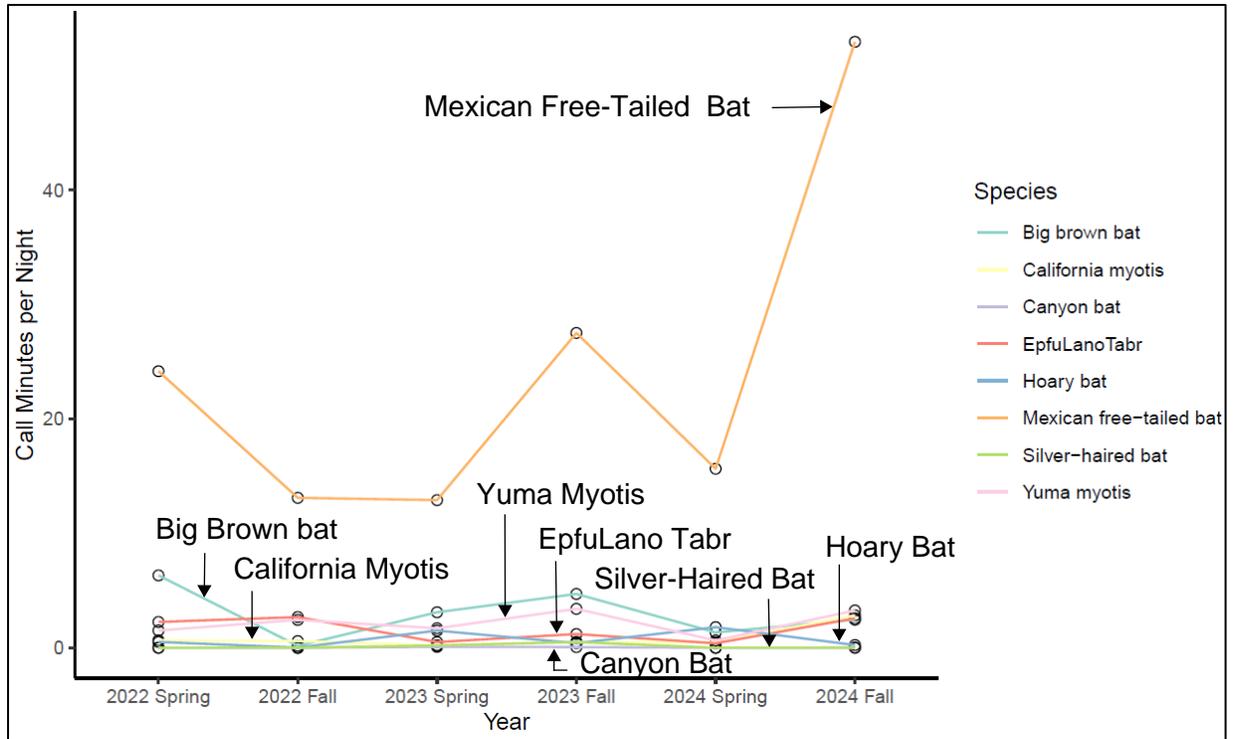
**Figure 5. Relative Activity of Non-Special-Status Bats (Call Minutes Per Night) Recorded During Spring and Fall Acoustic Monitoring from 2022 - 2024.**

**Table 4 Acoustic Detections at Three Monitoring Sites in Heber Dunes SVRA Between 2019 and 2024**
**Notes: S = spring, F = fall, * = a single season of acoustic monitoring was conducted, ? = potential calls detected.**

| SPECIES | Channel-Structure | | | | | | Channel-Open | | | | | | Residence | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020* | 2021 | 2022 | 2023 | **2024** | 2019 | 2020* | 2021 | 2022 | 2023 | **2024** | 2019 | 2020* | 2021* | 2022 | 2023 | **2024** |
| Pallid Bat[1] *Antrozous pallidus* | – | – | – | S | -- | – | – | – | – | S | – | – | – | – | – | – | – | – |
| Western Yellow Bat[1] *Lasiurus xanthinus* | S, F | F | S | S, F | S, F | S | S, F | F | S, F | S, F | S, F | S, F | S | F | S | S, F | S, F | S, F |
| Western Red Bat[1] *Lasiurus frantzii* | S, F | F | – | – | – | – | S, F | F | | – | – | S, F | S, F | F | – | – | – | S |
| Hoary Bat *Lasiurus cinereus* | S | – | S | S | S, F | S | S | F | S, F | S | S, F | S, F | – | F | S | S, F | S, F | S, F |
| Big Brown Bat *Eptesicus fuscus* | S | F | S, F | S, F | S, F | S | F | F | S, F | S, F | S, F | S, F | S, F | F | – | – | S, F | S, F |
| Arizona Bat *Myotis occultus* | S?, F? | – | – | – | – | – | – | F? | S? | – | – | – | S, F | – | – | – | – | – |
| California Myotis *Myotis californicus* | – | – | – | S, F | S, F | S | – | F | F | S, F | S, F | S, F | – | – | S | S, F | S, F | S, F |
| Yuma Myotis *Myotis yumanensis* | F | F | S | S, F | S, F | S | F | F | S, F | S, F | S, F | S, F | F | F | – | S, F | S, F | S, F |
| Canyon Bat *Parastrellus hesperus* | – | – | – | – | S, F | – | – | F | – | – | S, F | – | – | – | – | – | S, F | – |
| Big Free-tailed Bat[1] *Nyctinomops macrotis* | S, F | – | S | S, F | S, F | -- | S, F | F | S, F | S | S, F | – | S, F | – | S | S, F | S, F | – |
| Pocketed Free-tailed Bat[1] *Nyctinomops femorosaccus* | S, F | F | S, F | S, F | S, F | S | S | F | S, F | S | S, F | S, F | S, F | F | S | S, F | S, F | S, F |
| Mexican Free-tailed Bat *Tadarida brasiliensis* | S, F | F | S, F | S, F | S, F | S | S, F | F | S, F | S, F | S, F | S, F | S, F | F | S | S, F | S, F | S, F |
| Western Mastiff Bat[1] *Eumops perotis* | – | – | S | S | S | – | F | – | F | S, F | – | S | F | F | – | S, F | – | – |
| California Leaf-nosed Bat[1] *Macrotis californicus* | – | – | – | – | – | – | – | F? | – | – | – | F | – | – | – | – | – | – |
| Silver-haired bat *Lasiurus noctivagans* | – | – | – | – | S, F | – | – | – | – | – | S, F | – | – | – | – | – | S, F | – |

[1]California species of special concern

# 4  Summary

*Special-Status Species*

One new special-status bat species, the California leaf-nosed bat, was detected from one call file/call minute. This is the first time that this species has been confirmed detected since monitoring has been conducted on the site. A questionable call with the characteristics of this species was detected in 2020. Like other Phyllostomid bat species, the California leaf-nosed bat emits low intensity calls that are rarely detected with bat detectors. They also use vision and hearing to locate prey (Bell 1984). For these reasons, acoustic monitoring is less reliable in detecting this species when they are present. That said, no suitable roost habitat (e.g., caves, mines, rocky outcrops) for the leaf-nosed bat is present on the site. Thus, this species is only an infrequent transient and forager when present.

The pocketed free-tailed bat and western yellow bat were the most active species in 2024. The pocketed free-tailed bat and big free-tailed bat have been regularly detected since monitoring began in 2019. Because of the paucity of verified library calls and metrics of their call characteristics, and potential similarity of their calls, we took a conservative approach and began reporting the calls as *Nyctinomops* sp. in 2022. However, updated classifier algorithms and field-verified call libraries for these species are now available with the latest Sonobat software update (Sonobat 30). Based on this new information, Sonobat's classification performance has increased for this species, and we have a better understanding of the species' call characteristics for manually vetting call files. Thus, we can identify calls from these species with greater confidence, and all the *Nyctinomops* calls that were detected this year were the pocketed free-tailed bat. This species was also one of the top two special-status species detected on the site in the fall months. The other highly active species on site was the western yellow bat, with slightly more detections in the fall monitoring period. Both species are year-round residents in the region.

The western red bat and mastiff bat were less active this year. The western red bat is known in the region; but is primarily associated with mature cottonwood and other mixed riparian forests, which are not present on the site or in the regional vicinity. Infrequent detections of this species may be transient individuals during seasonal movements. The western mastiff bat was only detected in the spring, but this species is known to occur year-round in southern California (Barbour and Davis 1969, Krutzsch 1955) and has been detected in the fall during past monitoring efforts on the site (MIG 2024).

*Non-Special-Status Species*

Non-special-status species that were detected are the big brown bat, hoary bat, California myotis, Yuma myotis, and Mexican free-tailed bat. With the exception of the hoary bat, all of the non-special-status species that were detected were more active in the fall compared to their spring activity. Unlike previous years, no calls that could be identified with a high degree of certainty as silver-haired bats were detected, but some of the calls in the EpfuLanoTabr group

may be attributed to this species. The hoary bat is associated with forested habitats at high elevations in Southern California, so their detections may be that of transient individuals moving across the landscape. The Mexican free-tailed bat was the most active of all the non-special-status species on the site across both seasons but was most active during the fall monitoring period. As noted in previous reports, this species is an important crop insect predator (Cleveland et al. 2006, Lee and McCracken 2005, Whitaker and Weeks 2001), and their high activity may be associated with the extensive agricultural landscape that surrounds the site. The big brown bat is uncommon in arid environments (Harris 2008), and its low activity reflects this. This species roosts in cavities in large trees and buildings. Because these features are limited on the site, it is unlikely that this species roosts on site.

The Yuma myotis and California myotis were similarly active during the spring and fall monitoring periods. Both species are common in California. The Yuma myotis is closely associated with aquatic habitats and is known to feed predominantly on aquatic insects (Barbour and Davis 1969, Ober and Hayes 2008). The California myotis forages in rocky habitats with open water, open woodlands and forests, and brushy habitats (Krutzsch 1954). These species probably regularly forage over South Alamo Canal adjacent to the site. Both species roost in trees, but Yuma myotis are believed to roost in large-diameter trees that form large hollows or cavities as well as in buildings (Braun et al. 2015, Tye and Geluso 2019, Krutzsch 1954), both of which are limited on the site. It is possible that California myotis occasionally roost on site in small tree crevices, if present, and under fan palm foliage as well, but this habitat is also limited on the site.

*Year to Year Seasonal Activity Comparisons*

The pocketed free-tailed bat and western yellow bat had the most notable annual seasonal activity differences. There was an increase in pocketed free-tailed bat activity in 2024, particularly in the fall monitoring period, compared to 2022 and 2023. We suspect that the updated call algorithms used to classify calls and call parameters used to manually vet calls with Sonobat resulted in the increased detection of this species in 2024. Until 2024, western yellow bats had been more active during spring monitoring, compared to the fall monitoring, but the inverse was observed in 2024. At this time, the most that can be said is that these differences are at least partially due to general annual variation.

The California leaf-nosed bat, western mastiff bat, and western red bat have had consistently low activity between 2022 and 2024. Because leaf-nosed bats are poorly represented in acoustic surveys, this result is not a surprise. The western mastiff bat and western red bat also continue to have low activity since 2022. The western mastiff bat is known in southern California but is rarely detected in Imperial County and has been declining in southern California (Natural History Museum of Los Angeles County 2022, Pierson and Rainey 1998). The acoustic results are consistent with the trends for this species. For the western red bat, we expect low activity, if

any, from occasional transient/migratory individuals because they are mostly associated with mature riparian forest, which is not present on the site or in the region.

Mexican free-tailed bats continue to be the most active non-special-status species on site, and their 2024 fall activity was higher than it has been since 2022. In addition to the improvements for the *Nyctinomops* species, Sonobat 30 increased its classification performance for the Mexican free-tailed bat as well, so it is possible that fewer ambiguous calls were scrubbed from the data during initial file scrubbing.

# 5   Recommendations

There were some discrepancies with sampling effort in 2024 compared to 2022 and 2023. There were 31 fewer nights of sampling in 2024 compared to 2022, and 56 fewer nights of sampling in 2024 compared to 2023. It is unclear why but it is presumed to be due to technical or power issues. We recommend that bat detectors be checked once or twice during the monitoring period to ensure that they are working properly so that the full monitoring period is captured.

# 6   References

AECOM. 2011. Heber Dunes SVRA General Plan Draft Environmental Impact Report. Biological Resources Section 3.7.

Barbour, R. W., W. H. Davis. 1969. Bats of America. The University Press of Kentucky, Lexington.

Bell, G.P. 1984. The sensory basis of prey location by the California leaf-nosed bat Macrotus californicus (Chiroptera: Phyllostomidae).

Braun, J.K., V. Yang, S.B. Gonzales, and M.A. Mares. 2015. *Myotis yumanensis* (Chiroptera: Vespertilionidae). Mammalian Species 47(918):1-14.

Cleveland, C. J., M. Betke, P. Federico, J. D. Frank, T. G. Hallam, J. Horn, J. D. López Jr., G. F. McCracken, R. A. Medellín, A. Moreno-Valdez, C. G. Sansone, J. K. Westbrook, and T. H. Kunz. 2006. Economic value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. Frontiers in Ecology and the Environment. 4(5): 238-243.

Harris, J. 2008. Big Brown Bat *in* California Wildlife Habitat Relationships System California Department of Fish and Wildlife California Interagency Wildlife Task Group.

Krutzsch, P. H. 1954 Notes on the habits of the bat, *Myotis californicus*. Journal of Mammalogy. 35(4):539-545.

Krutzsch, P.H. 1955. Observations on the California mastiff bat. J. Mamm. 36: 407-414.

Lee, Y. and G. F. McCracken. 2005. Dietary variation of Brazilian free-tailed bats links to migratory populations of pest insects. Journal of Mammalogy, 86(1):67-76.

MIG. 2024. Heber Dunes State Vehicular Recreation Area 2023 Acoustic Bat Survey Report. Prepared for Ocotillo Wells District Heber Dunes State Vehicular Recreation Area.

Miller, B. W. 2001. A method for determining relative activity of free-flying bats using a new activity index for acoustic monitoring. Acta Chiropterologica 3:93-105.

Natural History Museum of Los Angeles County. 2022. Rediscovering the western mastiff bat. A bat struggling to survive in Los Angeles. Accessed February 2025 from https://storymaps.arcgis.com/stories/6046f5c5dee04b809e4faf8c0eb73551

Ober, H. K., and J. P. Hayes. 2008. Prey selection by bats in forests of western region. Journal of Mammalogy 89(5): 1191-1200.

Pierson, E.D. and W. E. Rainey. 1998. Distribution, habitat associations, status, and survey methodologies for three Molossid bat species (*Eumops perotis*, *Nyctinomops femorosaccus*, *Nyctinomops macrotis*) and the Vespertilionid (*Euderma maculatum*). Report prepared for the California Department of Fish and Game Wildlife Management Division Bird and Mammal Conservation Program.

Reichert, B, C. Lausen, C. Corben, K. Livengood, J. Szewczak, T. Weller, S. Loeb, R. Rodriguez, E. Britzke, T. Hohoff, J. Siemers, B. Burkholder, and C. Herzog. 2017. Guide to Acoustic Detectors Settings v1.0. North American Bat Monitoring Program (NABat).

Tye, S.P. and K. Geluso. 2019. Day roosts of Myotis (Mammalia: Chiroptera) in an arid riparian corridor in southwestern New Mexico. Western North American Naturalist 79(4): 515-522.

Western Bat Working Group. 2023. Species Accounts for the western mastiff bat, big-free-tailed bat, canyon bat, California leaf-nosed bat, and pocketed free-tailed bat. Accessed February 2024 from http://wbwg.org/ western-bat-species/.

Whitaker, J. O. and H. P. Weeks Jr. 2001. Food of *Eptesicus fuscus*, the big brown bat, in Indiana in the absence of cultivated fields and agricultural pests. Proceedings of the Indiana Academy of Science 110:123-125.

## Appendix A: Representative Sonograms of Bat Species Detected at Heber Dunes SVRA in 2024
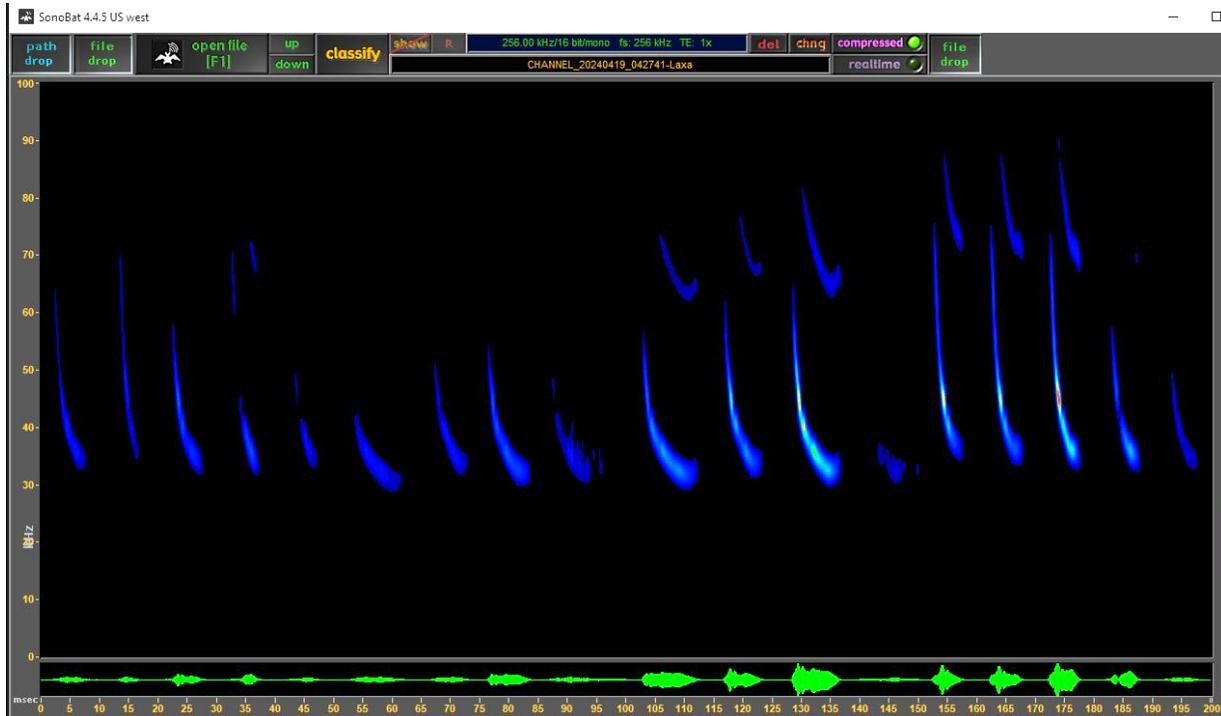


Western yellow bat search phase calls recorded April 19, 2024 at the Channel Open site.
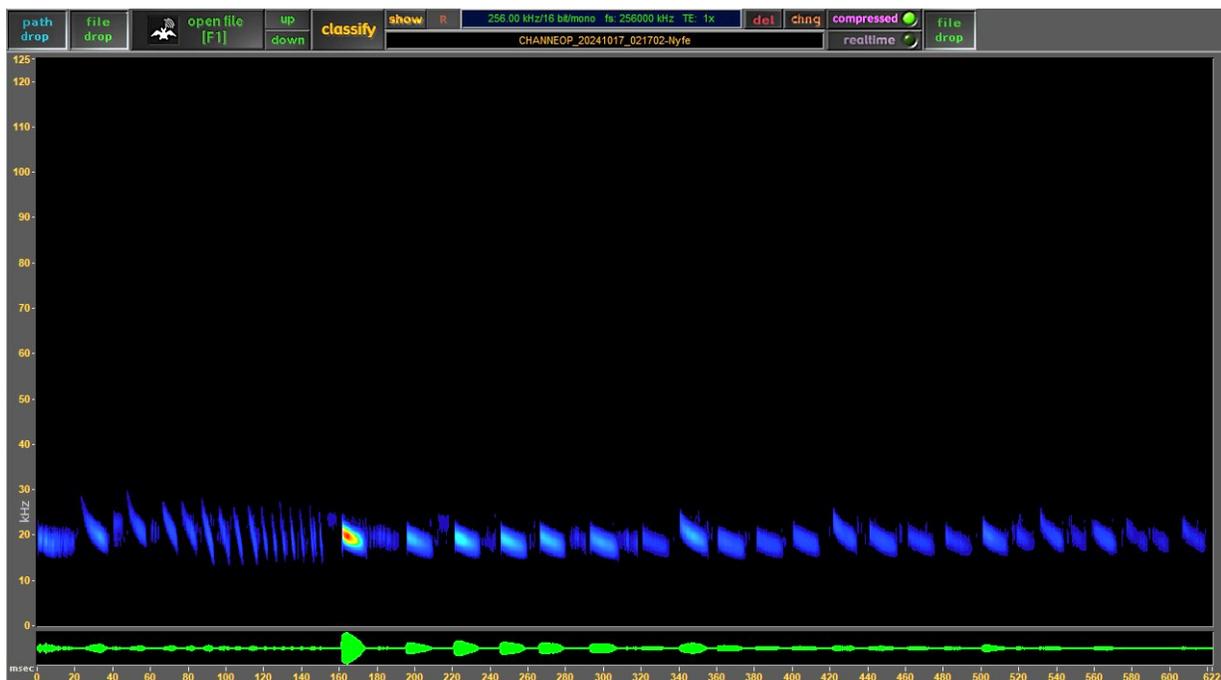


Pocketed free-tailed bat search phase and approach phase calls recorded October 17, 2024 at the Channel Open site.
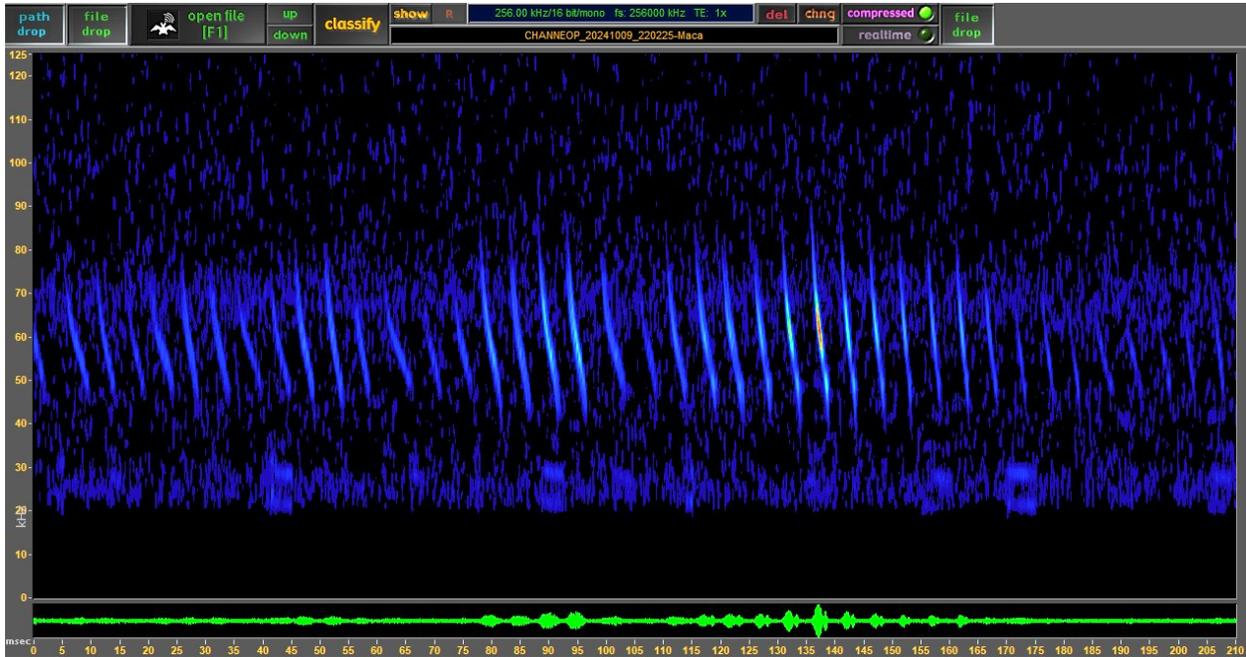
California leaf-nosed bat search phase calls recorded October 9, 2024 at the Residence site.
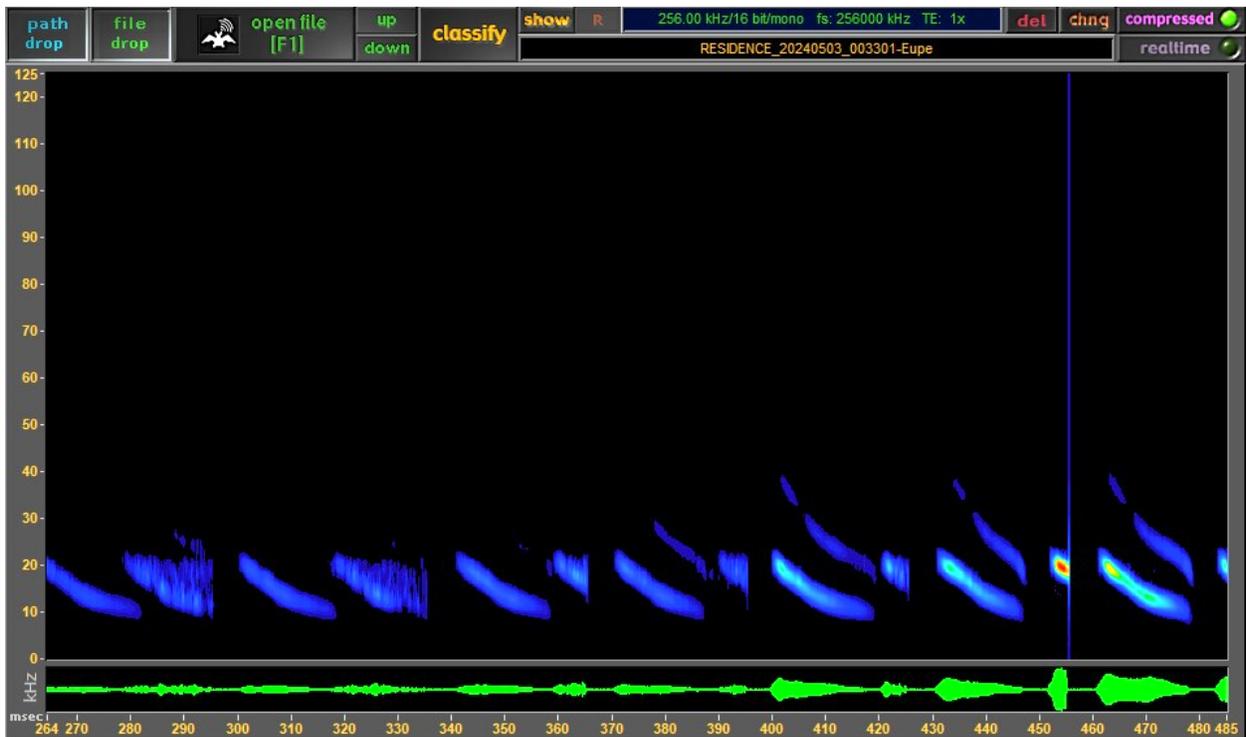


Western mastiff bat search phase calls recorded May 3, 2024 at the Residence site.
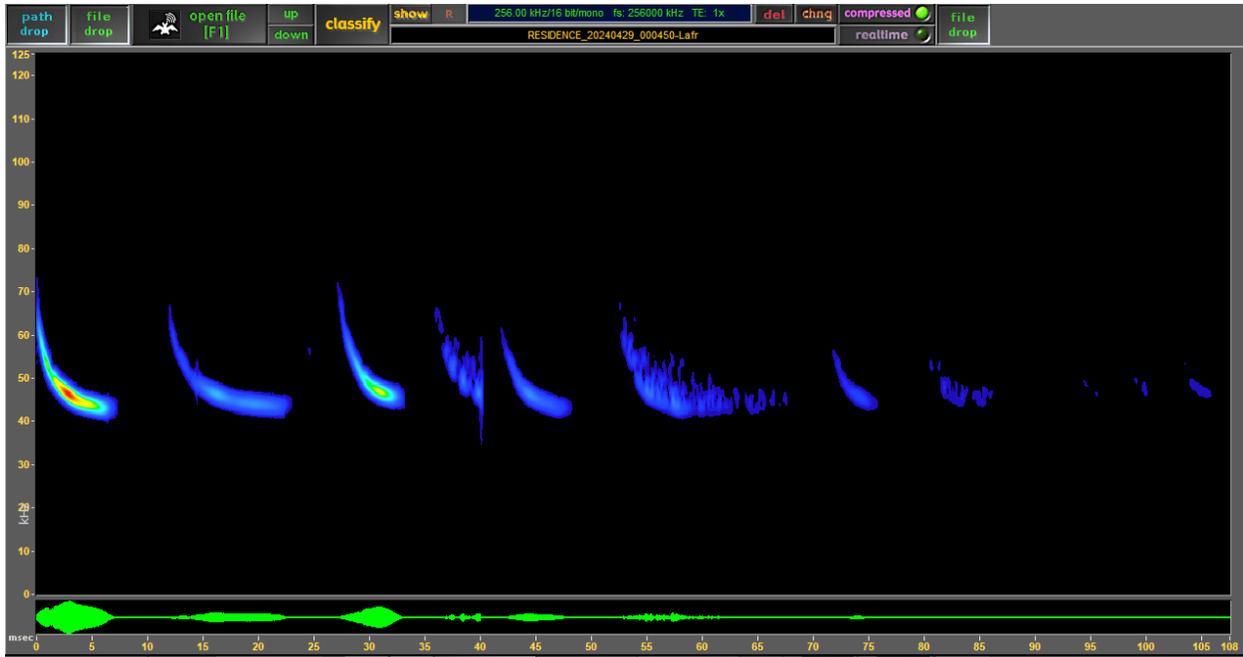
Western red bat search phase calls recorded April 29, 2024 at the Residence site.
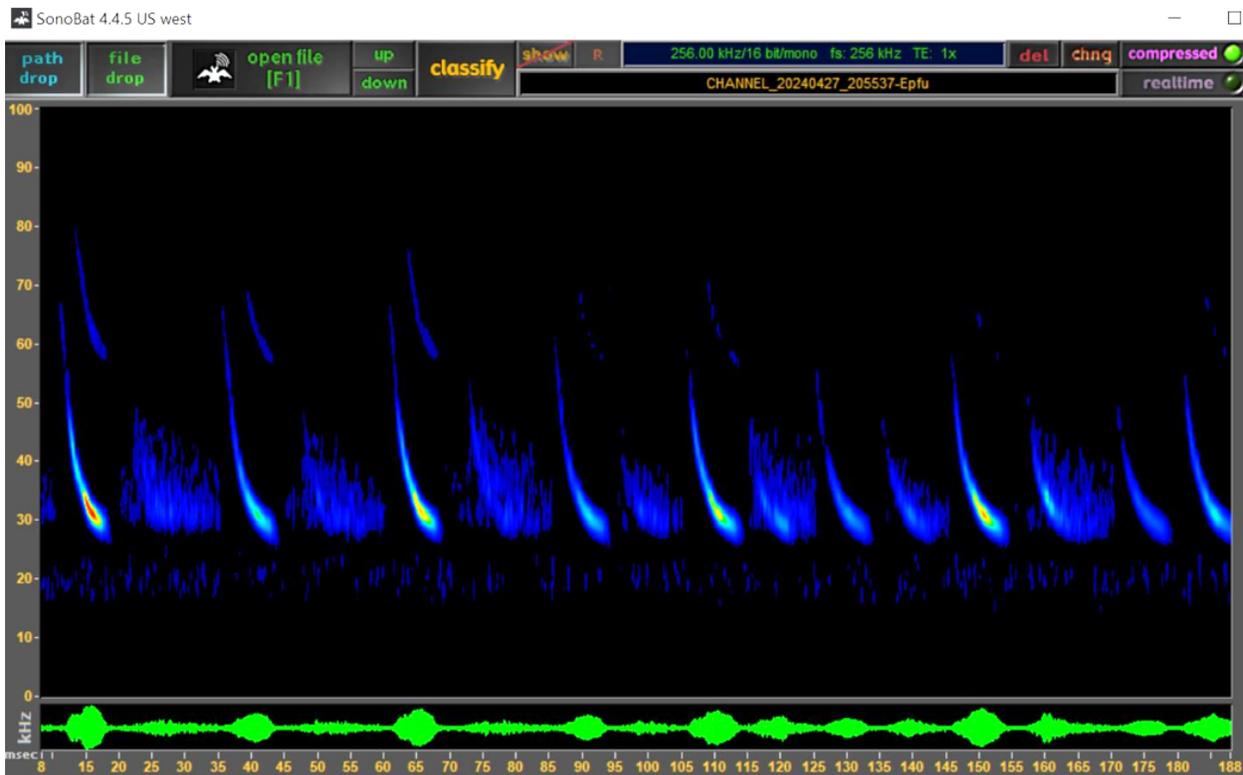


Big brown bat search phase calls recorded April 27, 2024 at the Channel Open Site.
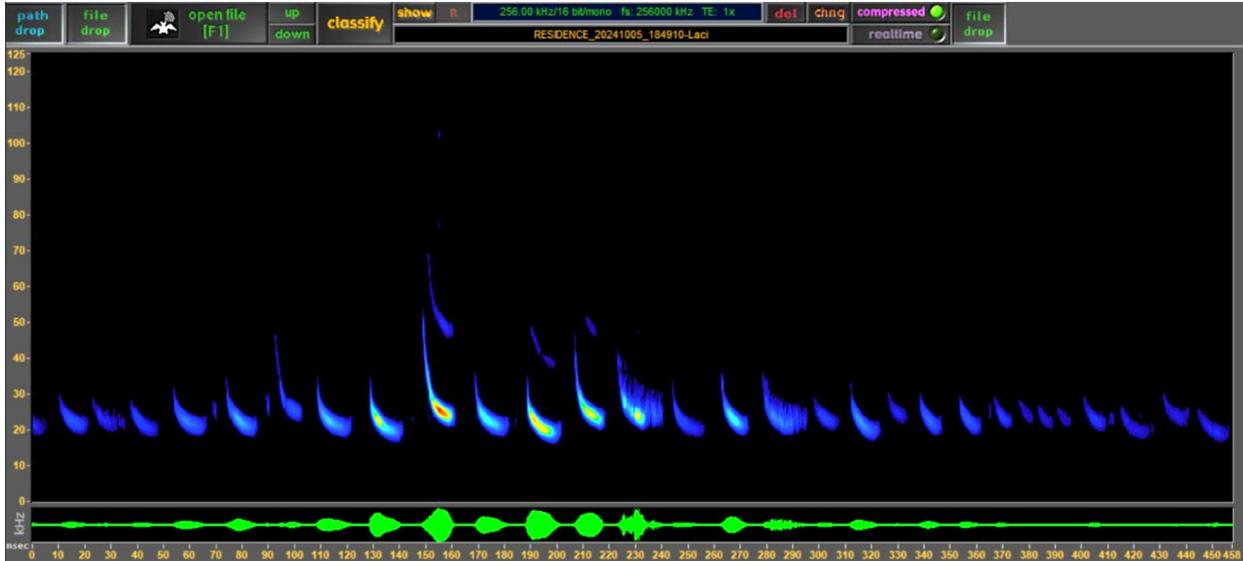
Hoary bat search phase calls recorded October 5, 2024 at the Residence site.
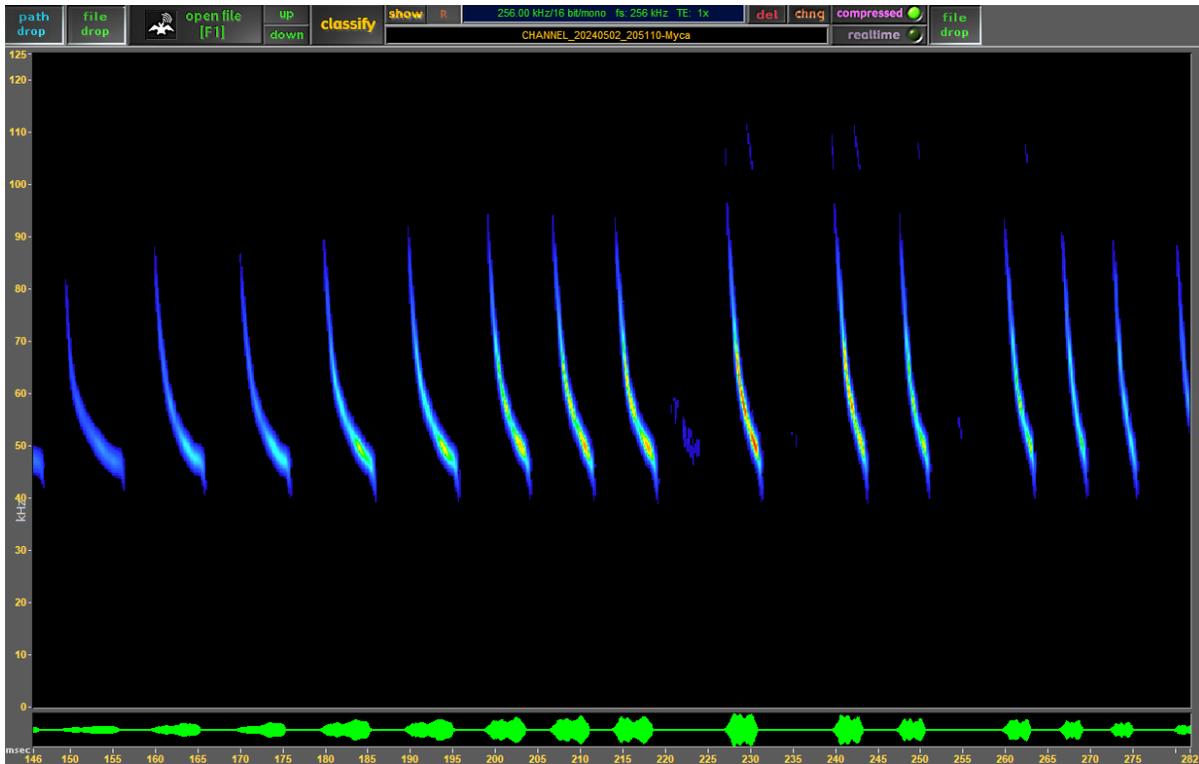


California myotis search phase calls recorded May 2, 2024 at the Channel Open site.
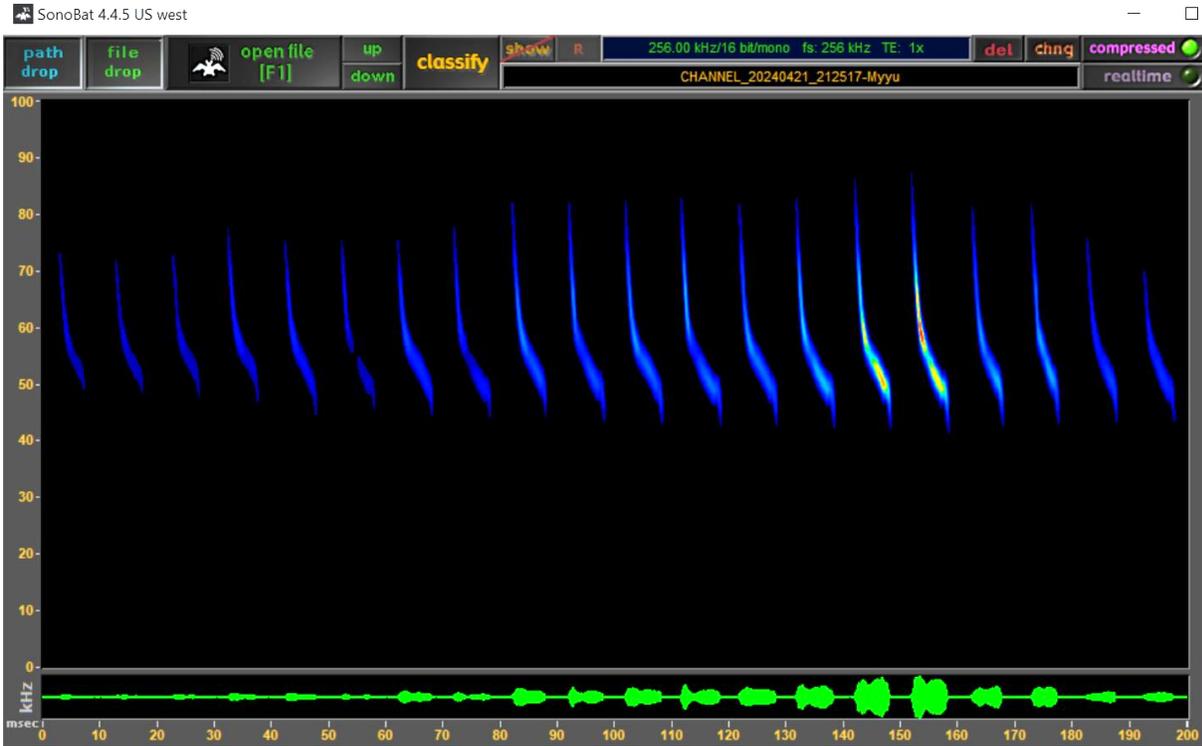
Yuma myotis search phase calls recorded April 21, 2024 at the Channel Open site.



Mexican free-tailed bat search phase calls recorded April 19, 2024 at the Channel Open site.