

The logo for the Southern Western Conservation Agency (SWCA) is positioned vertically on the left side of the page. It consists of the letters 'S', 'W', 'C', and 'A' in a large, stylized, light blue font, stacked one above the other.

# Analysis of Bat Acoustic Data for the MSHCP Amendment – Final Project Report

MARCH 2025

PREPARED FOR

**Desert Conservation Program  
Clark County Department of  
Environment and Sustainability**

PREPARED BY

**SWCA Environmental Consultants**



# **ANALYSIS OF BAT ACOUSTIC DATA FOR THE MSHCP AMENDMENT – FINAL PROJECT REPORT**

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## EXECUTIVE SUMMARY

In accordance with the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and the associated Incidental Take Permit, Clark County (the County) manages properties for the benefit of species covered by the MSHCP. SWCA, under contract with the County, conducted passive bat detection throughout Clark County in 2022 through 2024 to document occurrence and habitat use for two MSHCP-covered bat species, Townsend's big-eared bat (*Corynorhinus townsendii*) and spotted bat (*Euderma maculatum*). As part of this study, SWCA deployed bat detectors at a total of 60 survey locations during this period, resulting in a total bat acoustic survey effort of 442 detector-nights. The material described herein provides analysis, interpretation, and summary reporting for this dataset, including species-level identification for all potential bat species. The primary goal of this project is to determine bat species occurrence and habitat use, including current and proposed MSHCP-covered species, so that future management decisions can be tailored to support bat habitat within Clark County.

Acoustic survey locations were selected to optimize the probability of detecting spotted bat. Survey locations were placed within the County's Riparian Reserve Units, proposed MSHCP Amendment Impact Areas, the proposed MSHCP Amendment Special Management Areas, and other state and federally managed lands in Clark County. Acoustic surveys were performed primarily within potential spotted bat foraging habitat at 60 locations. At each acoustic survey location, a full-spectrum bat detector was deployed once, between May and September, for a minimum of 5 nights, from approximately 30 minutes before sunset to 30 minutes after sunrise. Each detector microphone was attached to an aluminum extension pole elevated 3 to 7.5 meters above ground surface. Acoustic survey locations were within or adjacent to areas known to be used by spotted bats, consisting of mesquite (*Prosopis* spp.) bosque, emergent marsh, cliff faces, springs, agricultural fields, and/or other water features.

Analysis of this acoustic dataset resulted in a total of 20 bat species detected within Clark County (18 in 2022 and 19 in 2024). Acoustic bat surveys detected three species currently listed as covered under the current MSHCP: long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), and silver-haired bat (*Lasionycteris noctivagans*). These surveys also detected the two species of bat designated as covered under the proposed amendment to the MSHCP (spotted bat and Townsend's big-eared bat). Acoustic detections of pocketed free-tailed bat (*Nyctinomops femorosaccus*) at three survey locations represents the second confirmed record for this species in Nevada, and, presumably, the northernmost record for the species. A description of bat occurrence and habitat use within Clark County in 2022 and 2024 is provided herein.

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# 1 INTRODUCTION

## 1.1 Description of the Project

In accordance with the Clark County Multiple Species Habitat Conservation Plan (MSHCP), the Clark County Desert Conservation Program (the County) protects and manages habitat for protected species within its MSHCP properties, including habitat for bat species covered by the MSHCP (Clark County Department of Comprehensive Planning and U.S. Fish and Wildlife Service 2000). A proposed amendment to the MSHCP includes a revision to the MSHCP properties and also the species listed as covered under the plan. To better understand and subsequently protect these species, the County commissioned habitat distribution models for 50 species (Nussear and Simandle 2020; Southwest Ecology LLC 2018). These models will be used to identify potential areas for conservation and protection from development or disturbance. To better refine some of these models, the County scoped this project to collect additional occurrence data for two proposed covered, or target, bat species: spotted bat (*Euderma maculatum*) and Townsend's big-eared bat (*Corynorhinus townsendii*). SWCA, under contract with the County, conducted passive bat detection throughout Clark County in 2022 (SWCA 2023) through 2024 (SWCA 2024) to document occurrence and habitat use for these target bat species. As part of this study, SWCA deployed bat detectors at a total of 60 sites during this period, resulting in a total bat acoustic survey effort of 442 detector-nights. The material described herein provides analysis, interpretation, and summary reporting for this acoustic dataset, including species-level identification for all potential bat species. Additional, detailed analysis of acoustic and roost survey detections for target bat species is provided in the final project reports for 2022 (SWCA 2023) and 2024 (SWCA 2024) surveys.

## 1.2 Background and Need

On March 28, 2001, the U.S. Fish and Wildlife Service (USFWS) issued an incidental take permit for the MSHCP, which covered 78 species, including three bat species (USFWS 2001). The process of amending the MSHCP began in 2007. One of the goals of the amendment is to minimize the number of species covered by the MSHCP to focus on those most at risk. Through this process, the number of species covered under the proposed amendment would be reduced to 29, including two bat species (Clark County 2019). As part of this process, the County commissioned the development of habitat distribution models for 50 new species to help determine which species should be covered (Nussear and Simandle 2020; Southwest Ecology LLC 2018). Distribution is poorly understood for the two bat species proposed for coverage under the amendment (spotted bat and Townsend's big-eared bat) (hereafter target species). During the model development process, several areas lacking data were identified for the target species, and the County determined that additional data were needed to refine the target species' models. SWCA Environmental Consultants (SWCA) was contracted in 2022 and 2023 to conduct bat surveys to assist in filling in these data gaps.

## 1.3 Management Actions, Goals, and Objectives

The goal of the bat surveys project is to increase knowledge of the distribution and characterization of suitable habitat for target bat species within Clark County. The primary objective of the project is to determine bat species occurrence and habitat use, including current and proposed MSHCP-covered species, so that future management decisions can be tailored to support bat habitat within Clark County.

## 2 Methods and Materials

### 2.1 Site Selection

SWCA initially selected 84 acoustic survey sites within Clark County on lands managed by federal, state, and county entities where data gaps existed for the target species. Data provided by the County and used in site selection included the habitat suitability models and existing detection locations for spotted bat (Southwest Ecology LLC 2018). SWCA also requested and/or reviewed additional agency and publicly available spatial data for occurrence records (J. Williams, personal communication with M. Swink, SWCA; NatureServe 2022, 2023; Nevada Division of Natural Heritage [NDNH] 2022, 2024). These location data were used to select sites that fit the prioritization criteria described below. As part of this survey effort, SWCA identified potential survey locations where the distribution model for spotted bat predicted high levels of habitat suitability, or available desktop data analysis suggested potential occurrence, or both (Figure 1). Identification of more survey locations than necessary allowed for sites to be replaced easily if field evaluation revealed access impediments, safety concerns, or any other factors that might prevent survey at any selected site. Areas of high habitat suitability that overlapped the proposed MSHCP Amendment Impact Areas, proposed MSHCP Amendment Reserve System polygons, or proposed MSHCP Amendment Special Management Area polygons were prioritized in selection of survey locations. Potential survey locations were within approximately 1 mile (1.6 kilometers [km]) of access roads and on lands administered by either the Bureau of Land Management (BLM), Clark County, National Park Service (NPS), Nevada Department of Wildlife (NDOW), State of Nevada, U.S. Fish and Wildlife Service (USFWS), or U.S. Forest Service (FS). From the 84 potential survey locations, an experienced bat biologist evaluated observed conditions to microsite up to 60 acoustic survey locations within suitable habitat for spotted bat. SWCA coordinated with the County to ensure that survey location selection met overall project goals.

#### 2.1.1 Site Selection Criteria

SWCA used the spotted bat habitat suitability model and existing detection location data to identify selected sites that fit the prioritization criteria, as described below (see Figure 1). Acoustic survey locations for spotted bat targeted historical acoustic and capture detection locations, as well as areas with suitable foraging habitat (e.g., riparian marsh and mesquite [*Prosopis* spp.] bosque) and roosting habitat (e.g., large cliff faces in mountainous areas). Sites were then selected using the following prioritization criteria:

- location inside or outside a proposed MSHCP Amendment Impact Area or Reserve Area (inside preferred),
- location inside or outside a proposed SMA (inside preferred),
- proximity to a road navigable with a truck ( $\leq 1$  mile [1.6 km] preferred), and
- location on private or public land (public land preferred).

Following the initial selection process, an SWCA bat biologist performed a desktop review using the criteria above to evaluate potential site locations in areas outside of habitat modeled as suitable. The result of this selection process was a collection of 60 primary survey locations and an available set of 24 alternative survey locations, which could be used if unforeseen access or navigation issues were identified.

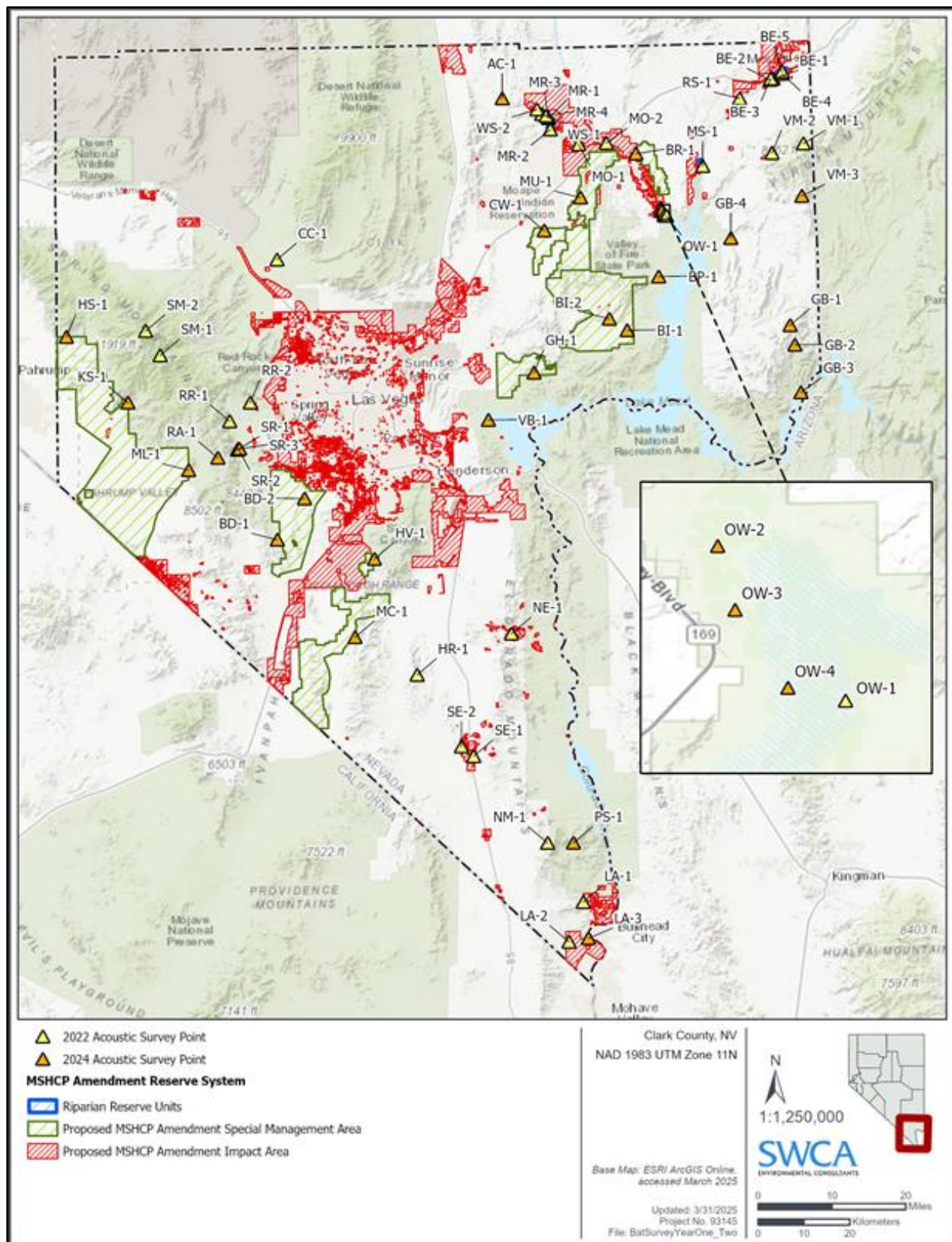


Figure 1. Bat acoustic survey locations.

## **2.2 Surveys**

Survey methods described below are based on established bat acoustic (Loeb et al. 2015; Reichert et al. 2018) survey protocols which are generally recognized as preferable methods for detecting most North American bat species.

### **2.2.1 Acoustic Surveys**

SWCA completed bat acoustic surveys to increase occurrence data of target bat species within Clark County. SWCA deployed acoustic bat detectors to survey 60 total sites within Clark County. At each recording location, an SM4BAT FS (Wildlife Acoustics) full-spectrum detector and SMM-U1 ultrasonic microphone were deployed to collect bat vocalizations. Each microphone was attached to an extendable aluminum pole and elevated at least 3 meters (m) above ground surface. Detectors were calibrated to optimize low-intensity acoustic recordings of ultra-low-frequency bat species and record within their respective frequency ranges. Detectors were placed adjacent to potential bat attractant features such as water features and natural corridors, whenever present. Each detector was programmed to operate nightly for a minimum of 5 detector-nights (defined as the period from 30 minutes before sunset to 30 minutes after sunrise). Following each survey session, a bat biologist retrieved acoustic data, inspected acoustic detectors and microphones, and then redeployed equipment at a new survey location. 2022 acoustic surveys were conducted between June 3 and September 29, while 2024 surveys occurred between May 3 and September 13. Survey timing was informed by review of target species occurrence data within Clark County (Bradley et al. 2006; Las Vegas Wash Coordination Committee 2011; NDNH 2022, 2024; Southwest Ecology LLC 2018; Williams et al. 2006) to optimize detection probability during higher bat activity periods associated with breeding and foraging behavior (Tables 1 and 2).

### **2.2.2 Habitat Data**

Surveyors recorded data on selected habitat components and structural metrics at each acoustic survey location. These data consisted of the dominant vegetation species and average and maximum vegetation height (in meters). Additionally, surveyors took several representative overview photographs of each survey location, and recorded habitat information for each distinct habitat type. All data were recorded on a Samsung smartphone (Galaxy S10 or S22) using ArcGIS Field Maps (version 2024.1.3-2.0).

## **2.3 Acoustic Data Processing and Analysis**

SWCA identified acoustic recordings of bat species through a combination of bat classification software and manual vetting. An experienced bat biologist performed batch-processing, including noise filtering and automated bat call classification, of the recorded dataset. In total, 267,179 acoustic files were recorded during bat acoustic surveys. These data were batch-processed by SWCA bat biologist Michael Swink using SonoBat version 30.1 bat call analysis software, which resulted in the removal of noise (non-bat) files and the identification of 179,500 potential bat files. These files were further batch-processed, which resulted in the automated identification of files to bat species. SonoBat provides multiple regional classifier suites that contain various bat species known to occur within each geographic region. Due to the high species diversity of bats historically documented to occur within Clark County (Bradley et al. 2006; Las Vegas Wash Coordination Committee 2011; Reid 2006; NDOW 2022; Williams et al. 2006), multiple regional classifiers were selected for batch processing and/or manual file vetting to evaluate all the potential bat species identified for the project area.

A subset of files classified as bat recordings (one file per species per detector per night) were verified manually. Only high-quality recordings (i.e., low-noise, long-duration sequences containing a minimum

of 8 fully formed pulses [4 pulses for *Eumops perotis*] with consistent inter-pulse intervals indicating search-phase flight behavior) that were classified to species by the regional Sonobat classifier were then further manually identified to bat species.

**Table 1. 2022 Bat Acoustic Survey Schedule and Locations**

Location	Survey Point Identification	Land Management*	MSHCP Status†	Deployment Date (2022)	Retrieval Date (2022)	Detector-Nights	Microphone Height (m)
Muddy River	MR-01	Clark County	Reserve	6/03	6/10	7	5.6
Muddy River	MR-02	Clark County	—	6/03	6/10	7	7.5
Riverside	RS-01	Clark County	Impact; Reserve	6/10	6/17	7	5.6
Nelson	NE-01	BLM	Impact	6/14	6/21	7	5.6
Newberry Mountains	NM-01	BLM	—	6/14	6/21	7	5.6
Highland Range	HR-01	BLM	—	6/21	6/28	7	5.6
Corn Creek	CC-01	USFWS	—	6/24	7/01	7	7.5
Warm Springs	WS-01	SNWA	Impact	6/29	7/06	7	7.5
Bunkerville West	BE-01	Clark County	Impact; Reserve	6/30	7/06	6	7.5
Virgin Mountains	VM-01	BLM	—	6/30	7/07	7	3
Bunkerville West	BE-02	Clark County	Impact; Reserve	7/06	7/11	5	7.5
Muddy River	MR-03	Clark County	Reserve	7/06	7/11	5	7.5
Muddy River	MR-04	Clark County	Reserve	7/11	7/25	14	7.5
Bunkerville West	BE-03	Clark County	Reserve	7/11	7/25	14	7.5
Bunkerville East	BE-04	Clark County	Reserve	7/25	8/02	3	7.5
Bunkerville East	BE-05	Clark County	Reserve	8/02	8/09	7	7.5
Overton WMA	OW-01	NDOW	—	8/02	8/09	7	7.5
Moapa	MO-01	BLM	Impact	8/10	8/17	7	5.6
Warm Springs	WS-02	SNWA	Impact	8/10	8/16	6	7.5
Moapa	MO-02	BLM	Impact	8/16	8/23	7	5.6
Spring Mountains	SM-01	FS	—	8/18	8/25	7	5.6
Spring Mountains	SM-02	FS	—	8/19	8/26	7	7.5
Virgin Mountains	VM-02	BLM	—	8/23	8/30	7	5.6
Red Rock Canyon	RR-01	BLM	—	9/02	9/09	7	7.5
Laughlin	LA-01	BLM	Impact	9/07	9/14	7	7.5
Searchlight	SE-01	Clark County	Impact	9/07	9/14	7	7.5
Mormon Mesa-South	MS-01	Clark County	Reserve	9/12	9/19	7	7.5
Searchlight	SE-02	BLM	Impact	9/14	9/21	7	5.6
Laughlin	LA-02	Clark County	Impact	9/14	9/21	7	7.5
Red Rock Canyon	RR-02	BLM	—	9/22	9/29	7	7.5

\* SNWA = Southern Nevada Water Authority, FS = U.S. Forest Service

† Impact = MSHCP Amendment Proposed Impact Area, Reserve = Riparian Reserve Unit

**Table 2. 2024 Bat Acoustic Survey Schedule and Locations**

Location	Survey Point ID	Land Management*	MSHCP Status†	Deployment Date (2024)	Retrieval Date (2024)	Detector-Nights	Microphone Height (m)
Summit Spring	GB-1	BLM	–	5/03	5/10	7	7.5
Connolly Spring	GB-2	BLM	–	5/10	5/17	7	7.5
Bitter Spring	BI-1	BLM	SMA	5/10	5/17	7	7.5
Arrow Canyon Dam	AC-1	BLM	–	5/12	5/21	9	5.0
Devil's Cove	GB-3	NPS	–	5/17	5/24	7	5.6
West Longwell Ridge	BI-2	BLM	SMA	5/17	5/24	7	5.6
Red Bluff Spring	GB-4	BLM	–	5/24	5/31	7	5.6
Overton Wildlife Management Area (OWMA), Muddy River	OW-2	NDOW	–	5/24	5/31	7	5.6
Cabin Spring	VM-3	BLM	–	5/31	6/07	7	5.6
OWMA, alfalfa fields, Muddy River	OW-3	NDOW	–	5/31	6/07	7	6.0
Blue Point Spring	BP-1	NPS	–	5/31	6/07	7	7.5
Spring Mountain Ranch State Park (SMRSP)	SR-1	NSP	–	6/05	6/14	9	5.6
OWMA, alfalfa fields	OW-4	NDOW	–	6/7	6/18	11	3.5
Gale Hills	GH-1	BLM	SMA	6/7	6/18	11	5.6
SMRSP, small pond	SR-2	NSP	–	6/14	6/21	7	5.6
Bowman Reservoir	BR-1	BLM	SMA	6/18	6/25	7	5.6
SMRSP, Ash Grove	SR-3	NSP	–	6/21	6/27	6	5.6
California Ridge	MU-1	BLM	SMA	6/25	7/6	11	5.6
Rainbow Spring	RA-1	BLM	–	7/6	7/15	9	5.6
Mule Spring, Trout Canyon	ML-1	BLM	SMA	7/15	7/22	7	5.6
Kiup Spring, Trout Canyon	KS-1	BLM	SMA	7/15	7/22	7	5.6
Horse Spring	HS-1	BLM	SMA	7/15	7/22	7	3.8
Laughlin, Colorado River	LA-3	BLM	–	7/23	7/31	8	7.5
Pipe Spring	PS-1	NPS	–	7/31	8/7	7	4.0
Las Vegas Bay	VB-1	NPS	–	8/5	8/12	7	7.5
McClanahan Spring	MC-1	BLM	SMA	8/12	8/20	8	4.0
Hidden Valley	HV-1	BLM	SMA	8/20	8/26	6	4.0
Bird Spring	BD-1	BLM	–	8/30	9/07	8	5.6
California Wash	CW-1	BLM	SMA	9/03	9/10	7	7.5
Bird Spring Range	BD-2	BLM	SMA	9/7	9/13	6	5.6

\* BLM = Bureau of Land Management, NDOW = Nevada Department of Wildlife, NPS = National Park Service, NSP = Nevada State Parks

† SMA = MSHCP Amendment Special Management Area

Due to various factors, including environmental noise, echo, and non-bat wildlife recordings, a subset of manually reviewed files was not identifiable to species. Files that were not carried forward for analysis consisted of relatively lower-quality files that were either not manually reviewed or not identified to

species by the SonoBat classifier. A total of 1,724 bat echolocation files were manually identified to species using multiple reference materials, including acoustic bat identification keys (Szewczak 2017, 2018; Tyburec 2019), guides (Reichert et al. 2018), and vouchered reference recordings provided by SonoBat. Acoustic bat data files cannot be used to directly estimate bat populations because an individual may be responsible for numerous detected calls. These data can, however, be used to determine species occurrence among bat species and survey locations.

## **2.4 Data Summarization**

The effective range of an acoustic detector varies with multiple factors; these can include environmental noise, weather conditions, equipment specifications and settings, spatial clutter, and microphone placement. The ultrasonic, omnidirectional microphones used for this project (Wildlife Acoustics SMM-U1) can record high-quality, full-bandwidth bat call sequences within an approximately 30-m radius (SonoBat 2019); therefore, we assumed that bat species documented acoustically were using a portion of an approximate 56,548-m<sup>2</sup> hemispheroid centered around each survey point location. To summarize each species' use of an acoustic survey location, it was assumed that bats detected within a certain distance of a detector were commuting through, or foraging near, the habitat within that distance. Habitat data collected at each acoustic survey location provide a summary of the vegetation within the detector vicinity.

## **3 RESULTS AND EVIDENCE OF THE RESULTS**

### **3.1 Objectives Completed**

The objective of determining bat species occurrence and habitat use, including current and proposed MSHCP-covered species, was completed. SWCA recorded multiple acoustic detections for a total of 20 bat species within Clark County, and these data are described in detail in Section 3.3.1.

### **3.2 Site Location and Survey Effort**

#### **3.2.1 Acoustic Surveys**

A subset of proposed acoustic survey locations was not accessible, due to access routes being closed or washed out. As a result, SWCA completed acoustic surveys at both proposed and alternate sites that were accessible and met the site selection criteria described in Section 2.1.1. Acoustic surveys were completed at a total of 60 sites within Clark County. Acoustic survey locations were on lands administered by Clark County, the BLM, State of Nevada, or NDOW. Acoustic surveys were conducted between June 3 and September 29, 2022, and between May 3 and September 14, 2024, by SWCA bat biologist Michael Swink. Detectors successfully recorded for a minimum of 3 consecutive detector-nights and a maximum of 14 consecutive detector-nights (average = 7.4), for a total of 214 detector nights recorded in 2022, and 228 detector-nights recorded in 2024. Periodic wind and rain events are common during the summer months in the Mojave Desert and were noted during the acoustic survey period; to minimize the effects of environmental noise and rainwater intrusion on microphone function and recording quality, a longer deployment schedule, relative to North American Bat Monitoring Program monitoring protocol recommendations (Loeb et al. 2015), was selected (see Tables 1 and 2 for the schedule and location of bat acoustic surveys performed in Clark County in 2022 and 2024, respectively).

## 3.3 Findings

### 3.3.1 Bat Acoustic Detections

A total of 20 bat species were identified through analysis of acoustic survey data (18 species in 2022 and 19 species in 2024) (Table 3). Acoustic bat surveys detected three species currently listed as covered under the current MSHCP: long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), and silver-haired bat (*Lasionycteris noctivagans*). These surveys also detected two species of bat designated as covered under the proposed amendment to the MSHCP: spotted bat and Townsend's big-eared bat. Acoustic detections of pocketed free-tailed bat (*Nyctinomops femorosaccus*) at three survey locations represents the second confirmed record for this species in Nevada, and, based on desktop review, the northernmost record for the species (NatureServe 2024; NBWG 2024; NDNH 2024).

**Table 3. Bat species detected acoustically within Clark County in 2022 and 2024.**

Common Name (Scientific Name)	6-letter Code	Year	MSHCP Status*	Detection Location
Pallid bat ( <i>Antrozous pallidus</i> )	ANTPAL	2022, 2024	–	AC1, BD1, BE2, BE3, BI1, BI2, BR1, CC1, GB1, GB3, GB4, GH1, HR1, HS1, LA2, LA3, MC1, ML1, MO2, MR1, MR2, MR3, MR4, MU1, NM1, OW1, OW4, PS1, RA1, RR1, RS1, SR1, SR2, VB1, VM1, VM2, VM3
Townsend's big-eared bat ( <i>Corynorhinus townsendii</i> )	CORTOW	2022, 2024	E, PC	AC1, BI1, BR1, GB1, GB2, HR1, KS1, LA3, ML1, MO1, MR1, MR2, MR3, MR4, NM1, OW1, OW2, OW3, OW4, PS1, RA1, RR1, SR1, SR2, SR3, VM1, VM2, VM3, WS2
Big brown bat ( <i>Eptesicus fuscus</i> )	EPTFUS	2022, 2024	–	AC1, BE1, BE2, BE3, BE4, BE5, CC1, GB3, GB4, HR1, HS1, KS1, LA1, LA3, MC1, ML1, MO1, MR1, MR2, MR4, NM1, OW1, OW2, OW4, PS1, RA1, RR1, SE2, SM1, SM2, SR1, SR2, SR3, VM1, VM2, VM3, WS1, WS2
Spotted bat ( <i>Euderma maculatum</i> )	EUDMAC	2022, 2024	PC	BI1, BI2, BR1, GB4, MO1, MR1, MR3, MU1, OW1, OW2, OW3, OW4, WS1, WS2
Western bonneted bat ( <i>Eumops perotis</i> )	EUMPER	2022, 2024	–	BI2, BR1, GB1, GB3, GH1, LA1, LA3, MS1, RR1
Allen's big-eared bat ( <i>Idionycteris phyllotis</i> )	IDIPHY	2022, 2024	–	GB1, GB3, VM2
Silver-haired bat ( <i>Lasionycteris noctivagans</i> )	LASNOC	2022, 2024	C	AC1, BR1, CC1, MO1, SE1, SR1, SR2, VM1, WS1
Northern hoary bat ( <i>Lasiurus cinereus</i> )	LASCIN	2022, 2024	–	AC1, BI1, BI2, GB1, GB2, LA1, RR1, SE1, SM2, VM2
Desert red bat ( <i>Lasiurus frantzii</i> )	LASFRA	2022, 2024	–	MR3, OW1, SR3
Western yellow bat ( <i>Lasiurus xanthinus</i> )	LASXAN	2022, 2024	–	AC1, BE5, MO1, MO2, MR1, MR3, MR4, MS1, OW1, OW2, OW3, OW4, RS1, WS1, WS2
Californian leaf-nosed bat ( <i>Macrotus californicus</i> )	MACCAL	2024	–	GB4, OW4
California myotis ( <i>Myotis californicus</i> )	MYOCAL	2022, 2024	–	AC1, BD1, BD2, BE1, BE2, BE3, BE5, BI1, BI2, BP1, BR1, CC1, GB1, GB2, GB3, GB4, GH1, HR1, HV1, KS1, LA1, LA3, MC1, ML1, MO1, MR2, MR3, MR4, MS1, MU1, NE1, NM1, OW1, OW2, OW3, OW4, PS1, RA1, RR1, RR2, RS1, SE1, SM1, SR1, SR2, SR3, VB1, VM1, VM2, VM3, WS1
Western small-footed myotis ( <i>Myotis ciliolabrum</i> )	MYOCIL	2022, 2024	E	BD1, HS1, KS1, MC1, RA1, SM1, SR1, SR2, SR3



Common Name (Scientific Name)	6-letter Code	Year	MSHCP Status*	Detection Location
Long-eared myotis ( <i>Myotis evotis</i> )	MYOEVO	2022	C	SM1, SM2
Fringed myotis ( <i>Myotis thysanodes</i> )	MYOTHY	2022, 2024	–	BD1, GB2, GB4, ML1, MR3, MR4, OW1, RR1, VM2, VM3
Long-legged myotis ( <i>Myotis volans</i> )	MYOVOL	2024	C	RA1, VM3
Yuma myotis ( <i>Myotis yumanensis</i> )	MYOYUM	2022, 2024	–	AC1, BE1, BE2, BE3, BE5, BI1, GB4, LA1, LA3, MO1, MR1, MR3, OW1, OW2, OW3, OW4, SE1, SR2, WS1
Pocketed free-tailed bat ( <i>Nyctinomops femorosaccus</i> )	NYCFEM	2022, 2024	–	BE4, GB4, OW2, OW4
Canyon bat ( <i>Parastrellus hesperus</i> )	PARHES	2022, 2024	–	AC1, BD1, BD2, BE1, BE2, BE3, BE4, BE5, BI1, BI2, BP1, BR1, CC1, CW1, GB1, GB2, GB3, GB4, GH1, HR1, HS1, HV1, LA1, LA2, LA3, MC1, ML1, MO1, MO2, MR1, MR2, MR3, MR4, MS1, MU1, NE1, NM1, OW1, OW2, OW3, OW4, PS1, RA1, RR1, RR2, RS1, SE1, SR1, SR2, SR3, VB1, VM1, VM2, VM3, WS1, WS2
Brazilian free-tailed bat ( <i>Tadarida brasiliensis</i> )	TADBRA	2022, 2024	–	AC1, BE1, BE2, BE3, BE4, BE5, BI1, BI2, BP1, BR1, CC1, CW1, GB1, GB2, GB3, GB4, GH1, HR1, HS1, LA1, LA2, LA3, MC1, MO1, MO2, MR1, MR2, MR3, MR4, MS1, MU1, NE1, NM1, OW1, OW2, OW3, OW4, PS1, RA1, RR1, RR2, RS1, SE1, SE2, SM1, SM2, SR1, SR2, SR3, VB1, VM1, VM2, VM3, WS1, WS2

\* MSHCP status (Clark County 2000, 2019): C=covered; E=evaluation; PC=proposed covered

The most commonly detected bat species were canyon bat (*Parastrellus hesperus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and California myotis (*Myotis californicus*). The highest species richness was observed along riparian corridors (MR-3), near agricultural fields (OW-4), and adjacent to cliff-roosting habitat and isolated surface water features (GB-4). The survey locations with the highest overall bat use were MR-4, OW-1, and OW-4; all of these are located within warm desert riparian habitat within the Muddy River floodplain in north-central Clark County. OW-1 and OW-4 are located adjacent to a mosaic of alfalfa fields, irrigation canals, and riparian corridors (Figures 2 and 3). Survey locations with the lowest bat species richness, BD-2, SE-2, and NE-1, also exhibited the lowest overall use and were located within arid, upland areas of Mojave desert scrub distant from riparian vegetation and surface water features.

### 3.3.2 Habitat Data

Surveyors recorded data on selected habitat components and structural metrics at each roost and acoustic survey location. In total, 339 photographs at acoustic survey locations and associated habitat data were recorded. Average vegetation height at each acoustic survey location ranged from 0.5 to 25 m. Maximum vegetation height at each acoustic survey location ranged from 1 to 30 m. The most reported species of vegetation were creosote bush (*Larrea tridentata*), burrobush (*Ambrosia* spp.), and blackbrush (*Coleogyne ramosissima*). Surface water was within 30 m of the acoustic detector at 32 (53%) of the acoustic survey locations.

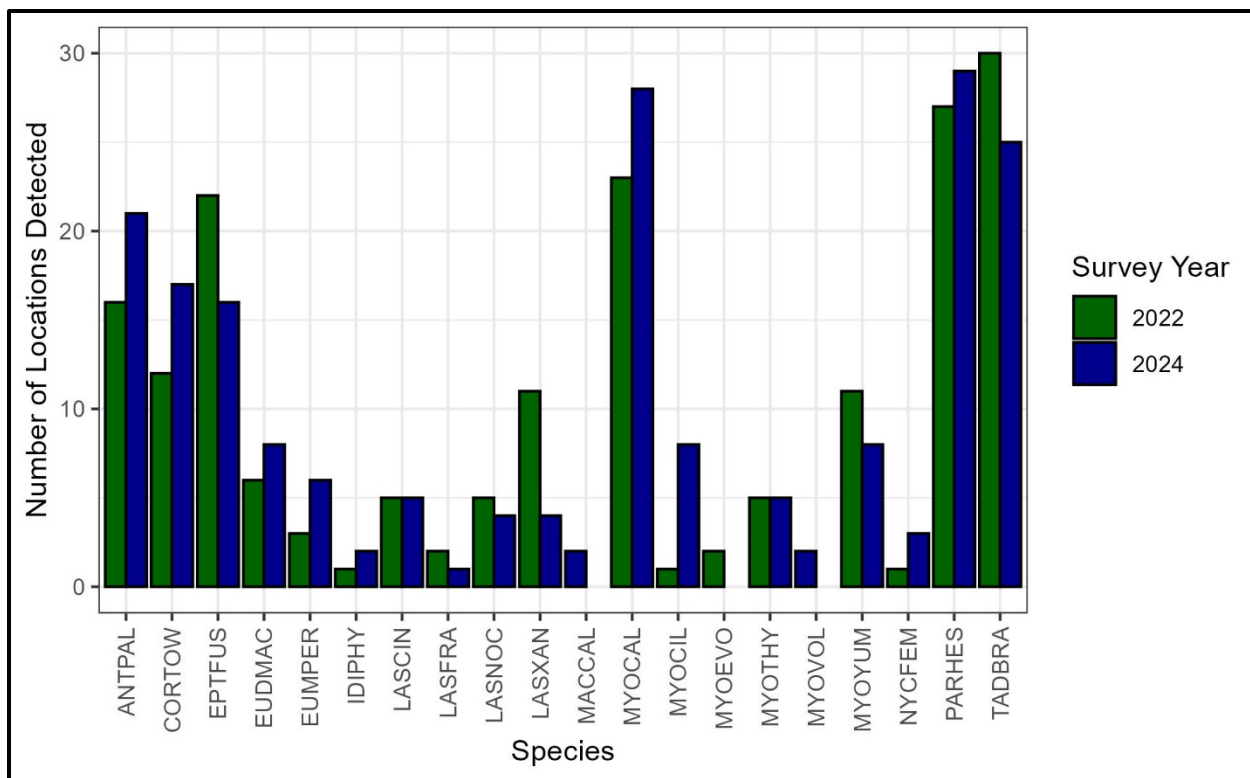


Figure 2. Total number of detection locations for each bat species, by year.

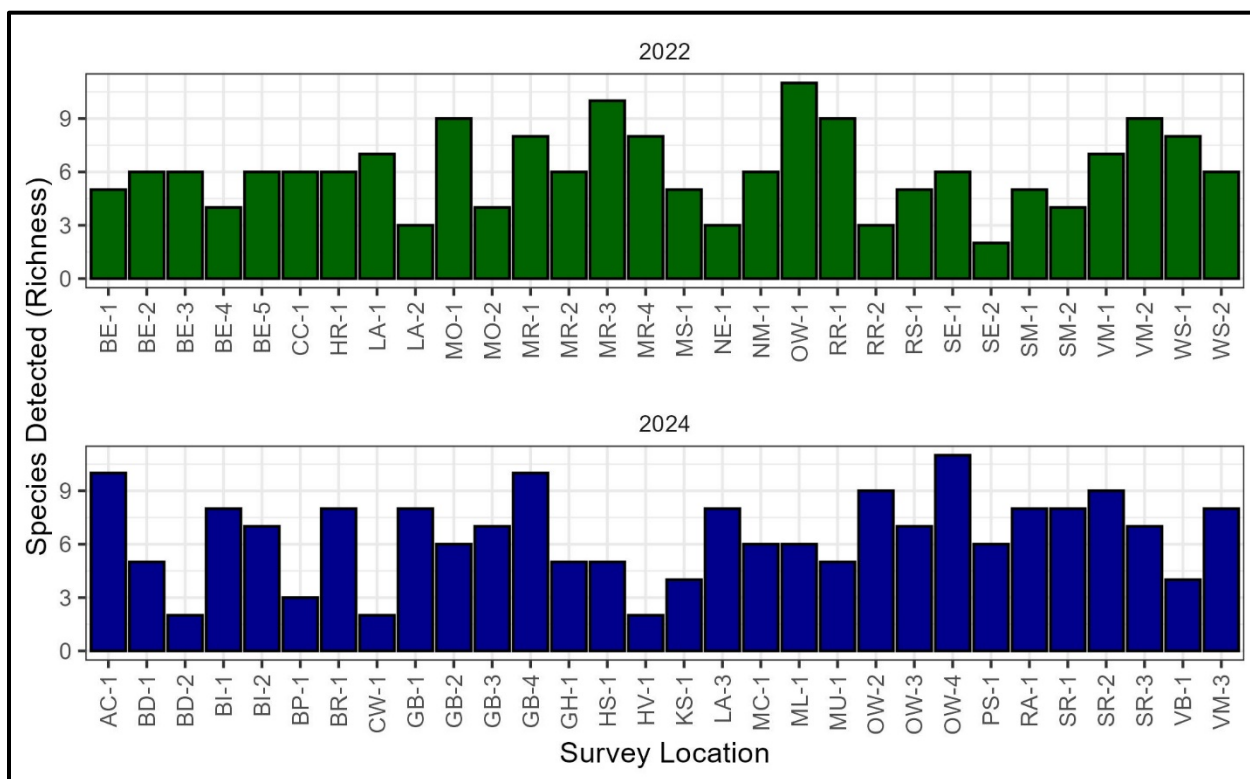


Figure 3. Bat Species Richness by Location and Year.

## **4 EVALUATION/DISCUSSION OF RESULTS**

Many factors (e.g., behavior, environmental conditions, equipment failure, prey availability, and local population size) can influence bat detection probability, and low detection probability can result in species not being detected, despite their presence during a survey. Survey methodology and schedule were selected to be the most applicable across the suite of target species, but each species occupies roosting and foraging habitat at unique spatial and temporal scales. Weather conditions such as increased rain and wind are known to suppress bat activity, bat prey availability, and acoustic recording quality and functionality. Fluctuations in temperature and precipitation may also alter the timing, location, and use patterns of bat foraging and roosting resources. Due to these factors, determination of true absence of a species within a survey location can be difficult and is beyond the scope of these surveys. Therefore, discussions for each of the bat species below are focused on observed patterns of detections.

### **4.1 Bat Habitat Features**

The highest species richness was documented along riparian corridors (MR-4; Figure 4), near agricultural fields (OW-4; Figure 5), and adjacent to cliff-roosting habitat and isolated surface water features (GB-4; Figure 6). The survey locations with the highest overall bat use were MR-4, OW-1, and OW-4; all of these are located within warm desert riparian habitat within the Muddy River floodplain in north-central Clark County. Survey locations with the lowest bat species richness, BD-2, SE-2, and NE-1, also exhibited the lowest overall use and were located within arid, upland areas of Mojave desert scrub distant from riparian vegetation and surface water features.



**Figure 4. Warm desert riparian and mixed exotic coniferous forest habitat at acoustic survey location MR-4, where the highest bat use was detected in 2022.**



**Figure 5. Open water, warm desert riparian, and emergent marsh habitat at acoustic survey location OW-1, where the highest bat species richness was detected in 2022.**

Multiple bat recordings were collected at acoustic survey locations OW-1, OW-2, OW-3, and OW-4 within the Overton Wildlife Management Area (OWMA). These locations were all adjacent to actively managed and fallowed agricultural fields, predominantly alfalfa (*Medicago sativa*), in addition to warm desert riparian woodland (mostly saltcedar [*Tamarix ramosissima*]) and riparian forest (Goodding's willow [*Salix gooddingii*]) growing along the active channel of, and irrigation ditches fed from, the Muddy River. The Muddy River channel and agricultural fields adjacent to acoustic survey locations within the OWMA likely support relatively high densities of flying insect species (e.g., moths, beetles, and flies) on which several bat species feed. Notable detections within the OWMA include spotted bat, Townsend's big-eared bat, pocketed free-tailed bat, and all three of the Lasiurine bat species that occur in Nevada: desert red bat (*Lasiurus frantzii*), Northern hoary bat (*Lasiurus cinereus*), and Western yellow bat (*Lasiurus xanthinus*).

Three cliff-roosting bat species were detected acoustically in both years: spotted bat (Pierson and Rainey 1998), western bonneted bat, and pocketed free-tailed bat. Numerous mountain ranges within the county, including Red Rock Canyon, the Virgin Mountains, the Newberry Mountains, and the Arrow Canyon Range, exhibit extensive examples of potential cliff-roosting bat habitat. Spotted bats may fly as far as 50 miles (80 km) in a given night from a day roost site to feeding sites (Reid 2006), although research suggests that feeding sites are often within 6 miles (10 km) of a roost (Luce and Keinath 2007; Wai-Ping and Fenton 1989). Acoustic survey locations BI-1 and GB-4, where pocketed free-tailed bat and spotted bat were detected, were placed at relatively remote surface water features with low to moderate riparian woodland cover and potential cliff-roosting bat habitat within 6 miles (10 km). BI-2 and MU-1, where Western bonneted bat was detected, were located in rocky, upland areas along steep canyon walls, forming a narrow, constricted flight corridor for commuting bats. Vegetation at both of these sites was dominated by creosotebush–burrobush (*Ambrosia dumosa*) desert scrub.





**Figure 6. Warm desert riparian and agricultural habitat at acoustic survey location OW-4, where the highest bat species richness and use was detected in 2024.**



**Figure 7. Habitat at acoustic survey location GB-4, where multiple bat species were detected in 2024, including spotted bat, Townsend's big-eared bat, pocketed free-tailed bat, and California leaf-nosed bat.**

Townsend's big-eared bat, a proposed MSHCP-covered species, was detected acoustically at a total of 29 survey locations. These detections were primarily within lower-elevation warm desert riparian corridors along the Muddy River and at ephemeral springs located in mid-elevation foothills within pinyon-juniper woodland. Townsend's big-eared bat is known to forage within various forest and woodland habitats, including warm desert riparian areas, mid-elevation pinyon-juniper (*Pinus-Juniperus*) woodland, and higher elevation mixed coniferous forests (NDOW 2022; Reid 2006; Southwest Ecology LLC 2018; Wilson and Ruff 1999). Within Clark County, Townsend's big-eared bat forages within a variety of habitats across a broad elevational gradient, including warm desert riparian, montane riparian, and mixed woodlands. Townsend's big-eared bats feed almost exclusively on moths and prefer to forage within edge habitats between forested and open areas. Lower-elevation locations with acoustic detections were not near any known roosting resources. Given that Townsend's big-eared bats may fly up to 30 miles (48 km) between roosting and foraging areas in a given night, it is likely that much of the activity recorded acoustically at these locations is associated with foraging. Acoustic detections at mid-elevation survey locations were likely associated with foraging or movement between roost and foraging locations.

Three bat species known to historically, or currently, occur within Clark County were not detected during 2022 or 2024 acoustic surveys: big free-tailed bat (*Nyctinomops macrotis*), cave myotis (*Myotis velifer*), and Mexican long-tongued bat (*Choeronycteris mexicana*). Big free-tailed bat was not detected through review of acoustic data collected for this project, although it has been historically detected in Clark County through acoustic surveys (NDNH 2024; SWCA 2020; Williams et al. 2006). Cave myotis detections are restricted to an abandoned mine in the far southern portion of the County along the Colorado River and are presumed to have a limited distribution in the County (NBWG 2024). Mexican long-tongued bat is only known from a single, live individual that was captured in the Las Vegas city limits in 1987 (Constantine 1987; Bradley et al. 2006); however, recent observations along the Colorado River in the Grand Canyon suggest that this species may be rediscovered in Clark County (Bradley et al. 2006). These species can be difficult to detect acoustically; additional, targeted roost and acoustic surveys could potentially confirm their seasonal and spatial distribution in Nevada.

## 5 CONCLUSION

The objective of determining bat species occurrence and habitat use, including current and proposed MSHCP-covered species, was completed. Analysis of the 2022 and 2024 acoustic datasets, originally designed to document additional target bat detections, yielded significant insight into the current occurrence, distribution, and habitat use of the bat species occurring in southern Nevada. These surveys documented 20 of the 22 (91%) of the bat species known to occur in Clark County. Additional species-specific conclusions are listed below.

- Spotted bat, a proposed MSHCP-covered species, was detected acoustically at 14 locations in north-central Clark County. Spotted bat recordings, including feeding trills, at survey sites MO-1, BI-1, BI-2, GB-4, OW-2, OW-3, and OW-4 suggest repeated foraging activity, and/or multiple bats, at these locations across several detector-nights. At two acoustic survey locations (BR-1 and MU-1) where spotted bats were detected, the low number of detector-nights with detections suggests that the bats were passing through or exhibiting relatively lower-intensity use within these areas.
- Townsend's big-eared bat, a proposed MSHCP-covered species, was detected acoustically at 29 survey locations. These detections were primarily within lower-elevation warm desert riparian corridors along the Muddy River and at ephemeral springs located in mid-elevation foothills within pinyon-juniper woodland.

- Long-eared myotis, an MSHCP-covered species, was detected at two survey locations in 2022: SM-1, located at approximately 7,800 feet amsl and SM-2, at approximately 8,700 feet above mean sea level, both within montane riparian forest habitat in the Spring Mountains in western Clark County.
- Long-legged myotis, an MSHCP-covered species, was detected in mixed coniferous woodland at two survey locations within Clark County: RA-1, located at Rainbow Spring, approximately 6,800 feet above mean sea level along the western boundary of the Spring Mountains; and VM-3, located near Cabin Spring along a rocky canyon at approximately 4,900 feet above mean sea level on the southern aspect of the Virgin Mountains in eastern Clark County.
- Silver-haired bat, an MSHCP-covered species, was detected at multiple locations (AC-1, BR-1, CC-1, MO-1, SE-1, SR-1, SR2, VM-1, and WS-1) within Clark County in 2022 and 2024. Most of the detection for this species were located in either low-elevation, warm desert riparian woodland or mid-elevation mixed oak-conifer woodland.
- Acoustic surveys resulted in three detection locations for pocketed free-tailed bat, which represent the second confirmed Nevada state record, and presumably the northernmost known distribution record, for this species.

## **6 RECOMMENDATIONS**

The following recommendations are based on observations from the 2022 (SWCA 2023) and 2024 (SWCA 2024) bat surveys and factors discussed in this report. These actions would support the County's goal of acquiring, managing, and improving wildlife habitat in Clark County:

- Nearly every bat species occurring in Nevada is designated as a special status species under one or more various federal, state, and local statutes, including BLM (2023), NDOW (2022), Nevada Administrative Code 503.030, and Clark County (2019). Habitat loss is one of the primary threats to bat populations worldwide (Frick et al. 2020). Acoustic bat data collected for this project indicates that multiple bat species, including MSHCP-covered species, are foraging, and likely roosting, within and adjacent to County-managed lands. As directed by the *Clark County Desert Conservation Program Riparian Reserves Management Plan* (Clark County 2023), the County should continue to purchase parcels within Clark County with the intent to further protect and enhance habitat for MSHCP-covered species.
- SWCA recommends continued bat acoustic studies within Clark County, especially within the proposed MSHCP Reserve System, to evaluate the spatial and temporal patterns in bat species composition, activity, and habitat use within these areas. Future bat surveys should consider revisiting potential habitat areas located within the SMAs proposed under the MSHCP Amendment. Several of the Year 2 target bat detections were within these areas, and additional survey effort in these areas would be highly productive in refining our understanding of target bat roosting and foraging habitat availability, baseline conditions, seasonal trends, and use patterns, which would further support the County's goals and objectives for managing covered species under the proposed MSHCP Amendment.
- Big free-tailed bat, cave myotis, and Mexican long-tongued bat are known to historically, or currently, occur within Clark County but were not detected during 2022 or 2024 acoustic surveys. These species can be difficult to detect acoustically and warrant additional, species-specific surveys to confirm their seasonal and spatial distribution in Nevada.

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## 7 LITERATURE CITED

- Bradley, P.V., M.J. O’Farrell, J.A. Williams, and J.E. Newmark (eds.). 2006. *The Revised Nevada Bat Conservation Plan*. Reno: Nevada Bat Working Group.
- Brown, P. 2006. *Lower Colorado River Bat Monitoring Protocol*. January.
- Clark County. 2019. Clark County MSHCP Proposed Covered Species List. March.
- . 2023. *Clark County Desert Conservation Program Riparian Reserves Management Plan*. Version 1.4, April 2023. Available at: [https://files.clarkcountynv.gov/clarkcounty/Environmental%20Sustainability/Desert%20Conservation/Management%20Plans/Riparian%20Reserve%20Unit%20Mgmt%20Plan\\_Ver%201.4%20-%20April%202023.pdf](https://files.clarkcountynv.gov/clarkcounty/Environmental%20Sustainability/Desert%20Conservation/Management%20Plans/Riparian%20Reserve%20Unit%20Mgmt%20Plan_Ver%201.4%20-%20April%202023.pdf). Accessed November 2023.
- Clark County Department of Comprehensive Planning and U.S. Fish and Wildlife Service. 2000. *Clark County Multiple Species Habitat Conservation Plan*. San Diego, California: Recon.
- Constantine, D.G. 1987. Long-tongued bat and spotted bat at Las Vegas, Nevada. *The Southwestern Naturalist*, 32:392.
- Las Vegas Wash Coordination Committee. 2011. *Las Vegas Wash Bat Survey, 2004–2009*. Available at: <https://www.lvwash.org/assets/pdf/resources-wildlife-bats.pdf>. Accessed November 2024.
- Loeb, S., T. Rodhouse, L. Ellison, C. Lausen, J. Reichard, K. Irvine, T. Ingersoll, J. Coleman, W. Thogmartin, J. Sauer, C. Francis, M. Bayless, T. Stanley, and D. Johnson. 2015. *A Plan for the North American Bat Monitoring Program (NABat)*. General Technical Report SRS-208. Asheville, North Carolina: U.S. Forest Service, Southern Research Station.
- Luce, R.J., and D. Keinath. 2007. *Spotted Bat (Euderma maculatum): A Technical Conservation Assessment*. Prepared for USDA Forest Service, Rocky Mountain Region. Available at: [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5181916.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5181916.pdf). Accessed November 2024.
- NatureServe. 2022. NatureServe Explorer. Available at: <https://explorer.natureserve.org/>. Accessed May 2022.
- . 2023. NatureServe Explorer. Available at: <https://explorer.natureserve.org/>. Accessed August 2023.
- . 2022. *The 2022–2032 Wildlife Action Plan*. Available at: <https://www.ndow.org/wp-content/uploads/2023/11/2022-SWAP-Full-Doc-FINAL-print.pdf>. Accessed April 2024.
- Nevada Bat Working Group (NBWG). 2024. Nevada Bat Conservation Plan.
- Nevada Division of Natural Heritage (NDNH). 2022. Geographic information system sensitive species data request for Nevada. Accessed April 2022.
- . 2024. Geographic information system sensitive species data request for Nevada. Accessed April 2024.

- Nussear, K., and E. Simandle. 2020. *Covered Species Analysis Support – Final Report*. Prepared for the Desert Conservation Program, Las Vegas, Nevada, Project No. 2013-UNR-1460E. Reno: University of Nevada. Available at: <https://files.clarkcountynv.gov/clarknv/Environmental%20Sustainability/DCP%20Reports/2020/Covered%20Species%20Analysis%20Support%20Phase%20II%20Final%20Report.pdf?t=1629245668120&t=1629245668120>. Accessed April 2022.
- Pierson, E.D., and W.E. Rainey. 1998. Distribution of the spotted bat, *Euderma maculatum*, in California. *Journal of Mammalogy* 79(4):1296–1305.
- Reichert, B., C. Lausen, S. Loeb, T. Weller, R. Allen, E. Britzke, T. Hohoff, J. Siemers, B. Burkholder, C. Herzog, and M. Verant. 2018. *A Guide to Processing Bat Acoustic Data for the North American Bat Monitoring Program (NABat)*. Open-File Report 2018–1068. Reston, Virginia: U.S. Geological Survey. Available at: <https://doi.org/10.3133/ofr20181068>. Accessed August 2023.
- Reid, F. 2006. *Peterson Field Guide to Mammals of North America*. Fourth edition. Mariner Books.
- SonoBat. 2019. Frequently Asked Questions. Available at: <https://sonobat.com/faq/>. Accessed March 20, 2023.
- Southwest Ecology LLC. 2018. *Covered Species Analysis Support – Final Report*. Prepared for the Desert Conservation Program, Las Vegas, Nevada, Project No. 2011-SWECO-901B. Available at: <https://files.clarkcountynv.gov/clarknv/Environmental%20Sustainability/DCP%20Reports/2018/Covered%20Species%20Analysis%20Support%20Final%20Rpt.pdf?t=1629245668120&t=1629245668120>. Accessed September 2022.
- SWCA Environmental Consultants (SWCA). 2020. *Clark County Bat Recording Analysis: Final Project Report*. Prepared for Desert Conservation Program, Clark County Department of Environment and Sustainability.
- . 2023. *Bat Surveys Year 1 Final Project Report*. Las Vegas, Nevada. April.
- . 2024. *Bat Surveys Year 2 Final Project Report*. Las Vegas, Nevada. November.
- Szewczak, J. 2017. Echolocation Call Characteristics of Southwestern US Bats. SonoBat Version 4.x.
- . 2018. Echolocation Call Characteristics of Western US Bats. June.
- Tyburec, J. 2019. Echolocation Call Spectrograms: A Primer for Acoustic ID.
- U.S. Fish and Wildlife Service (USFWS). 2001. Clark County Desert Conservation Plan Permit TE-034927-0.
- Wai-Ping, V., and M.B. Fenton. 1989. Ecology of spotted bat (*Euderma maculatum*) roosting and foraging. *Journal of Mammalogy* 70:617–622.
- Williams, J.A., M.J. O’Farrell, and B.R. Riddle. 2006. Habitat use by bats in a riparian corridor of the Mojave Desert in southern Nevada. *Journal of Mammalogy* 87(6):1145–1153. Available at: <https://academic.oup.com/jmammal/article/87/6/1145/885979>. Accessed February 16, 2023.
- Wilson, D.E., S. Ruff (eds.). (1999). *The Smithsonian Book of North American Mammals*. American Society of Mammalogists and Smithsonian Institution Press, Vancouver: UBC Press.

## **APPENDIX A**

### **Bat Species Call Sequence Spectrograms**

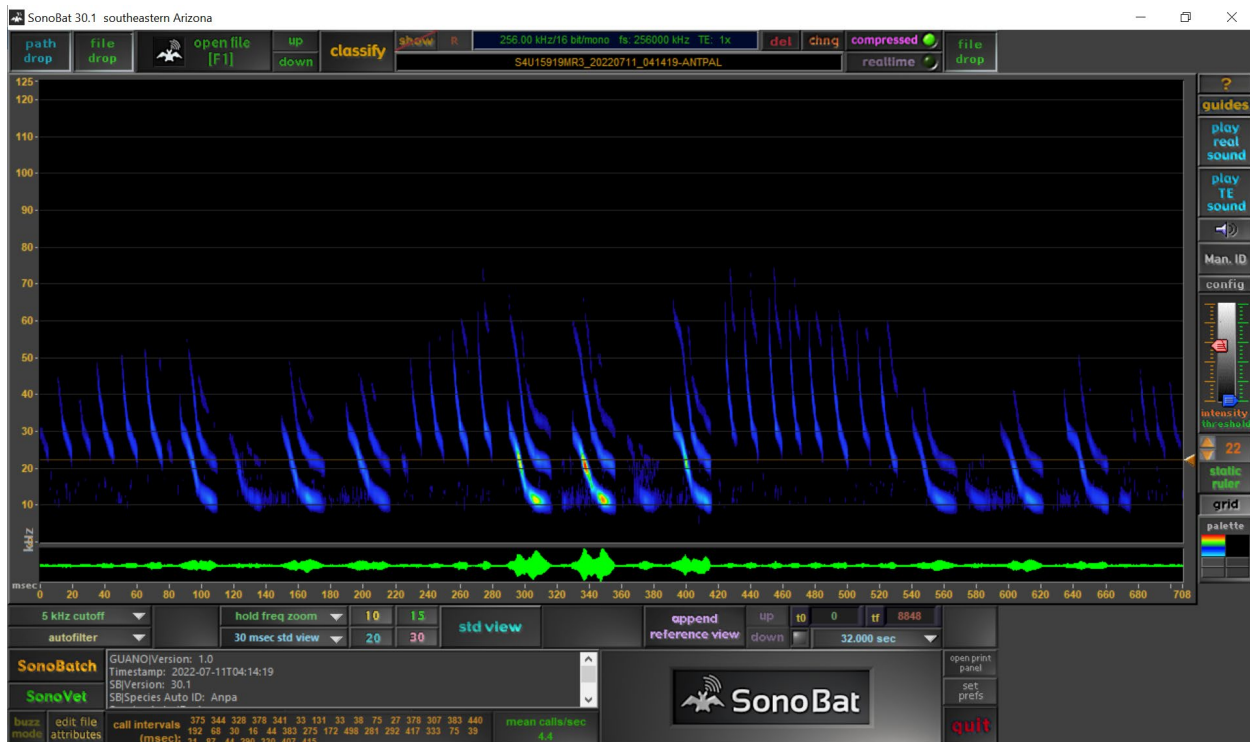


Figure A-1. Pallid bat (*Antrozous pallidus*) call sequence, with social directives, from acoustic survey location MR-3, Clark County, July 11, 2022.

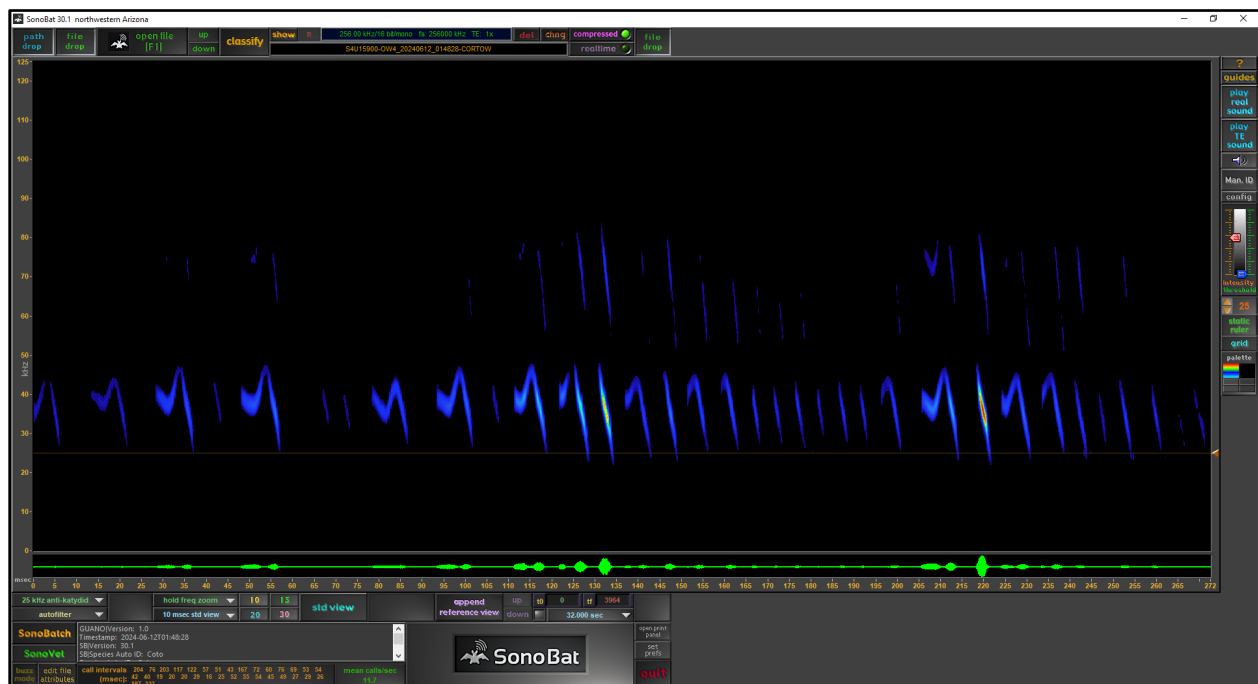


Figure A-2. Townsend's big-eared bat (*Corynorhinus townsendii*) call sequence, including directives, from acoustic survey location OW-4, Clark County, June 12, 2024.

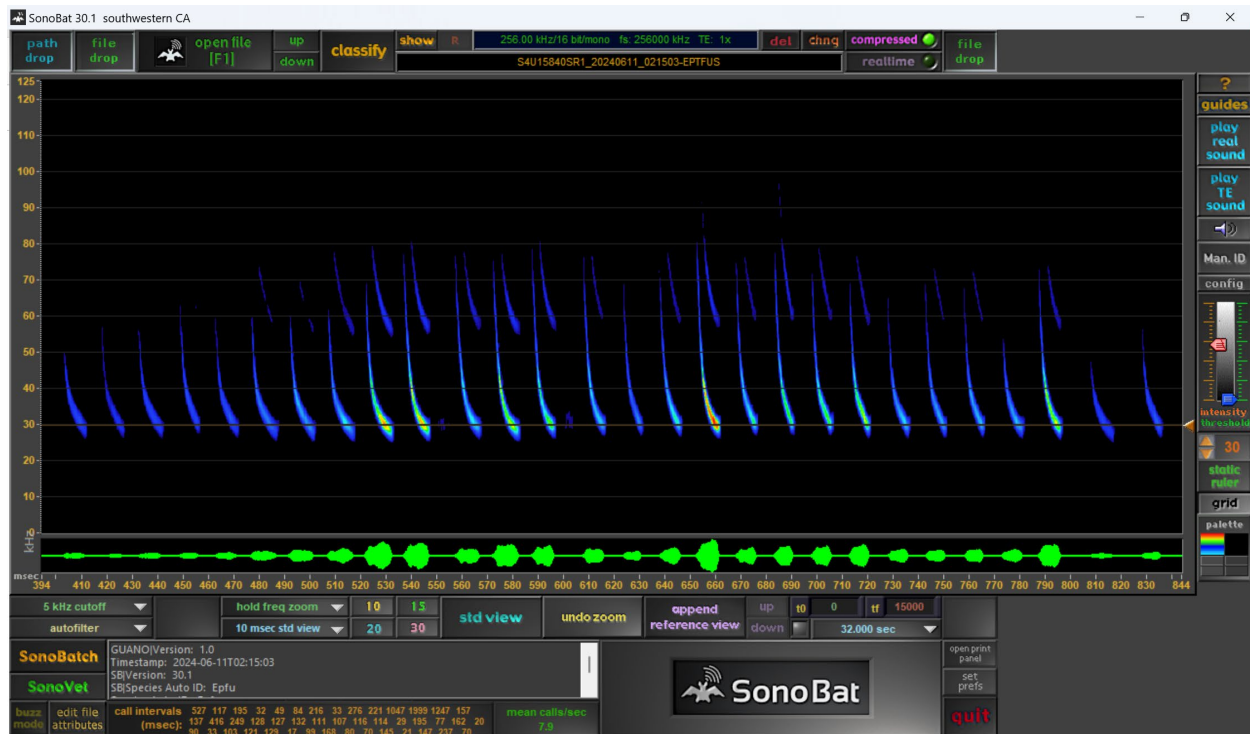


Figure A-3. Big brown bat (*Eptesicus fuscus*) call sequence, from acoustic survey location SR-1, Clark County, June 11, 2024.

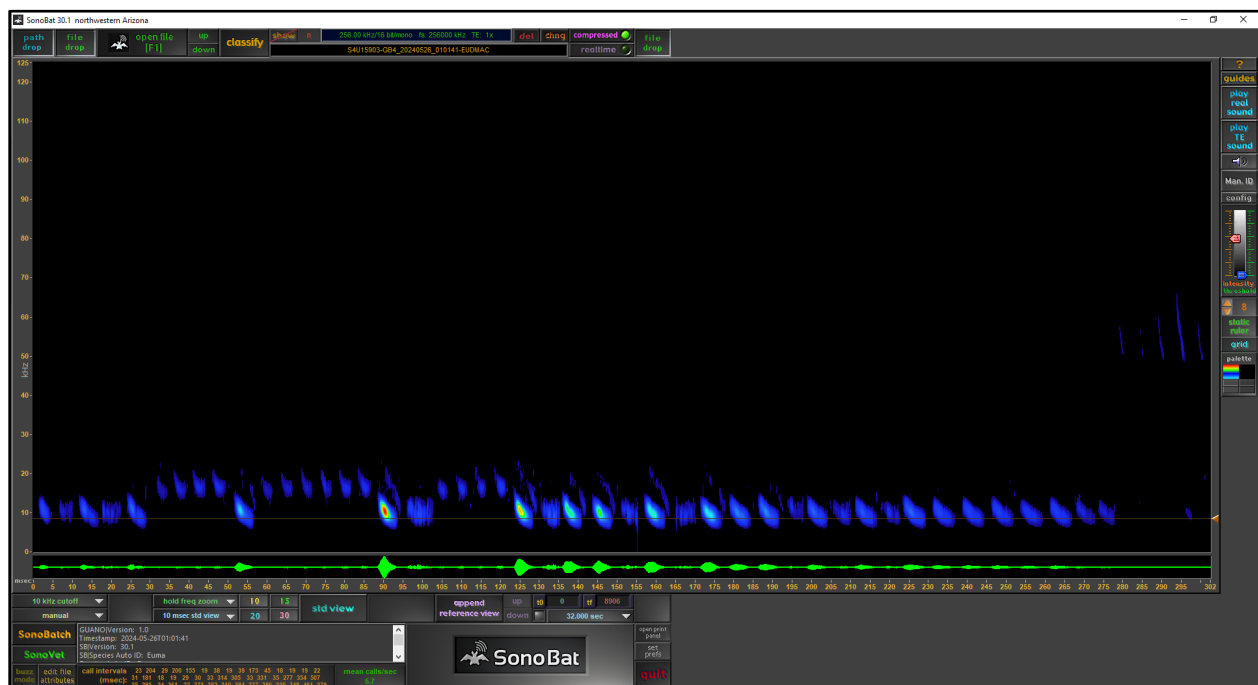


Figure A-4. Spotted bat (*Euderma maculatum*) call sequence, including trills, from acoustic survey location GB-4, Clark County, May 26, 2024.

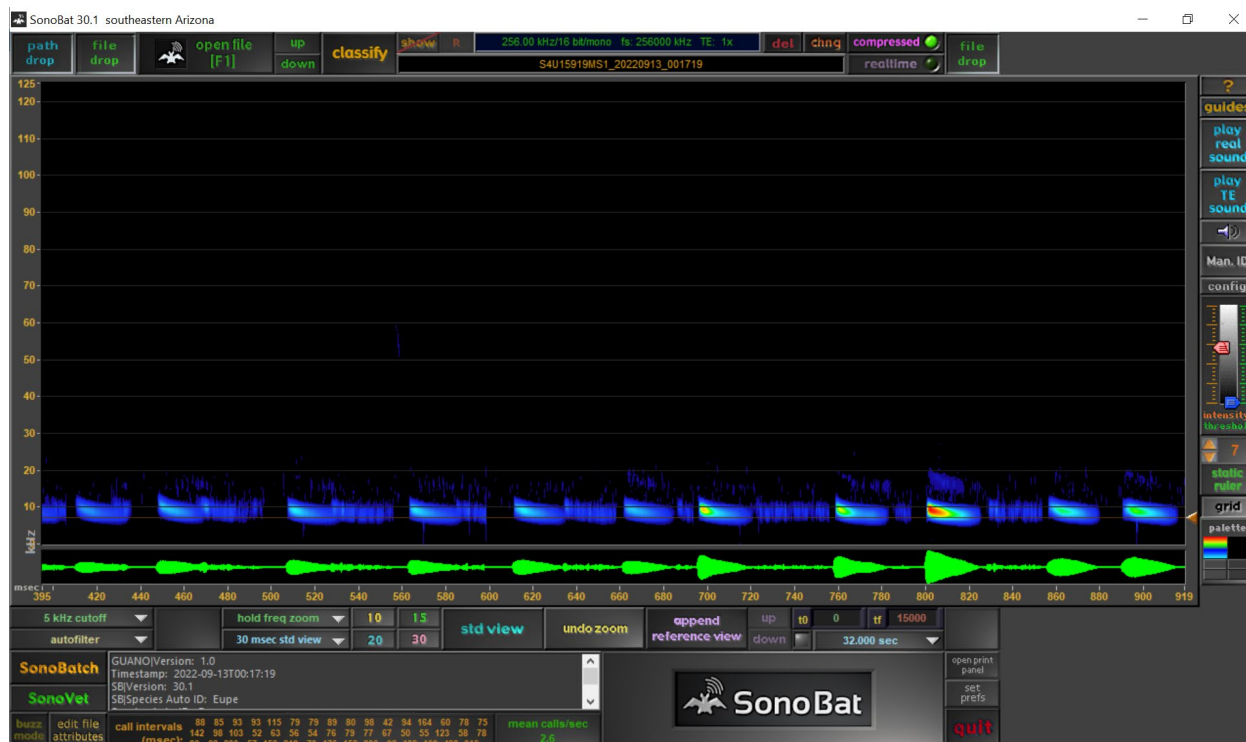


Figure A-5. Western bonneted bat (*Eumops perotis*) call sequence, from acoustic survey location MS-1, Clark County, September 13, 2022.

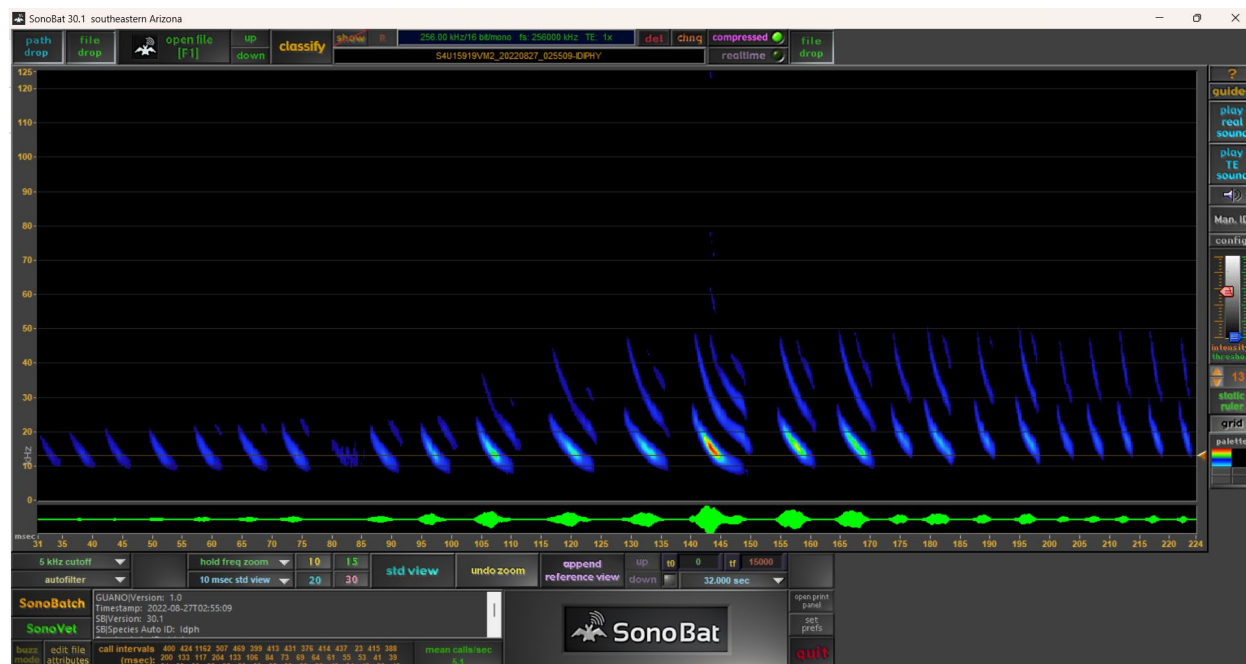


Figure A-6. Allen's big-eared bat (*Idionycteris phyllotis*) call sequence, from acoustic survey location VM-2, Clark County, August 27, 2022.

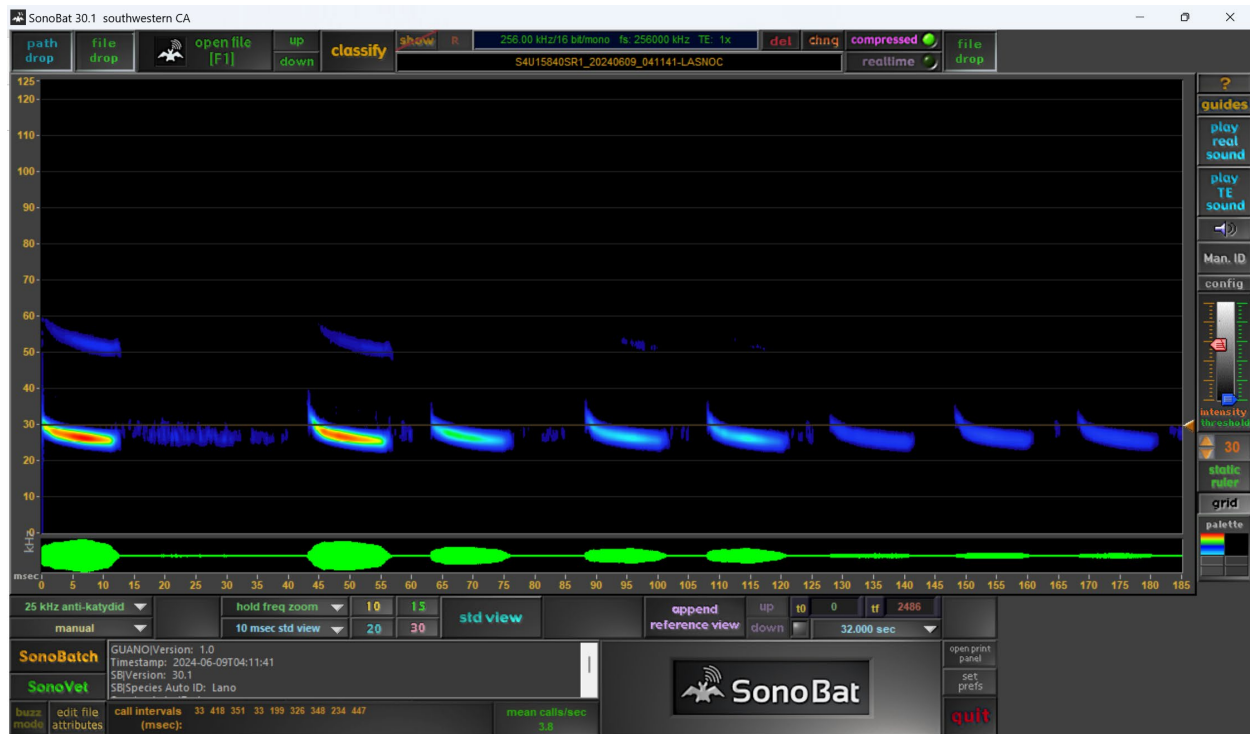


Figure A-7. Silver-haired bat (*Lasionycteris noctivagans*) call sequence, from acoustic survey location SR-1, Clark County, June 9, 2024.

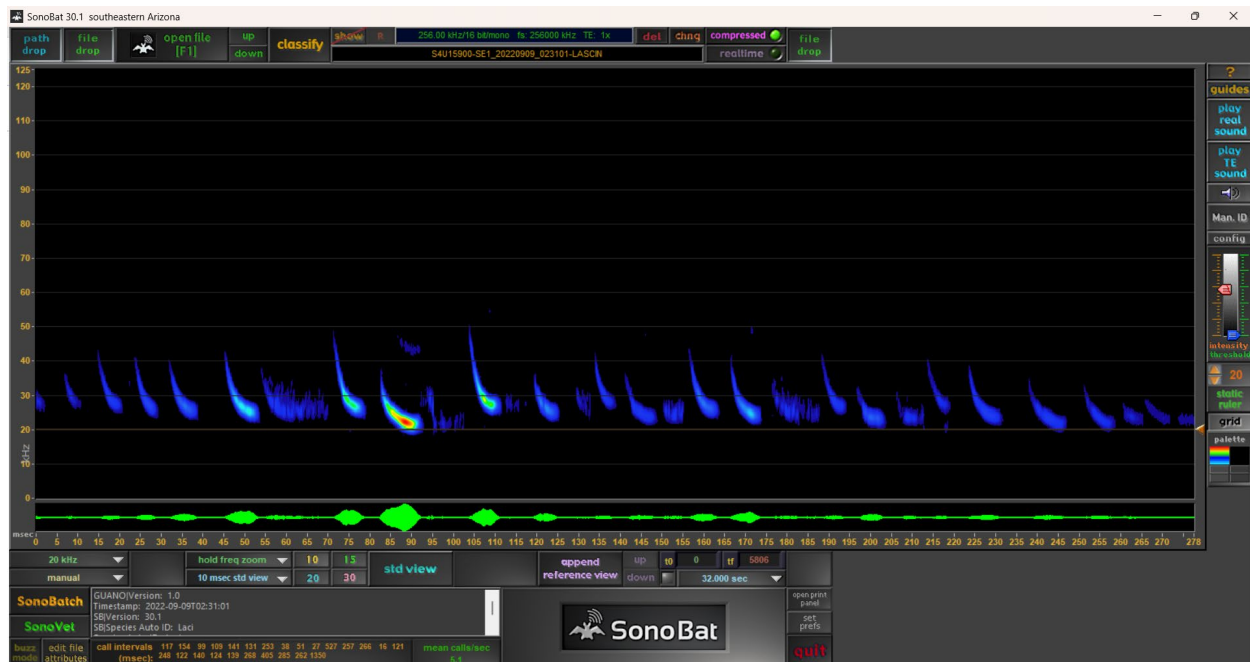


Figure A-8. Northern hoary bat (*Lasiurus cinereus*) call sequence, from acoustic survey location SE-1, Clark County, September 9, 2022.



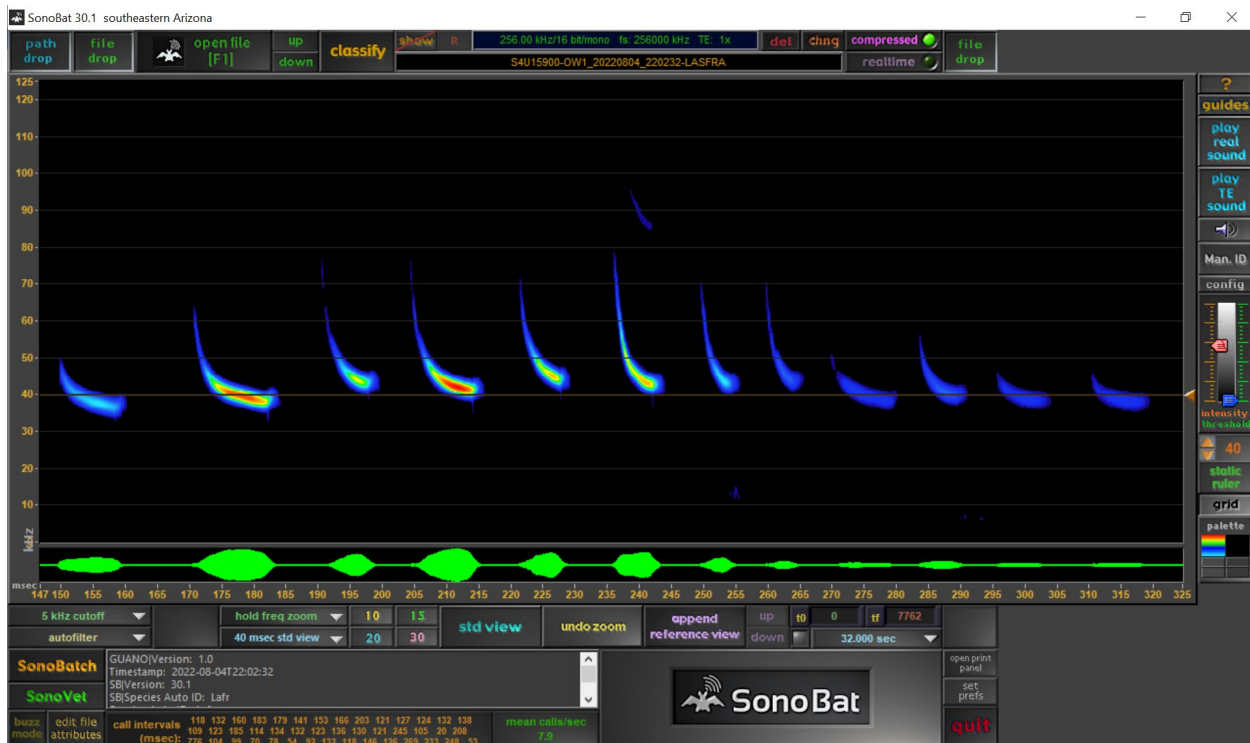


Figure A-9. Desert red bat (*Lasiurus frantzii*) call sequence, from acoustic survey location OW-1, Clark County, August 4, 2022.

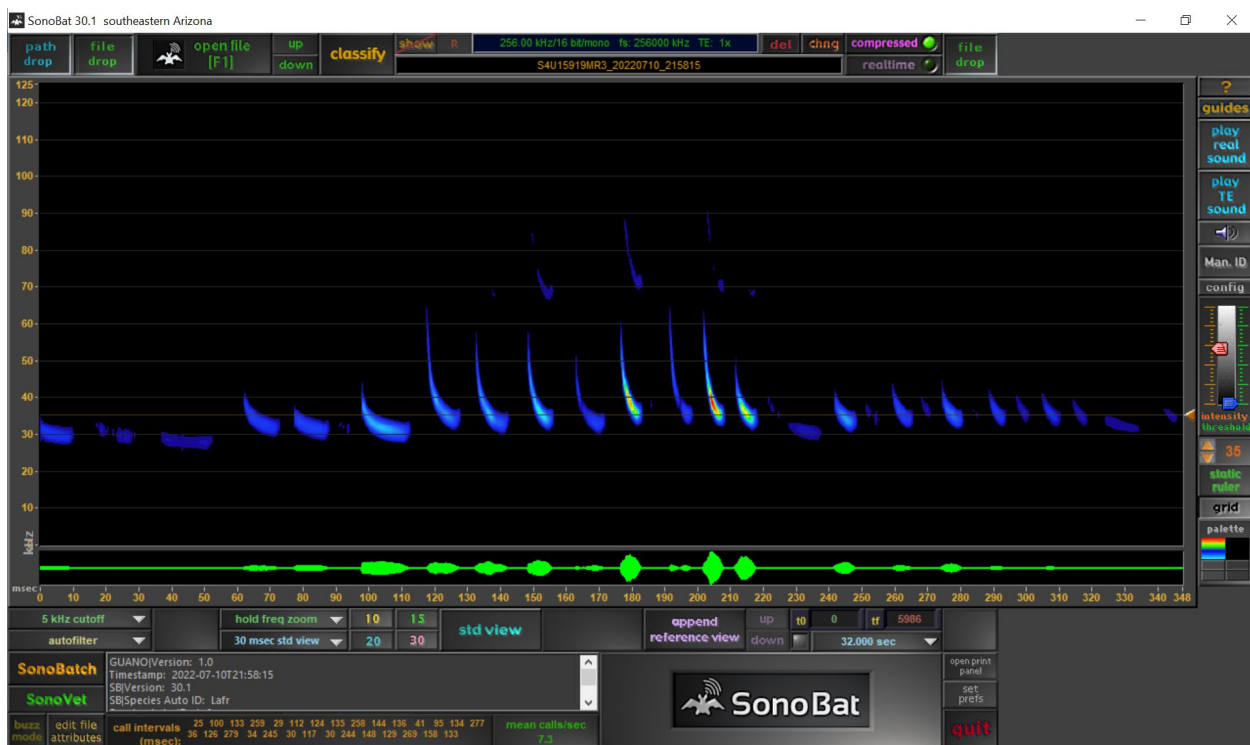


Figure A-10. Western yellow bat (*Lasiurus xanthinus*) call sequence, from acoustic survey location MR-3, Clark County, July 10, 2022.



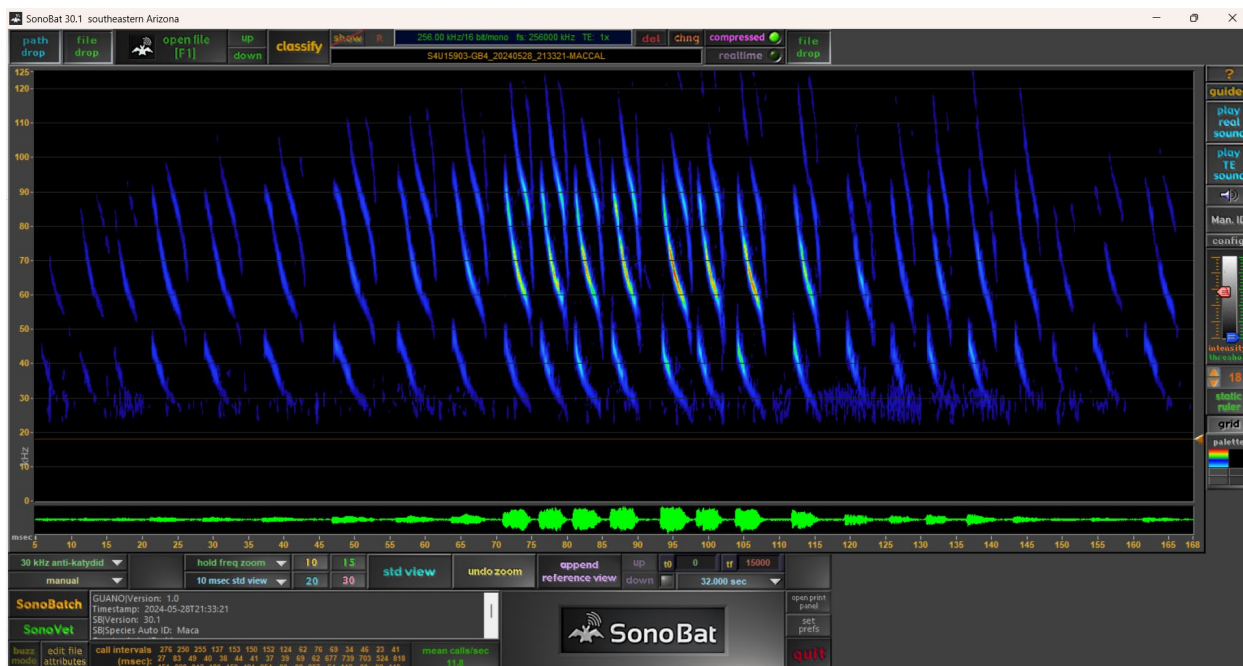


Figure A-11. California leaf-nosed bat (*Macrotus californicus*) call sequence, from acoustic survey location GB-4, Clark County, May 28, 2024.

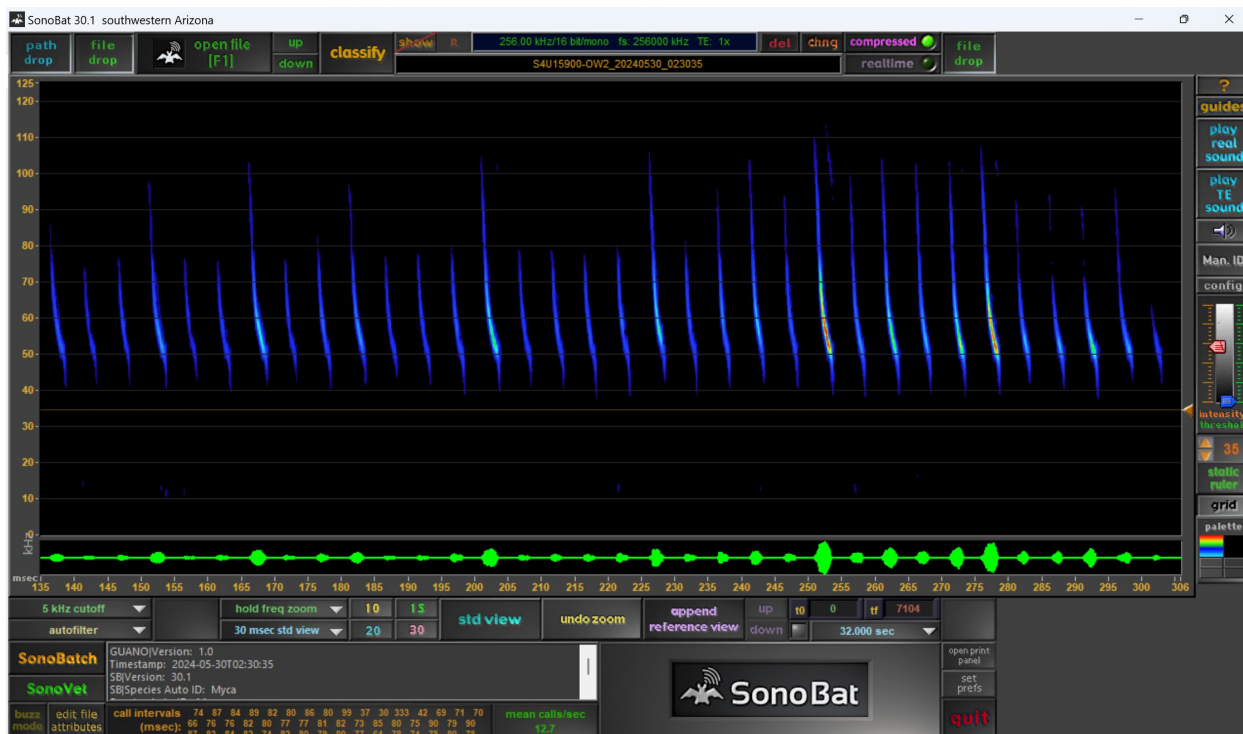


Figure A-12. California myotis (*Myotis californicus*) call sequence, from acoustic survey location OW-2, Clark County, May 30, 2024.

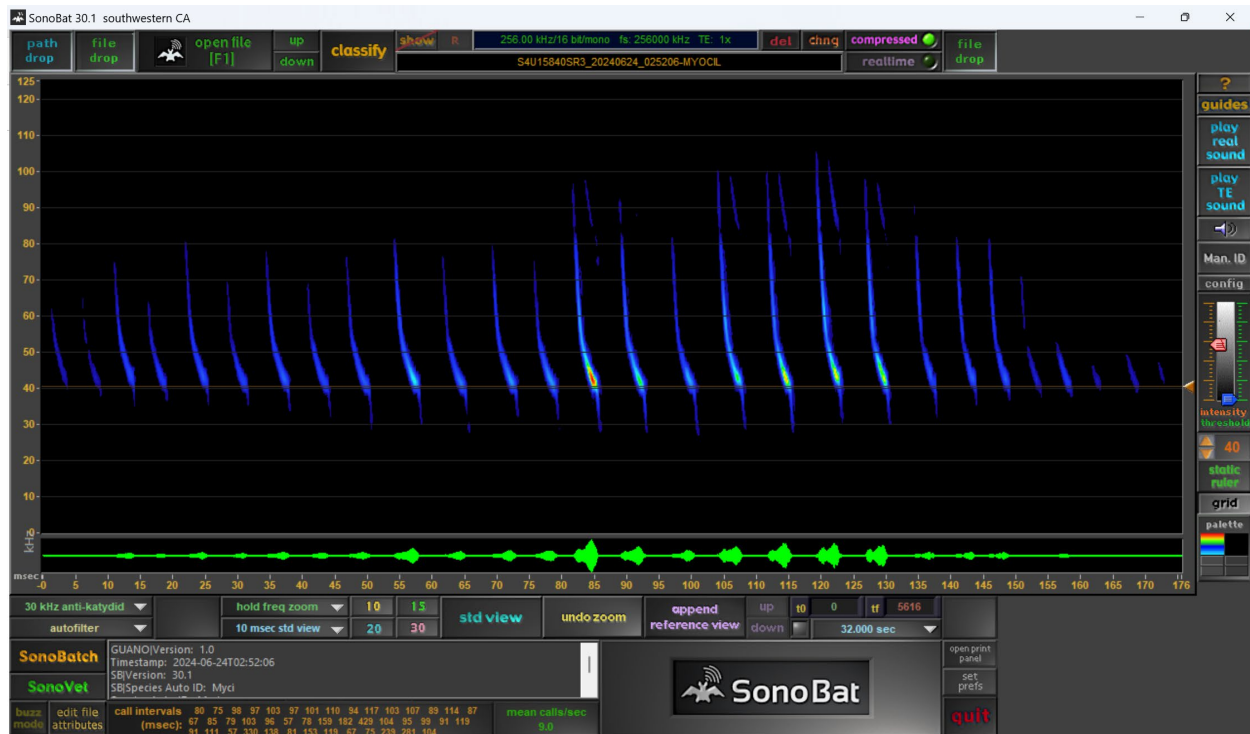


Figure A-13. Western small-footed myotis (*Myotis ciliolabrum*) call sequence, from acoustic survey location SR-3, Clark County, June 24, 2024.

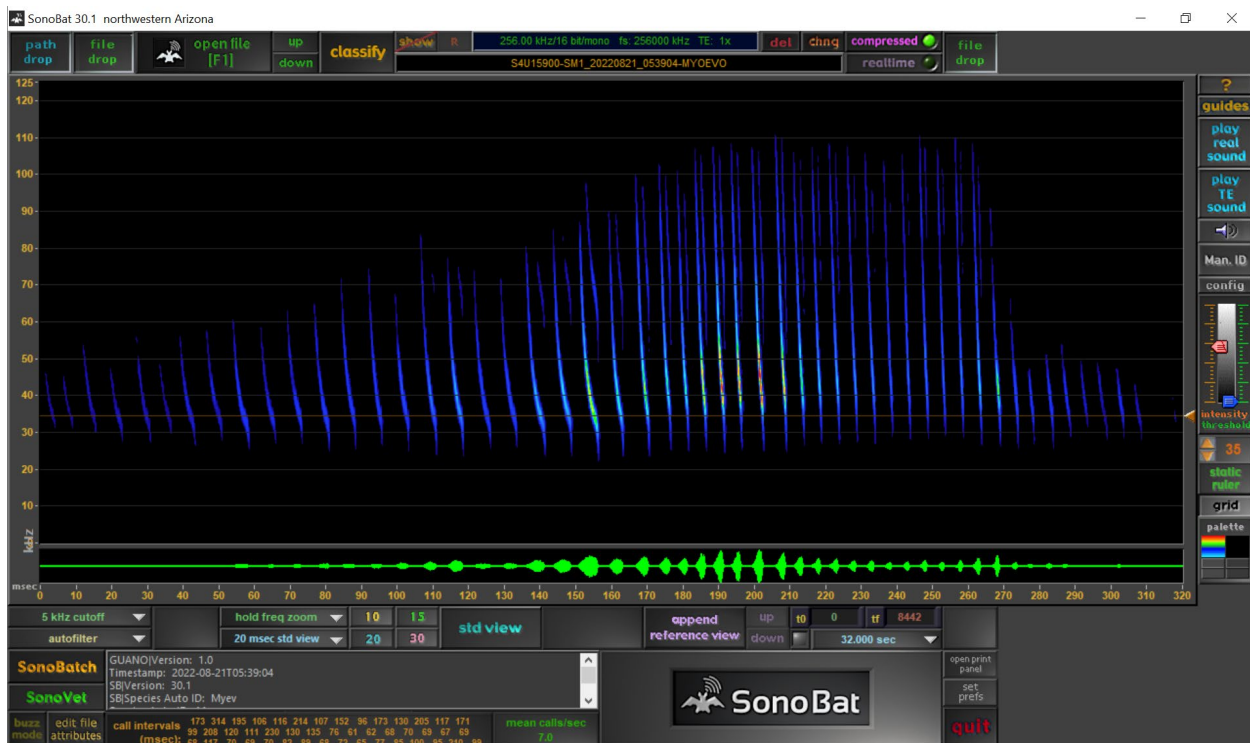


Figure A-14. Long-eared myotis (*Myotis evotis*) call sequence, from acoustic survey location SM-1, Clark County, August 21, 2022.

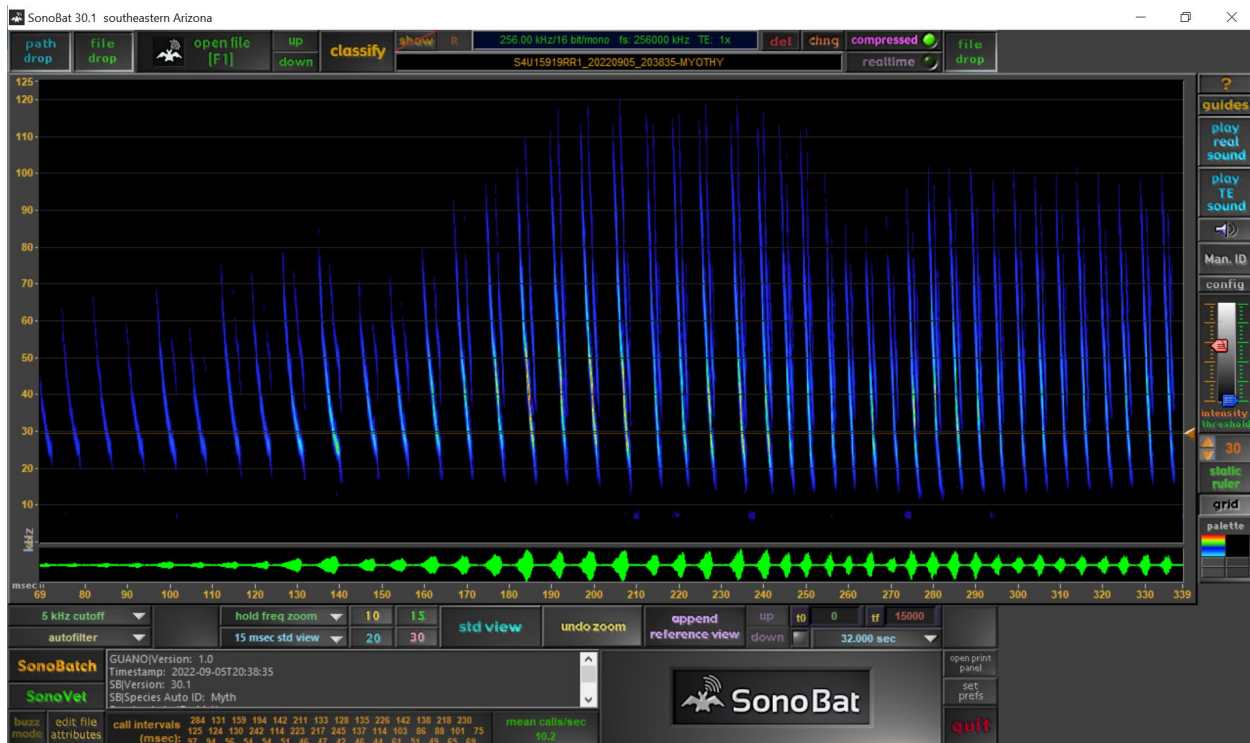


Figure A-15. Fringed myotis (*Myotis thysanodes*) call sequence, from acoustic survey location RR-1, Clark County, September 5, 2022.

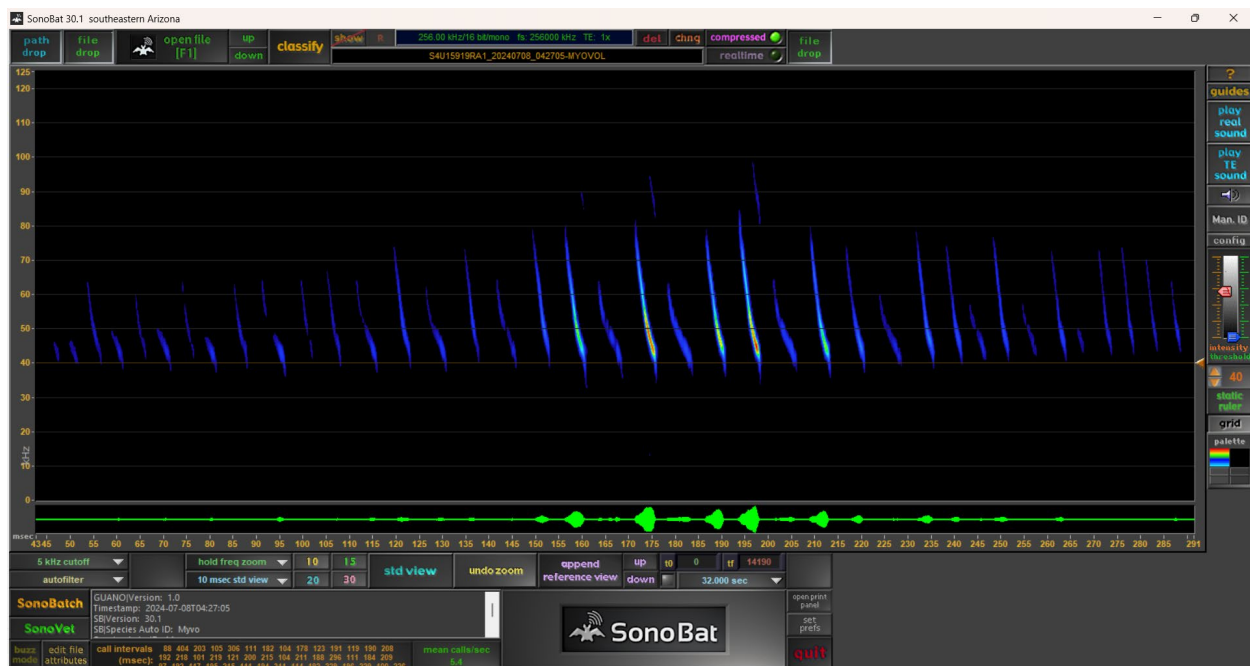


Figure A-16. Long-legged myotis (*Myotis volans*) call sequence, from acoustic survey location RA-1, Clark County, July 8, 2024.



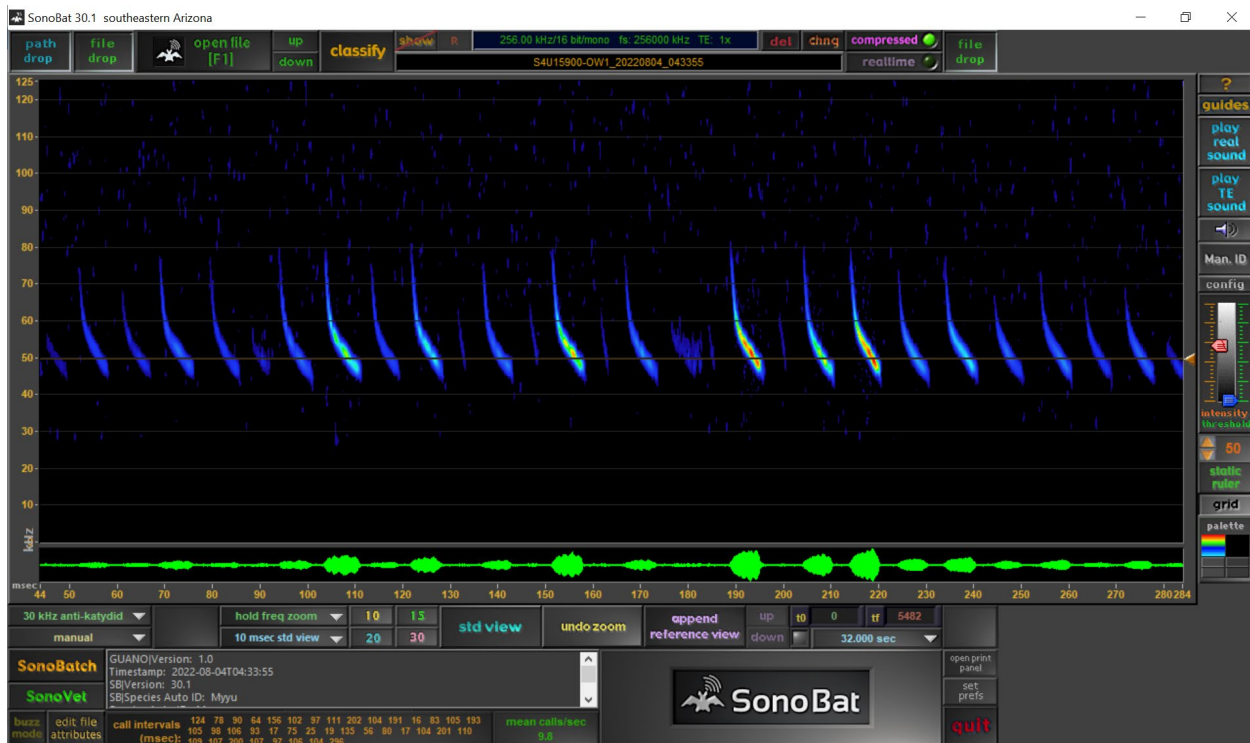


Figure A-17. Yuma myotis (*Myotis yumanensis*) call sequence, from acoustic survey location OW-1, Clark County, August 4, 2022.

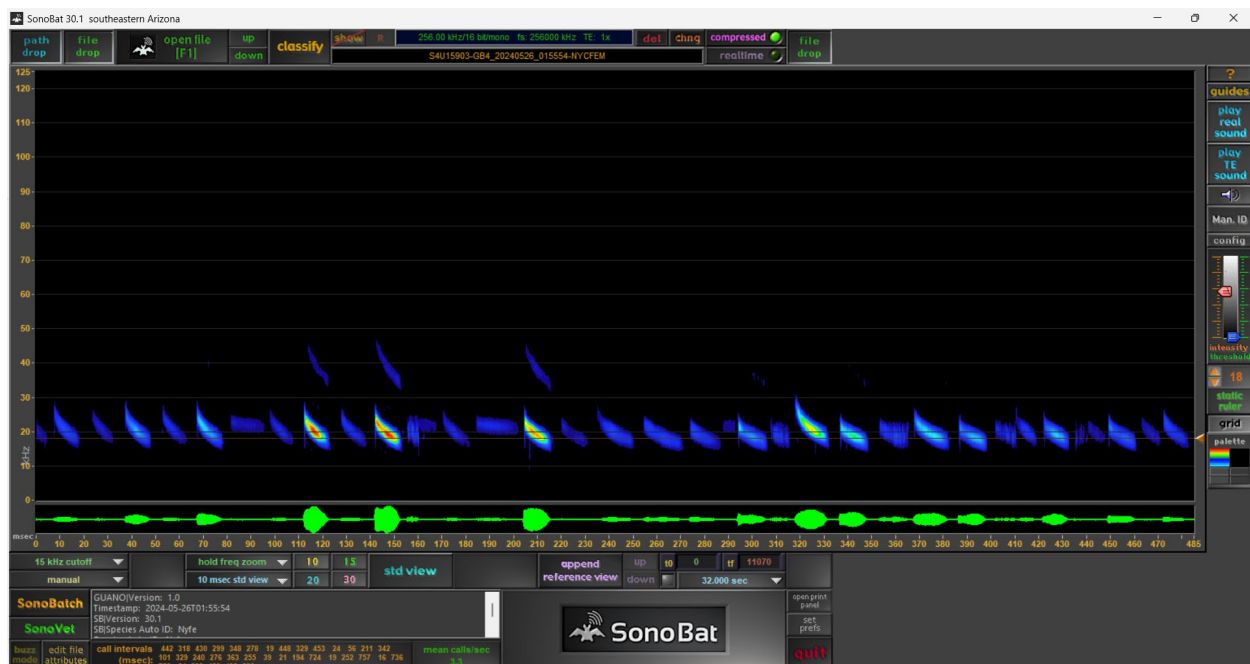


Figure A-18. Pocketed free-tailed bat (*Nyctinomops femorosaccus*) call sequence, from acoustic survey location GB-4, Clark County, May 26, 2024.

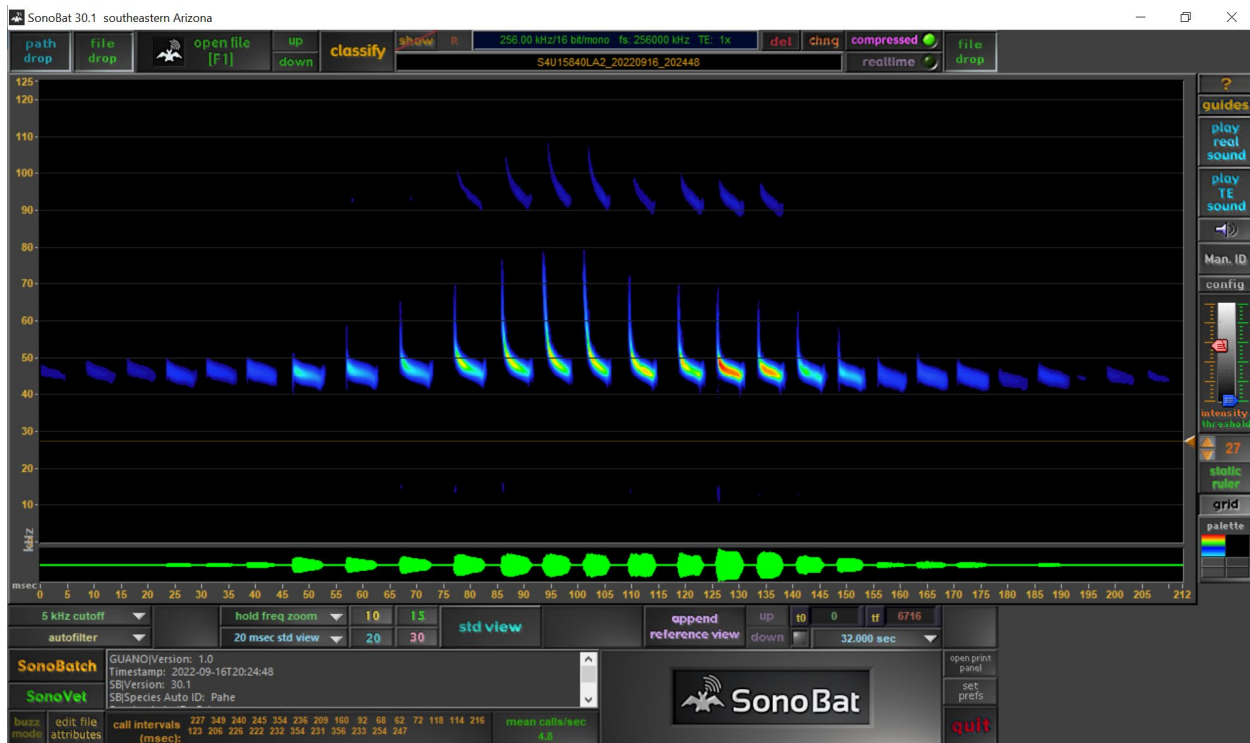


Figure A-19. Canyon bat (*Parastrellus hesperus*) call sequence, from acoustic survey location LA-2, Clark County, September 16, 2022.

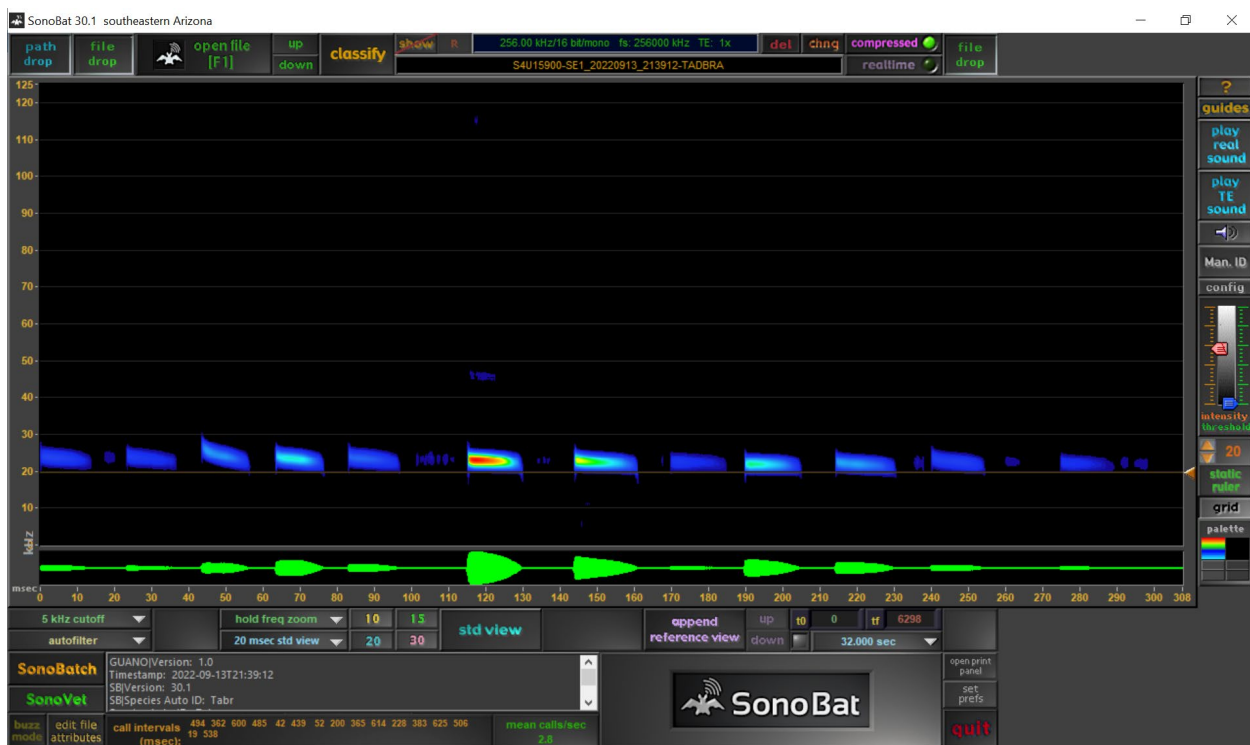


Figure A-20. Brazilian free-tailed bat (*Tadarida brasiliensis*) call sequence, from acoustic survey location SE-1, Clark County, September 13, 2022.