Post-Development Acoustic Monitoring of LCR MSCP Bat Species

2015 – 2016 Annual Report
Lower Colorado River Multi-Species Conservation Program
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Lower Colorado River
Multi-Species Conservation Program

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of LCR MSCP Bat Species

2015 – 2016 Annual Report

Prepared by:
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Arizona Game and Fish Department, Wildlife Contracts Branch

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

September 2018
### ACRONYMS AND ABBREVIATIONS

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<td>Endangered Species Act</td>
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<td><em>id est</em>; that is</td>
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<td>LCR</td>
<td>lower Colorado River</td>
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<tr>
<td>LCR MSCP</td>
<td>Lower Colorado River Multi-Species Conservation Program</td>
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<td>PVER</td>
<td>Palo Verde Ecological Reserve</td>
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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, and June 1 to August 31, 2016. These stations were located in six Lower Colorado River Multi-Species Conservation Program (LCR MSCP) conservation areas and one habitat creation area that consists 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 (*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 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 between 2015 and 2016. No pale Townsend’s big-eared bat calls were detected on recordings at any location during the summers of 2015 or 2016. 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 Cibola Valley Conservation Area CVCA1 station, and California leaf-nosed bats were recorded with the greatest activity at the Yuma East Wetlands YEW1 station. Pale Townsend’s big-eared bat activity was not recorded 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 YEW1 during the reporting period, June – August 2015–2016. The auto-classifier for pale Townsend’s big-eared bats showed promising results compared to the Analook filters, which may lead to more efficient processing of these calls. The Analook filters

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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 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.
marked 42,027 files as potential pale Townsend’s big-eared bat calls, while the auto-classifier identified 446 calls. Conversely, the auto-classifier likely overestimated activity for western red bats and marked more potential calls as western red bats than the Analook filters. Activity and occupancy for LCR MSCP species and other species assessed with the auto-classifier was recorded at the greatest levels at the largest, most mature, and complex conservation areas.
\textbf{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 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 daily 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 (\textit{Lasiurus blossevillii}) roosting habitat and 765 acres of western yellow bat (\textit{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 bat (\textit{Macrotus californicus}) and pale Townsend’s big-eared bat (\textit{Corynorhinus townsendii} = \textit{Plecotus townsendii pallescens} = \textit{C.}). (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 \cite{Piaggio and Perkins 2005} rather than the pale Townsend’s big-eared bat \cite{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 southwest of Parker, Arizona (figure 2). The Colorado River Indian Tribes planted and manages this habitat creation area. The area 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
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).
relocated to the Crane Roost area in 2013 because it was determined that the Crane Roost area is more similar to other conservation area sites (figure 4). The acoustic station was renamed Crane Roost, as it is in a different location.

The CVCA is located north of Cibola, Arizona, on Arizona Game and Fish owned lands. When fully planted, the CVCA will be over 1,000 acres in size. It currently consists of cottonwood-willow and honey mesquite. The first acoustic monitoring station (CVCA1) was deployed in mature cottonwood-willow habitat in 2011. The second acoustic 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 acoustic station (PVER1) was deployed in mature cottonwood-willow habitat in 2012. The second acoustic 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).
Figure 4.—The Cibola NWR Unit #1 original bat acoustic monitoring station location (CNU1) and the current location (Crane Roost).
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, treatment, number of nights recorded during the sampling period, and year of station deployment

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

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.

During the 2015 and 2016 sampling seasons, several equipment malfunctions resulted in periods of data loss. AKTP1 malfunctioned in 2015 (June 22 – July 22) due to a faulty battery connection and time required to properly charge after the connection had been fixed (see table 1). AKTP1 did record acoustic activity for the remaining 61 days and is thus displayed in table 1. 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. This station also had a kinked microphone cable, which may have led to a reduced amount of calls being detected for the recording period. The Crane Roost station malfunctioned during 2016 (June 1–16), also due to corrupt compact flashcards. YEW1 could not be deployed at the beginning of 2015 (June 1–10) because the
road had been washed out and was impassable. BLCA1, PVER1, CVCA1, CVCA2, and HH1 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 Method**

The volume of call minutes was quantified for the two LCR MSCP covered species (western red and western yellow bats) and the two LCR MSCP evaluation species (California leaf-nosed 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 visual verification methods that had been developed by a previous LCR MSCP acoustic monitoring project (Broderick 2008).

Using Analook software, a series of acoustic filters were created for the focal bat species. The analysis 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.

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

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 visual verification method. The Kaleidoscope software does not have a 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 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 bats, hoary bats (*Lasiurus cinereus*), California myotis (*Myotis californicus*), Arizona myotis (*Myotis occultus*), Yuma myotis (*Myotis yumanensis*), canyon bats (*Parastrellus hesperus*), and Mexican free-tailed bats (*Tadarida brasiliensis*). Output from the 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 that 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. Though it’s possible, 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 myotis 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 acoustic monitoring station, between stations and years. It can be utilized to detect increases, decreases, or constant activity at the stations.

## RESULTS

### Analook Visual Verification Results

#### Western Red Bat

Western red bats were detected between 2015 and 2016 using the Analook visual verification method. None were detected at the ‘Ahakhav Tribal Preserve or Hunters Hole in 2015, but they were detected the following year (table 2). All results in the narrative have been rounded to the nearest hundredth (1/100), while data in the figures show the full value.

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

<table>
<thead>
<tr>
<th>Conservation area or habitat creation area</th>
<th>Station acronym</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Ahakhav Tribal Preserve</td>
<td>AKTP1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td>Beal Lake Conservation Area</td>
<td>BLCA1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cibola National Wildlife Refuge Unit #1 Conservation Area</td>
<td>Crane Roost</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cibola Valley Conservation Area</td>
<td>CVCA1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>CVCA2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hunters Hole</td>
<td>HH1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td>Palo Verde Ecological Reserve</td>
<td>PVER1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>PVER2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Yuma East Wetlands</td>
<td>YEWO</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The only western red bat activity at AKTP1 was recorded during July 2016. The greatest average nightly call minutes was 0.06, and the greatest proportion of night occupied was also 0.06 (figure 9). No activity was recorded during 2015 or during June or August 2016.

![Western Red Bat Average Nightly Call Minutes - AKTP1](chart1.png)

*Western Red Bat Average Nightly Call Minutes - AKTP1*

![Western Red Bat Proportion of Nights Occupied - AKTP1](chart2.png)

*Western Red Bat Proportion of Nights Occupied - AKTP1*

The greatest western red bat average nightly call minutes (0.58) and proportion of nights occupied (0.39) at BLCA1 were recorded during July 2015. The greatest average nightly call minutes (0.16) and proportion of nights occupied (0.16) for 2016 were also in July. The average nightly call minutes for western red bats at the BLCA was greater in 2015 than in 2016. There was an equal proportion of nights occupied in August 2015 and August 2016 (0.13) despite August 2015 having greater average nightly call minutes (figure 10). The proportion of nights occupied for western red bats at BLCA1 was greater in 2015.

![Western Red Bat Average Nightly Call Minutes - BLCA1](chart3.png)

*Western Red Bat Proportion of Nights Occupied - BLCA1*

The greatest western red bat average nightly call minutes (0.35) and proportion of nights occupied (0.23) at the Crane Roost station were recorded during August 2015. The greatest average nightly call minutes (0.06) and proportion of nights occupied (0.06) recorded during 2016 were also in August. No western red bat call minutes or proportion of nights occupied was recorded during June 2016, when only 14 nights of activity were recorded due to a station malfunction (figure 11). The greatest average nightly call minutes for western red bats at the Crane Roost station was recorded during 2015. The greatest proportion of
Figure 10.—Western red bat average nightly call minutes and proportion of nights occupied at BLCA1, using Analook.

Figure 11.—Western red bat average nightly call minutes and proportion of nights occupied at Crane Roost, using Analook.
* Station malfunction leading to partial monthly data collected in June 2016.
nights occupied for western red bats at the Crane Roost station was recorded during 2015. Activity and occupancy were lower in 2016, when fewer nights were recorded due to a station malfunction.

The greatest western red bat average nightly call minutes (3.77) and proportion of nights occupied (0.74) at CVCA1 were recorded during July 2016. The greatest average nightly call minutes (1.45) and proportion of nights occupied (0.55) during 2015 were recorded in August 2015. The greatest average nightly call minutes for western red bats at CVCA1 was recorded during 2016. The greatest proportion of nights occupied for western red bats at CVCA1 was recorded during 2016 (figure 12).

![Western Red Bat Average Nightly Call Minutes - CVCA1](image1)

![Western Red Bat Proportion of Nights Occupied - CVCA1](image2)

Figure 12.—Western red bat average nightly call minutes and proportion of nights occupied at CVCA1, using Analook.

The greatest western red bat average nightly call minutes (0.32) at CVCA2 was recorded during July 2015, while the greatest proportion of nights occupied occurred during August 2015 and July 2016 (0.23). The greatest average nightly call minutes (0.26) and proportion of nights occupied 0.23) recorded during 2016 were recorded in July. The greatest average nightly call minutes for western red bats at CVCA2 was recorded during 2015 (figure 13). The greatest proportion of nights occupied for western red bats at CVCA2 was recorded equally during 2015 and 2016. This occurred while the 2015 season had more recorded average nightly call minutes than the 2016 season.
Figure 13.—Western red bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.

The greatest western red bat average nightly call minutes at HH1 were recorded equally during July and August 2015 (0.03). No call minutes were recorded during 2016 or during June 2015. The greatest proportion of nights occupied for western red bats at HH1 were recorded equally during July and August 2015 (0.03). No proportion of nights occupied were recorded during 2016 or during June 2015 (figure 14). The greatest average nightly call minutes and greatest proportion of nights occupied for western red bats at HH1 were recorded during 2015, with no activity recorded during 2016.

The greatest western red bat average nightly call minutes at PVER1 were recorded during July in 2015 (4.13). The greatest average nightly call minutes during 2016 also occurred in July (1.52). The greatest average nightly call minutes for western red bats at PVER1 were recorded during 2015. The greatest proportion of nights occupied for western red bats at PVER1 were recorded during August 2015 (0.87). The greatest proportion of nights occupied during 2016 was recorded during July (0.61) (figure 15). June 2016 had a greater proportion of nights occupied than June 2015, although June 2015 had greater average nightly call minutes (figure 15). The greatest proportion of nights occupied for western red bats at PVER1 were recorded during 2015.
Figure 14.—Western red bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.

Figure 15.—Western red bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook.
The greatest western red bat average nightly call minutes (0.04) and proportion of nights occupied (0.07) at PVER2 were recorded during June 2015 and June 2016, respectively. No call minutes were recorded during July 2015, August 2015, or August 2016. The greatest average nightly call minutes for western red bats at PVER2 were recorded during 2016. No occupancy was recorded during July 2015, August 2015, or August 2016 (figure 16). The greatest proportion of nights occupied for western red bats at PVER2 were recorded during 2016 likely because fewer nights were recorded in 2015.

![Western Red Bat Average Nightly Call Minutes - PVER2](image)

![Western Red Bat Proportion of Nights Occupied - PVER2](image)

**Figure 16.**—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, and June 2016. No data were collected in July 2015.

The greatest western red bat average nightly call minutes (0.58) and proportion of nights occupied (0.26) at YEW1 were recorded during July 2016. The greatest average nightly call minutes (0.23) and proportion of nights occupied (0.19) during 2015 were also recorded during July. No call minutes or proportion of nights occupied was recorded during June 2015. The station malfunctioned for a portion of June 2015, which may explain the lack of activity during this time (figure 17). The greatest average nightly call minutes for western red bats at YEW1 were recorded during 2016. The greatest proportion of nights occupied for western red bats at YEW1 were also recorded during 2016.
Figure 17.—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**

Western yellow bats were recorded at all acoustic monitoring stations during 2015 and 2016, except PVER2 during 2016, using the Analook visual verification method (table 3).

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

<table>
<thead>
<tr>
<th>Conservation area or habitat creation area</th>
<th>Station acronym</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Ahakhav Tribal Preserve</td>
<td>AKTP1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Beal Lake Conservation Area</td>
<td>BLCA1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cibola National Wildlife Refuge Unit #1 Conservation Area</td>
<td>Crane Roost</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cibola Valley Conservation Area</td>
<td>CVCA1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>CVCA2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hunters Hole</td>
<td>HH1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Palo Verde Ecological Reserve</td>
<td>PVER1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>PVER2</td>
<td>X</td>
<td>None detected</td>
</tr>
<tr>
<td>Yuma East Wetlands</td>
<td>YEW1</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The greatest average call minutes (4.44, 6.13) and proportion of nights occupied (0.78, 0.94) for western yellow bats at AKTP1 were recorded during July 2015 and July 2016, respectively. Very little activity and occupancy were recorded in June 2016, with no activity recorded in June 2015. The greatest average nightly call minutes and proportion of nights occupied for western yellow bats at AKTP1 were recorded during 2016. The station malfunctioned for a portion of June and July 2015, which may have resulted in less activity and occupancy recorded during 2015 (figure 18). There was a greater proportion of nights occupied in August 2015 than August 2016, despite August 2016 having greater average nightly call minutes compared to 2015.

Figure 18.—Western yellow bat average nightly call minutes and proportion of nights occupied at AKTP1, using Analook.
* Station malfunction leading to partial monthly data collected in June and July 2015.

The greatest western yellow bat average nightly call minutes (0.23) at BLCA1 was recorded during July 2016. The greatest average nightly call minutes recorded during 2015 were recorded equally in July and August (0.10). No average nightly call minutes or proportion of nights occupied was recorded in June 2016. The greatest proportion of nights occupied for western yellow bats at BLCA1 were recorded equally during July 2015, July 2016, and August 2015 (0.10). The equal number of proportion of nights occupied during July 2015 and 2016 occurred despite July 2016 having more than double the amount of average nightly call minutes (0.23) than July 2015 (0.10) (figure 19). The greatest proportion of nights occupied for western yellow bats at BLCA1 was recorded during 2015, with the greatest average nightly call minutes recorded during 2016.
The greatest western yellow bat average nightly call minutes (0.10) and proportion of nights occupied (0.10) at the Crane Roost station were recorded during August 2016. The greatest average nightly call minutes and proportion of nights occupied recorded during 2015 were also recorded in August (0.06). No average nightly call minutes or proportion of nights occupied was recorded in June 2015, June 2016, or July 2016 (figure 20). The greatest average nightly call minutes and proportion of nights occupied recorded for western yellow bats at the Crane Roost station during 2015 and 2016 were recorded equally. This occurred while the station malfunctioned for a portion of June 2016.

The greatest western yellow bat average nightly call minutes (25.81) at CVCA1 were recorded during July 2015. The greatest average nightly call minutes (5.39) recorded during 2016 were recorded in August. The greatest average nightly call minutes for western yellow bats at CVCA1 were recorded during 2015. The greatest proportion of nights occupied for western yellow bats at CVCA1 was similar in June, July, and August 2015 as well as in July 2016 (all 0.97) (figure 21). Although there was a large disparity in average nightly call minutes between the 2015 and 2016 seasons, the proportion of nights occupied were more closely matched (figure 21). The greatest proportion of nights occupied for western yellow bats at CVCA1 were recorded during 2015.
Figure 20.—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.

Figure 21.—Western yellow bat average nightly call minutes and proportion of nights occupied at CVCA1, using Analook.
The greatest western yellow bat average nightly call minutes (1.97) at CVCA2 was recorded during July 2015. The greatest average nightly call minutes (0.71) and proportion of nights occupied (0.39) recorded during 2016 were also recorded in July. Overall, the greatest average nightly call minutes for western yellow bats at CVCA2 was recorded during 2015. The greatest proportion of nights occupied (0.77) for western yellow bats at CVCA2 was recorded during August 2015 despite July 2015 having the greatest recorded average nightly call minutes (figure 22). The greatest proportion of nights occupied for western yellow bats at CVCA2 was recorded during 2015.

![Figure 22.—Western yellow bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.](image)

The greatest western yellow bat average nightly call minutes (0.94) and proportion of nights occupied (0.65) at HH1 were recorded during July 2015. The greatest average nightly call minutes (0.58) and proportion of nights occupied (0.42) recorded during 2016 were also recorded in July (figure 23). Overall, the greatest average nightly call minutes for western yellow bats at HH1 were recorded during 2015. The greatest proportion of nights occupied for western yellow bats at HH1 were recorded during 2015.

The greatest western yellow bat average nightly call minutes (10.10) at PVER1 were recorded during August 2015. The greatest average nightly call minutes (3.03) and proportion of nights occupied (0.90) recorded during 2016 were also recorded in August (figure 24). The greatest average nightly call minutes for western yellow bats at PVER1 were recorded during 2015.
Figure 23.—Western yellow bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.

Figure 24.—Western yellow bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook.
The greatest proportion of nights occupied (0.97) for western yellow bats at PVER1 were recorded during July 2015 (see figure 24) despite August 2015 having greater average nightly call minutes than July 2015. Although the 2015 season had considerably more activity in the form of average nightly call minutes, the 2016 season had a greater proportion of nights occupied in June and August. The greatest proportion of nights occupied for western yellow bats at PVER1 were recorded during 2015.

The greatest western yellow bat average nightly call minutes (0.67) and proportion of nights occupied (0.33) at PVER2 were recorded during August 2015. No call minutes or proportion of nights occupied was recorded during 2016 or in July 2015 (figure 25). The greatest average nightly call minutes and proportion of nights occupied for western yellow bats at PVER2 were recorded during 2015. PVER2 only recorded 26 nights during 2015 and also malfunctioned during the 2016 season. A twisted microphone cable was detected in 2016, which may have led to a reduced number of calls being recorded.

The greatest western yellow bat average nightly call minutes (4.35) and proportion of nights occupied (0.94) at YEW1 were recorded during July 2015. The greatest average nightly call minutes (1.84) and proportion of nights occupied (0.65) recorded during 2016 also occurred in July (figure 26). The greatest average nightly call minutes and proportion of nights occupied for western yellow bats at YEW1 were recorded during 2015. The station malfunctioned for a portion of June 2015.

**Figure 25.**—Western yellow bat average nightly call minutes and proportion of nights occupied PVER2, using Analook.
* Station malfunction leading to partial monthly data collected in June 2015, August 2015, and June 2016. No data were collected in July 2015.
Figure 26.—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

California leaf-nosed bats were detected between 2015 and 2016 using the Analook visual verification method. None were detected at AKTP1, BLCA1, HH1, or PVER1 during 2015, but they were detected during 2016 at those stations. No California leaf-nosed bats were detected at the Crane Roost station, CVCA1, CVCA2, or YEW1 during 2016, but they were detected in 2015. No California leaf-nosed bat were detected at PVER2 during 2015 or 2016 (table 4).

<table>
<thead>
<tr>
<th>Conservation area or habitat creation area</th>
<th>Station acronym</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Ahakhav Tribal Preserve</td>
<td>AKTP1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td>Beal Lake Conservation Area</td>
<td>BLCA1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td>Cibola National Wildlife Refuge Unit #1 Conservation Area</td>
<td>Crane Roost</td>
<td>X</td>
<td>None detected</td>
</tr>
<tr>
<td>Cibola Valley Conservation Area</td>
<td>CVCA1</td>
<td>X</td>
<td>None detected</td>
</tr>
<tr>
<td></td>
<td>CVCA2</td>
<td>X</td>
<td>None detected</td>
</tr>
<tr>
<td>Hunters Hole</td>
<td>HH1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td>Palo Verde Ecological Reserve</td>
<td>PVER1</td>
<td>None detected</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>PVER2</td>
<td>None detected</td>
<td>None detected</td>
</tr>
<tr>
<td>Yuma East Wetlands</td>
<td>YEW1</td>
<td>X</td>
<td>None detected</td>
</tr>
</tbody>
</table>
The only California leaf-nosed bat average nightly call minutes and proportion of nights occupied (both 0.03) at AKTP1 were recorded during July 2016 (figure 27). No average nightly call minutes or proportion of nights occupied were recorded during 2015 or during June or August 2016. The lack of activity and occupancy during 2015 may be attributed to a station malfunction that led to a portion of June and July not being recorded.

Figure 27.—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 and July 2015.

The only California leaf-nosed bat average nightly call minutes and proportion of nights occupied at BLCA1 were recorded during June 2016 (figure 28). The average nightly call minutes and the proportion of nights occupied were both 0.07. No average nightly call minutes or proportion of nights occupied was recorded during 2015 or during July and August 2016. No proportion of nights occupied were recorded during 2015 or during July and August 2016.

The greatest California leaf-nosed bat average nightly call minutes and proportion of nights occupied at the Crane Roost station were recorded during June 2015 (figure 29). The average nightly call minutes and proportion of nights occupied were both 0.03. No average nightly call minutes or proportion of nights occupied was recorded during 2016 or during July and August 2015. A station malfunction at the Crane Roost station occurred during June 2016, which may explain the lack of activity and occupancy.
Figure 28.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied BLCA1, using Analook.

* Station malfunction leading to partial monthly data collected in June 2016.

Figure 29.—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.
The greatest California leaf-nosed bat average nightly call minutes and proportion of nights occupied (both 0.06) at CVCA1 were recorded during August 2015 (figure 30). No average nightly call minutes or proportion of nights occupied were recorded during 2016.

![Figure 30](image)

*Figure 30.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at CVCA1, using Analook.*

The greatest California leaf-nosed bat average nightly call minutes (0.29) and proportion of nights occupied (0.16) at CVCA2 were recorded during August 2015 (figure 31). No average nightly call minutes or proportion of nights occupied was recorded during 2016 or in June 2015.

The only California leaf-nosed bat average nightly call minutes and proportion of nights occupied (both 0.03) at HH1 were recorded during August 2016 (figure 32). No average nightly call minutes or proportion of nights occupied was recorded during 2015 or in June or July 2016.

The only California leaf-nosed bat average nightly call minutes and proportion of nights occupied (both 0.07) at PVER1 were recorded during June 2016 (figure 33). No average nightly call minutes or proportion of nights occupied was recorded during 2015 or in July or August 2016.

No California leaf-nosed bat activity or occupancy was recorded at PVER2 during 2015 or 2016. Malfunctions at this station during both seasons may be responsible for the lack of activity and occupancy.
Figure 31.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at CVCA2, using Analook.
All results in the narrative have been rounded to the nearest hundredth (1/100), while data in the figures show the full value.

Figure 32.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at HH1, using Analook.
All results in the narrative have been rounded to the nearest hundredth (1/100), while data in the figures show the full value.
The greatest California leaf-nosed bat average nightly call minutes (0.19) and proportion of nights occupied (0.16) at YEW1 were recorded during July 2015 (figure 34). No average nightly call minutes or proportion of nights occupied was recorded during 2016. The station was unable to be deployed on time during 2015, leading to a portion of June not being recorded.

Figure 33.—California leaf-nosed bat average nightly call minutes and proportion of nights occupied at PVER1, using Analook. All results in the narrative have been rounded to the nearest hundredth (1/100), while data in the figures show the full value.

Figure 34.—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. All results in the narrative have been rounded to the nearest hundredth (1/100), while data in the figures show the full value.
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 method and the nature of their whispering calls, no pale Townsend’s big-eared bat calls were detected during 2015 or 2016 monitoring at any location.

Kaleidoscope Auto-Classifier Results
Western Red Bat
A comparison of the visually verified Analook and the Kaleidoscope auto-classified western red bat calls revealed different findings. The auto-classifier consistently identified a greater number of calls as western red bats (35,048 total) than the visual verification method across sites (799) (table 5). The Kaleidoscope auto-classifier also consistently identified more occupancy than the Analook visual verification method, with over 90% occupancy (and often 100%) at every station from 2015 and 2016, with the exceptions of HH1 during 2015 (71%) and PVER2 during 2016 (50%). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. The Analook filters identified 30,983 calls as potential western red bats and identified less calls than the auto-classifier, with the exception of CVCA1, PVER1, and PVER2 (table 5).

Table 5.—Western red bat Kaleidoscope auto-classifier, Analook filter, and Analook visual verification call identification results

<table>
<thead>
<tr>
<th>Station acronym</th>
<th>Kaleidoscope auto-classifier results</th>
<th>Analook filter results</th>
<th>Analook visual verification results</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKTP1</td>
<td>2,424</td>
<td>451</td>
<td>2</td>
</tr>
<tr>
<td>BLCA1</td>
<td>10,056</td>
<td>7,672</td>
<td>60</td>
</tr>
<tr>
<td>Crane Roost</td>
<td>2,972</td>
<td>1,404</td>
<td>26</td>
</tr>
<tr>
<td>CVCA1</td>
<td>6,502</td>
<td>8,090</td>
<td>234</td>
</tr>
<tr>
<td>CVCA2</td>
<td>2,424</td>
<td>1,193</td>
<td>42</td>
</tr>
<tr>
<td>HH1</td>
<td>699</td>
<td>218</td>
<td>3</td>
</tr>
<tr>
<td>PVER1</td>
<td>7,469</td>
<td>10,428</td>
<td>396</td>
</tr>
<tr>
<td>PVER2</td>
<td>155</td>
<td>366</td>
<td>3</td>
</tr>
<tr>
<td>YEW1</td>
<td>2,347</td>
<td>1,161</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>35,048</strong></td>
<td><strong>30,983</strong></td>
<td><strong>799</strong></td>
</tr>
</tbody>
</table>
AKTP1

The visual verification of the Analook filter results only detected western red bat activity and occupancy at AKTP1 in July 2016 (see figure 9), which was much lower in magnitude than the activity (figure 35) and occupancy detected by the Kaleidoscope auto-classifier. The auto-classifier identified July 2016 as having the greatest average nightly call minutes with a proportion of nights occupied at 0.98 in 2015 and 1.0 in 2017.

![Western Red Bat Kaleidoscope Results AKTP1](image)

![Western Red Bat Analook Verified Call Minutes AKTP1](image)

Figure 35.—Western red bat Kaleidoscope and verified Analook call minutes at AKTP1.
* Station malfunction leading to partial monthly data collected in June and July 2015.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 451 call sequences classified as western red bats by the Analook filters, and two calls were visually verified as western red bats. The Kaleidoscope auto-classifier classified five times as many (2,424) call sequences as western red bats.
**BLCA1**

The 2015 season had the greatest western red bat average nightly call minutes detected using the Analook visual verification method, and the 2016 season had the greatest average nightly call minutes detected using the Kaleidoscope auto-classifier (see figure 10; figure 36). The proportion of nights occupied detected by the auto-classifier were 1.0 in both 2015 and 2016, which was greater that the occupancy detected using the Analook visual verification method (see figure 10).

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 7,672 call sequences classified as western red bats by the Analook filters, but only 60 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified 10,056 call sequences as western red bats.

![Figure 36.—Western red bat Kaleidoscope results and verified Analook call minutes at BLCA1.](image)

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37
Crane Roost Station

Through the Analook visual verification methods, activity and occupancy were recorded across all months (see figure 11; figure 37), except June 2016, and at a much lower magnitude than activity (figure 37) and occupancy recorded by the Kaleidoscope auto-classifier. The 2015 season had the greatest western red bat average nightly call minutes through the verification methods and the auto-classifier. The proportion of nights occupied detected by the auto-classifier were 1.0 in both 2015 and 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 1,404 call sequences classified as western red bats by the Analook filters, and 26 calls of those calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified twice as many (2,972) call sequences as western red bats.

Figure 37.—Western red bat Kaleidoscope results and verified Analook call minutes at the Crane Roost station.
* Station malfunction leading to partial monthly data collected in June 2016.
Through the Analook visual verification methods, activity and occupancy were recorded across all months (see figure 12; figure 38) but at a much lower magnitude than the activity (figure 38) and occupancy recorded by the Kaleidoscope auto-classifier. The 2016 season had the greatest western red bat average nightly call minutes through the verification method and the auto-classifier. The proportion of nights occupied detected by the auto-classifier were 1.0 in both 2015 and 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 8,090 call sequences classified as western red bats by the Analook filters, and 234 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified 6,502 call sequences as western red bats.

![Western Red Bat Kaleidoscope Results CVCA1](image1)

![Western Red Bat Analook Verified Call Minutes CVCA1](image2)

*Figure 38.—Western red bat Kaleidoscope results and verified Analook call minutes at CVCA1.*
CVCA2
Through the Analook visual verification methods, activity and occupancy were recorded across all months (see figure 13), but at a much lower magnitude than the activity (figure 39) and occupancy recorded by the Kaleidoscope auto-classifier. The 2015 season had the greatest western red bat average nightly call minutes through the verification method. The 2016 season had the greatest western red bat average nightly call minutes through the auto-classifier. The proportion of nights occupied detected by the auto-classifier were 1.0 in 2015 and 0.99 in 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 1,193 call sequences classified as western red bats by the Analook filters, and 42 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified twice as many (2,424) call sequences as western red bats.

![Western Red Bat Kaleidoscope Results CVCA2](image1)
![Western Red Bat Analook Verified Call Minutes CVCA2](image2)

Figure 39.—Western red bat Kaleidoscope results and verified Analook call minutes at CVCA2.
Through the Analook visual verification methods, activity and occupancy were recorded only during July and August 2015 (see figure 14). The 2015 season had the greatest western red bat average nightly call minutes through the verification method. The 2016 season had the greatest western red bat average nightly call minutes through the Kaleidoscope auto-classifier (figure 40). The proportion of nights occupied detected by the auto-classifier were 0.71 in 2015 and 0.90 in 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 218 call sequences classified as western red bats by the Analook filters, and 3 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified three times as many (699) call sequences as western red bats.

Figure 40.—Western red bat Kaleidoscope results and verified Analook call minutes at HH1.
PVER1

Through the Analook visual verification methods, activity and occupancy were recorded across all months (see figure 15) but at a much lower magnitude than the activity (figure 38) and occupancy recorded by the Kaleidoscope auto-classifier (figure 41). The 2015 season had the greatest western red bat average nightly call minutes through the verification method. The 2016 season had the greatest western red bat average nightly call minutes through the auto-classifier. The proportion of nights occupied detected by the auto-classifier were 1.0 in both 2015 and 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 10,428 call sequences classified as western red bats by the Analook filters, and 396 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified 7,469 call sequences as western red bats.

![Figure 41.—Western red bat Kaleidoscope results and verified Analook call minutes at PVER1.](image)
Through the Analook visual verification methods, activity and occupancy were recorded during June 2015, June 2016, and July 2016 (see figure 16). The Kaleidoscope auto-classifier results showed high western red bat activity across all months (figure 42), with the exception of July 2015 (0 auto-classified calls), and with a high proportion of nights occupied. The 2016 season had the greatest western red bat average nightly call minutes through the verification method. The 2015 season had the greatest western red bat average nightly call minutes through the auto-classifier. The proportion of nights occupied detected by the auto-classifier were 0.92 in 2015 and 0.50 in 2016.

The automated portion of both methods were compared, the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 366 call sequences classified as western red bats by the Analook filters, and 3 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified 155 call sequences as western red bats.

Figure 42.—Western red bat Kaleidoscope results and verified Analook call minutes at PVER2.
* Station malfunction leading to partial monthly data collected in June 2015, August 2015, and June 2016. No data were collected in July 2015.
Through the Analook visual verification methods, activity and occupancy were recorded across all months, with the exception of June 2015 (see figure 17). The 2016 season had the greatest western red bat average nightly call minutes through the verification method and the Kaleidoscope auto-classifier (figure 43). The proportion of nights occupied detected by the auto-classifier were 1.0 in 2015 and 0.99 in 2016.

The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 1,161 call sequences classified as western red bats by the Analook filters, and 33 calls were visually verified to be western red bats. The Kaleidoscope auto-classifier classified 2,347 call sequences as western red bats.

![Figure 43.—Western red bat Kaleidoscope results and verified Analook call minutes at YEW1.](image)

* Station malfunction leading to partial monthly data collected in June 2015.
Pale Townsend’s Big-Eared Bat

No pale Townsend’s big-eared bat activity was detected through the Analook visual verification method at any site during 2015 and 2016. The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. The Analook filters for this species flagged 42,027 calls as potential pale Townsend’s big-eared bats across all sites, while the Kaleidoscope auto-classifier flagged a total of 446 calls (table 6).

Table 6.—Pale Townsend’s big-eared bat Kaleidoscope auto-classifier, Analook filter, and Analook visual verification call identification results

<table>
<thead>
<tr>
<th>Station acronym</th>
<th>Kaleidoscope auto-classifier results</th>
<th>Analook filter results</th>
<th>Analook visual verification results</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKTP1</td>
<td>40</td>
<td>1,008</td>
<td>0</td>
</tr>
<tr>
<td>BLCA1</td>
<td>46</td>
<td>9,108</td>
<td>0</td>
</tr>
<tr>
<td>Crane Roost</td>
<td>45</td>
<td>2,229</td>
<td>0</td>
</tr>
<tr>
<td>CVCA1</td>
<td>109</td>
<td>11,802</td>
<td>0</td>
</tr>
<tr>
<td>CVCA2</td>
<td>36</td>
<td>6,593</td>
<td>0</td>
</tr>
<tr>
<td>HH1</td>
<td>3</td>
<td>142</td>
<td>0</td>
</tr>
<tr>
<td>PVER1</td>
<td>58</td>
<td>7,737</td>
<td>0</td>
</tr>
<tr>
<td>PVER2</td>
<td>3</td>
<td>69</td>
<td>0</td>
</tr>
<tr>
<td>YEW1</td>
<td>106</td>
<td>3,339</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>446</td>
<td>42,027</td>
<td>0</td>
</tr>
</tbody>
</table>

AKTP1

The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in July 2015 (figure 44). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 1,008 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 40 call sequences as pale Townsend’s big-eared bats.

BLCA1

The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in July 2015 (figure 45). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 9,108 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 46 call sequences as pale Townsend’s big-eared bats.
Figure 44.—Pale Townsend’s big-eared bat Kaleidoscope results at AKTP1. * Station malfunction leading to partial monthly data collected in June and July 2015.

Figure 45.—Pale Townsend’s big-eared bat Kaleidoscope results at BLCA1.
Crane Roost Station
The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in July 2016 (figure 46). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 2,229 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 45 call sequences as pale Townsend’s big-eared bats.

Figure 46.—Pale Townsend’s big-eared bat Kaleidoscope results at the Crane Roost station.
* Station malfunction leading to partial monthly data collected in June 2016.
CVCA1

The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in July 2015 (figure 47). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 11,802 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 109 call sequences as pale Townsend’s big-eared bats.

Figure 47.—Pale Townsend’s big-eared bat Kaleidoscope results at CVCA1.
**CVCA2**

The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes occurring in July 2016 and the greatest proportion of nights occupied occurring in June 2016 (figure 48). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 6,593 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 36 call sequences as pale Townsend’s big-eared bats.

![Graphs showing data for pale Townsend's big-eared bats](image)

**Figure 48.—Pale Townsend's big-eared bat Kaleidoscope results at CVCA2.**
**HH1**

The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring equally in July and August 2015 and July 2016 (figure 49). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 142 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just three call sequences as pale Townsend’s big-eared bats.

![Figure 49.—Pale Townsend's big-eared bat Kaleidoscope results at HH1.](image-url)
The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in July 2016. (figure 50). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 7,737 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 58 call sequences as pale Townsend’s big-eared bats.

Figure 50.—Pale Townsend’s big-eared bat Kaleidoscope results at PVER1.
The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes and proportion of nights occupied occurring in June 2016 (figure 51). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 69 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just three call sequences as pale Townsend’s big-eared bats.

Figure 51.—Pale Townsend’s big-eared bat Kaleidoscope results at PVER2.
* Station malfunction leading to partial monthly data collected in June 2015, August 2015, and June 2016. No data were collected in July 2015.
YEW1
The Kaleidoscope auto-classifier flagged some activity and occupancy for pale Townsend’s big-eared bats, with the greatest average nightly call minutes occurring in July 2016 and the greatest proportion of nights occupied occurring in August 2016 (figure 52). The automated portion of both methods were compared: the Analook filters without visual verification and the Kaleidoscope auto-classifier. There were 3,339 call sequences classified as this species by the Analook filters, and 0 calls were visually verified. The Kaleidoscope auto-classifier classified just 106 call sequences as pale Townsend’s big-eared bats.

![Figure 52.—Pale Townsend’s big-eared bat Kaleidoscope results at YEW1.](image)

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

Species Results
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 bats, hoary bats, California myotis, Arizona myotis, Yuma myotis, canyon bats, and Mexican free-tailed bats.

The Kaleidoscope auto-classifier identified Arizona myotis as having the greatest average nightly call minutes for any species at AKTP1 (figure 53). Other species with high activity levels at AKTP1 were canyon bats, Mexican free-tailed bats, and greater mastiff bats. The greatest average nightly call minutes at AKTP1 occurred during 2016.
Figure 53.—Kaleidoscope results for 2015 and 2016 at AKTP1.
* Station malfunction leading to partial monthly data collected in June and July 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 blossevillian*),
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 freetailed bat (*Tadarida brasiliensis*).
The Kaleidoscope auto-classifier identified canyon bats as having the greatest average nightly call minutes for any species at BLCA1 (figure 54). Other species with high activity levels at BLCA1 were Arizona myotis, Yuma myotis, and western red bat. The greatest average nightly call minutes at BLCA1 occurred during 2016.

**Figure 54.—Kaleidoscope results for 2015 and 2016 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 freetailed bat (*Tadarida brasiliensis*).
The Kaleidoscope auto-classifier identified canyon bats as having the greatest average nightly call minutes for any species at the Crane Roost station (figure 55). Other species with high activity levels at this station were Yuma myotis, Arizona myotis, and western red bats. The greatest average nightly call minutes at the Crane Roost station occurred during 2016.

Figure 55.—Kaleidoscope results for 2015 and 2016 at the Crane Roost station.
* Station malfunction leading to partial monthly data collected in June 2016.

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*), MYHU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).
The Kaleidoscope auto-classifier identified Mexican free-tailed bats as having the greatest average nightly call minutes for any species at CVCA1 (figure 56). 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.

Figure 56.—Kaleidoscope results for 2015 and 2016 at CVCA1.

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*).
The Kaleidoscope auto-classifier identified Yuma myotis as having the greatest average nightly call minutes for any species at CVCA2 (figure 57). Other species with high activity levels at CVCA2 were canyon bats, Arizona myotis, big brown bats, and Mexican free-tailed bats. The greatest average nightly call minutes at CVCA2 occurred during 2016.

Figure 57.—Kaleidoscope results for 2015 and 2016 at CVCA2.
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*).
The Kaleidoscope auto-classifier identified Yuma myotis as having the greatest average nightly call minutes for any species at HH1 (figure 58). Other species with high activity levels at HH1 were Mexican free-tailed and greater mastiff bats. The greatest average nightly call minutes at HH1 occurred during 2016.

![HH1 Kaleidoscope Results](image)

**Figure 58.—Kaleidoscope results for 2015 and 2016 at HH1.** 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*).
The Kaleidoscope auto-classifier identified Mexican free-tailed bats as having the greatest average nightly call minutes for any species at PVER1 (figure 59). 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.

![PVER1 Kaleidoscope Results](image)

**Figure 59.**—Kaleidoscope results for 2015 and 2016 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*), MYU = Yuma myotis (*Myotis yumanensis*), PAHE = canyon bat (*Parastrellus hesperus*), and TABR = Mexican free-tailed bat (*Tadarida brasiliensis*).
The Kaleidoscope auto-classifier identified canyon bats as having the greatest average nightly call minutes for any species at PVER2 (figure 60). The other species with high activity levels at PVER2 was the Mexican free-tailed bat. The greatest average nightly call minutes at PVER2 occurred during 2015.

**Figure 60.—Kaleidoscope results for 2015 and 2016 at PVER2.**
* Station malfunction leading to partial monthly data collected in June 2015, August 2015, and June 2016. No data were collected in July 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*).
The Kaleidoscope auto-classifier identified Mexican free-tailed bats as having the greatest average nightly call minutes for any species at YEW1 (figure 61). The other species with high activity levels at YEW1 were big brown bats, Yuma myotis, pallid bats, and canyon bats. The greatest average nightly call minutes at YEW1 occurred during 2015.

Figure 61.—Kaleidoscope results for 2015 and 2016 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*).
Site Comparisons

Western Red Bat

The greatest average nightly call minutes and proportion of nights occupied for western red bats using the Analook visual verification method during 2015 were recorded at PVER1 (figures 62 and 63). The greatest average nightly call minutes recorded during 2016 were recorded at CVCA1, but the greatest proportion of nights occupied were recorded at PVER1. Call minutes and proportion of nights occupied were recorded at all sites during both 2015 and 2016, with the exceptions of AKTP1 during 2015 and HH1 during 2016. The site with the second greatest average nightly call minutes during 2015 was CVCA1, followed by BLCA1, CVCA2, and Crane Roost. The site with the second greatest average nightly call minutes during 2016 was PVER1, followed by YEW1 and AKTP1. The site with the second greatest proportion of nights occupied during 2015 was CVCA1, followed by BLCA1, CVCA2, and Crane Roost. The site with the second greatest proportion of nights occupied during 2016 was CVCA1, followed by AKTP1, YEW1, CVCA2, and BLCA1.

![Western Red Bat Average Nightly Call Minutes](image)

**Figure 62.**—Western red bat average nightly call minutes station comparison.

* Station malfunction occurred at site.
The Kaleidoscope auto-classifier produced different results than the visual verification method. Considerably more average nightly call minutes and proportion of nights occupied were recorded by the auto-classifier. Nearly every station, with the exceptions of HH1 and PVER2, had 100% of nights occupied. BLCA1 had the greatest average nightly call minutes during both 2015 and 2016, followed by PVER1 and CVCA1 (figure 64). The lowest average nightly call minutes was recorded at HH1 and PVER2. 

Figure 63.—Western red bat proportion of nights occupied station comparison. * Station malfunction occurred at site.

Figure 64.—Western red bat Kaleidoscope results station comparison. * Station malfunction occurred at site.
Western Yellow Bat

The greatest average nightly call minutes and proportion of nights occupied for western yellow bats using the Analook visual verification method during 2015 and 2016 were recorded at CVCA1 (figures 65 and 66). The site with the second greatest average nightly call minutes during 2015 was PVER1, followed by YEW1, AKTP1, and CVCA2. The site with the second greatest average nightly call minutes during 2016 was AKTP1, followed by PVER1 and YEW1. The site with the second greatest proportion of nights occupied during 2015 was YEW1, followed by PVER1, CVCA2, and AKTP1. The site with the second greatest proportion of nights occupied during 2016 was PVER1, followed by AKTP1, YEW1, HH1, and CVCA2. No call minutes or proportion of nights occupied was recorded during 2016 at PVER2. Greater average nightly call minutes and proportion of nights occupied were recorded during 2015 across all sites for western yellow bats.

**Figure 65.—Western yellow bat average nightly call minutes station comparison.**

* Station malfunction occurred at site.
Figure 66.—Western yellow bat proportion of nights occupied station comparison.
* Station malfunction occurred at site.
California Leaf-Nosed Bat

California leaf-nosed bat average nightly call minutes and proportion of nights occupied were recorded sporadically and in low numbers due to the low-amplitude calls this species produces. The greatest average nightly call minutes and proportion of nights occupied using the Analook visual verification method during 2015 were recorded at YEW1, followed by CVCA2, CVCA1, and the Crane Roost station (figures 67 and 68). No activity or occupancy was recorded at AKTP1, BLCA1, HH1, PVER1, or PVER2 in 2015. The greatest average nightly call minutes and proportion of nights occupied during 2016 were recorded equally at BLCA1 and PVER1 followed equally again by AKTP1 and HH1. No activity or occupancy was recorded at the Crane Roost station, CVCA1, CVCA2, PVER2, or YEW1 during 2016. Greater average nightly call minutes and proportion of nights occupied were recorded during 2015 for California leaf-nosed bats.

Figure 67.—California leaf-nosed bat average nightly call minutes station comparison.

* Station malfunction occurred at site.
Figure 68.—California leaf-nosed bat proportion of nights occupied station comparison.
* Station malfunction occurred at station.
Pale Townsend’s Big-Eared Bat

No verified activity or occupancy was recorded for pale Townsend’s big-eared bats with the Analook visual verification method because of the low-amplitude calls this species produces. 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 69). The greatest average nightly call minutes during 2016 were recorded at YEW1, followed by CVCA1, PVER1, and AKTP1. Greater average nightly call minutes were recorded during 2016 season for pale Townsend’s big-eared bats.

**Figure 69.—Pale Townsend’s big-eared bat Kaleidoscope results station comparison.**

* Station malfunction occurred at station.

**DISCUSSION**

Through the Analook visual verification method, the greatest activity and occupancy for western red and yellow bats was detected at CVCA1 and PVER1, and at CVCA2 and YEW1 for California leaf-nosed bats. No pale Townsend’s big-eared bat calls were detected through the Analook visual verification method, but they were recorded with the Kaleidoscope auto-classifier, and their greatest activity and occupancy was at YEW1 and CVCA1. The auto-classifier overestimated western red bat activity and occupancy, but it has the potential to be useful for pale Townsend’s big-eared bat calls. The greatest activity across all species by the Kaleidoscope auto-classifier was detected at CVCA1 and PVER1.
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 were located in the most mature and complex vegetation of the conservation areas. The PVER and CVCA were 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 PVER1 and CVCA1 occurred in July, which coincides with the time of year juvenile bats become volant. Other sites with their greatest recorded activity and occupancy in July were AKTP1, BLCA1, and YEW1. CVCA2 had the greatest average nightly call minutes in July but greater occupancy in August. Very little activity and occupancy were recorded at PVER2 (greatest in June) and HH1 (July and August equally).

Greater average nightly call minutes and proportion of nights occupied for western red bats were recorded during 2015 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 proportion of nights occupied. In a given year, habitat near a detector may be optimal for a maternity roost or foraging, leading to an increase in average nightly call minutes but not necessarily nights occupied. The 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. 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), while the proportion of nights occupied did not show such a large disparity (0.71 versus 0.55). 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 call verification method, they 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 conservation area with the greatest western red bat activity. Through the verification method, 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 it varied among monitoring sites, with the Analook filters identifying more potential calls at several monitoring sites. These greater potential western red bat calls identified by the auto-classifier likely represent misidentified calls from other species, but we cannot discount 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 the accuracy of the filters used in both methods are improved in the future.

Western Yellow Bats

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 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 YEWH, while YEWH actually had a slightly greater proportion of nights occupied (0.70 versus 0.68). The majority of western yellow bat activity and occupancy occurred later in summer during July and August, with no station recording its greatest activity in June. Like western red bats, western yellow bat young typically become volant in July, which would lead to the increased activity observed in July and August. 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. No Kaleidoscope 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 analyses.
California Leaf-Nosed Bat

California leaf-nosed bats were recorded in low numbers across the 2015 and 2016 seasons at the nine conservation areas. These bats produce a low-amplitude call that is difficult to detect through acoustic methods. California leaf-nosed bats were not recorded in either 2015 or 2016 at any monitoring site. They were detected at the Crane Roost station, CVCA1, CVCA2, and YEW1 during 2015 and at AKTP1, BLCA1, HH1, and PVER1 during 2016. California leaf-nosed bats were not detected at PVER2 during 2015 and 2016. The greatest average nightly call minutes and proportion of nights occupied occurred at YEW1 and CVCA2. 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 analyses.

Pale Townsend’s Big-Eared Bat

Pale Townsend’s big-eared bats were not recorded at any conservation area with the visual verification method during 2015 and 2016. 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 each season. 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 Townsend's 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.

Kaleidoscope Auto-Classifier

The species with the 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. 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
PVER1, BLCA1, CVCA2, YEW1, AKTP1, 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 for other species as well along the LCR.

When assessing the four LCR MSCP-covered 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. 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 documented 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 emit low-amplitude calls and are difficult to detect acoustically.
LITERATURE CITED


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