Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development Acoustic Monitoring of LCR MSCP Bat Species

2017 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Work conducted under LCR MSCP Work Task F04

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

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U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

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Lower Colorado River Multi-Species Conservation Program

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2017 Annual Report

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ACRONYMS AND ABBREVIATIONS

AKTP1	‘Ahakhav Tribal Preserve acoustic station #1
BLCA	Beal Lake Conservation Area
BLCA1	Beal Lake Conservation Area acoustic station #1
Cibola NWR Unit #1	Cibola National Wildlife Refuge Unit #1 Conservation Area
Crane Roost	Cibola National Wildlife Refuge Unit #1 acoustic station at Crane Roost
CVCA	Cibola Valley Conservation Area
CVCA1	Cibola Valley Conservation Area acoustic station #1
CVCA2	Cibola Valley Conservation Area acoustic station #2
ESA	Endangered Species Act
HH1	Hunters Hole acoustic station #1
i.e.	*id est*; that is
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
PVER	Palo Verde Ecological Reserve
PVER1	Palo Verde Ecological Reserve acoustic station #1
PVER2	Palo Verde Ecological Reserve acoustic station #2
Reclamation	Bureau of Reclamation
YEW1	Yuma East Wetlands acoustic station #1

Symbols

≥	greater than or equal to
%	percent

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Attachment

1 Monthly Activity and Occupancy

2 Yearly Activity of Other Riparian Bat Species (Using the Kaliedoscope Auto Classifier)

EXECUTIVE SUMMARY

Acoustic bat call data were analyzed from nine Anabat™ acoustic monitoring stations along the lower Colorado River (LCR) from June 1 to August 31, 2015–2017. These stations were located in six Lower Colorado River Multi-Species Conservation Program (LCR MSCP) conservation areas and one habitat creation area that consist of Fremont cottonwood-Goodding's willow (*Populus fremontii-Salix gooddingii*), honey mesquite (*Prosopis glandulosa*), marsh, and backwater habitats. The acoustic recordings were analyzed for the calls of four bat species for which habitat and/or conservation actions are being implemented by the LCR MSCP: western red bats (*Lasiurus blossevilli*), western yellow bats (*Lasiurus xanthinus*), California leaf-nosed bats (*Macrotus californicus*), and pale Townsend's big-eared bats[1] (*Corynorhinus townsendii pallescens = Plecotus townsendii pallescens = C. townsendii townsendii*). The acoustic recordings were analyzed for the calls of the 2 covered and 2 evaluation species as well as 10 additional bat species using the Kaleidoscope Pro (version 4.3.1) auto-classifier in order to compare the effectiveness of this software at detecting and distinguishing bat species along the LCR against the Analook Zero=Crossings Analysis using call filters (with visual verification method). In addition to recording species presence, the project documents the variation in bat activity across time and space to inform LCR MSCP habitat credit accomplishments and habitat management.

Western red bats, western yellow bats, and California leaf-nosed bats were recorded at all Anabat™ acoustic monitoring stations during 2015, 2016, and 2017. The only pale Townsend's big-eared bat call recorded at any location during the summers of 2015, 2016, and 2017 occurred at the Cibola Valley Conservation Area CVCA2 station in August 2017. Activity (presented as average nightly call minutes) and occupancy (presented as proportion of nights occupied) varied among monitoring sites, years, and species. Western red bats were recorded with the greatest activity at the Palo Verde Ecological Reserve PVER1 station, western yellow bats were recorded with the greatest activity at the CVCA1 station, and California leaf-nosed bats were recorded with the greatest activity at the CVCA2 station. Pale Townsend's big-eared bat activity was not detected with the Analook visual verification method due to the quiet nature of their calls, but they were recorded to be greatest by the Kaleidoscope auto-classifier at CVCA1 during the reporting period, June – August 2015–2017. The auto-classifier for pale Townsend's big-eared bats showed promising results

[1] Genetic analyses on the pale Townsend's big-eared bat indicate that the LCR is likely in the range of the Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*) rather than the pale Townsend's big-eared bat (Piaggio and Perkins 2005). Bats recorded along the LCR will be referred to as the pale Townsend's big-eared bat in this report, as the name change has not yet been verified by the U.S. Fish and Wildlife Service.

compared to the Analook filters, which may lead to more efficient processing of these calls. The Analook filters marked 53,598 files as potential pale Townsend's big-eared bat calls, while the auto-classifier identified 480 calls. The auto-classifier (46,696) likely overestimated activity for western red bats and marked more potential calls as western red bats than the Analook filters (40,722). Activity and occupancy for LCR MSCP species and other species assessed with the auto-classifier were recorded at the greatest levels at the largest, most mature, and complex conservation areas.

INTRODUCTION

This document is a summary of acoustic bat call data collected at nine Anabat™ acoustic monitoring stations in six Lower Colorado River Multi-Species Conservation Program (LCR MSCP) conservation areas (Beal Lake Conservation Area [BLCA], Palo Verde Ecological Reserve [PVER], Cibola Valley Conservation Area [CVCA], Cibola National Wildlife Refuge Unit #1 Conservation Area [Cibola NWR Unit #1], Yuma East Wetlands, and Hunters Hole), and one habitat creation area (the ‘Ahakhav Tribal Preserve) along the lower Colorado River (LCR). The purpose of this project is to monitor the presence of bat species for the LCR MSCP. In addition to recording species presence, the project documents the variation in bat activity across time and space to inform LCR MSCP habitat credit accomplishments and habitat management.

Acoustic sampling is an effective and economical means to monitor bat populations. Analyses of recordings from ultrasonic bat detectors are now widely applied when assessing bat distribution and activity over a range of temporal scales in various landscape contexts. Two methods were compared for identifying bat acoustic calls recorded in 2015 and 2016: the Analook Zero=Crossings Analysis using call filters (with visual verification method) used in prior years and a new method, the Kaleidoscope Pro (version 4.3.1) auto-classifier. Activity (presented as average nightly call minutes) and occupancy (presented as proportion of nights occupied) estimates using both methods were compared for the 2 covered and 2 evaluation species as well as 10 other species to assess the potential utility of auto-classification as a cost-effective means of call analyzation.

The LCR MSCP is a multi-stakeholder Federal and non-Federal partnership responding to the need to balance the use of LCR water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act (ESA). This program works toward the recovery of listed species through habitat and species conservation and reduces the likelihood of additional species listings under the ESA. The LCR MSCP is required to create 765 acres of western red bat (*Lasiurus blossevillii*) roosting habitat and 765 acres of western yellow bat (*Lasiurus xanthinus*) roosting or foraging habitat. It is also evaluating the need to cover two additional species under the LCR MSCP permit: California leaf-nosed bats (*Macrotus californicus*) and pale Townsend’s big-eared bats (*Corynorhinus townsendii = Plecotus townsendii pallescens = C. townsendii townsendii*). (Genetic analyses on the pale Townsend’s big-eared bat indicate that the LCR is likely in the range of the Pacific Townsend’s big-eared bat [*Corynorhinus townsendii townsendii*] rather than the pale Townsend’s big-eared bats [Piaggio and Perkins 2005]. Bats recorded along the LCR will be referred to as the pale Townsend’s big-eared bat in this report, as the name change has not yet been verified by the U.S. Fish and Wildlife Service).

STUDY AREA

The study area consists of nine Anabat™ acoustic monitoring stations located along the LCR from the Havasu National Wildlife Refuge in the north to Hunters Hole located near the international border with Mexico (figure 1). Conservation areas were created by the LCR MSCP through their Habitat Conservation Plan (LCR MSCP 2004), which requires the creation of over 8,100 acres of various land cover types to provide habitat for targeted LCR MSCP covered species. Four land cover types are integrated in the LCR MSCP and include Fremont cottonwood-Goodding's willow (*Populus fremontii-Salix gooddingii*) (hereafter cottonwood-willow) (5,940 acres), honey mesquite (*Prosopis glandulosa*) (1,320 acres), marsh (512 acres), and backwater (360 acres). Native species used in the conservation area plantings include coyote willow (*Salix exigua*), desert broom (*Baccharis sarothroides*), Fremont cottonwood, Goodding's willow, heliotrope (*Heliotropium curassavicum*), honey mesquite, mule fat (*Baccharis salicifolia*), quailbush (*Atriplex lentiformis*), and willow baccharis (*Baccharis salicina*). Conservation areas are planted in phases and contain a mixture of mature and maturing vegetation. In addition, some conservation areas, such as Yuma East Wetlands and the BLCA on the Havasu National Wildlife Refuge, are taking longer to mature and have shorter canopy heights compared to sites at the CVCA and PVER.

One acoustic monitoring station is located at the 'Ahakhav Tribal Preserve in Parker, Arizona. The Colorado River Indian Tribes planted and manages this habitat creation area (figure 2). It exhibits vegetation characteristics similar to the LCR MSCP conservation areas and is analyzed with the data from those areas. The 'Ahakhav Tribal Preserve is 154 acres in size and consists of cottonwood-willow and mesquite (*Prosopis* spp.). AKTP1 is located in cottonwood-willow habitat.

The BLCA is located on the Havasu National Wildlife Refuge within the historic flood plain of the LCR. It is 121 acres in size and consists of cottonwood-willow, honey mesquite, and marsh habitat (figure 3). BLCA1 is located in cottonwood-willow habitat.

Cibola NWR Unit #1 is located in the Cibola National Wildlife Refuge near Cibola, Arizona. This conservation area is nearly 950 acres in size and consists of a mosaic of cottonwood-willow, agriculture, honey mesquite, wetland, native vegetation, and undeveloped land. The CNU1 acoustic station was initially deployed in 2011 at the Cibola NWR Unit #1 Nature Trail area but was relocated to the Crane Roost area in 2013 because it was determined that the area is more similar to other conservation area sites (figure 4). The station was renamed Crane Roost, as it is in a different location.

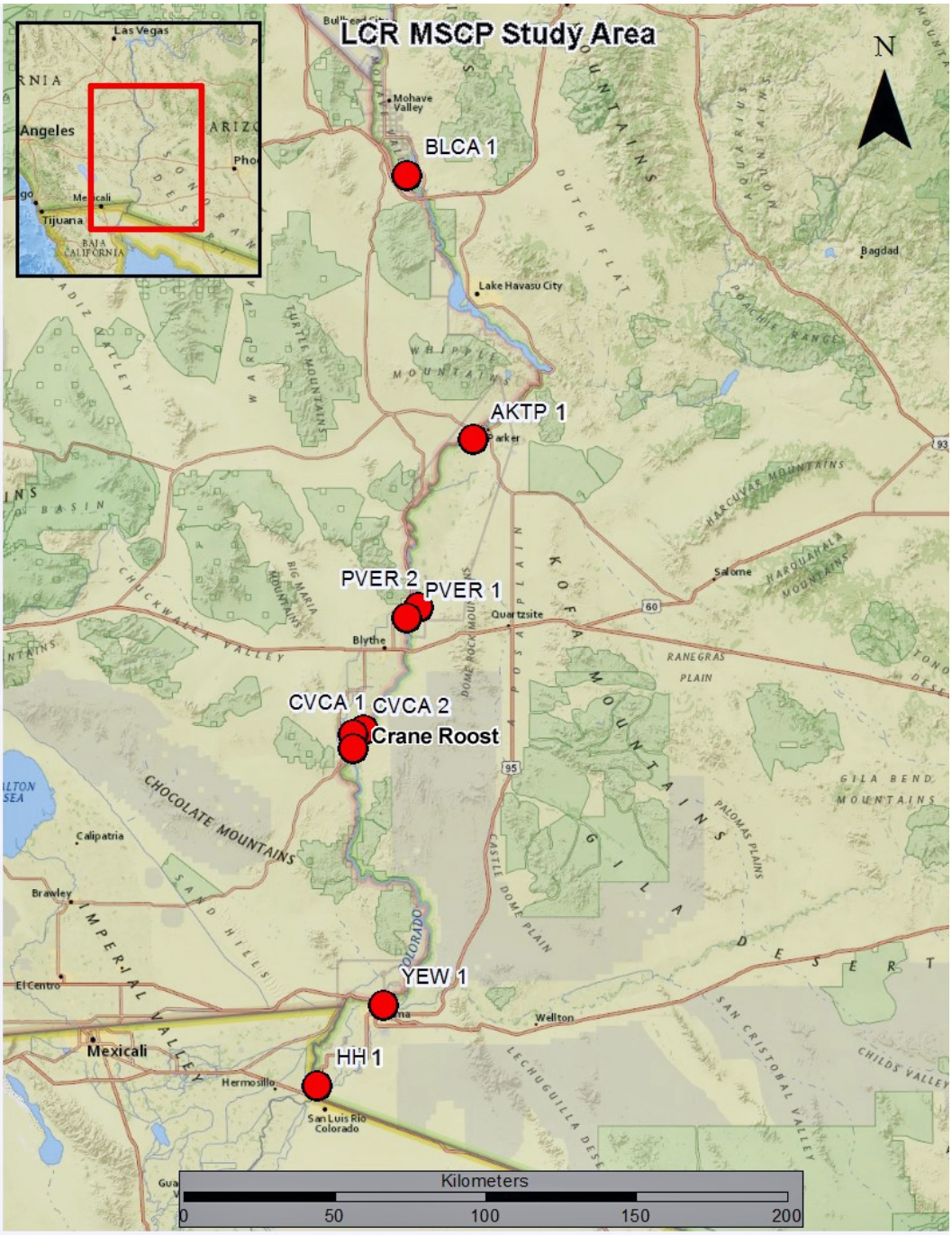


Figure 1.—Study area and location of acoustic monitoring stations.

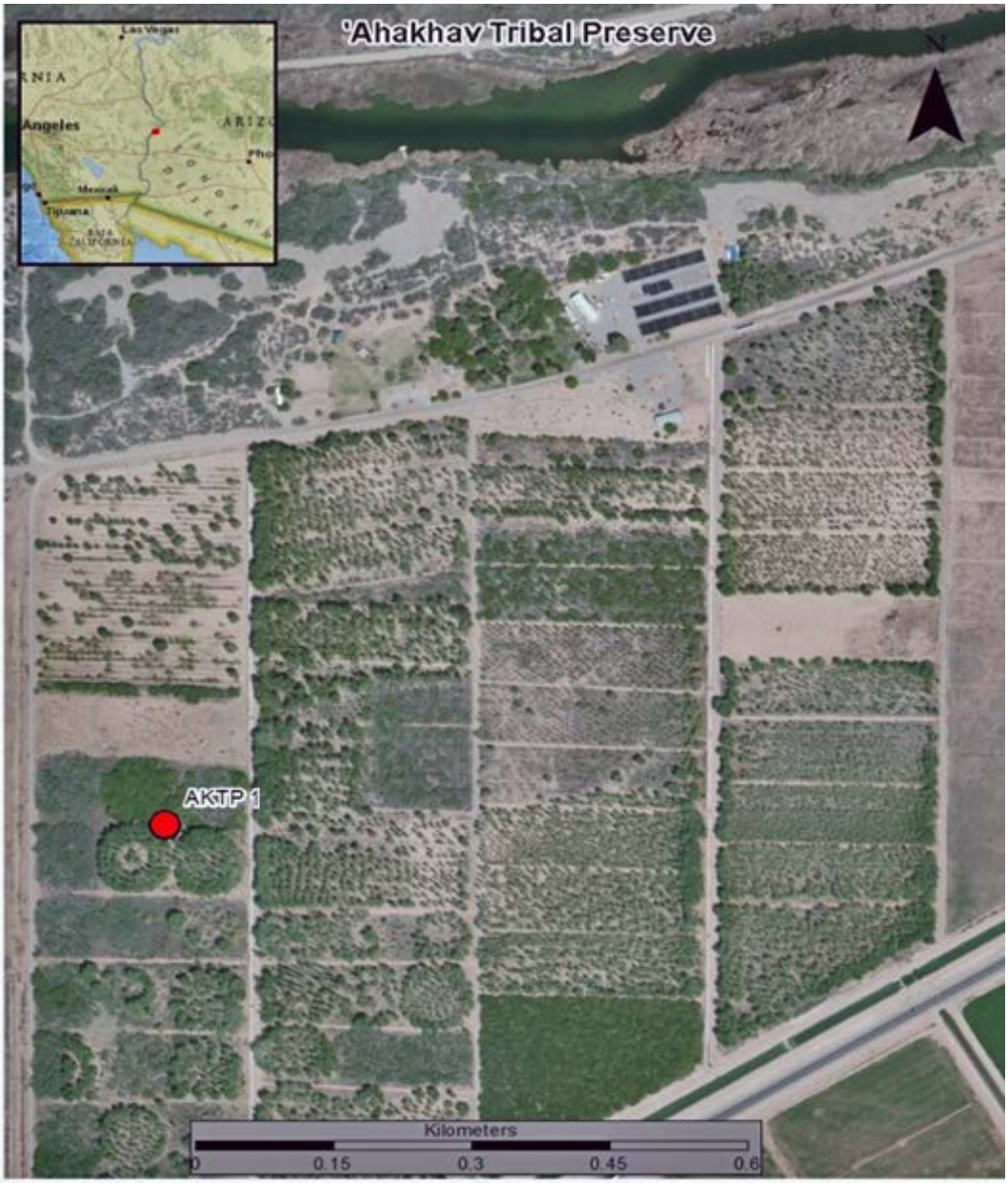


Figure 2.—The 'Ahakhav Tribal Preserve acoustic monitoring station (AKTP1).

Figure 3.—The BLCA acoustic monitoring station (BLCA1).

Figure 4.—The Cibola NWR Unit #1 original bat acoustic monitoring station location (CNU1) and the current location (Crane Roost).

The CVCA is located north of Cibola, Arizona, on Arizona Game and Fish owned lands. When fully planted, it will be over 1,000 acres in size. The CVCA currently consists of cottonwood-willow and honey mesquite. The first station (CVCA1) was deployed in mature cottonwood-willow habitat in 2011. The second station (CVCA2) was deployed in less dense cottonwood-willow habitat 2013 (figure 5).

Hunters Hole is located adjacent to the international border with Mexico near San Luis, Arizona. It is 44 acres, planted on an irrigated field, and it consists of cottonwood-willow, honey mesquite, native grasses, and marsh habitat (figure 6). HH1 is located on the edge of cottonwood-willow habitat.

The PVER is located northeast of Blythe, California, on California Department of Fish and Wildlife lands within the historic flood plain of the LCR. It is over 1,350 acres in size and consists of cottonwood-willow, honey mesquite, and alkali sacaton (*Sporobolus airoides*). The first station (PVER1) was deployed in mature cottonwood-willow habitat in 2012. The second station (PVER2) was deployed in less dense cottonwood-willow habitat in 2013 to provide sufficient coverage for this large conservation area (figure 7).

Yuma East Wetlands is located in Yuma, Arizona, on lands owned by the Quechan Tribe, the city of Yuma, and the Arizona Game and Fish Department. Yuma East Wetlands is 350 acres and consists of cottonwood-willow, honey mesquite, and marsh habitat (figure 8). YEW1 is located in cottonwood-willow habitat.

METHODS

Data Collection Methods

Data were summarized from nine permanent Anabat™ detectors in six LCR MSCP conservation areas and one habitat creation area (the ‘Ahakhav Tribal Preserve) along the LCR (table 1; see figure 1).

These nine acoustic monitoring stations provide a temporal and spatial estimate of bat activity and daily occupancy. These stations consist of Anabat™ II detectors with associated ZCAIM (a device that takes a frequency signal from an Anabat™ detector, detects the zero-crossings in the signal, and stores the signals on a compact flashcard) and Anabat™ SD1 and SD2 detectors. Compact flashcards at the stations accumulated data at the rate of about 12 megabytes per night during periods of very high bat activity (about 1,500 calls per night). This provides approximately 4 months of data collection for the 1-gigabyte cards used. Data were recorded from June 1 through August 31 of each year in order to determine bat presence during summer. The stations were surveyed and the data downloaded in June, July, and August, with an additional trip in May to address any maintenance issues.

Figure 5.—The CVCA acoustic monitoring stations (CVCA1 and CVCA2).

Figure 6.—The Hunters Hole acoustic monitoring station (HH1).

Figure 7.—The PVER acoustic monitoring stations (PVER1 and PVER2).

Figure 8.—The Yuma East Wetlands acoustic monitoring station (YEW1).

Table 1.—Station name, acronym, number of nights recorded during the sampling period, and year of station deployment

Conservation area or habitat creation area (listed north to south)	Station acronym	Nights recorded 2015	Nights Recorded 2016	Nights Recorded 2017	Year deployed
Beal Lake Conservation Area	BLCA1	92	92	92	2008
‘Ahakhav Tribal Preserve	AKTP1	61	92	57	2012
Palo Verde Ecological Reserve	PVER1	92	92	92	2012
	PVER2	26	77	43	2013
Cibola Valley Conservation Area	CVCA1	92	92	8	2011
	CVCA2	92	92	91	2013
Cibola National Wildlife Refuge Unit #1 Conservation Area	Crane Roost	92	76	77	2011
Yuma East Wetlands	YEW1	69	92	92	2013
Hunters Hole	HH1	92	92	62	2013
Totals (percent of nights recorded)	**–**	**708 (86%)**	**797 (96%)**	**614 (74%)**	**–**

During the 2015, 2016, and 2017 sampling seasons, several equipment malfunctions resulted in periods of data loss. The units were checked the day after they were installed for the season and the day after each card was downloaded or replaced to ensure the units collected data the first night. The units cannot be checked remotely to ensure they are functioning between site visits.

- AKTP1 malfunctioned in 2015 (June 22 – July 22) due to a faulty battery connection. AKTP1 did record acoustic activity for the remaining 61 days due to the time required to properly charge the battery after the connection had been fixed (see table 1). AKTP1 again malfunctioned during 2017 (June 14 – July 17). This was likely due, in part, to the trees growing densely around the station throughout summer, which reduced the effectiveness of the solar battery charger.

- PVER2 had multiple issues during 2015 (June 24 – August 12 and August 16–31), and the Anabat™ unit had to be replaced. PVER2 also malfunctioned during 2016 (June 1–15). It was determined that the compact flashcards were corrupt. The station also had a kinked microphone cable that may have led to a reduced amount of calls being recorded for the recording period. PVER2 malfunctioned during 2017 as well (June 1 – July 19) due what was first thought to be a malfunctioning unit but ultimately was determined to be a broken microphone cable. The Anabat™ unit used in this station in 2016 had burn marks, so it is possible that the tower and equipment was damaged by lightning strikes in 2016 and 2017.

- The Crane Roost station malfunctioned during 2016 (June 1–16) also due to corrupt compact flashcards. The station also malfunctioned during 2017 (June 1 and July 4–17). The battery had to be replaced on June 2, 2017. No reason could be determined for the data loss in July 2017; the unit functioned properly through August.

- CVCA1 malfunctioned during 2017, resulting in only 8 nights of recorded data (June 1–July 28 and August 6–31). Equipment was swapped out and the cause of malfunction could not be determined.

- CVCA2 malfunctioned during 2017 (no data on June 1). A different compact flash card was installed on June 2, and no further issues were encountered.

- YEW1 could not be deployed at the beginning of 2015 (June 1–10) because the road had been washed out and was impassable. The unit operated properly for the remainder of 2015 and June – August 2016 and 2017.

- HH1 malfunctioned during 2017 (June 1 and June 14 – July 12). The compact flash card was replaced on June 2, 2017, and operated correctly. The battery cables were found to be corroded in July, which affected the Anabat™ unit power. They were cleaned July 12, 2017, and the unit functioned properly through August 2017.

- BLCA1 and PVER1 functioned properly throughout the recording period (see table 1). Data collected at these nine stations were used to evaluate bat use magnitude and diversity.

Analook Visual Verification Methods

Analook Zero=Crossings Analysis

The volume of call minutes was quantified for the two covered and two evaluation LCR MSCP species (western red bats, western yellow bats, California leaf-nosed bats, and pale Townsend's big-eared bats). Acoustic bat calls were recorded nightly from sunset to sunrise, and the files were processed using filters and methods that had been developed by a previous LCR MSCP acoustic monitoring project (Broderick 2008). A series of acoustic filters were created for the focal bat species using the Analook software. The Analook software uses a Zero=Crossings Analysis. It was based on first running files through an "All bats" filter to eliminate any files with significant background and insect noise. Background and insect noise usually occurs at low frequencies and can be confused with bat calls. The "All bats" filter recognizes the patterns of background and insect noise and removes these files from consideration. Then,

the remaining calls were run through species-specific filters and analyzed individually to sort out species with similar call shapes and frequencies to the four focal species. Western red bat calls were then run through two species-specific filters (a low frequency and a high frequency). The low-frequency filter recorded bat calls ending between 40–47.5 kilohertz, and the high-frequency filter recorded bat calls ending between 52–80 kilohertz. The high-frequency filters were applied after discussions with Bureau of Reclamation (Reclamation) biologists (Broderick and Calvert 2011, personal communication) revealed they had recorded western red bat calls at higher frequencies along the LCR. Pale Townsend's big-eared bats are known to emit low-amplitude vocalizations in an attempt to capture their Lepidopteran prey, which makes them difficult to detect with acoustic methods (O'Farrell and Gannon 1999). Pale Townsend's big-eared bats produce a dual harmonic and cannot be positively identified unless the presence of this diagnostic harmonic is detected. The calls were compared and the filters tested on hand-release reference calls recorded along the LCR provided by Reclamation biologists (Broderick and Calvert 2011, personal communication) and reference calls from across the Southwestern United States.

Visual Verification of Analook Results

All calls that were flagged as a species of interest by the Analook filters were visually analyzed, and only those calls that fit all of the call parameters for the given species and that could confidently be identified are presented.

Activity and Occupancy

Call minutes were used in order to reduce bias in estimating bat activity at Anabat™ stations. A call minute is defined as a 1-minute interval in which a particular species is recorded at least once, regardless of the number of call sequences, or the number of files for that species recorded within that minute (Broderick 2010; Brown 2006; Kalcounis et al. 1999). The call minutes index reduced the bias associated with the tendency for individual bats to be recorded multiple times or for multiple bats of a single species to be recorded within an individual file (Miller 2001; Williams et al. 2006; Vizcarra et al. 2010). Bat minutes measure activity while reducing the tendency to classify calls as the result of one bat making multiple calls or many bats making a single call. Therefore, data were also analyzed using a presence/absence framework as the measure of occupancy and are presented as nights occupied and proportion of nights occupied at the acoustic monitoring stations. The approach is based on naïve occupancy (i.e., if the species is present and within range of the stations, it will be recorded). Therefore, detection probabilities are not taken into account (i.e., imperfect detections). It should be noted that detection is indicative of presence, but non-detection of the species is not equivalent to absence (MacKenzie et al. 2002).

Monitoring was limited to the distance in which the station could record reliable bat calls, and it is not known if a bat was present or absent just beyond the range of the station.

Stations were compared based on average nightly call minutes per species, per station, as well as the proportion of nights a species occupied the station area during the year. Because the results may be biased based on station malfunctions, data based on average nightly call minutes per month were also compared, which removed nights when a station was not recording. As such, the comparisons among stations represent a qualitative measure of activity and are not to be extrapolated to evaluate population dynamics or occupancy trends. It is believed that these methods provide a simple, standardized way of comparing activity across the stations and species.

Kaleidoscope Auto-Classifier Method

All calls recorded were also analyzed using the Kaleidoscope Pro (version 4.3.1) auto-classifier in an effort to determine if this is a cost-effective means of analyzing calls and to compare this method with the Analook filters and the Analook visual verification method. The Kaleidoscope software does not have an auto-classifier for California leaf-nosed or western yellow bats, but western red and pale Townsend's big-eared bats were evaluated as well as other calls the auto-classifier identified. The auto-classifier was used to assess the data in two ways: (1) as a comparison with LCR MSCP species verified calls and (2) as an index for overall bat activity at each acoustic monitoring station.

The Kaleidoscope auto-classifier has 12 species classifiers for the study area: pallid bats *(Antrozous pallidus*), pale Townsend's big-eared bats, big brown bats (*Eptesicus fuscus*), spotted bats (*Euderma maculatum*), greater mastiff bats (*Eumops perotis*), western red bat, hoary bat (*Lasiurus cinereus*), California myotis (*Myotis californicus*), Arizona myotis (*Myotis occultus*), Yuma myotis (*Myotis yumanensis*), canyon bat (*Parastrellus hesperus*), and Mexican free-tailed bats (*Tadarida brasiliensis*).

Output from the Kaleidoscope auto-classifier was not visually verified, and it is likely that many calls were misidentified. Calls can be misidentified by the auto-classifier because certain species can produce similar calls to others that can only be identified by visual verification. Species that have similar calls and can be misidentified by the auto-classifier are big brown bats, hoary bats, and Mexican free-tailed bats, which all can have characteristics of each other's calls. Hoary bats are seasonally migratory and found at higher elevations during summer. They are most likely not present in conservation areas during June, July, or August. Calls identified as hoary bats during the sampling period are almost certainly big brown bats or Mexican free-tailed bats. California and Yuma myotis

can also produce similar calls. Arizona myotis calls can be similar to cave myotis (*Myotis velifer*), but there is no auto-classifier for cave myotis; therefore, some Arizona myotis calls are almost certainly misidentified cave myotis calls.

The Kaleidoscope activity index can be used as a quantitative measure of bat activity at each station, between stations and years. It can be utilized to detect increases, decreases, or constant activity at acoustic stations.

RESULTS

Activity and occupancy for western red bats, western yellow bats, and California leaf-nosed bats at each conservation area ranged widely across sites and years. Seasonal activity and occupancy is referenced in the "Results" section, and detailed graphs depicting monthly average nightly call minutes and proportion of nights occupied can be found in attachment 1.

Western Red Bat

Western red bats were detected in 2015, 2016, and 2017 using the Analook visual verification methods. None were detected at the 'Ahakhav Tribal Preserve or Hunters Hole in 2015, but they were detected in 2016. They were not detected at AKTP1 in 2017 (table 2). Activity and occupancy of western red bats at each conservation area ranged widely across sites and years, with occupancy generally reflecting seasonal patterns of activity for visually verified results, while occupancy was 100% (or nearly 100%) at every site for the Kaleidoscope results. All results have been rounded to the nearest hundredth (1/100).

Table 2.—Western red bat detections 2015, 2016, and 2017

Conservation area or habitat creation area	Station acronym	2015	2016	2017
'Ahakhav Tribal Preserve	AKTP1	None detected	X	None detected
Beal Lake Conservation Area	BLCA1	X	X	X
Cibola National Wildlife Refuge Unit #1 Conservation Area	Crane Roost	X	X	X
Cibola Valley Conservation Area	CVCA1	X	X	X
	CVCA2	X	X	X
Hunters Hole	HH1	None detected	X	X
Palo Verde Ecological Reserve	PVER1	X	X	X
	PVER2	X	X	X
Yuma East Wetlands	YEW1	X	X	X

Analook Visual Verification Methods Station Comparison

Western Red Bat Yearly Comparison

2015

The greatest average nightly call minutes (2.85) and proportion of nights occupied (0.71) for western red bats during 2015 were recorded at PVER1 (see figures 9 and 10).

2016

The greatest average nightly call minutes (1.72) recorded during 2016 were recorded at CVCA1, but the greatest proportion of nights occupied (0.55) for western red bats were recorded at PVER1 (see figures 9 and 10).

2017

The greatest average nightly call minutes (2.26) and proportion of nights occupied (0.78) for western red bats during 2017 were recorded at PVER1 (see figures 9 and 10).

Western Red Bat Station Comparison

AKTP1

Activity and occupancy were the lowest at AKTP1 from 2015 through 2017, with the only western red bat activity (0.02) and occupancy (0.02) recorded during 2016 (see figures 9 and 10; attachment 1 [figure 1-1]). Station malfunctions in June and July 2015 and 2017 may partly explain the lack of detections at this site.

BLCA1

Activity (0.45) and occupancy (0.27) were greatest at BLCA1 during 2015 and the lowest during 2016 (0.14 for activity and occupancy) (see figures 9 and 10; attachment 1 [figure 1-2]).

Crane Roost Station

At the Crane Roost station, bat activity (0.22) and occupancy (0.14) was greatest in 2015, with the most detections recorded in August (see figures 9 and 10; attachment 1 [figure 1-3]). Station malfunctions in 2016 and 2017 may partly explain the lower activity recorded in these years.

CVCA1

A large peak in activity (3.77) and occupancy (0.74) was observed at CVCA1 in July 2016 (figures 9 and 10; attachment 1 [figure 1-4]). This peak led to overall activity (1.72) being greatest in 2016, but the greatest annual occupancy was in 2015 (0.44). Station malfunctions resulted in missing data for June 2017 and reduced data in July and August 2017.

CVCA2

A large peak in activity (0.81) and occupancy (0.42) was also observed at CVCA2 in July 2017. This peak led to overall activity (0.42) and occupancy (0.29) being greatest in 2017 at CVCA2 (figures 9 and 10; attachment 1 [figure 1-5]). Only 1 night of data were missing due to station malfunction in June 2017.

HH1

Activity and occupancy were both very low at HH1, with activity and occupancy recorded only in 2015 (0.02) and 2017 (0.03), with no detections in June (figures 9 and 10; attachment 1 [figure 1-6]).

PVER1

The greatest activity (2.85 in 2015) and occupancy (0.78 in 2017) from any site were noted at PVER1, with the peak seasonal activity in July 2015 (4.13) and greatest occupancy in August 2017 (0.90) (figures 9 and 10; attachment 1 [figure 1-7]).

PVER2

Bat activity and occupancy were much lower at PVER2, and station malfunctions impacted data collection in all three years. Activity (0.06) and occupancy (0.06) were greatest in 2017 (figures 9 and 10; attachment 1 [figure 1-8]).

YEW1

At YEW1, a peak in activity was recorded in July 2016 (0.58), with the greatest occupancy (0.26) observed equally in July 2016 and August 2017. The greatest annual activity and occupancy at YEW1 was recorded in 2017 (0.30 and 0.21, respectively) (figures 9 and 10; attachment 1 [figure 1-9). A station malfunction reduced the amount of data collected in June 2015.

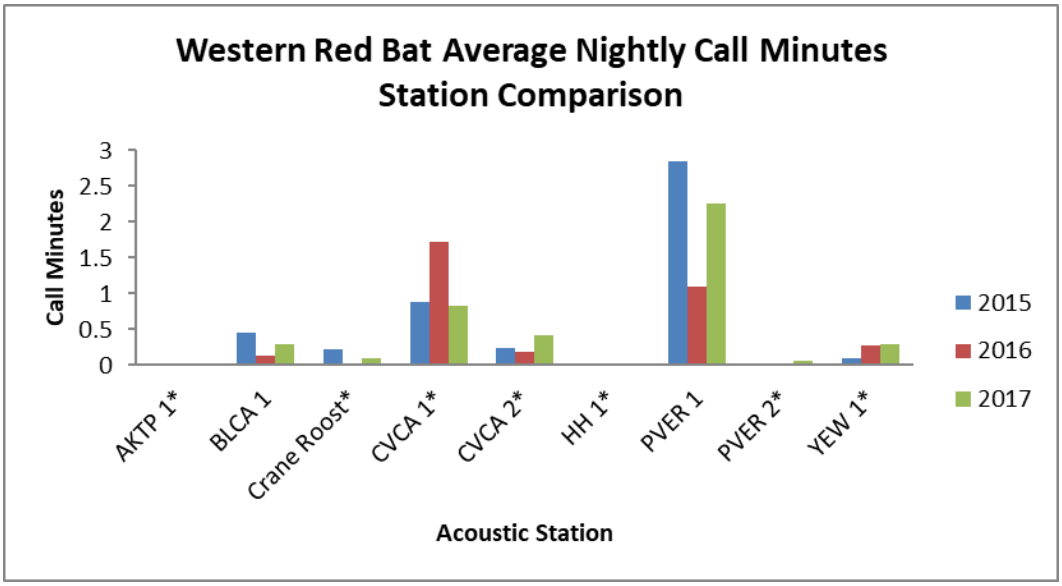


Figure 9.—Western red bat average nightly call minutes station comparison.
* Station malfunction occurred at site.

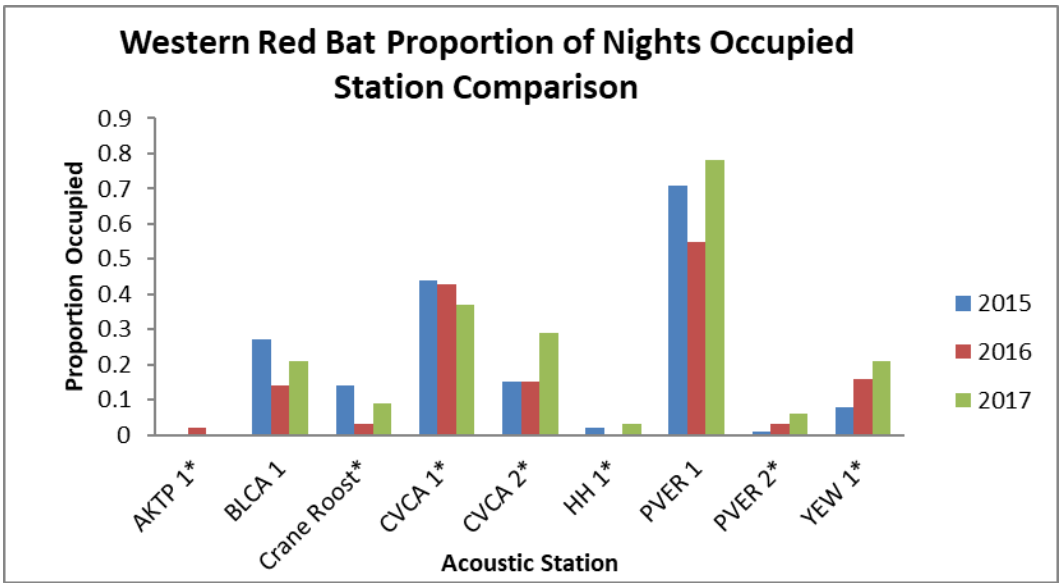


Figure 10.—Western red bat proportion of nights occupied station comparison.
* Station malfunction occurred at site.

Western Red Bat Kaleidoscope Results

The Kaleidoscope auto-classifier produced different results than the visual verification methods. Considerably more average nightly call minutes and proportion of nights occupied were recorded by the auto-classifier. The Kaleidoscope auto-classifier consistently identified more occupancy than the visual verification methods, with the proportion of nights occupied ≥ 0.90 (and often 1.0) at every station from 2015 through 2017. The exceptions were HHCA1 during 2015 (0.71 and 2017 [0.70] and PVER 2 during 2016 [0.50]).BLCA1 had the greatest average nightly call minutes during 2015, 2016, and 2017, followed by PVER1 (figure 11). The lowest average nightly call minutes was recorded at the HH1 and PVER2, which matches results from the visual verification methods. Graphs comparing seasonal data of call minutes from the auto-classifier and verified visual verification are in attachment 1 (figures 1–27 to 1–35).

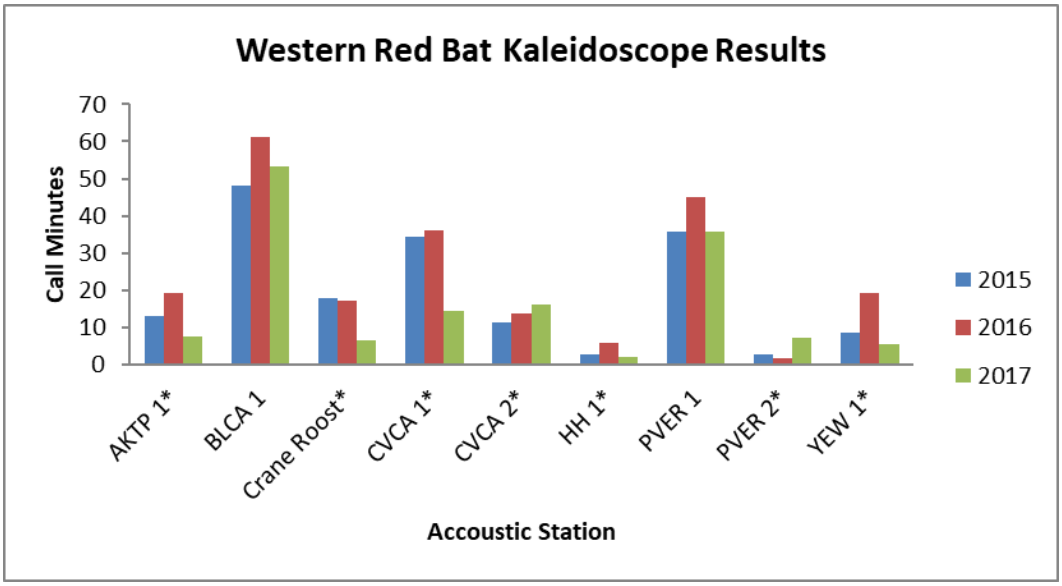


Figure 11.—Western red bat Kaleidoscope results station comparison.
* Station malfunction occurred at site.

Western Yellow Bat

Western yellow bats were detected at all stations during 2015, 2016, and 2017 using the Analook visual verification methods, with the exception of PVER2 in 2016 and AKTP1 in 2017 (table 3). Activity and occupancy of western yellow bats at each conservation area ranged widely across sites and years, with occupancy generally reflecting seasonal patterns of activity for visually verified result (figures 12 and 13). No Kaleidoscope auto-classifier exists for western yellow bats, so a comparison between visually verified and auto-classifier results could not be undertaken.

Table 3.—Western yellow bat detections 2015, 2016, and 2017

Conservation area or habitat creation area	Station acronym	2015	2016	2017
‘Ahakhav Tribal Preserve	AKTP1	X	X	None detected
Beal Lake Conservation Area	BLCA1	X	X	X
Cibola National Wildlife Refuge Unit #1 Conservation Area	Crane Roost	X	X	X
Cibola Valley Conservation Area	CVCA1	X	X	X
	CVCA2	X	X	X
Hunters Hole	HH1	X	X	X
Palo Verde Ecological Reserve	PVER1	X	X	X
	PVER2	X	None detected	X
Yuma East Wetlands	YEW1	X	X	X

Analook Visual Verification Methods Station Comparison

Western Yellow Bat Yearly Comparison

2015

The greatest average nightly call minutes (16.81) and proportion of nights occupied (0.97) for western yellow bats during 2015 occurred at CVCA1 (see figures 12 and 13).

2016

The greatest average nightly call minutes (4.22) and proportion of nights occupied (0.91) for western yellow bats during 2016 occurred at CVCA1 (see figures 12 and 13).

2017

The greatest average nightly call minutes (5.3) and proportion of nights occupied (0.8) for western yellow bats during 2017 occurred at CVCA1 (see figures 12 and 13).

Western Yellow Bat Station Comparison

AKTP1

Activity and occupancy were moderate at AKTP1 from 2015 (1.9 and 0.41) through 2016 (2.64 and 0.52), with no activity or occupancy recorded in 2017 (see figures 12 and 13; attachment 1 [figure 1-10]). The majority of activity was recorded in July at AKTP1 (attachment 1). Station malfunctions in June and July 2015 and 2017 reduced the amount of data collected for those months.

BLCA1

Activity and occupancy were consistently low at BLCA1 from 2015 to 2017. The greatest activity (0.09) was recorded in 2016, and the greatest occupancy in 2015 (0.08) (see figures 12 and 13; attachment 1 [figure 1-11]).

Crane Roost Station

Activity and occupancy were the lowest at the Crane Roost station from 2015 through 2017 compared to all other conservation areas, with the greatest activity (0.05) and occupancy (0.05) recorded in 2017 and the least recorded equally in 2015 and 2016 (0.03 and 0.03) (see figures 12 and 13; attachment 1 [figure 1-12]). Station malfunctions in 2016 and 2017 may partly explain the lower activity recorded in these years.

CVCA1

A large peak in activity (16.81) and occupancy (0.97) was observed at CVCA1 in 2015, with the greatest activity recorded in July (25.81) and August (20.48) and occupancy remaining constant throughout 2015 for each month (0.97). Activity and occupancy were the greatest at CVCA1 from 2015 through 2017 compared to all other conservation areas (see figures 12 and 13; attachment 1 [figure 1-13]). Station malfunctions resulted in missing data for June 2017 and reduced data in July and August 2017.

CVCA2

Much like CVCA1, a peak in activity (1.3) and occupancy (0.45) was also observed at CVCA2 during 2015 compared to 2016 (0.41 and 0.22) and 2017

(0.4 and 0.3). Like CVCA1, the greatest activity and occupancy occurred during July and August, with little recorded in June (see figures 12 and 13; attachment 1 [figure 1-14). Only 1 night of data were missing due to a station malfunction in June 2017.

HH1

Activity and occupancy were generally consistent at HH1 from 2015 through 2017, with the greatest levels recorded during 2015 (0.54 and 0.41), followed by 2017 (0.5 and 0.3) and 2016 (0.44 and 0.3). The greatest activity and occupancy at HH1 were recorded in July in 2015, 2016, and 2017 (figures 12 and 13; attachment 1 [figure 1-15]).

PVER1

A high amount of activity and occupancy was recorded at PVER1, with a peak in 2015 (6.12 and 0.68). While activity varied from 2015 through 2017, occupancy remained relatively stable in 2015 (0.68), 2016 (0.63) and 2017 (0.58). The greatest activity was recorded in July from 2015 through 2017, but the greatest occupancy was recorded in August (figures 12 and 13; attachment 1 [figure 1-16]).

PVER2

Bat activity and occupancy were much lower at PVER2, with none recorded in 2016. The greatest activity (0.27) and occupancy (0.15) were recorded during 2015 (figures 12 and 13; attachment 1 [figure 1-17]). The greatest activity and occupancy were recorded during August, with none recorded during July. Station malfunctions impacted data collection in all three years.

YEW1

At YEW1, a peak in activity (2.55) and occupancy (0.7) was recorded in 2015 (figures 12 and 13; attachment 1 [figure 1-18]). The greatest activity and occupancy were observed in July in 2015, 2016 and 2017. A station malfunction reduced the amount of data collected in June 2015.

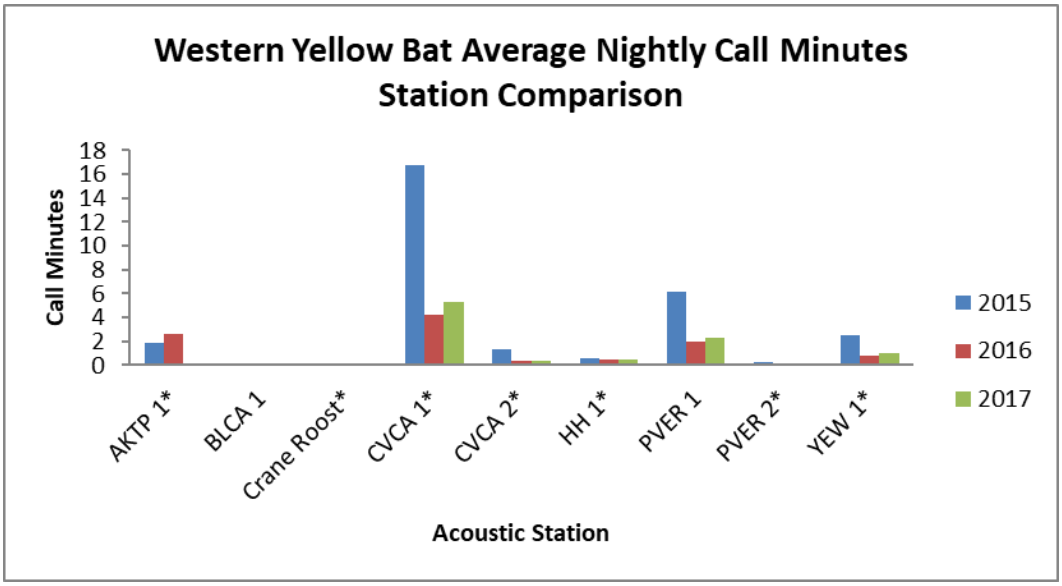


Figure 12.—Western yellow bat average nightly call minutes station comparison.
* Station malfunction occurred at site.

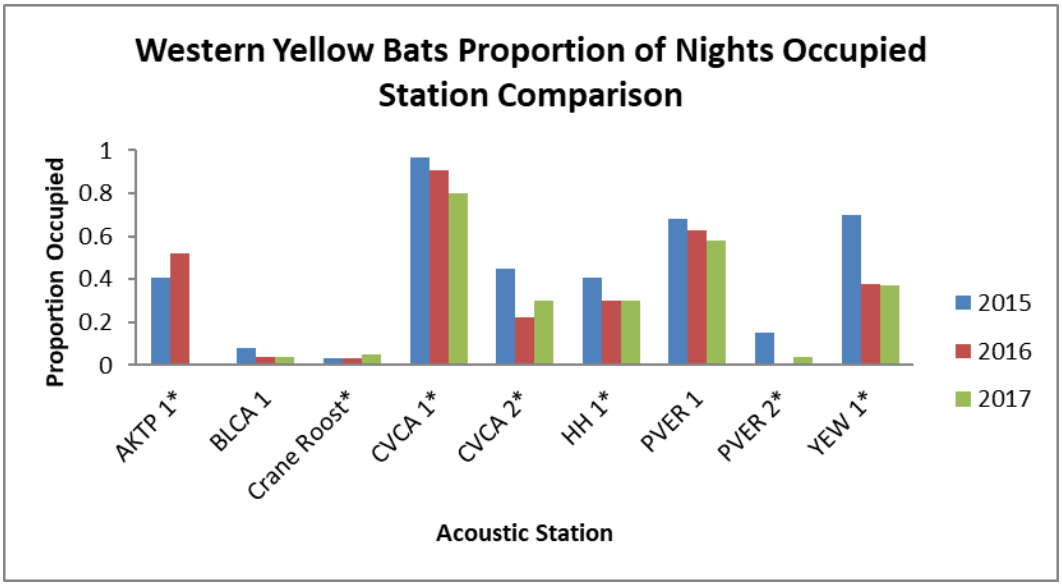


Figure 13.—Western yellow bat proportion of nights occupied station comparison.
* Station malfunction occurred at site.

California Leaf-nosed Bat

California leaf-nosed bats were detected in 2015, 2016, and 2017 using the Analook visual verification methods. None were detected at AKTP1, BLCA1, HH1, PVER1, or PVER2 during 2015, but they were detected during 2016 at those sites (except PVER2). No California leaf-nosed bats were detected at the Crane Roost station, CVCA1, CVCA2, PVER2, or YEW1 during 2016, but they were detected in 2015 (except PVER2). No California leaf-nosed bats were detected at CVCA1 or PVER2 during 2017 (table 4). Activity and occupancy of California leaf-nosed bats at each conservation area ranged widely across sites and years. Activity and occupancy were recorded sporadically and in low numbers due to the low-amplitude calls this species produces. No Kaleidoscope auto-classifier exists for California leaf-nosed bats, so a comparison between visually verified and auto-classifier results could not be undertaken.

Table 4.—California leaf-nosed bat detections 2015, 2016, and 2017

Conservation area or habitat creation area	Station acronym	2015	2016	2017
‘Ahakhav Tribal Preserve	AKTP1	None detected	X	X
Beal Lake Conservation Area	BLCA1	None detected	X	X
Cibola National Wildlife Refuge Unit #1 Conservation Area	Crane Roost	X	None detected	X
Cibola Valley Conservation Area	CVCA1	X	None detected	None detected
	CVCA2	X	None detected	X
Hunters Hole	HH1	None detected	X	X
Palo Verde Ecological Reserve	PVER1	None detected	X	X
	PVER2	None detected	None detected	None detected
Yuma East Wetlands	YEW1	X	None detected	X

Analook Visual Verification Methods Station Comparison

California Leaf-nosed Bat Yearly Comparison

2015

The greatest average nightly call minutes (0.14) and proportion of nights occupied (0.11) for California leaf-nosed bats during 2015occurred at YEW1 (see figures 14 and 15).

2016

The greatest average nightly call minutes (0.02) and proportion of nights occupied (0.02) for California leaf-nosed bats during 2016 occurred equally at BLCA1 and PVER1 (see figures 14 and 15).

2017

The greatest average nightly call minutes (0.38) and proportion of nights occupied (0.25) for California leaf-nosed bats during 2017 occurred at CVCA2 (see figures 14 and 15).

California Leaf-nosed Bat Station Comparison

AKTP1

Activity and occupancy were low at AKTP1, with none recorded during 2015 (figures 14 and 15). Activity and occupancy were only recorded during July 2016 (0.03 and 0.03) and August 2017 (0.06 and 0.06) (see figures 14 and 15; attachment 1 [figure 1-19). Station malfunctions in June and July 2015 and 2017 reduced the amount of data collected for those months.

BLCA1

Activity (0.16) and occupancy (0.15) were greatest at BLCA1 during 2017. Activity and occupancy were only recorded in June 2016, and none was recorded during 2015 (see figures 14 and 15; attachment 1 [figure 1-20]).

Crane Roost Station

Activity (0.14) and occupancy (0.13) were the greatest at the Crane Roost station in 2017 (see figures 14 and 15; attachment 1 [figure 1-21]). Activity and occupancy were only recorded in June 2015, and none was recorded during 2016. Station malfunctions in 2016 and 2017 may partly explain the lower activity recorded in these years.

CVCA1

Activity and occupancy were low at CVCA1, with the greatest recorded in 2015 (0.04 and 0.04), and none recorded in 2016 or 2017 (see figures 14 and 15; attachment 1 [figure 1-22]). Station malfunctions resulted in missing data for June 2017 and reduced data in July and August 2017.

CVCA2

The greatest activity and occupancy for any site occurred at CVCA2 from 2015 to 2017. The greatest activity (0.38) and occupancy (0.25) occurred during 2017, with none recorded during 2016 (figures 14 and 15; attachment 1 [figure 1-23]). Only 1 night of data were missing due to a station malfunction in June 2017.

HH1

Activity (0.09) and occupancy (0.03) were greatest at HH1 during 2017, with very little recorded in 2016 (0.01 and 0.01), and none recorded in 2015 (figures 14 and 15; attachment 1 [figure 1-24]). All activity and occupancy recorded at HH1 were observed in August.

PVER1

Activity (0.1) and occupancy (0.09) were greatest at PVER1 during 2017, with very little recorded in 2016 (0.02 and 0.02), and none were recorded in 2015 (figures 14 and 15; attachment 1 [figure 1-25]).

PVER2

No activity or occupancy was recorded at PVER2 from 2015 to 2017 (figures 14 and 15). Station malfunctions impacted data collection in all three years at PVER2.

YEW1

A moderate amount of activity was recorded at YEW1, with the greatest observed in 2015 (0.14 and 0.11). Very little activity (0.04) and occupancy (0.04) were recorded in 2017, and none were recorded in 2016 (figures 14 and 15; attachment 1 [figure 1-26]). A station malfunction reduced the amount of data collected in June 2015.

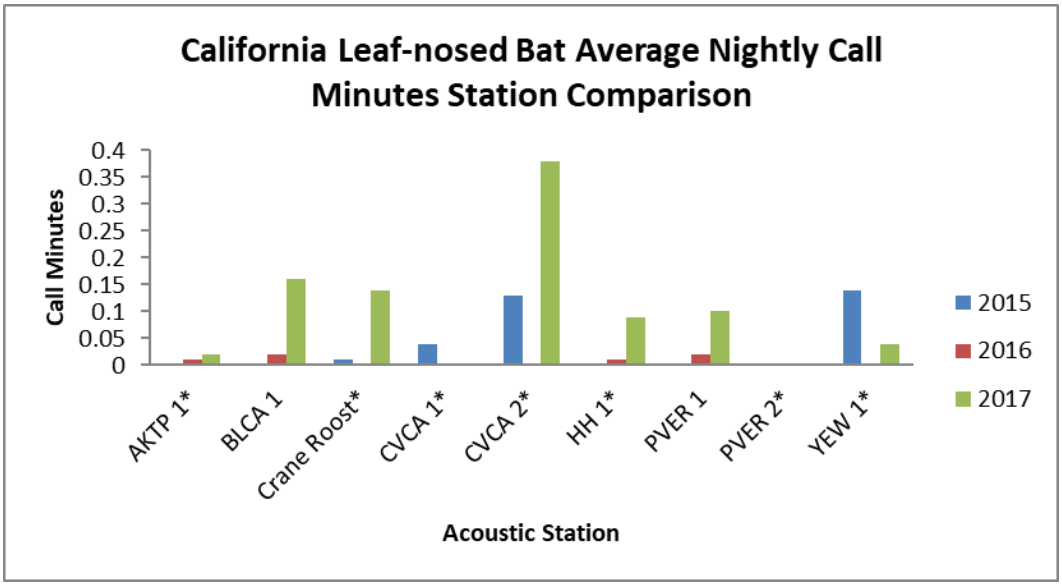


Figure 14.—California leaf-nosed bat average nightly call minutes station comparison.
* Station malfunction occurred at site.

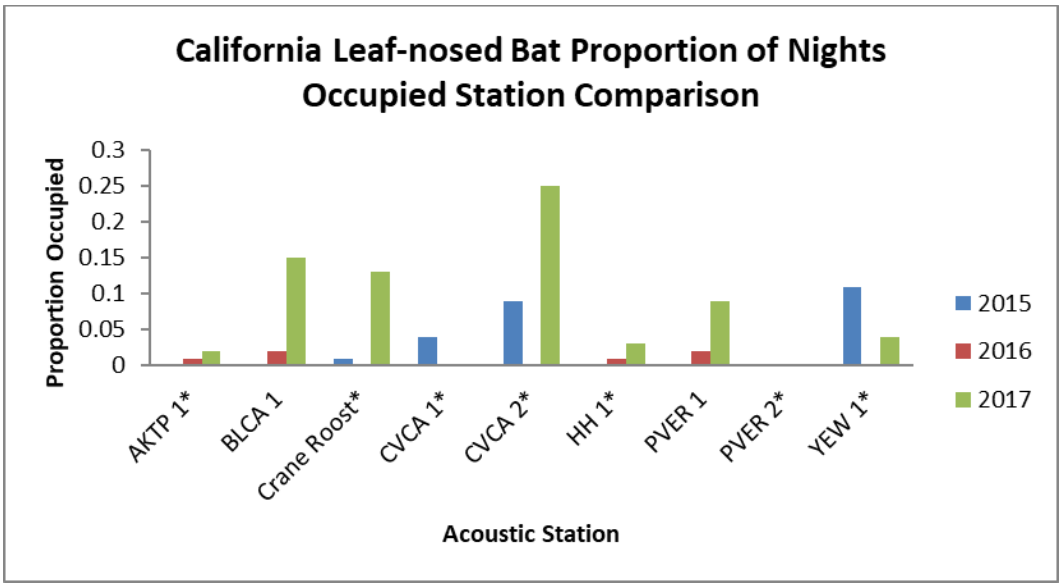


Figure 15.—California leaf-nosed bat proportion of nights occupied station comparison.
* Station malfunction occurred at station.

Pale Townsend's Big-eared Bat

Because of the conservative method of identifying Townsend's big-eared bat (*Corynorhinus townsendii*) calls to species and subspecies using the Analook visual verification methods and the nature of their whispering calls, no pale Townsend's big-eared bat calls were recorded during 2015 or 2016 at any location. One pale Townsend's big-eared bat call was recorded at CVCA2 during August 2017.

Kaleidoscope Results

The Kaleidoscope auto-classifier results indicated the greatest average nightly call minutes during 2015 were recorded at CVCA1, followed by YEW1, BLCA1, AKTP1, and the Crane Roost station (figure 16). The greatest average nightly call minutes during 2016 were recorded at YEW1, followed by CVCA1, PVER1, and AKTP1. The greatest average nightly call minutes recorded during 2017 were recorded at BLCA1, followed by CVCA1, YEW1, and PVER1. No activity for pale Townsend's big-eared bats was recorded at AKTP1, CVCA2, HH1, or PVER2 during 2017. Greater average nightly call minutes were recorded during 2016 for pale Townsend's big-eared bats.

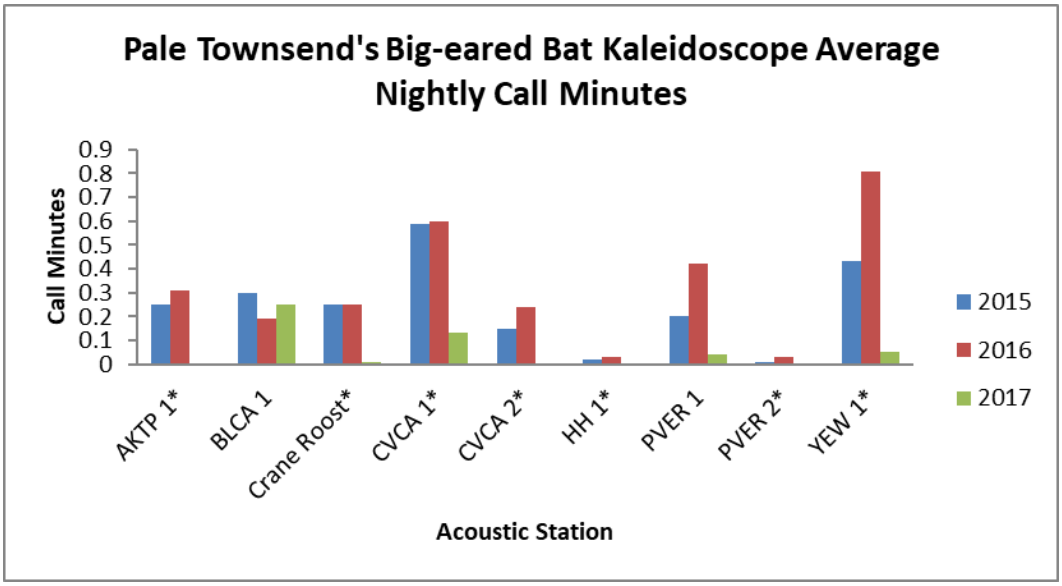


Figure 16.—Pale Townsend's big-eared bat Kaleidoscope results station comparison.
* Station malfunction occurred at station.

The proportion of nights that pale Townsend' big-eared bats were detected using the Kaleidoscope auto-classifier varied between stations and years. None were recorded at AKTP1, CVCA2, HH1, or PVER2 during 2017. The greatest proportion of nights occupied in 2017 was recorded at BLCA1 at 0.22, followed by CVCA at 0.07, YEW1 at 0.06, PVER1 at 0.04, and the Crane Roost station at 0.01 (figure 17). CVCA1 had the greatest proportion of nights occupied in 2015 at 0.44, and in 2016, the stations with the greatest proportion of nights occupied were CVCA1 and YEW1 at 0.43 (figure 17).

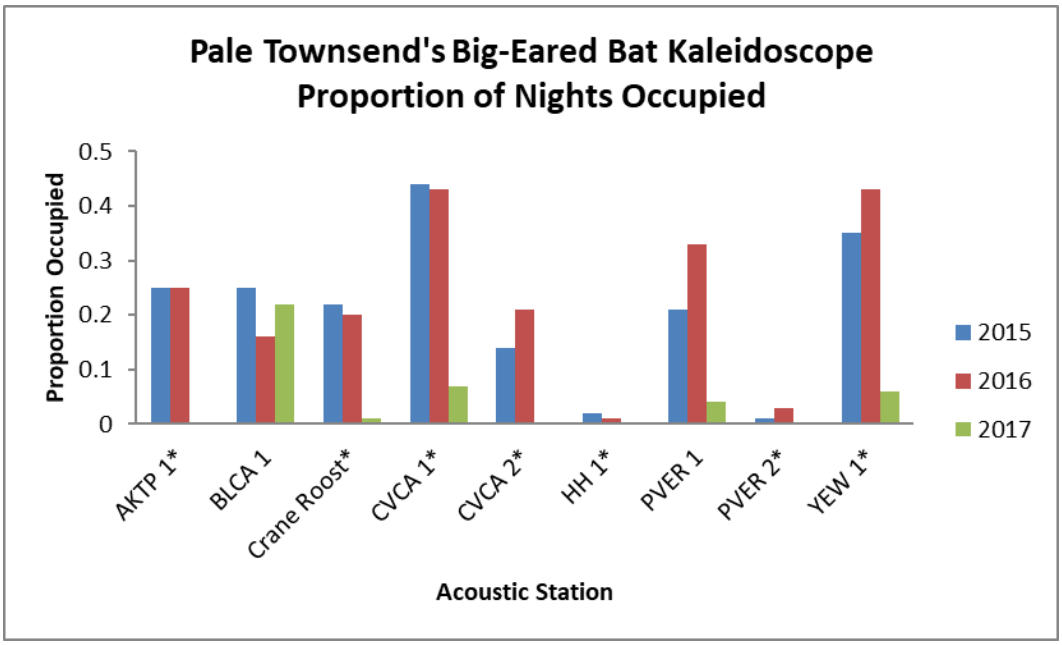


Figure 17.—Pale Townsend's big-eared bat Kaleidoscope results station comparison.
* Station malfunction occurred at station.

Comparison of Methods

Western Red Bat

A comparison of the Analook filter results, visually verified Analook filter results, and Kaleidoscope auto-classifier results for western red bat calls revealed different findings (table 5). The auto-classifier and Analook filters serve a similar purpose in that they both attempt to identify calls to the species level based on diagnostic characteristics of those species calls. The auto-classifier consistently identified a greater number of calls as western red bats (46,696 total) than the Analook filters across sites (40,722), with the exception of CVCA1, CVCA2, PVER1, and PVER2. Both the auto-classifier and Analook filters identified a greater number of calls as western red bats than the verified results (1,133). The auto-classifier also consistently identified more occupancy than the visual verification methods, with 100% (or nearly 100%) of nights occupied for all sites.

Table 5.—Number of western red bat calls detected by the Kaleidoscope auto-classifier, Analook filter, and Analook visual verification

Station acronym	Kaleidoscope results	Analook filter results	Analook visual verification results
AKTP1	2,851	532	2
BLCA1	14,954	9,646	87
Crane Roost	3,470	2,324	34
CVCA1	6,616	8,161	242
CVCA2	3,908	4,285	83
HH1	819	272	5
PVER1	10,768	13,427	611
PVER2	468	624	8
YEW1	2,842	1,451	61
Total	**46,696**	**40,722**	**1,133**

Pale Townsend's Big-eared Bat

No pale Townsend's big-eared bat activity was detected through visual verification of Analook filter results at any site during 2015 and 2016. One call was recorded in August 2017 at CVCA2. The Analook filters for this species flagged 53,598 calls as potential pale Townsend's big-eared bats across all sites, while the Kaleidoscope auto-classifier flagged a total of 480 calls (table 6; attachment 1 [figures 1-36 to 1-44).

Table 6.—Number of pale Townsend's big-eared bat calls detected by the Kaleidoscope auto-classifier, Analook filter, and Analook visual verification

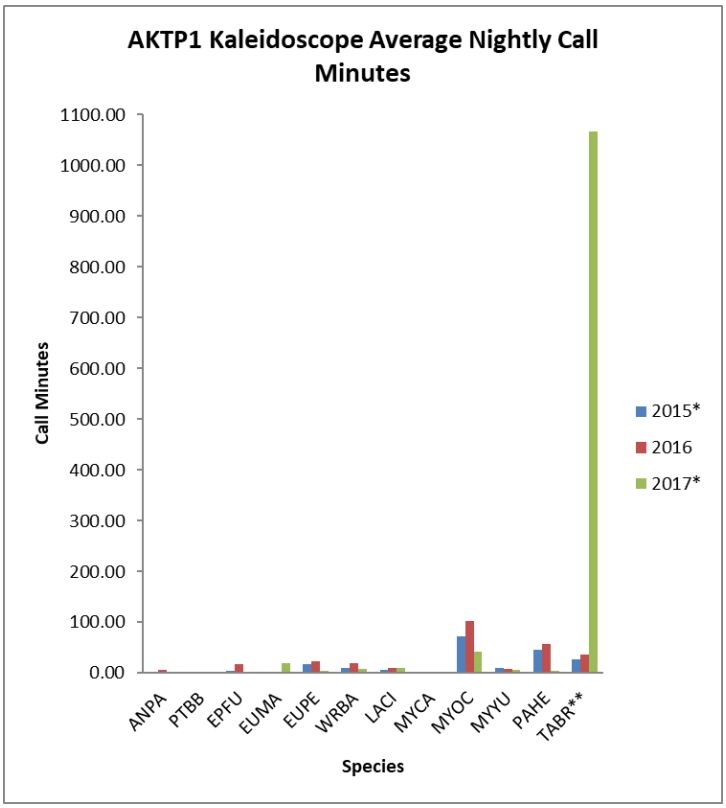
Station acronym	Kaleidoscope results	Analook filter results	Analook visual verification results
AKTP1	40	1,861	0
BLCA1	69	10,761	0
Crane Roost	46	3,559	0
CVCA1	110	11,855	0
CVCA2	36	10,951	1
HH1	3	166	0
PVER1	62	10,276	0
PVER2	3	266	0
YEW1	111	3,903	0
Total	480	53,598	1

Kaleidoscope Results for Other Riparian Bat Species

The Kaleidoscope auto-classifier has 12 species classifiers for the study area: pallid bats, pale Townsend's big-eared bats, big brown bats, spotted bats, greater mastiff bats, western red bat, hoary bats, California myotis, Arizona myotis, Yuma myotis, canyon bats, and Mexican free-tailed bats.

AKTP1

Mexican free-tailed bats had the greatest average nightly call minutes (376.68) for any species at AKTP1 recorded by the Kaleidoscope auto-classifier from 2015 through 2017 (attachment 2 [table 2-1]). This was largely driven by the station recording 1,066 average nightly call minutes for Mexican free-tailed bats during 2017, which is the greatest average nightly call minutes by far recorded for a single species (figure 18). The station recorded poor quality calls in 2017, which may have led to numerous calls being misidentified as Mexican free-tailed bats. Conversely, if these were actual Mexican free-tailed bats calls, it would suggest that they may be utilizing a new, nearby roost. Other species with high activity levels at AKTP1 were Arizona myotis and canyon bats (attachment 2 [table 2-1] and figure 18). The greatest average nightly call minutes at AKTP1 occurred during 2017 due to the extremely large number of Mexican free-tailed bats calls recorded. The 2017 average nightly call minutes was followed by 2016 and 2015.



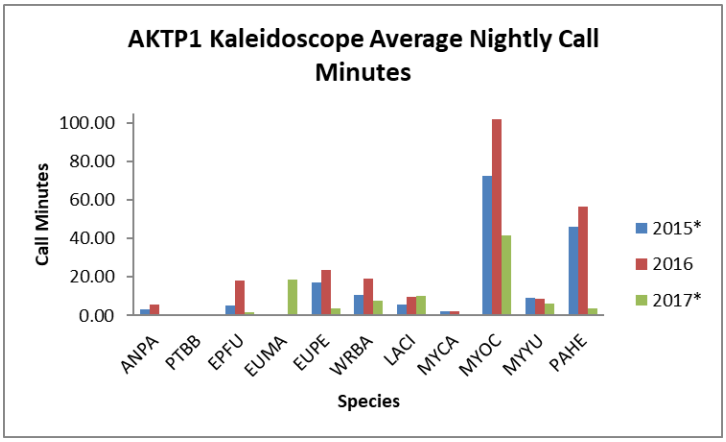


Figure 18a.—Kaleidoscope results for 2015, 2016, and 2017 at AKTP1.

* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.

** Mexican free-tailed bat average nightly call minutes in 2017 were actually 1,066.

ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

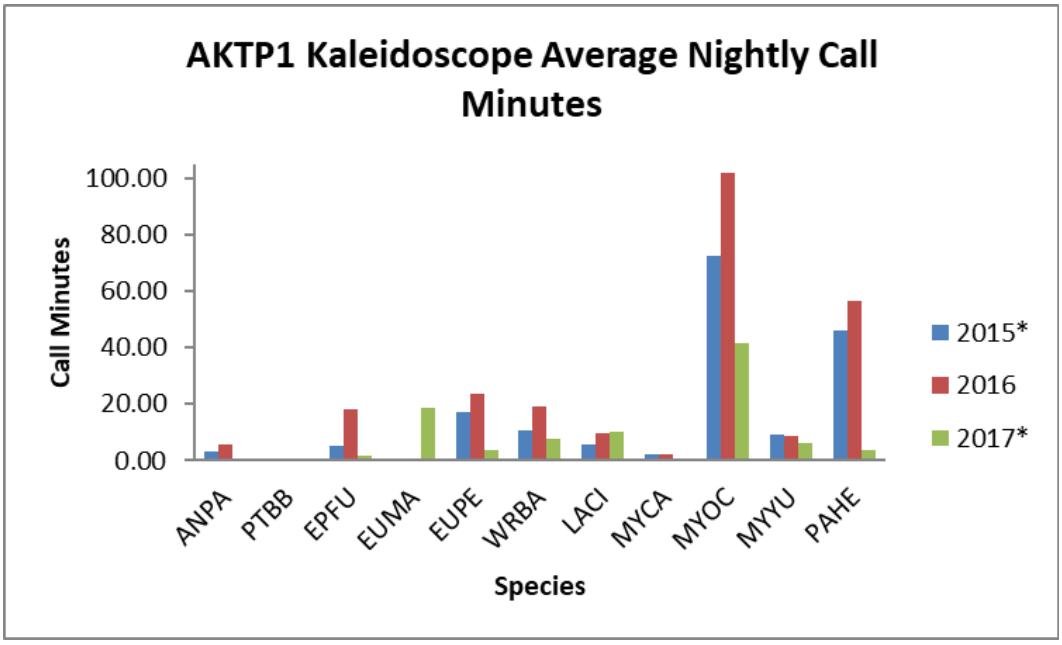


Figure 18b.—Kaleidoscope results for 2015, 2016, and 2017 at AKTP1 without Mexican free-tailed bat.
* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), and PAHE = canyon bat (*Parastrellus hesperus*

BLCA1

Canyon bats had the greatest average nightly call minutes (127.80) for any species recorded at BLCA1 by the Kaleidoscope auto-classifier (attachment 2 [table 2-2]). Other species with high activity levels at BLCA1 were Arizona and Yuma myotis. The greatest average nightly call minutes at BLCA1 occurred during 2016, followed by 2015 and 2017 (attachment 2 [table 2-2] and figure 19).

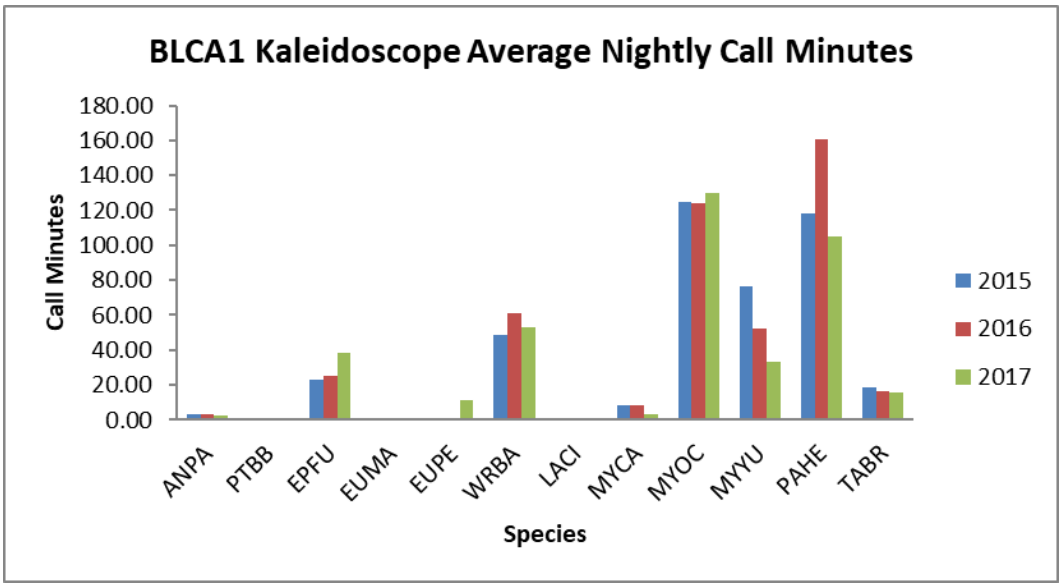


Figure 19.—Kaleidoscope results for 2015, 2016, and 2017 at BLCA1.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

Crane Roost Station

Canyon bats also had the greatest average nightly call minutes (99.58) for any species recorded at the Crane Roost station by the Kaleidoscope auto-classifier (attachment 2 [table 2-3]). Other species with high activity levels at this station were Arizona and Yuma myotis. The greatest average nightly call minutes at the Crane Roost station occurred during 2016, followed by 2017 and 2015 (attachment 2 [table 2-3] and figure 20).

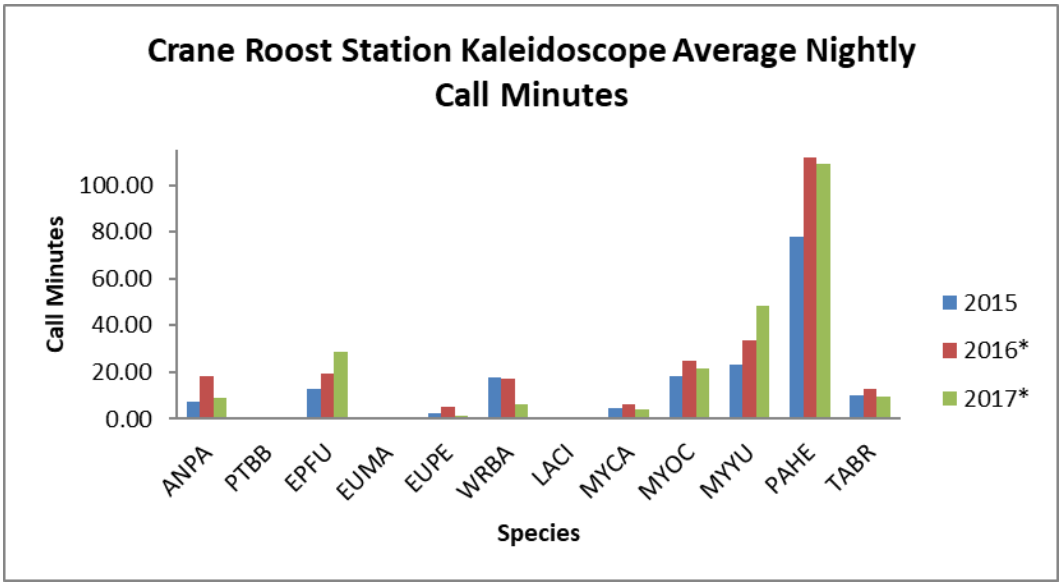


Figure 20.—Kaleidoscope results for 2015, 2016, and 2017 at the Crane Roost station.

* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

CVCA1

Mexican free-tailed bats had the greatest average nightly call minutes (259.74) for any species recorded at CVCA1 by the Kaleidoscope auto-classifier (attachment 2 [table 2-4]). Other species with high activity levels at CVCA1 were big brown bats and canyon bats. The greatest average nightly call minutes at CVCA1 occurred during 2016, followed by 2015 and 2017 (attachment 2 [table 2-4] and figure 21).

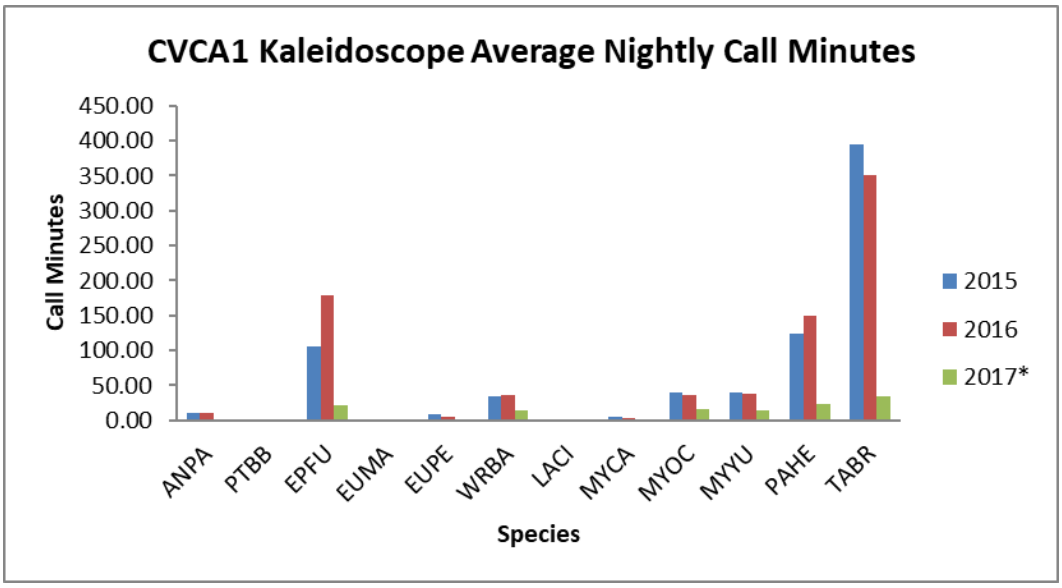


Figure 21.—Kaleidoscope results for 2015, 2016, and 2017 at CVCA1.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July 2017 and August 2017.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

CVCA2

Yuma myotis had the greatest average nightly call minutes (92.20) for any species recorded at CVCA2 by the Kaleidoscope auto-classifier (attachment 2 [table 2-5]). Other species with high activity levels at CVCA2 were canyon bats and big brown bats. The greatest average nightly call minutes at CVCA2 occurred during 2017, followed by 2016 and 2015 (attachment 2 [table 2-5] and figure 22).

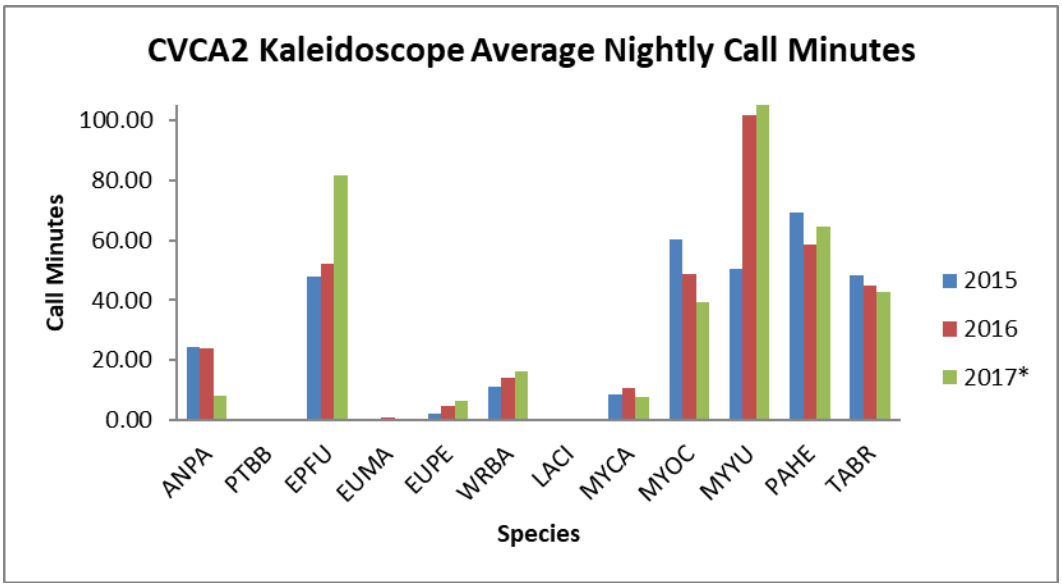


Figure 22.—Kaleidoscope results for 2015, 2016, and 2017 at CVCA2.
* Station malfunction led to partial monthly data collected in June 2017.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

HH1

Yuma myotis had the greatest average nightly call minutes (13.63) for any species recorded at HH1 by the Kaleidoscope auto-classifier (attachment 2 [table 2-6]). Other species with high activity levels at HH1 were greater mastiff bats and Mexican free-tailed bats. The greatest average nightly call minutes at HH1 occurred during 2017, followed by 2016 and 2015 (attachment 2 [table 2-6] and figure 23).

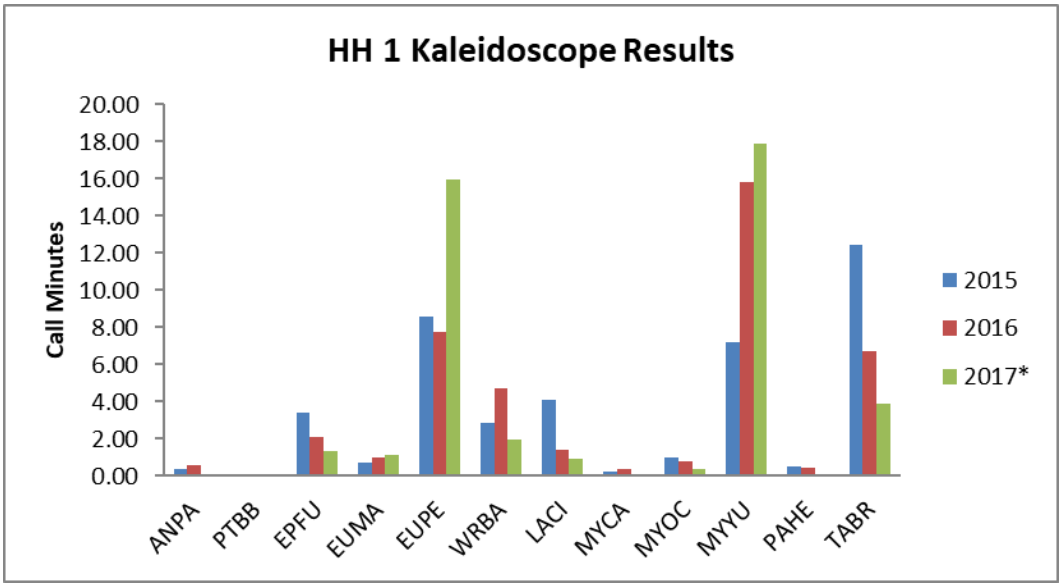


Figure 23.—Kaleidoscope results for 2015, 2016, and 2017 at HH1.
* Station malfunction led to partial monthly data collected in June 2017 and July 2017. ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

PVER1

Mexican free-tailed bats had the greatest average nightly call minutes (193.61) for any species recorded at PVER1 by the Kaleidoscope auto-classifier (attachment 2 [table 2-7]). Other species with high activity levels at PVER1 were canyon bats and big brown bats. The greatest average nightly call minutes at PVER1 occurred during 2016, followed by 2017 and 2015 (attachment 2 [table 2-7] and figure 24).

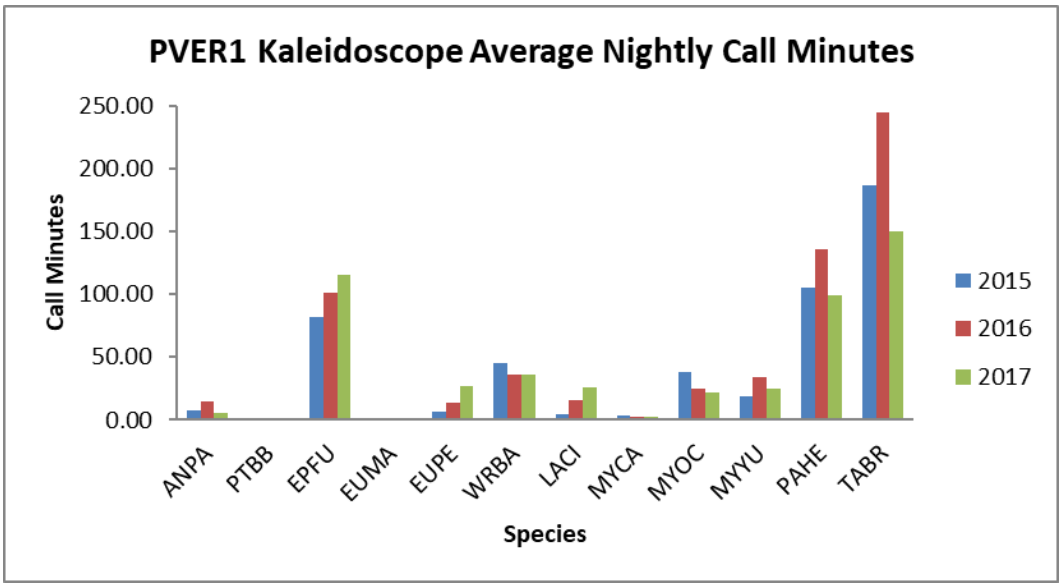


Figure 24.—Kaleidoscope results for 2015, 2016, and 2017 at PVER1.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

PVER2

Canyon bats had the greatest average nightly call minutes (29.65) for any species recorded at PVER2 by the Kaleidoscope auto-classifier (attachment 2 [table 2-8]). The other species with high activity levels at PVER2 was Mexican free-tailed bats. The greatest average nightly call minutes at PVER2 occurred during 2017, followed by 2015 and 2016 (attachment 2 [table 2-8] and figure 25).

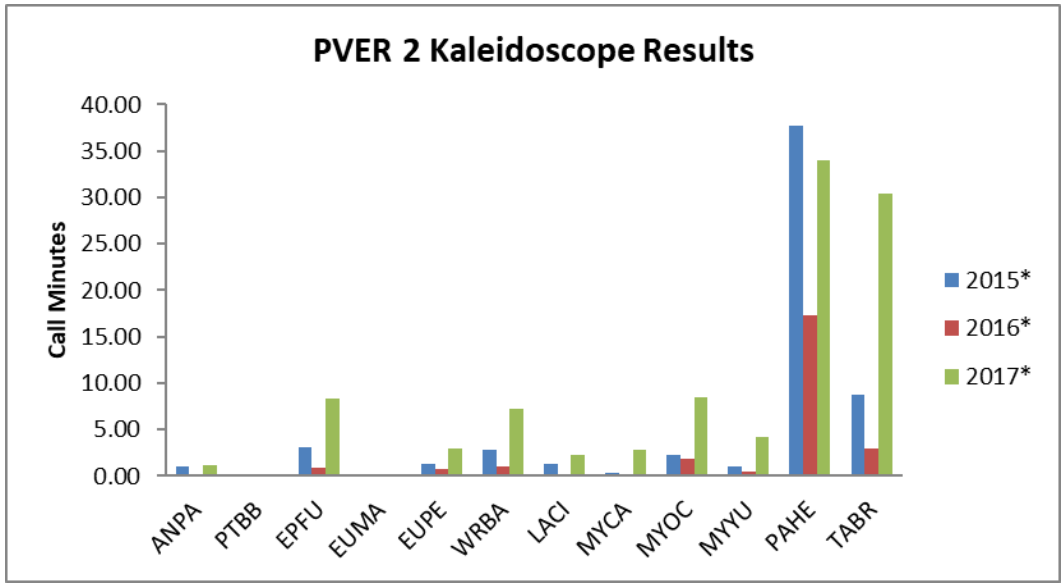


Figure 25.—Kaleidoscope results for 2015, 2016, and 2017 at PVER2.
* Station malfunction led to partial monthly data collected in 2015 (data loss: June 24 – August 12 and August 16–31), in 2016 (data loss: June 1-15), and in 2017(data loss: June 1 – July 19).
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

YEW1

Mexican free-tailed bats had the greatest average nightly call minutes (88.32) for any species recorded at YEW1 by the Kaleidoscope auto-classifier (attachment 2 [table 2-9]). The other species with high activity levels at YEW1 were big brown bats, Yuma myotis, pallid bats, and canyon bats. A spike in greater mastiff bat calls was also recorded in 2017. The greatest average nightly call minutes at YEW1 occurred during 2016, followed by 2015 and 2017 (attachment 2 [table 2-9] and figure 26).

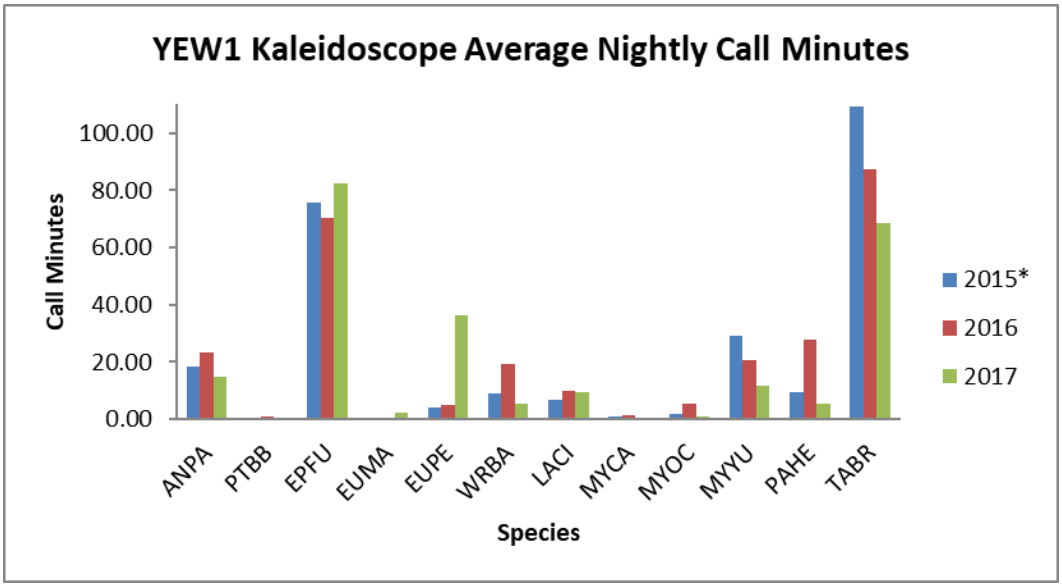


Figure 26.—YEW1 Kaleidoscope results for 2015, 2016, and 2017 at YEW1.
* Station malfunction leading to partial monthly data collected in June 2015.
ANPA = pallid bat (*Antrozous pallidus*), PTBB = pale Townsend's big-eared bat (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*), EPFU = big brown bat (*Eptesicus fuscus*), EUMA = spotted bat (*Euderma maculatum*), EUPE = greater mastiff bat (*Eumops perotis*), WRBA = western red bat (*Lasiurus blossevillii*), LACI = hoary bat (*Lasiurus cinereus*), MYCA = California myotis (*Myotis californicus*), MYOC = Arizona myotis (*Myotis occultus*), MYYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).

DISCUSSION

Through the visual verification methods, the greatest activity and occupancy for western red and yellow bats were recorded at CVCA1 and PVER1, and at CVCA2 and YEW1 for California leaf-nosed bats. One pale Townsend's big-eared bat call was detected through the visual verification methods at CVCA2, and they were recorded with the greatest activity and occupancy with the Kaleidoscope auto-classifier at YEW1 and CVCA1. The auto-classifier overestimated western red bat activity and occupancy but has the potential to be useful for pale Townsend's big-eared bat calls. The greatest activity across

all species for the auto-classifier was recorded at CVCA1, followed by AKTP1 and PVER1. An extremely large number of calls were classified as Mexican free-tailed bats in 2017 at AKTP1, leading to this location overtaking PVER1 in recorded auto-classifier activity.

Western Red Bat

Western red bat average nightly call minutes and proportion of nights occupied were recorded to be greatest at PVER1 and CVCA1. These stations are located in the most mature and complex vegetation of the conservation areas. The PVER and CVCA are also the largest continuous tracts of conservation area habitat and provide important foraging area and roosting locations for western red bats along the LCR. The greatest nightly call minutes and proportion of nights occupied at CVCA1 occurred in July, with the greatest nightly call minutes at PVER1 occurring in July, but the greatest proportion of nights occupied occurring in August, which coincides with the time of year juvenile bats become volant. Other sites with their greatest recorded activity and occupancy in July were CVCA2, AKTP1, and YEW1. BLCA1 had the greatest activity and occupancy in June. Very little activity and occupancy were recorded at PVER2 (greatest equally in June and July) and HH1 (July).

Greater average nightly call minutes were recorded across all sites in 2015, but 2017 contained the greatest proportion of nights occupied for western red bats. Thus, activity was greater but less consistent over the season in 2015 near the acoustic stations compared to 2017. The 2016 season contained the lowest average nightly call minutes and proportion of nights occupied across all sites. In assessing average nightly call minutes and proportion of nights occupied, it was found that average nightly call minutes fluctuate and display greater variations between years than the proportion of nights occupied. In a given year, habitat near a detector may be optimal for a roost, maternity roost or foraging, leading to an increase in average nightly call minutes but not necessarily nights occupied. Vegetation structure or prey base may change the following season, becoming less optimal near the detector but perhaps more optimal elsewhere in the conservation area, leading to a decrease in average nightly call minutes near the detector site that does not reflect a true decrease in bat use across the entire conservation area. An example of this can be found at CVCA1. If you relied solely on average nightly call minutes as an assessment of bat use, you would conclude that the 2016 season had a nearly two-fold level of activity more than the 2015 season, when in fact, the 2015 season had a slightly greater proportion of nights occupied. The alternative to this is comparing the 2016 and 2017 seasons. The 2017 season has roughly half the average nightly call minutes than the 2016 season. Another example is PVER1. Relying only on average nightly call minutes would lead to the conclusion that the 2015 season had considerably more bat use (2.85 versus 1.09 [2015] and 2.26 [2017]), while the proportion of

nights occupied did not show such a large disparity (0.71 versus 0.55 [2015] and 0.78 [2017]), with 2017 actually having a greater proportion of nights occupied despite lower average nightly call minutes. Therefore, the proportion of nights occupied may be the best way to describe bat use through acoustic detectors at conservation areas.

While the Kaleidoscope auto-classifier results were similar to the Analook visual verification methods (in that they generally identified the sites with the greatest and lowest activity levels), the Kaleidoscope method considerably overestimated western red bat activity at the conservation areas. If only the Kaleidoscope results were relied upon to assess bat use, BLCA1 would have been the acoustic station with the greatest western red bat activity. Through the Analook visual verification methods, BLCA1 had the third greatest activity and occupancy for western red bats behind CVCA1 and PVER1. Previous capture surveys also support the Analook visual verification methods, as captures for western red bats were greatest at the PVER and CVCA. The auto-classifier works much like the Analook filters but is considered to be more sophisticated in terms of analyzing call parameters for identification of each species. The auto-classifier identified more potential western red bat calls than the Analook filters overall, but differences between the results from these methods varied among monitoring sites, with the Analook filters identifying more potential calls at several locations. The greater potential western red bat calls identified by the auto-classifier likely represent misidentified calls from other species, but it cannot be discounted that the auto-classifier may have identified some western red bat calls the Analook filters did not detect. An indepth comparative analysis between these two methods was not an objective for this report but could prove to be useful as a management tool as its fit is improved in the future. Because these methods identify a different number of calls, which could potentially impact the verified results, it would be useful to determine which method identifies the greater number of verified calls.

Western Yellow Bat

Like western red bats, western yellow bats were recorded with the greatest average nightly call minutes and proportion of nights occupied at CVCA1 and PVER1. These are large, complex conservation areas that provide important edge habitat for foraging western yellow bats. The greatest average nightly call minutes and proportion of nights occupied occurred in July at CVCA1 and August at PVER1. Western yellow bats were also recorded with high average nightly call minutes and proportion of nights occupied at YEW1 and AKTP1 in July across 2015 and 2016. Like western red bats, larger fluctuations and disparities among average nightly call minutes were noted versus proportion of nights occupied. The largest disparity occurred at CVCA1, with 16.81 average nightly call minutes being recorded during 2015 versus 4.22 during 2016. The

difference in proportion of nights occupied between the two seasons was 0.97 in 2015 versus 0.91 in 2016, which equates to a difference of 5 nights. Another disparity to note is between YEW1 and PVER1 during 2015. Average nightly call minutes at PVER1 were 6.12 versus 2.55 at YEW1, while YEW1 actually had a slightly greater proportion of nights occupied (0.70 versus 0.68). PVER1 also differed between years, with average nightly call minutes during 2015 (6.12) greatly surpassing 2016 (1.93) and 2017 (2.3). The proportion of nights occupied between 2015 (0.68), 2016 (0.63), and 2017 (0.58) did not show such a large disparity. The majority of western yellow bat activity and occupancy occurs later in summer during July and August, with no station recording its greatest activity in June. Like western red bats, yellow bat young typically become volant in July, which would lead to the increased activity observed in July and August. Western yellow bats are also believed to be migratory along the LCR. BLCA1 and HH1 had the greatest activity and occupancy recorded in July, and CVCA2 had the greatest call minutes in July but greatest occupancy in August. The Crane Roost station and PVER2 had the greatest activity and occupancy recorded in August. Interestingly, the greatest activity and occupancy during any month at the Crane Roost station was in July 2017, but overall, August had the greatest activity and occupancy across years. Western yellow bats may be starting to utilize this site during a different temporal scale, and next season's data may confirm this. No western yellow bat activity was verified at AKTP1 during 2017, where during 2015 and 2016, it had the third greatest average nightly call minutes and fourth greatest proportion of nights occupied for any site. The calls recorded in 2017 at AKTP1 seemed to be lower quality, suggesting a microphone issue. A large number of Mexican free-tailed bats calls were also identified by the Kaleidoscope auto-classifier during 2017 at AKTP1. These may be attributing factors to the lack of verified western yellow bat activity at AKTP1 in 2017. No auto-classifier exists for western yellow bats, though the developers are in the process of designing one (Agranat 2017, personal communication) that may be useful for future analysis.

California Leaf-nosed Bat

California leaf-nosed bats were recorded in low numbers across 2015 and 2016 and the nine conservation areas. These bats produce a low-amplitude call that is difficult to detect through acoustic methods. They were detected at the Crane Roost station, CVCA1, CVCA2, and YEW1 during 2015, and at AKTP1, BLCA1, HH1, and PVER1 during 2016. They were detected at AKTP1, BLCA1, the Crane Roost station, CVCA2, HH1, PVER1, PVER2, and YEW1 during 2017. California leaf-nosed bats were not detected at PVER2 during 2015, 2016, or 2017. The greatest average nightly call minutes and proportion of nights occupied occurred at CVCA2 followed equally by BLCA1 and YEW1. BLCA1 and YEW1 have an equal number of average nightly call minutes, but BLCA1 has a slightly greater proportion of nights occupied. The 2017 season displayed a

considerable increase in activity and occupancy over 2015 and 2016. This increase is difficult to attribute to any one factor but may be that these conservation areas are maturing and harboring a favorable prey base for California leaf-nosed bats, and they are beginning to rely on these sites for a larger portion of their diet. No Kaleidoscope auto-classifier exists for California leaf-nosed bats, though the developers are in the process of designing one (Agranat 2017, personal communication) that may be useful for future analysis.

Pale Townsend's Big-eared Bat

Pale Townsend's big-eared bats were not recorded at any conservation area with Analook visual verification methods during 2015 or 2016, with just a single call verified at CVCA2 in August 2017. These bats emit an extremely low-amplitude call that is difficult to detect using acoustic methods alone. The Kaleidoscope auto-classifier results recorded YEW1 and CVCA1 as having the greatest average nightly call minutes and proportion of nights occupied. The auto-classifier recorded pale Townsend's big-eared bat activity at every conservation area during 2015 and 2016. A lower number of calls were identified by the auto-classifier in 2017, with no activity recorded at ATKP1, CVCA2, HH1, or PVER2. The auto-classifier identified an extremely low number of calls compared to the Analook filters. Where the Analook filters identified tens of thousands of calls as potential pale Townsend's big-eared bat calls, the auto-classifier identified hundreds. Given that a considerable amount of time is dedicated to visually verifying calls identified as potential pale Townsend's big-eared bat calls with little to no calls actually verified, the auto-classifier may be an efficient way to analyze these calls. A visual verification of the Kaleidoscope auto-classifier calls could be conducted to assess the accuracy of this method

Other Species Analyzed with the Kaleidoscope Auto-Classifier

The species with the second greatest average nightly call minutes at AKTP1 was the Arizona myotis. The only known roost along the LCR for this species is located in a palm tree less than 1 kilometer from AKTP1. Previous capture results have confirmed that this species is present at AKTP1 during the sampling period in considerable numbers. This species had the greatest average nightly call minutes at AKTP1 until 2017. A large number of calls during 2017 at AKTP1 were classified as Mexican free-tailed bats (1,066 average nightly call minutes). The calls recorded at AKTP1 during 2017 were not the best quality calls either due to a failing microphone or an object close to the microphone.

The station also malfunctioned and only recorded data from June 1–13 and July 18 – August 31. This may have impacted the calls and led to a large number being misidentified as Mexican free-tailed bats. Conversely, if these are actual Mexican free-tailed bats calls, it may be the result of a behavioral change due to a possible roost disturbance and/or a new roost being utilized nearby. Mexican free-tailed bats roost in extremely large numbers and have the ability to overwhelm an acoustic detector if they are present in response to a large-scale roost disturbance or change. Average nightly call minutes for Mexican free-tailed bats were comparable in June (1,246 per night) and August (1,323 per night), but July (254 per night) had much less activity.

The species identified by the Kaleidoscope auto-classifier across all monitoring sites as having the greatest average nightly call minutes are the Mexican free-tailed bats, canyon bats, big brown bats, and Yuma myotis. The greatest total average nightly call minutes identified by the auto-classifier for all species combined for 2015 and 2016 were recorded at CVCA1, followed by AKTP1, PVER1, BLCA1, CVCA2, YEW1, the Crane Roost station, PVER2, and HH1. These results for CVCA1 and PVER1 give support to the assertion that these large, mature, and complex conservation areas are providing important foraging and roosting habitat for not only LCR MSCP covered species but also for other species along the LCR. The activity at AKTP1 in 2017, which led to this site having the second greatest activity identified by the auto-classifier for 2015–17, may be an anomaly as discussed above, and another year of data will inform the hypothesis on what may be happening with bat activity at this station.

Assessing the four LCR MSCP bat species, it was found that western yellow bats were most prevalent, with the greatest activity and occupancy recorded across all conservation areas. Western yellow bats are highly dependent on non-native palms for use as roosts, and as the acoustic data seem to indicate, planted conservation areas for foraging along the LCR. Western red bats are dependent on conservation sites for roosting, foraging, and for maternity roosts. California leaf-nosed bats increased in verified activity in 2017 and are foraging at conservation areas. Although pale Townsend's big-eared bats are difficult to detect acoustically, they are most likely relying on conservation areas as foraging sites. The majority of activity and occupancy for all species occurred during July and August, with larger, more complex monitoring sites seeing the greatest average nightly call minutes and proportion of nights occupied.

It is important to note that average nightly call minutes and proportion of nights occupied are two indexes of bat activity and do not translate to population estimates. A correlation of the acoustic and capture data being collected by Reclamation biologists at LCR MSCP conservation areas would further inform natural resource managers on bat activity and diversity at these sites, as it has been recorded that a combination of the methods was more successful in detecting

bat species than either method alone (O'Farrell and Gannon 1999). Examining the capture data would be especially informative for California leaf-nosed and pale Townsend's big-eared bats, which both emit low-amplitude calls and are difficult to detect acoustically.

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ATTACHMENT 1

Monthly Activity and Occupancy

MONTHLY ACTIVITY AND OCCUPANCY (USING THE ANALOOK VISUAL VERIFICATION METHODS)

Western Red Bat

AKTP1

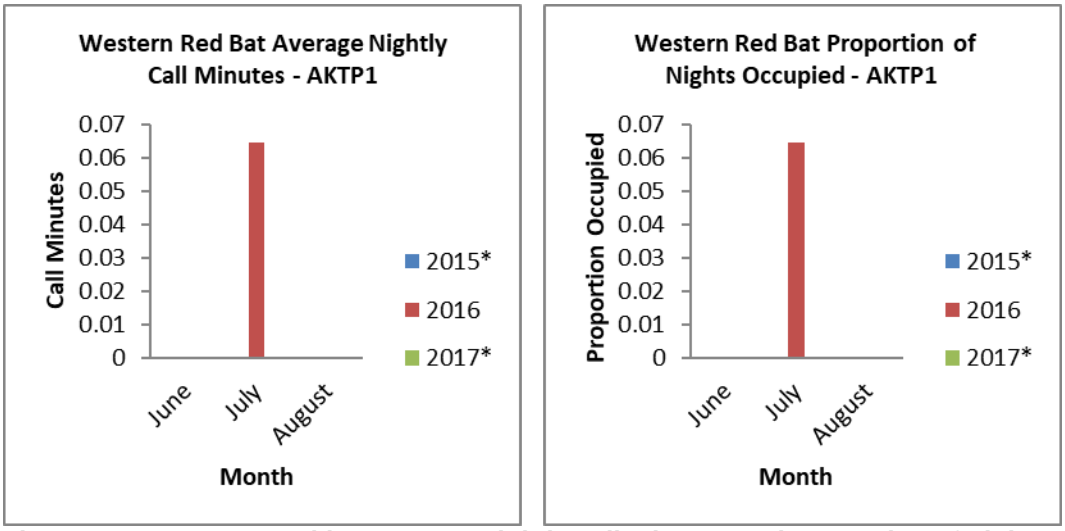


Figure 1-1.—Western red bat average nightly call minutes and proportion of nights occupied at AKTP1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.

BLCA1

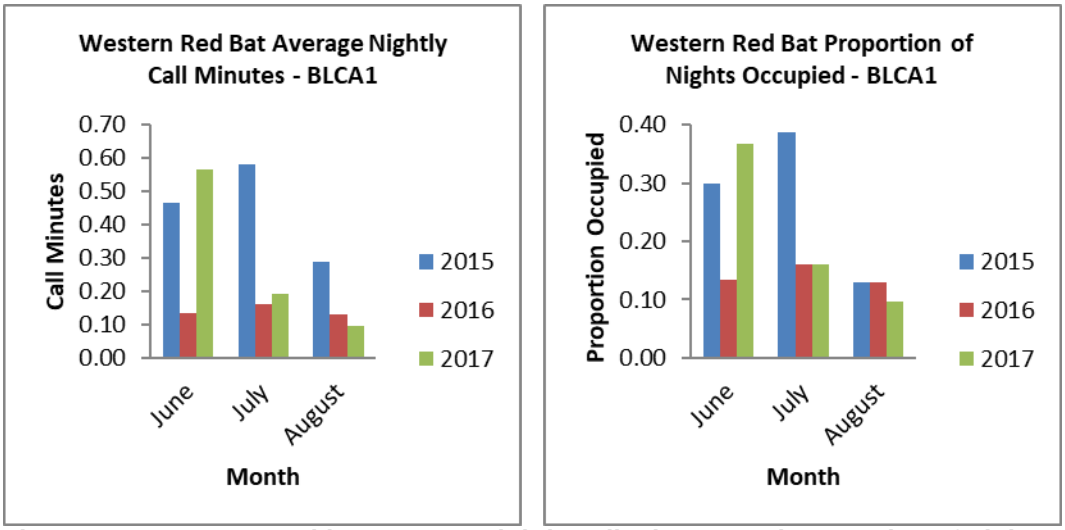


Figure 1-2.—Western red bat average nightly call minutes and proportion of nights occupied at BLCA1.

Crane Roost Station

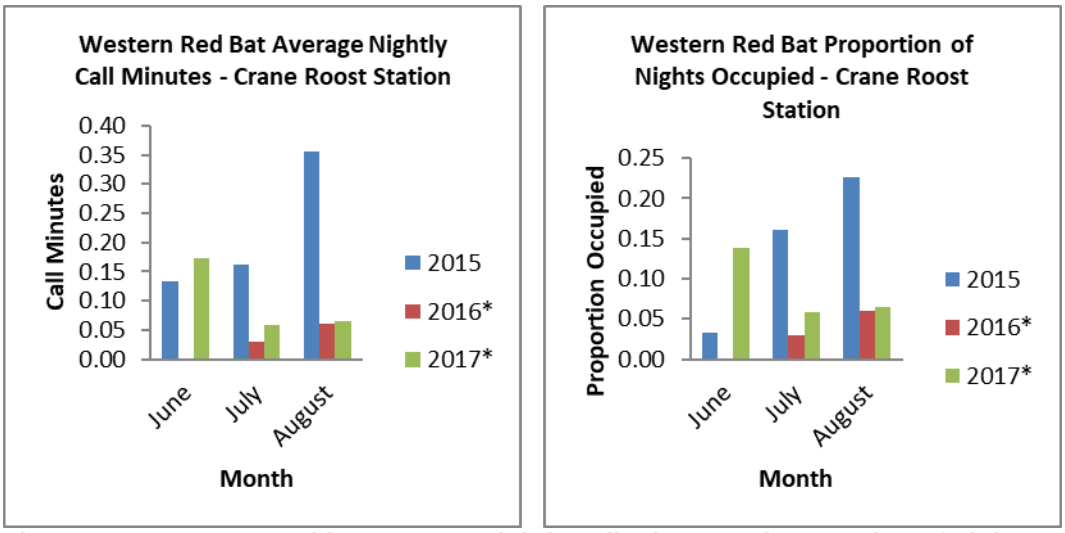


Figure 1-3.—Western red bat average nightly call minute and proportion of nights occupied at the Crane Roost station, using Analook.
* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

CVCA1

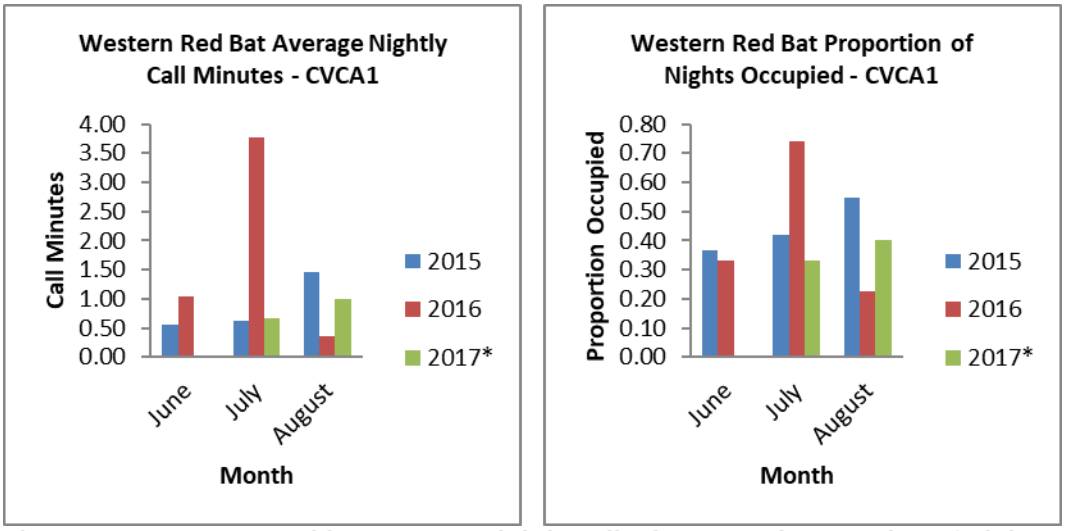


Figure 1-4.—Western red bat average nightly call minutes and proportion of nights occupied at CVCA1, using Analook.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July and August 2017.

CVCA2

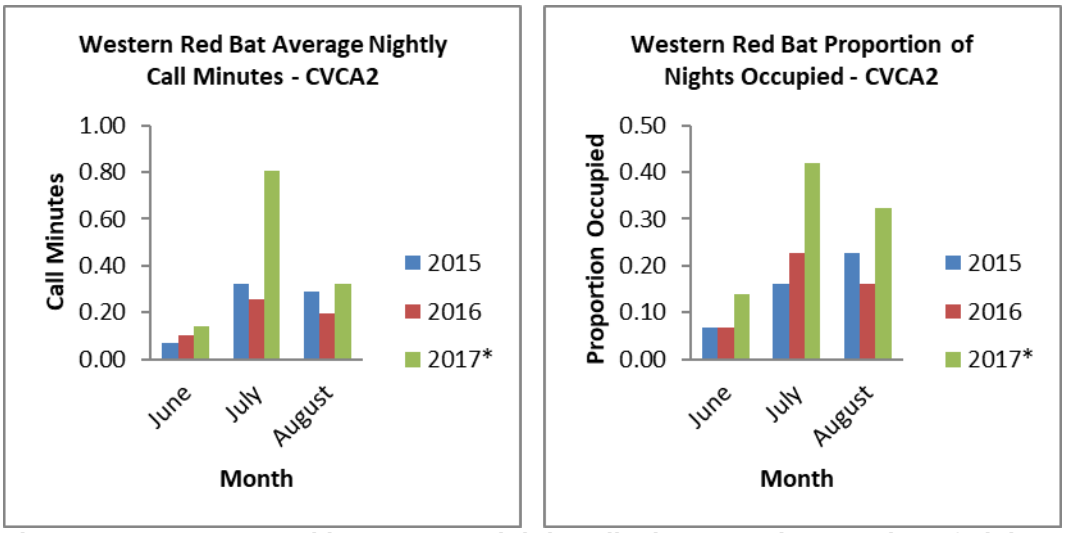


Figure 1-5.—Western red bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.
* Station malfunction led to partial monthly data collected in June 2017.

HH1

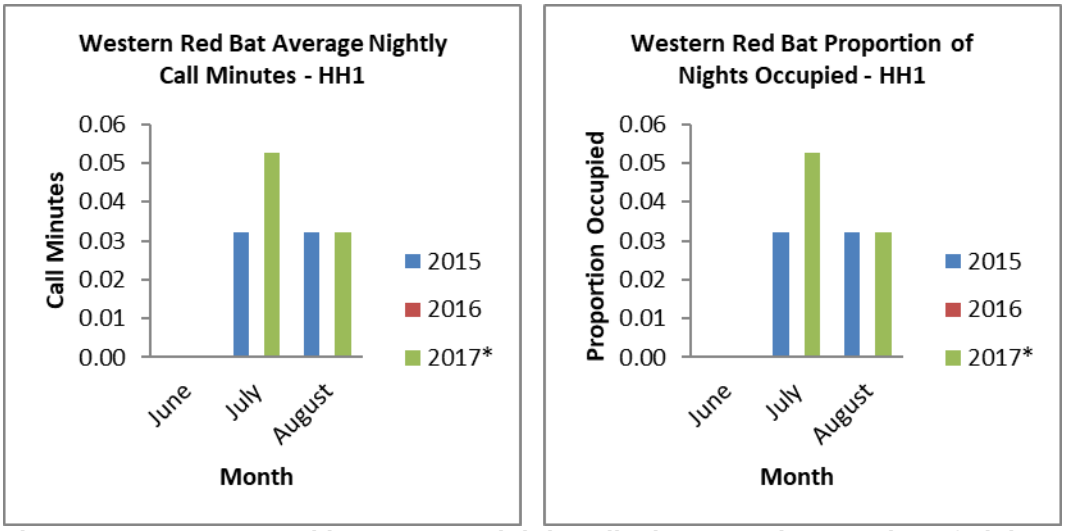


Figure 1-6.—Western red bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.
* Station malfunction led to partial monthly data collected in June and July 2017.

PVER1

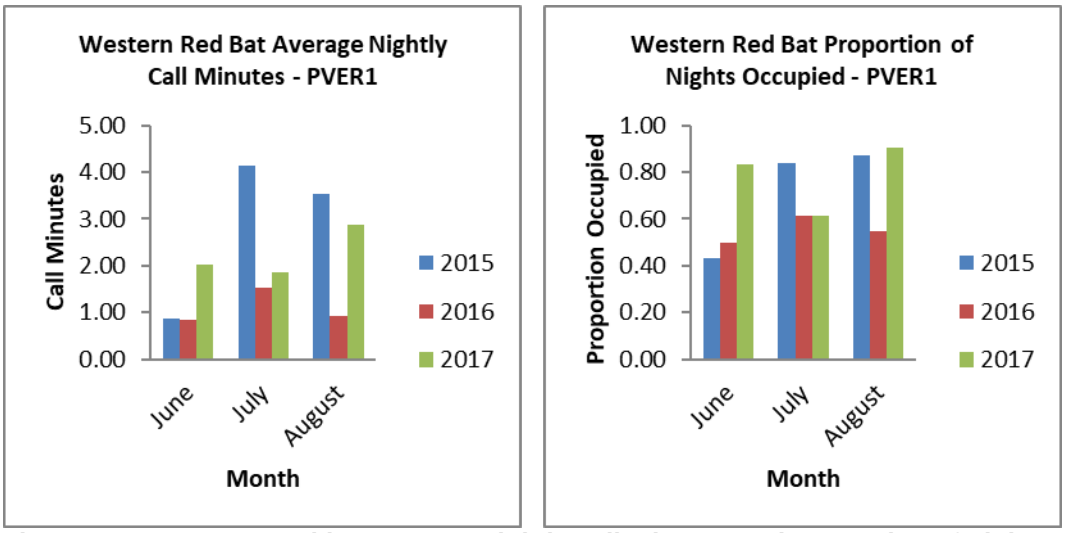


Figure 1-7.—Western red bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook.

PVER2

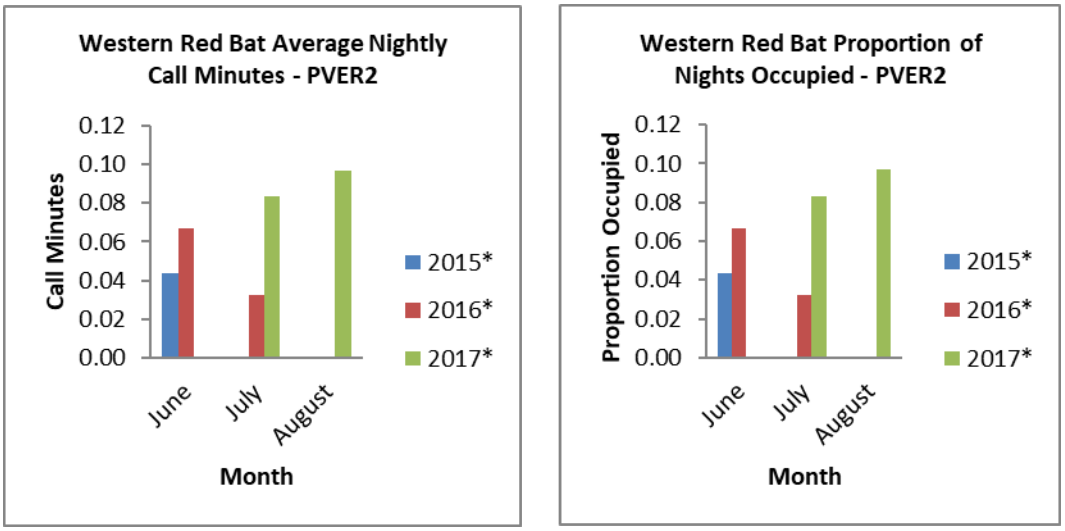


Figure 1-8.—Western red bat average nightly call minutes and proportion of nights occupied at PVER2, using Analook.

* Station malfunction leading to partial monthly data collected in June 2015, August 2015, June 2016, and July 2017. No data were collected in July 2015 or June 2017.

YEW1

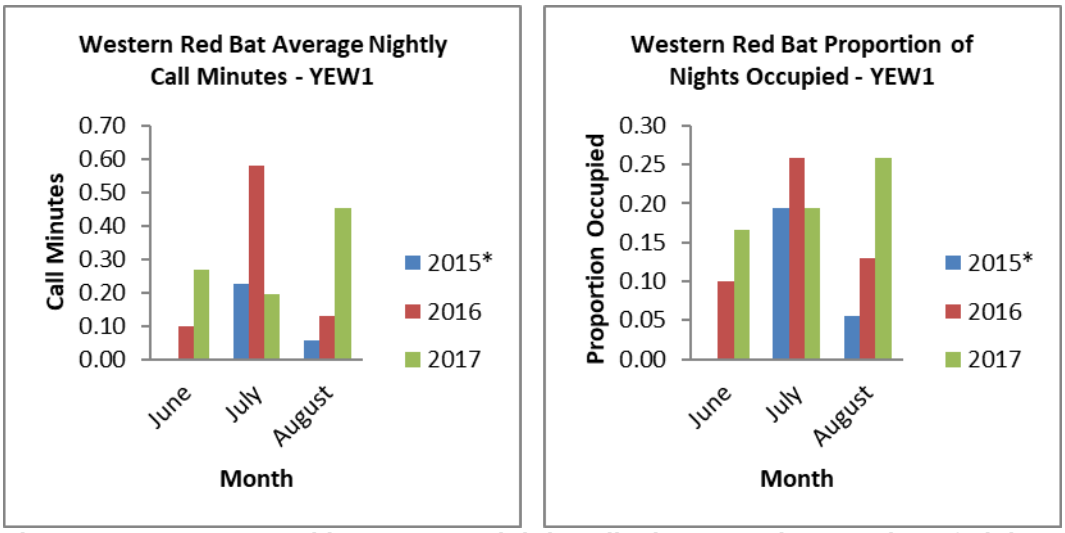


Figure 1-9.—Western red bat average nightly call minutes and proportion of nights occupied at YEW1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015.

Western Yellow Bat

AKTP1

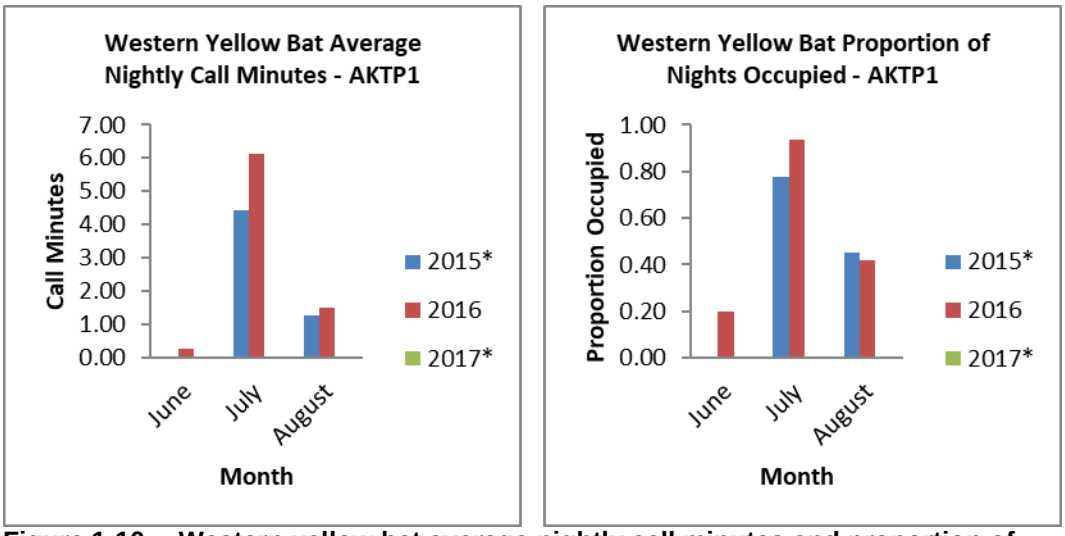


Figure 1-10.—Western yellow bat average nightly call minutes and proportion of nights occupied AKTP1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015, July 2015, June 2017, and July 2017.

BLCA1

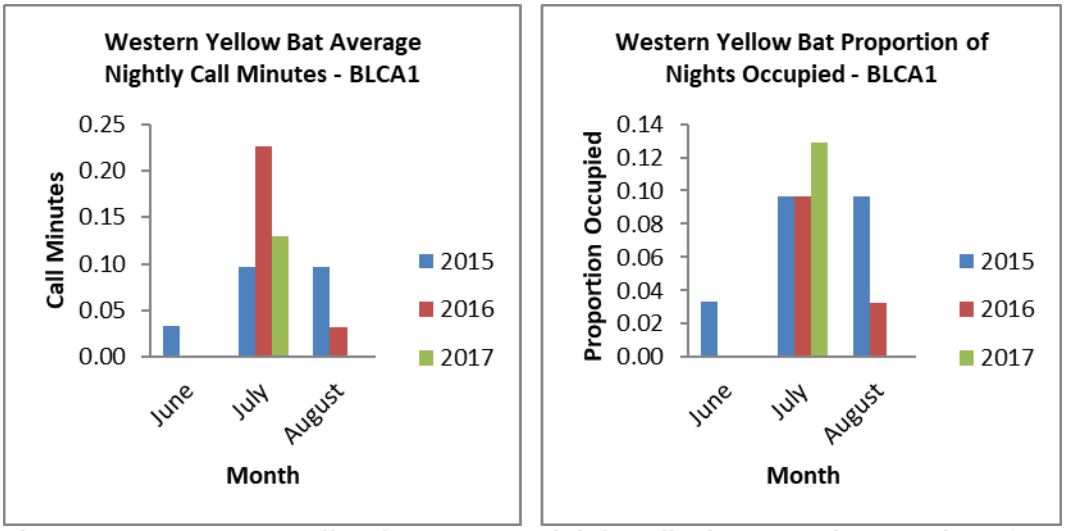


Figure 1-11.—Western yellow bat average nightly call minutes and proportion of nights occupied BLCA1, using Analook.

Crane Roost Station

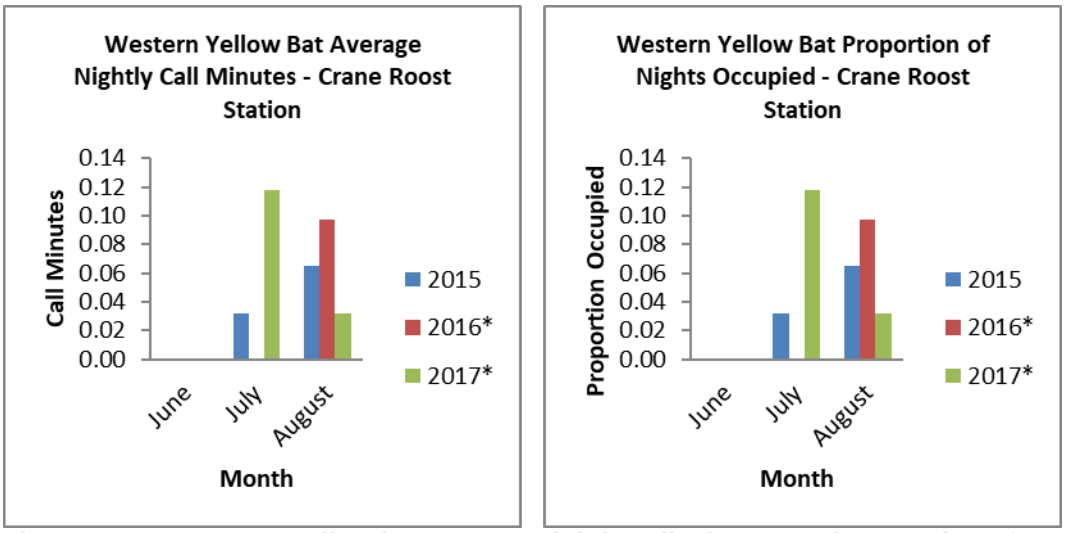


Figure 1-12.—Western yellow bat average nightly call minutes and proportion of nights occupied at the Crane Roost station, using Analook.
* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

CVCA1

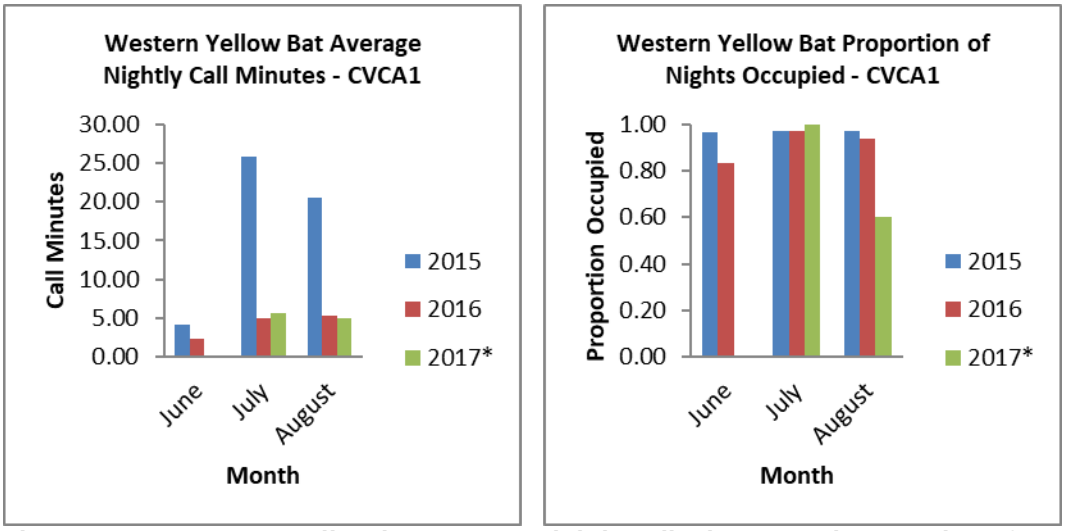


Figure 1-13.—Western yellow bat average nightly call minutes and proportion of nights occupied at CVCA1, using Analook.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July and August 2017.

CVCA2

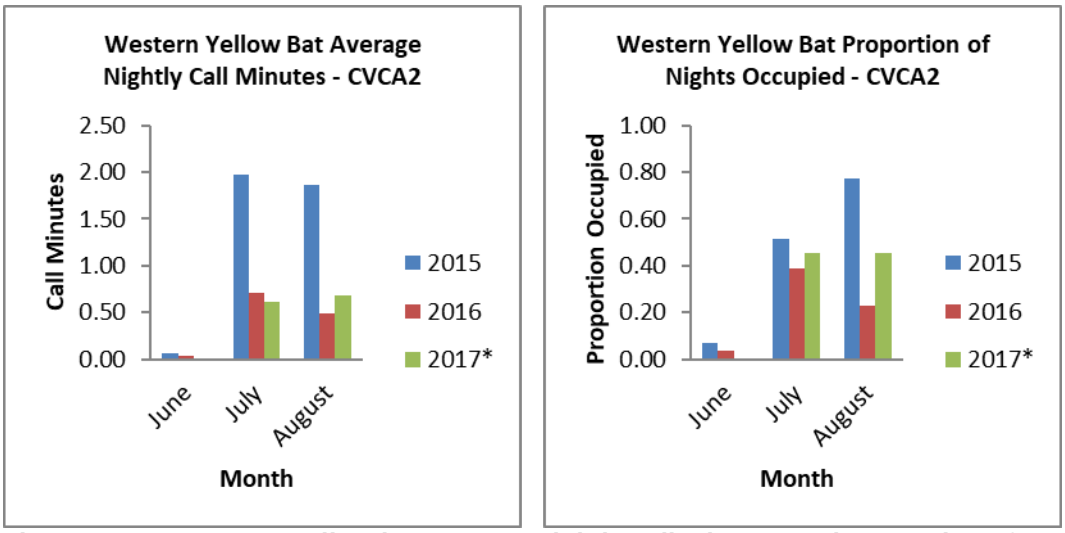


Figure 1-14.—Western yellow bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.
* Station malfunction leading to partial monthly data collected in June 2017.

HH1

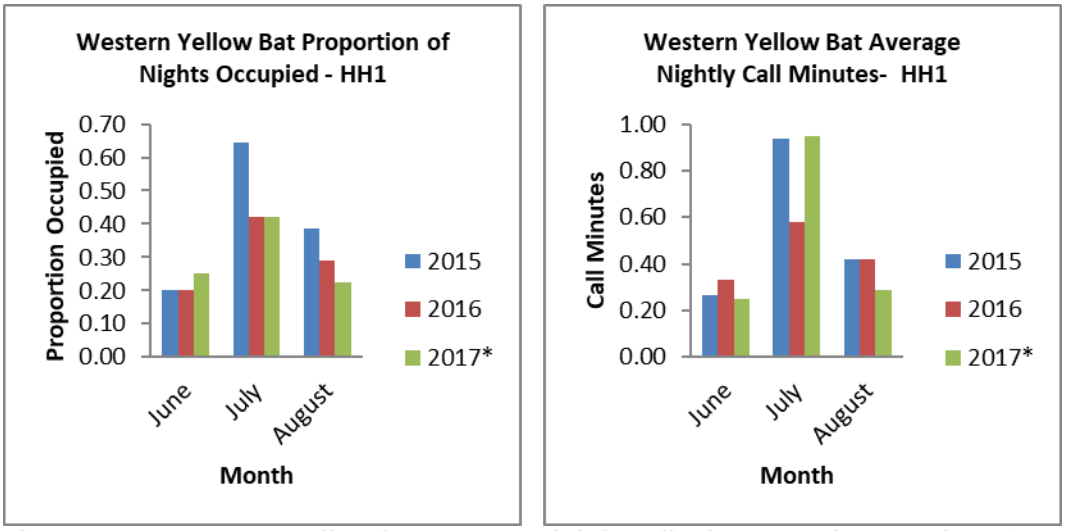


Figure 1-15.—Western yellow bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.
* Station malfunction leading to partial monthly data collected in June and July 2017.

PVER1

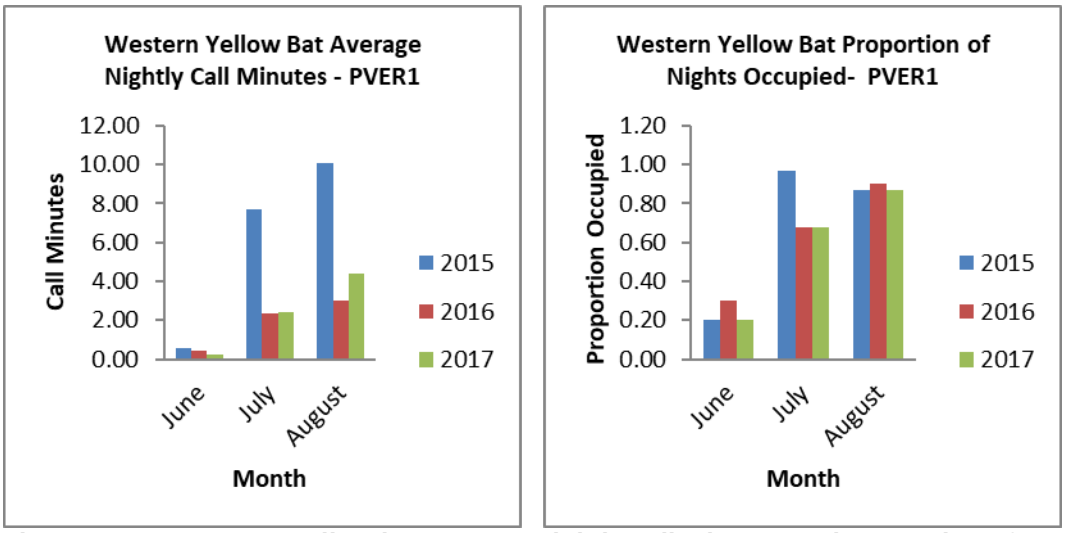


Figure 1-16.—Western yellow bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook.

PVER2

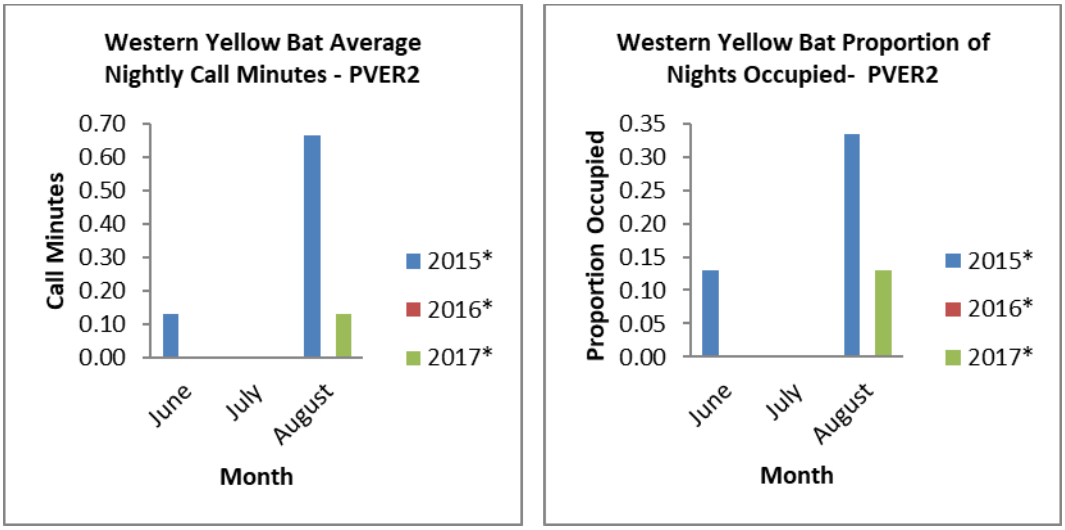


Figure 1-17.—Western yellow bat average nightly call minutes and proportion of nights occupied at PVER2, using Analook.

* Station malfunction led to partial monthly data collected in 2015 (data loss: June 24 – August 12 and August 16–31), in 2016 (data loss: June 1–15), and 2017(data loss: June 1 – July 19).

YEW1

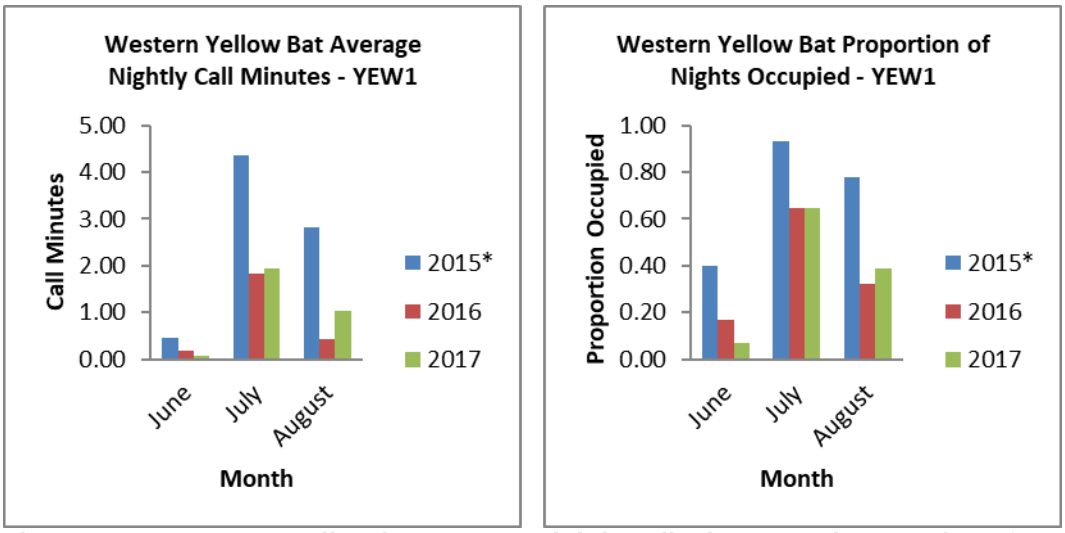


Figure 1-18.—Western yellow bat average nightly call minutes and proportion of nights occupied at YEW1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015.

California Leaf-nosed Bat

AKTP1

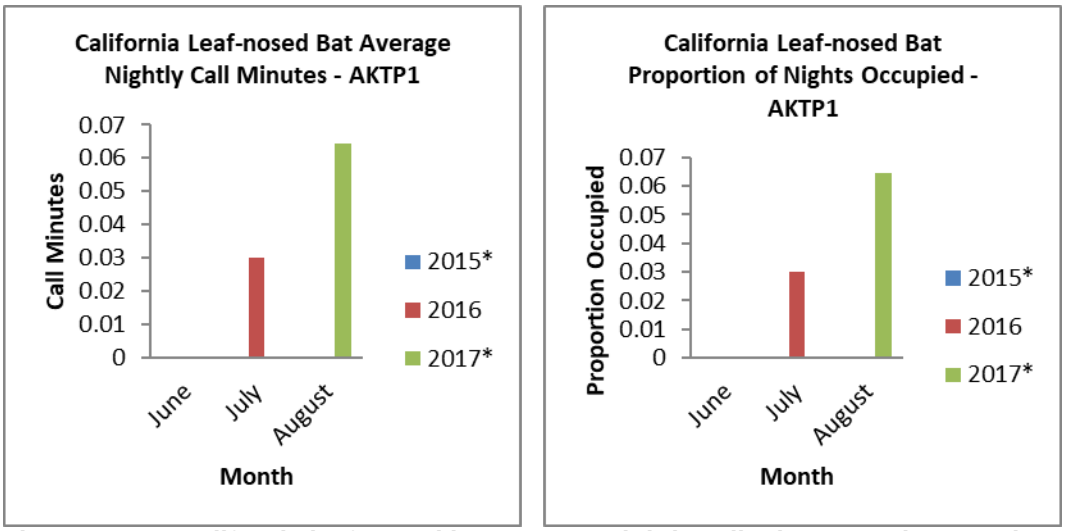


Figure 1-19.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at AKTP1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.

BLCA1

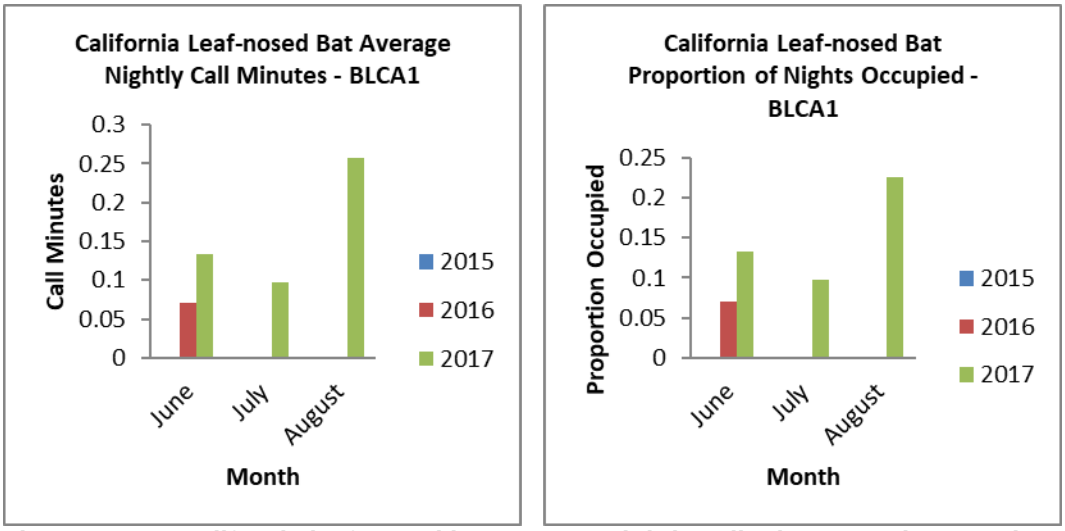
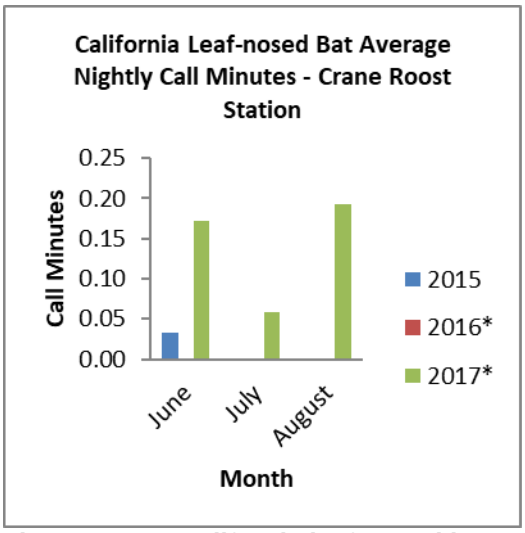


Figure 1-20.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at BLCA1, using Analook.

Crane Roost Station



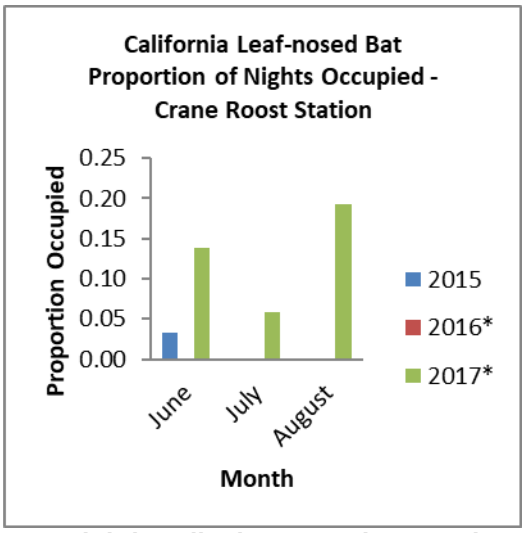
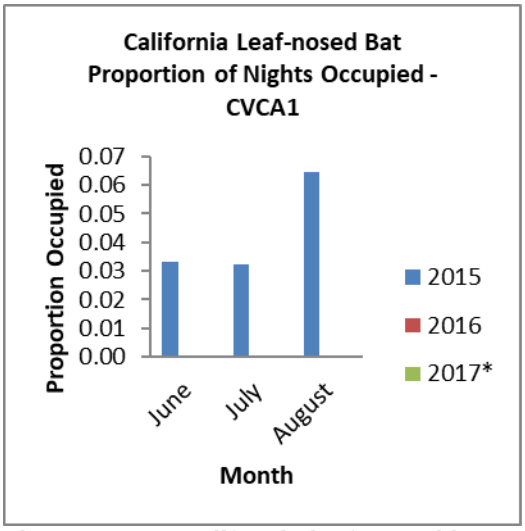


Figure 1-21.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at the Crane Roost station, using Analook.
* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

CVCA1



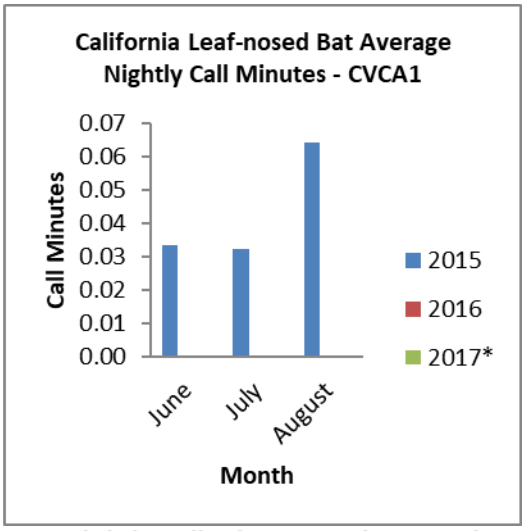


Figure 1-22.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at CVCA1 using Analook.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July 2017 and August 2017.

CVCA2

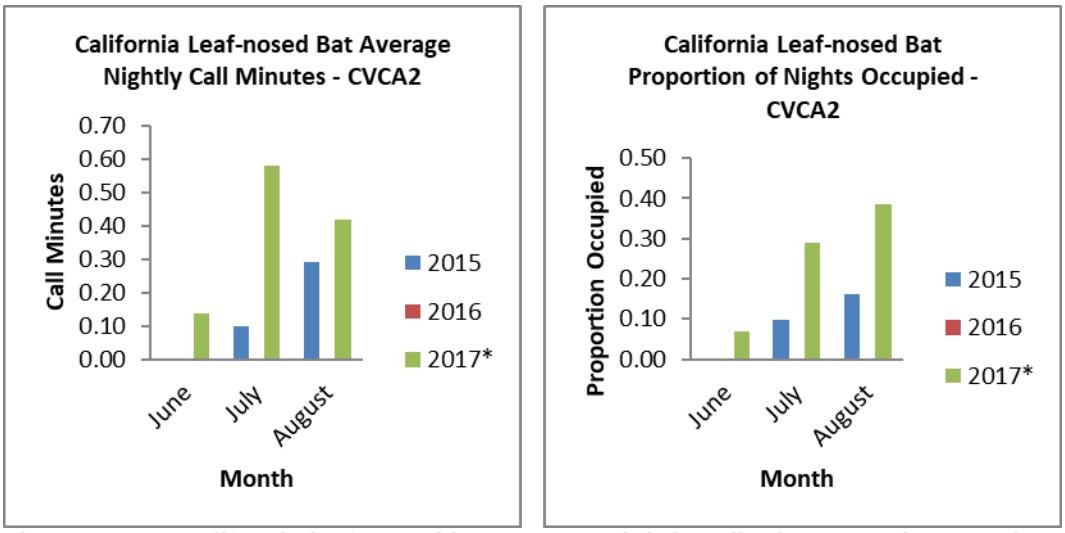


Figure 1-23.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.
* Station malfunction leading to partial monthly data collected in June 2017.

HH1

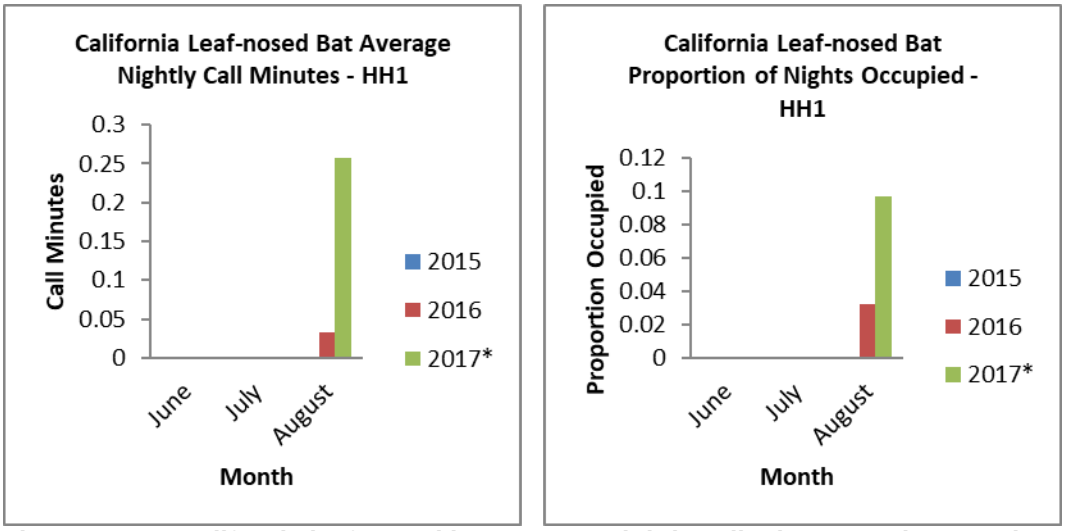


Figure 1-24.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2017 and July 2017.

PVER1

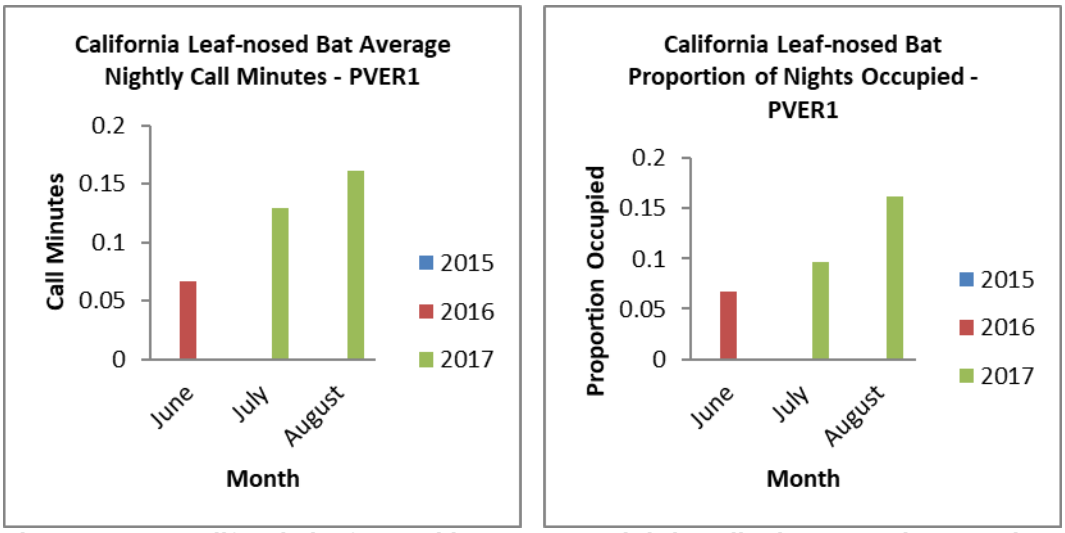


Figure 1-25.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook.

PVER2

No California leaf-nosed bat activity or occupancy was recorded at PVER2 during 2015, 2016, or 2017. Malfunctions at this station during all three seasons may be responsible for the lack of activity and occupancy.

YEW1

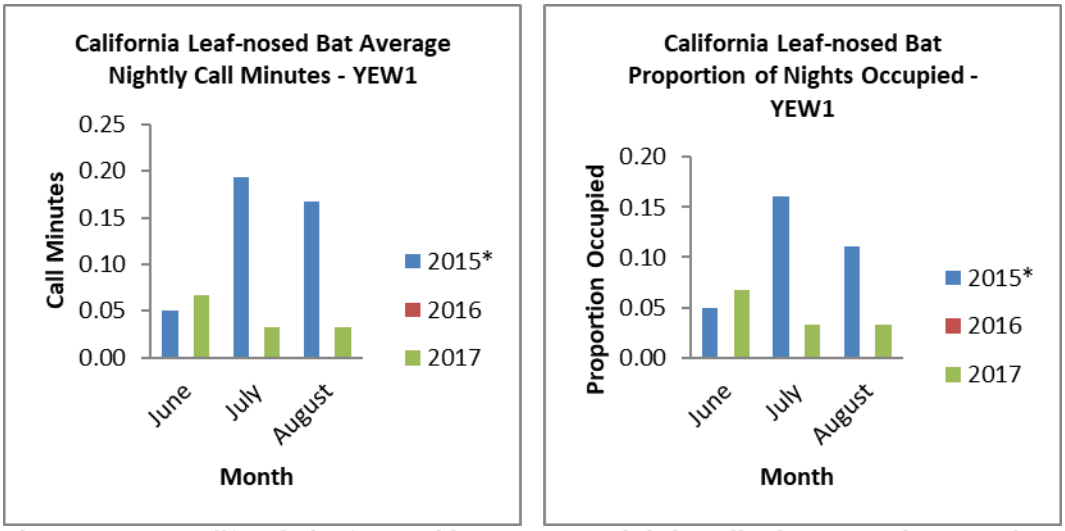


Figure 1-26.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at YEW1, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015.

KALEIDOSCOPE AUTO-CLASSIFIER VERSUS ANALOOK VISUAL VERIFICATION METHOD RESULTS

Western Red Bat

AKTP1

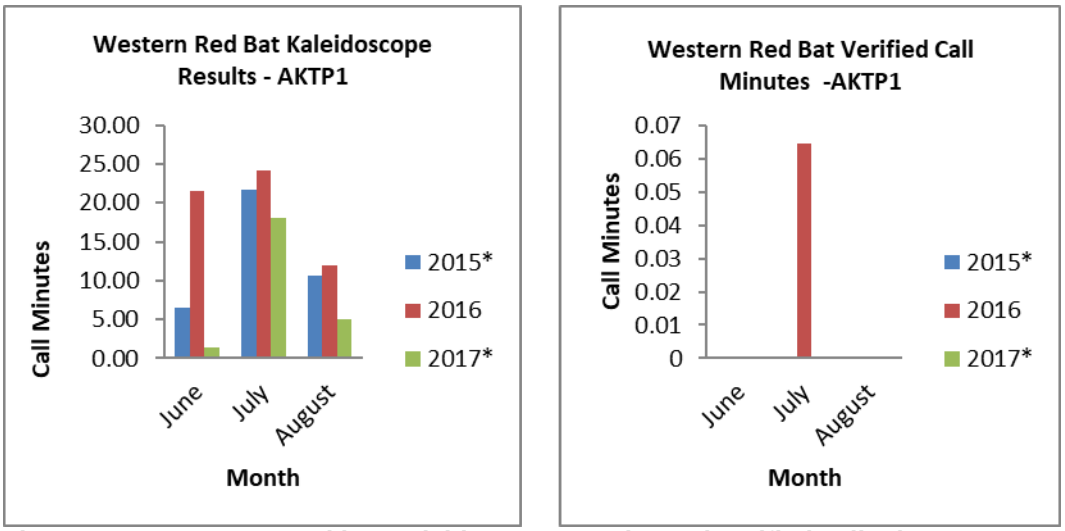


Figure 1-27.—Western red bat Kaleidoscope results and verified call minutes at AKTP1.
* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.

BLCA

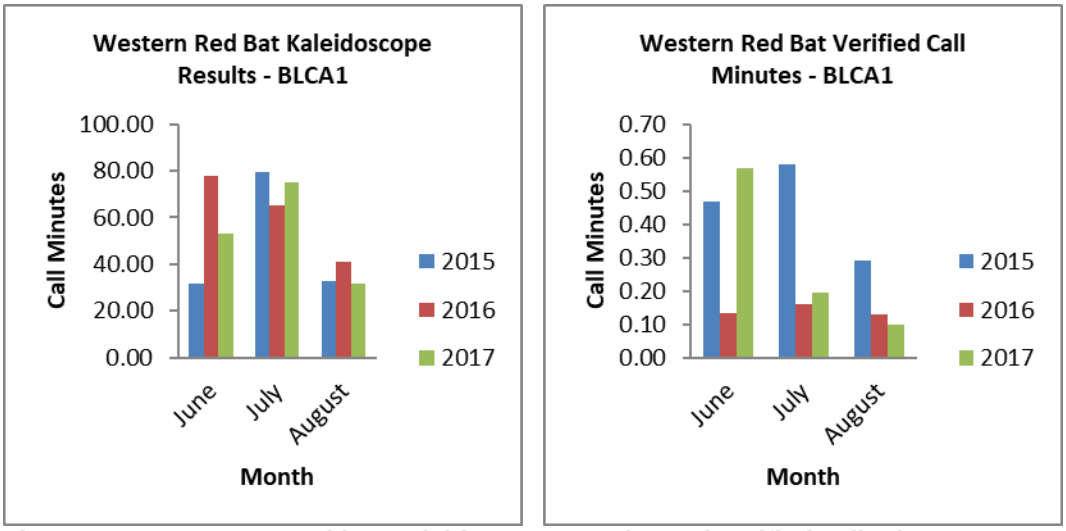


Figure 1-28.—Western red bat Kaleidoscope results and verified call minutes at BLCA1.

Crane Roost Station

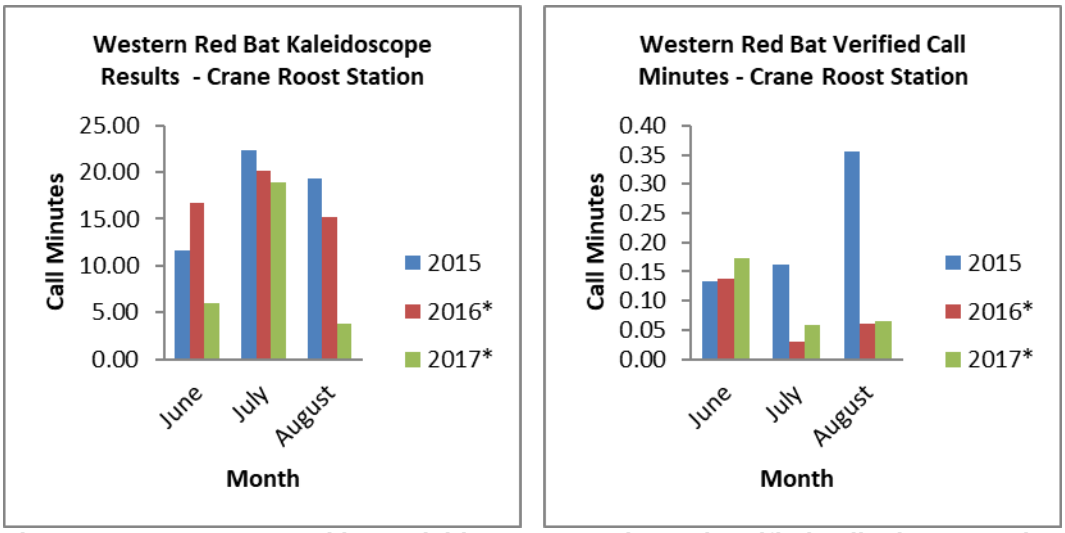


Figure 1-29.—Western red bat Kaleidoscope results and verified call minutes at the Crane Roost station.
* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

CVCA1

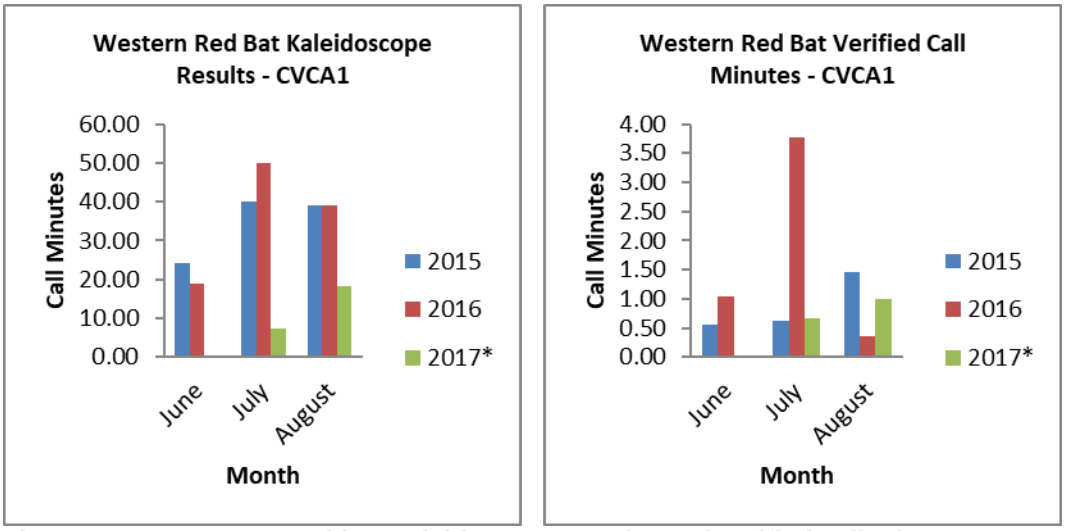


Figure 1-30.—Western red bat Kaleidoscope results and verified call minutes at CVCA1.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July and August 2017.

CVCA2

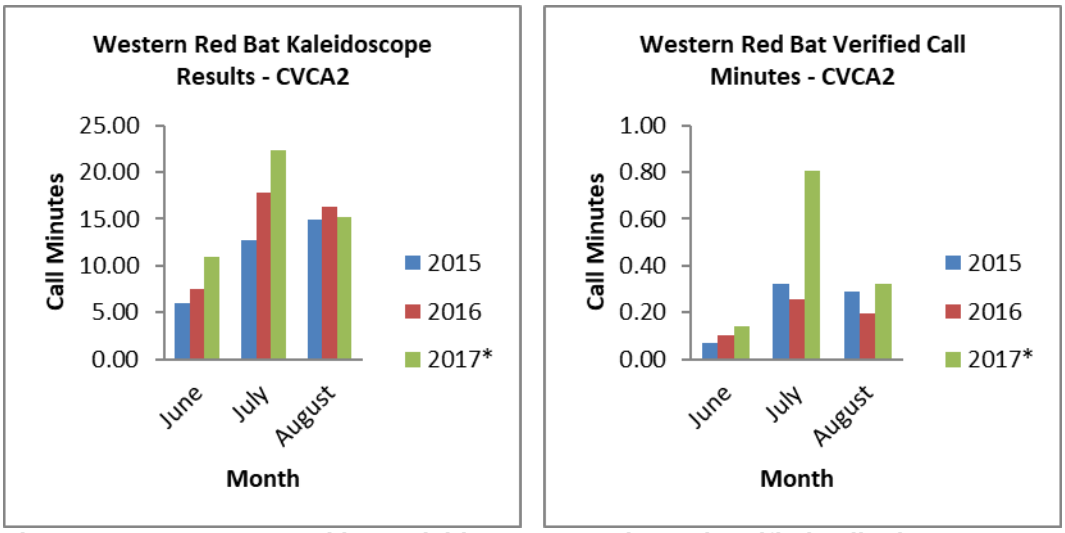


Figure 1-31.—Western red bat Kaleidoscope results and verified call minutes at CVCA2.
* Station malfunction leading to partial monthly data collected in June 2017.

HH1

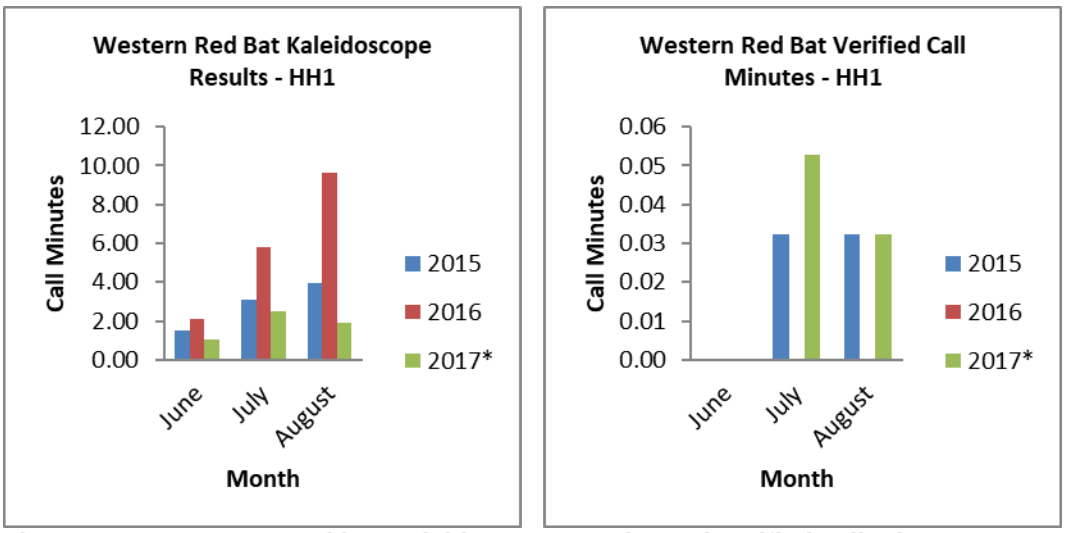


Figure 1-32.—Western red bat Kaleidoscope results and verified call minutes at HH1.
* Station malfunction leading to partial monthly data collected in June 2017 and July 2017.

PVER1

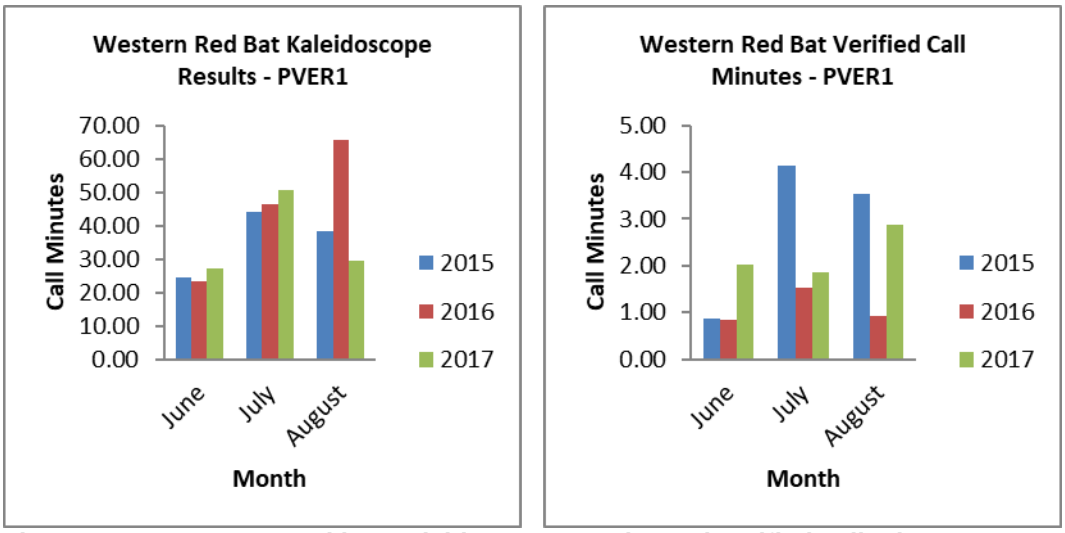


Figure 1-33.—Western red bat Kaleidoscope results and verified call minutes at PVER1.

PVER2

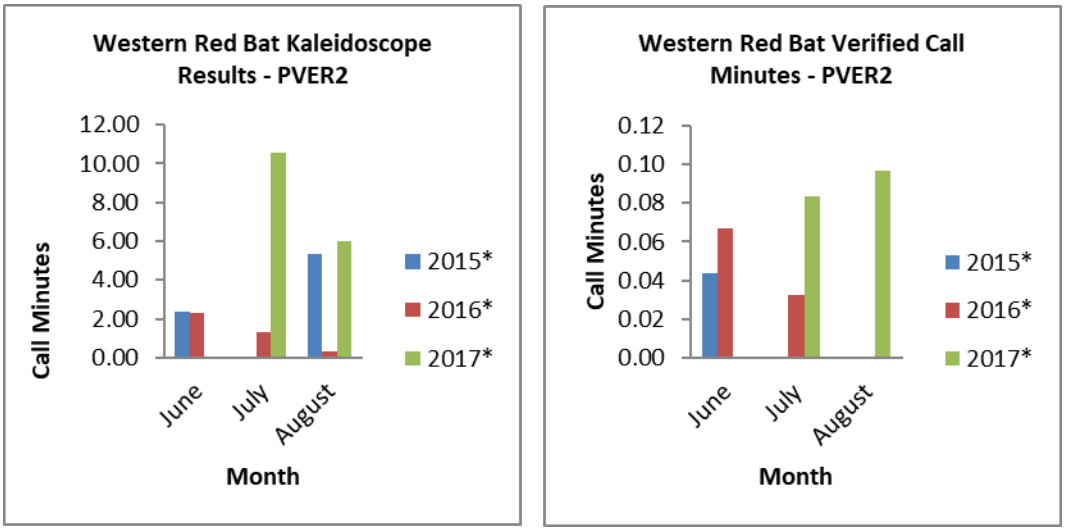


Figure 1-34.—Western red bat Kaleidoscope results and verified call minutes at PVER2.

* Station malfunction led to partial monthly data collected in 2015 (data loss: June 24 – August 12 and August 16–31), in 2016 (data loss: June 1–15), and 2017(data loss: June 1 – July 19).

YEW1

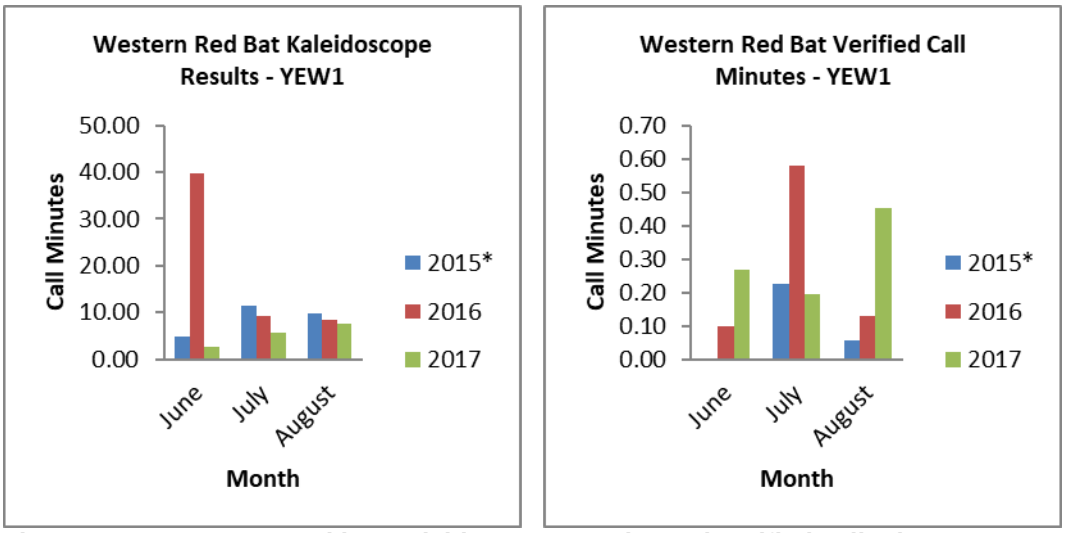


Figure 1-35.—Western red bat Kaleidoscope results and verified call minutes at YEW1.

* Station malfunction leading to partial monthly data collected in June 2015.

Pale Townsend's Big-Eared Bat (Kaleidoscope Auto-Classifier Results)

AKTP1

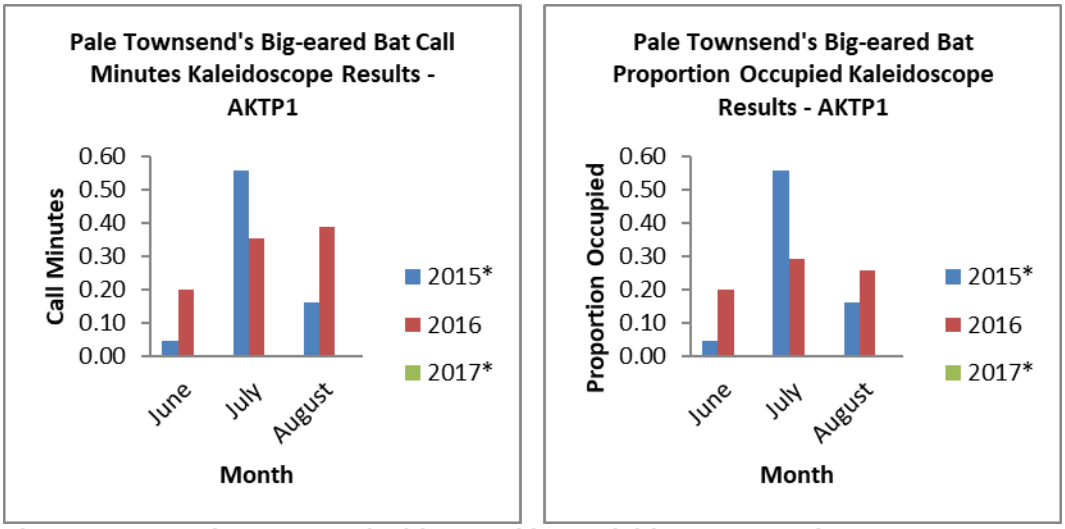


Figure 1-36.—Pale Townsend's big-eared bat Kaleidoscope results at AKTP1.
* Station malfunction leading to partial monthly data collected in June and July 2015 and July 2017.

BLCA1

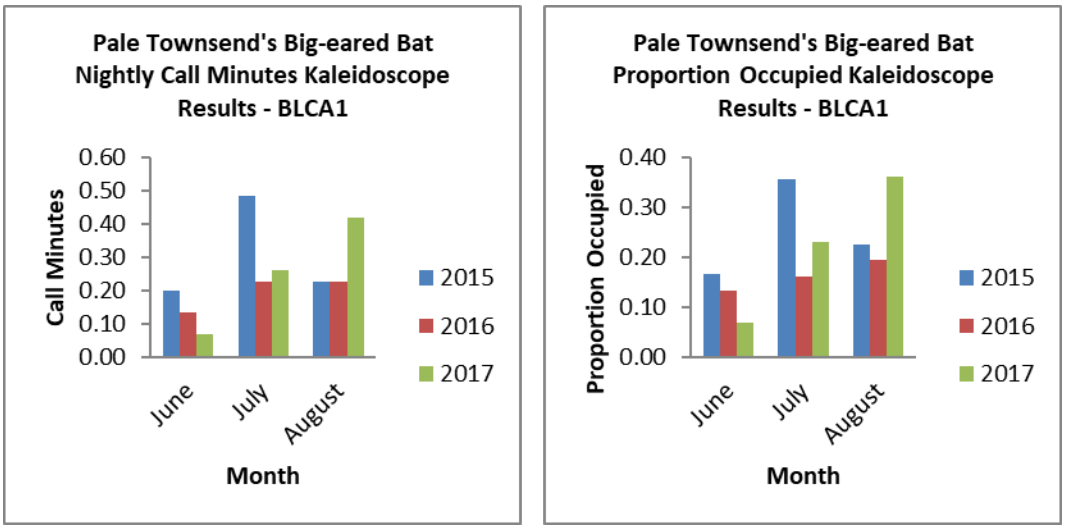


Figure 1-37.—Pale Townsend's big-eared bat Kaleidoscope results at BLCA1.

Crane Roost Station

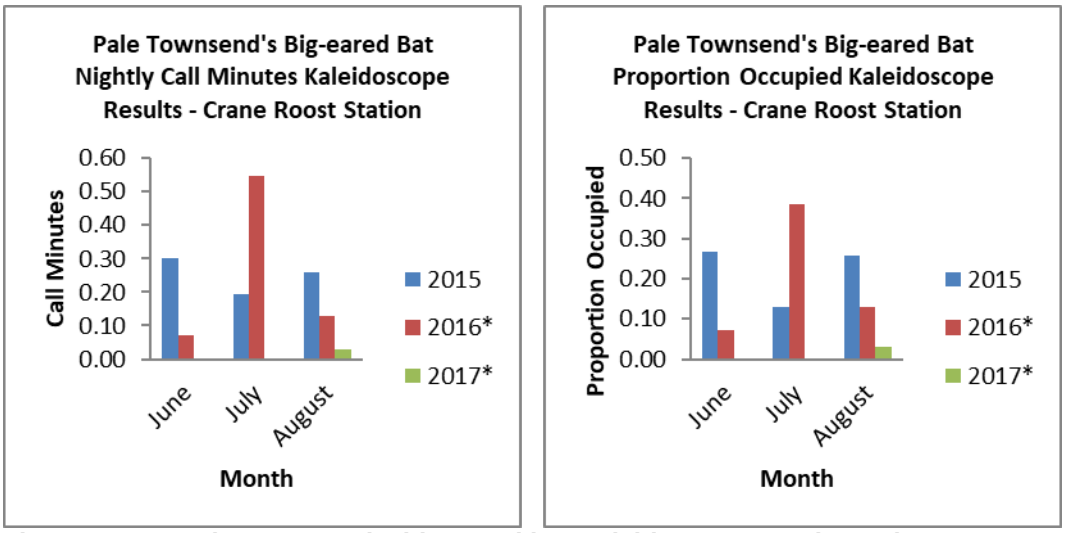


Figure 1-38.—Pale Townsend's big-eared bat Kaleidoscope results at the Crane Roost station.
* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

CVCA1

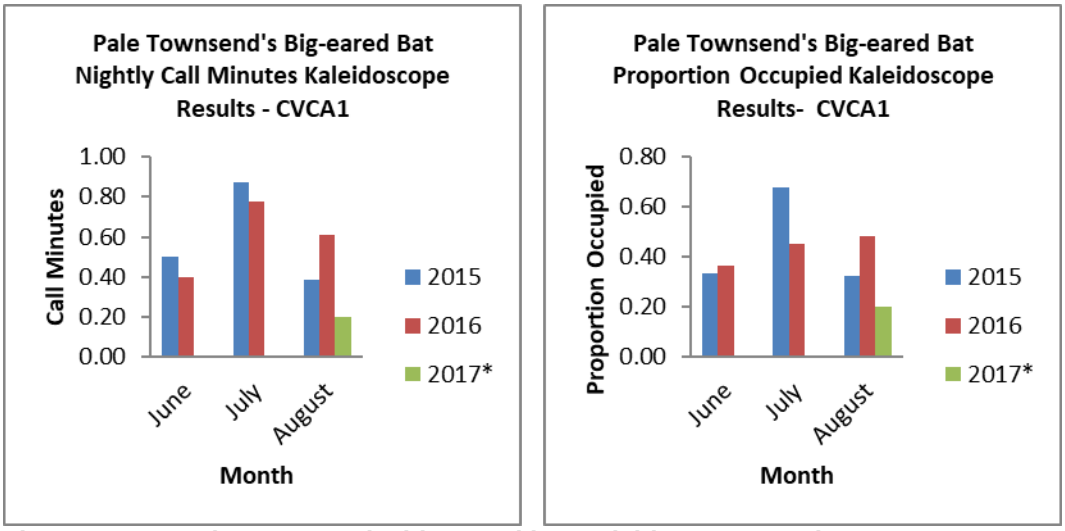


Figure 1-39.—Pale Townsend's big-eared bat Kaleidoscope results at CVCA1.
* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July 2017 and August 2017.

CVCA2

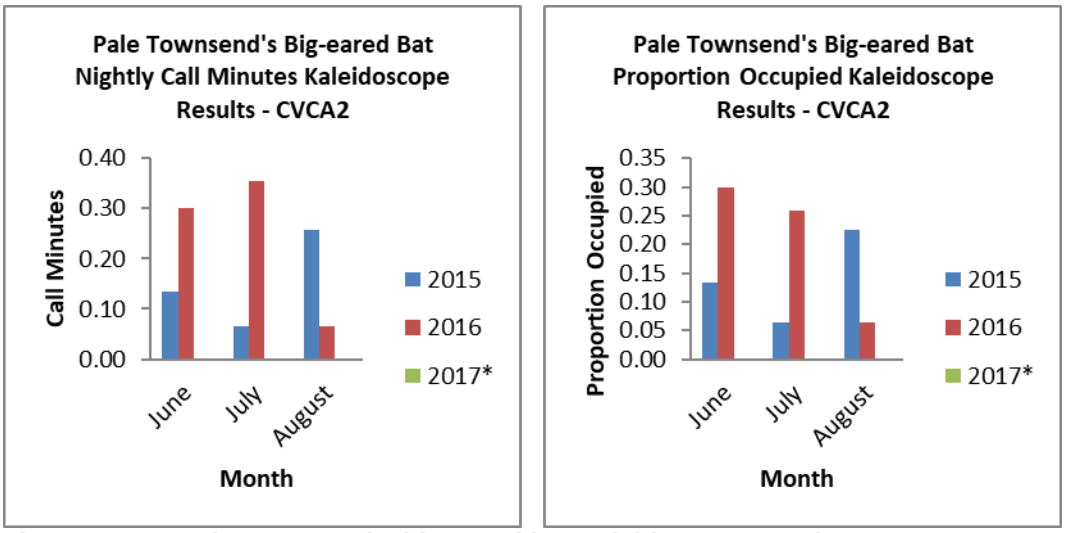


Figure 1-40.—Pale Townsend's big-eared bat Kaleidoscope results at CVCA2.
* Station malfunction led to partial monthly data collected in June 2017.

HH1

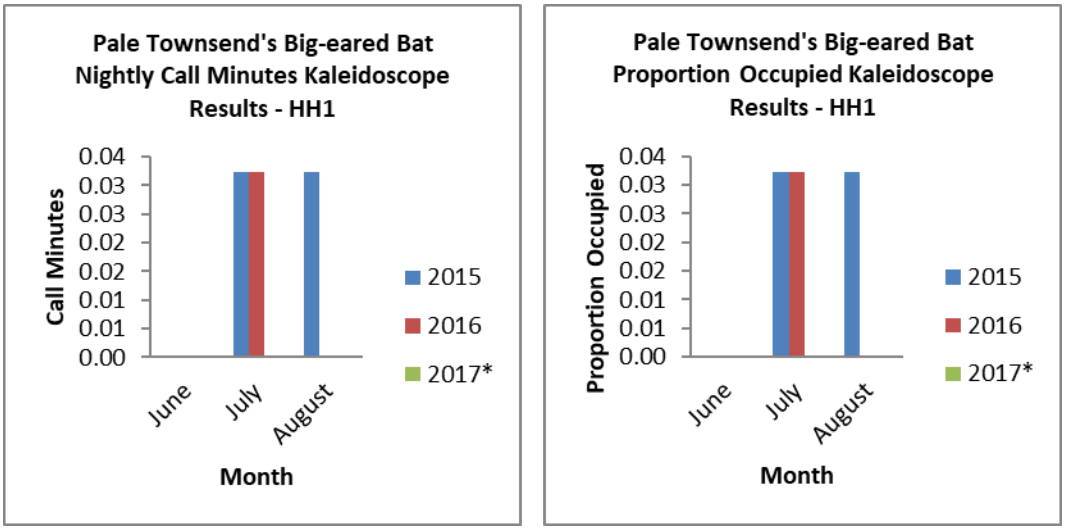


Figure 1-41.—Pale Townsend's big-eared bat Kaleidoscope results at HH1.
* Station malfunction leading to partial monthly data collected in June and July 2017.

PVER1

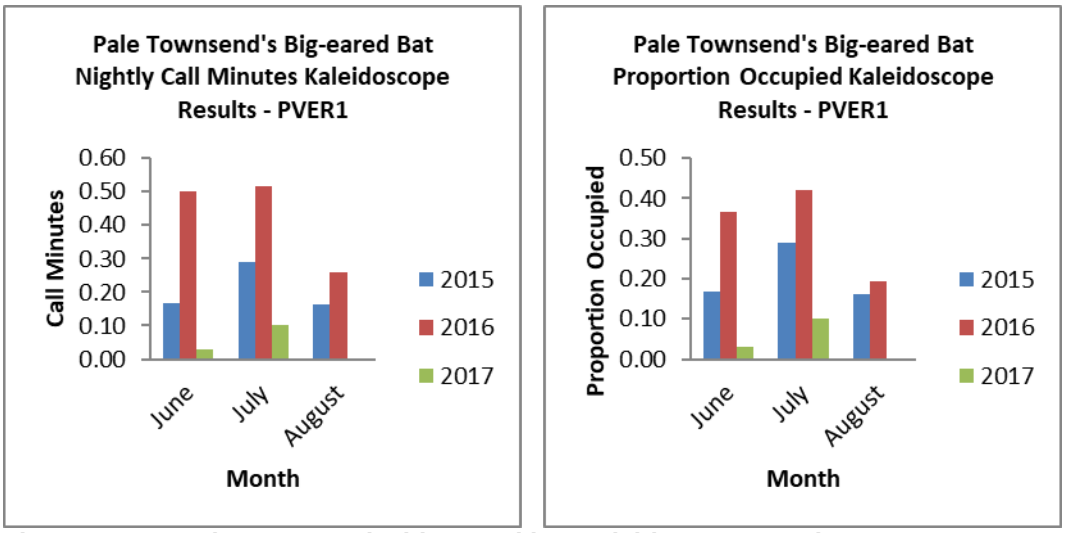


Figure 1-42.—Pale Townsend's big-eared bat Kaleidoscope results at PVER1.

PVER2

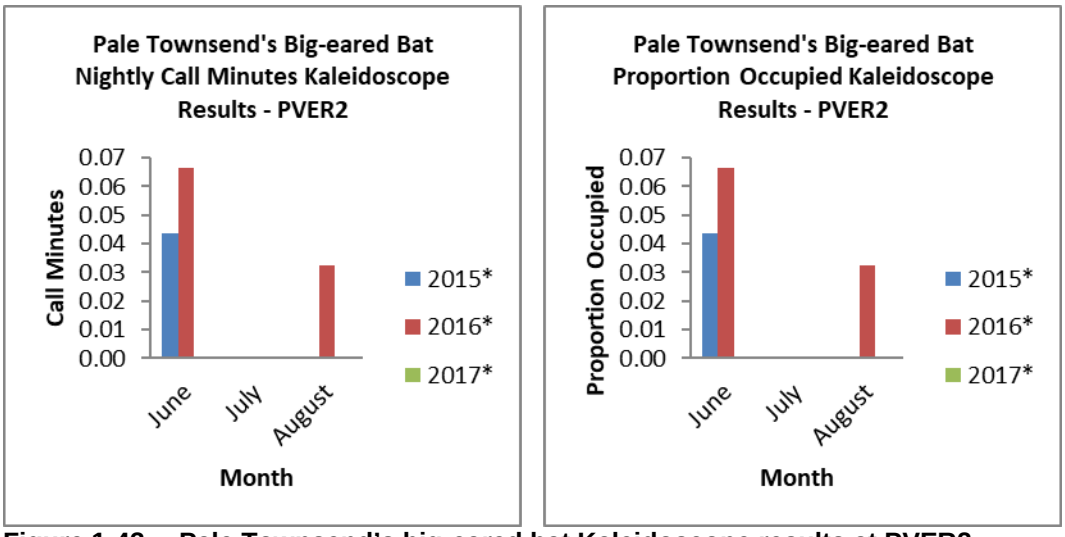


Figure 1-43.—Pale Townsend's big-eared bat Kaleidoscope results at PVER2.
* Station malfunction led to partial monthly data collected in 2015 (data loss: June 24 – August 12 and August 16–31), in 2016 (data loss: June 1–15), and 2017(data loss: June 1 – July 19).

YEW1

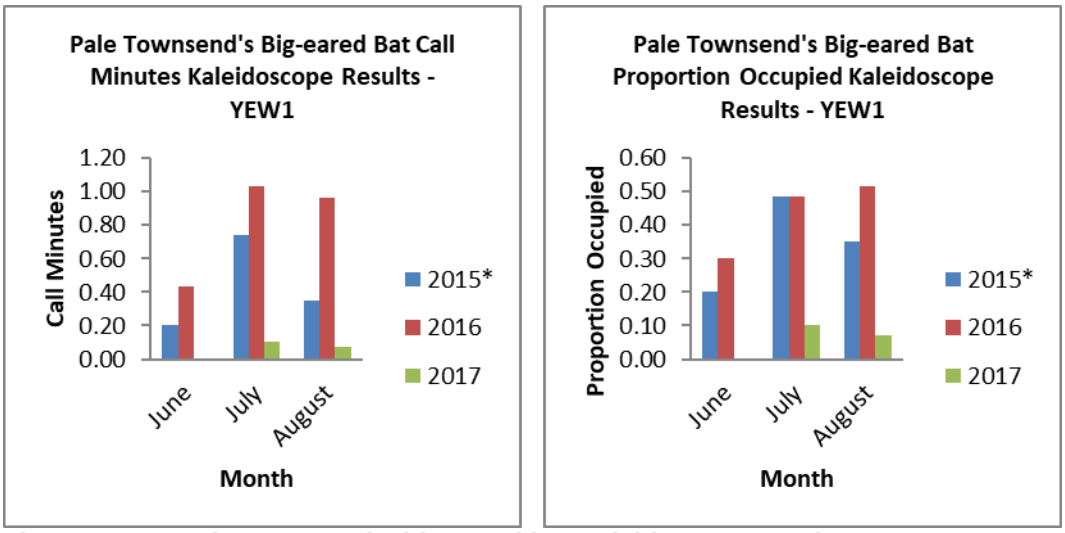


Figure 1-44.—Pale Townsend's big-eared bat Kaleidoscope results at YEW1.
* Station malfunction leading to partial monthly data collected in June 2015.

ATTACHMENT 2

Yearly Activity of Other Riparian Bat Species (Using the Kaliedoscope Auto Classifier)

ANPA = pallid bat (*Antrozous pallidus*)

PTBB = pale Townsend's big-eared bat[1] (*Corynorhinus townsendii* = *Plecotus townsendii pallescens* = *C. townsendii townsendii*)

EPFU = big brown bat (*Eptesicus fuscus*)

EUMA = spotted bat (*Euderma maculatum*)

EUPE = greater mastiff bat (*Eumops perotis*)

WRBA = western red bat (*Lasiurus blossevillii*)

LACI = hoary bat (*Lasiurus cinereus*)

MYCA = California myotis (*Myotis californicus*)

MYOC = Arizona myotis (*Myotis occultus*)

MYYU = Yuma myotis (*Myotis yumanensis*)

PAHE = canyon bat (*Parastrellus hesperus*)

TABR = Mexican free-tailed bat (*Tadarida brasiliensis*)

[1] Genetic analyses on the pale Townsend's big-eared bat indicate that the lower Colorado River is likely in the range of the Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*) rather than the pale Townsend's big-eared bat (Piaggio and Perkins 2005). Bats recorded along the lower Colorado River will be referred to as the pale Townsend's big-eared bat in this report, as the name change has not yet been verified by the U.S. Fish and Wildlife Service.

Table 2-1.—AKTP1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR**	Total of annual average call minutes for all species
2015*	3.11	0.18	5.25	0.02	17.10	10.85	5.70	2.23	72.70	9.16	46.34	26.87	199.52
2016	5.52	0.32	18.39	0.18	23.87	19.17	9.49	1.97	101.90	8.78	56.49	36.58	282.66
2017*	0.05	0	1.77	18.82	3.51	7.49	10.25	0.49	41.47	6.18	3.47	1,066.61	482.19
Average call minutes per species 2015 through 2017	2.90	0.17	8.47	6.34	14.83	12.51	8.48	1.56	72.03	8.04	35.43	376.68	

* Station malfunction leading to partial monthly data collected in June 2015, July 2015, and July 2017.
** Mexican free-tailed bat average nightly call minutes in 2017 were actually 1,066.

Table 2-2.—BLCA1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015	3.49	0.30	23.05	0.09	0.89	48.32	0.53	8.37	124.53	76.08	118.37	18.48	422.50
2016	3.39	0.20	25.43	0.01	0.26	61.16	0.23	8.43	124.08	52.58	160.34	16.38	452.49
2017	2.76	0.25	38.17	0.28	11.36	53.24	0.41	2.97	130.24	33.05	104.70	15.32	874.99
Average call minutes per species 2015 through 2017	3.21	0.25	28.89	0.13	4.17	54.24	0.39	6.59	126.28	53.90	127.80	16.73	

Table 2-3.—Crane Roost Station Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015	7.39	0.24	12.93	0.74	2.58	17.96	0.72	4.70	18.51	23.22	77.92	10.23	177.13
2016*	18.12	0.29	19.13	1.03	5.21	17.46	0.87	6.22	25.03	33.86	111.75	12.78	251.74
2017*	8.92	0.01	28.83	0.00	1.51	6.47	0.26	4.30	21.75	48.14	109.06	9.43	428.87
Average call minutes per species 2015 through 2017	11.48	0.18	20.30	0.59	3.10	13.96	0.62	5.07	21.76	35.07	99.58	10.81	

* Station malfunction leading to partial monthly data collected in June 2016, June 2017, and July 2017.

Table 2-4.—CVCA1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015	9.57	0.59	106.08	0.45	8.08	34.61	1.50	4.03	39.39	39.67	123.04	393.92	760.92
2016	11.14	0.60	179.53	0.74	5.22	36.18	1.03	3.58	36.39	38.20	148.61	350.92	812.14
2017*	1.50	0.13	21.50	0.00	1.00	14.25	0.00	0.88	15.38	13.25	23.25	34.38	1573.07
Average call minutes per species 2015 through 2017	7.40	0.44	102.37	0.39	4.76	28.35	0.84	2.83	30.39	30.37	98.30	259.74	

* Station malfunction leading to no data collected in June 2017 and partial monthly data collected in July 2017 and August 2017

Table 2-5.—CVCA2 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015	24.59	0.15	48.07	0.26	2.32	11.30	0.39	8.41	60.22	50.32	69.18	48.20	323.40
2016	23.97	0.25	52.13	0.78	4.74	14.02	0.50	10.78	48.55	101.72	58.45	44.70	360.59
2017*	8.10	0.00	81.53	0.10	6.66	16.31	0.32	7.53	39.30	124.58	64.52	42.68	683.99
Average call minutes per species 2015 through 2017	18.88	0.13	60.58	0.38	4.57	13.88	0.40	8.91	49.36	92.20	64.05	45.19	

* Station malfunction led to partial monthly data collected in June 2017.

Table 2-6.—HH1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015	0.40	0.02	3.39	0.72	8.60	2.86	4.11	0.25	0.98	7.21	0.49	12.41	41.43
2016	0.61	0.01	2.13	1.03	7.73	4.74	1.40	0.40	0.77	15.80	0.43	6.71	41.77
2017*	0.13	0.00	1.35	1.15	15.95	1.94	0.95	0.10	0.35	17.87	0.08	3.89	83.21
Average call minutes per species 2015 through 2017	0.38	0.01	2.29	0.97	10.76	3.18	2.15	0.25	0.70	13.63	0.33	7.67	

* Station malfunction led to partial monthly data collected in June 2017 and July 2017

Table 2-7.—PVER1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015*	7.22	0.21	82.21	0.04	6.66	45.45	4.52	3.64	38.38	18.66	105.16	186.55	498.71
2016	14.20	0.42	101.38	0.16	13.46	35.76	15.84	2.52	24.93	33.54	135.12	244.29	621.63
2017*	4.96	0.04	114.87	0.19	26.88	35.86	26.16	2.86	21.34	25.02	99.41	149.97	1120.34
Average call minutes per species 2015 through 2017	8.79	0.22	99.49	0.13	15.67	39.02	15.51	3.01	28.22	25.74	113.23	193.61	

Table 2-8.—PVER2 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015*	1.00	0.04	3.08	0.00	1.35	2.77	1.27	0.35	2.31	1.00	37.73	8.81	59.69
2016*	0.27	0.03	0.88	0.00	0.79	1.09	0.26	0.21	1.88	0.44	17.27	2.94	26.06
2017*	1.19	0.00	8.37	0.02	3.02	7.28	2.30	2.88	8.51	4.21	33.95	30.40	85.76
Average call minutes per species 2015 through 2017	0.82	0.02	4.11	0.01	1.72	3.71	1.28	1.14	4.23	1.88	29.65	14.05	

* Station malfunction led to partial monthly data collected in 2015 (data loss: June 24 – August 12 and August 16–31), in 2016 (data loss: June 1–15), and in 2017 (data loss: June 1 – July 19).

Table 2-9.—YEW1 Kaleidoscope auto-classifier average nightly call minutes by year for other riparian bat species

Year	ANPA	PTBB	EPFU	EUMA	EUPE	WRBA	LACI	MYCA	MYOC	MYYU	PAHE	TABR	Total of annual average call minutes for all species
2015*	18.50	0.49	75.66	0.24	3.94	9.09	6.79	0.78	1.65	29.32	9.66	109.12	265.24
2016	23.33	0.81	70.42	0.61	4.92	19.23	10.08	1.48	5.22	20.52	27.60	87.48	271.71
2017	14.79	0.05	82.21	2.15	36.46	5.38	9.41	0.24	1.00	11.83	5.57	68.36	237.45
Average call minutes per species 2015 through 2017	18.87	0.45	76.10	1.00	15.11	11.23	8.76	0.83	2.62	20.56	14.28	88.32	

* Station malfunction leading to partial monthly data collected in June 2015.