Bat Surveys
Year 2 Final Project Report

NOVEMBER 2024

PREPARED FOR

Desert Conservation Program
Clark County Department of
Environment and Sustainability

PREPARED BY

SWCA Environmental Consultants

BAT SURVEYS
YEAR 2 FINAL PROJECT REPORT

Prepared for

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EXECUTIVE SUMMARY

In 2023 and 2024 (Year 2), SWCA Environmental Consultants conducted bat acoustic and/or roost surveys at 93 selected sites within Clark County, Nevada. Surveys were conducted with the objective of recording additional detections of two bat species (target species) that would be covered under a proposed amendment to the Clark County Multiple Species Habitat Conservation Plan (MSHCP): spotted bat (*Euderma maculatum*) and Townsend's big-eared bat (*Corynorhinus townsendii*). These additional detections may be used to refine existing habitat distribution models for the target species.

Acoustic and roost survey locations were selected to optimize the probability of detecting target species. Survey locations were placed within the 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 target bat foraging habitat at 30 locations in 2024. At each acoustic survey location, a full-spectrum bat detector was deployed once, between May 3 and September 13 for 5 to 7 nights, from approximately 30 minutes before sunset to 30 minutes after sunrise. Each detector microphone was attached to an aluminum extension pole elevated 3.8 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. Internal roost surveys were performed at a total of 64 abandoned mines to detect Townsend's big-eared bat roosting use. Roost surveys were conducted in August 2023 and February 2024 to document seasonal and spatial variation in Townsend's big-eared bat roost use.

Acoustic surveys resulted in detections of both target species. Each species was recorded acoustically within multiple proposed MSHCP Amendment Special Management Areas. Acoustic survey results supported the habitat suitability models for spotted bat, with detections primarily recorded within warm desert riparian habitat, and cliff and canyon habitat, in north-central Clark County. Spotted bats were detected within areas modeled as foraging and roosting habitat, as well as open water and flight areas. Additional information on specific foraging and roosting use in Clark County is needed to better understand this species' potential distribution. Townsend's big-eared bat was detected acoustically within areas rated by the habitat suitability model as either unsuitable, marginal, or suitable, in primarily lower-elevation warm desert riparian corridors and at ephemeral springs located in mid-elevation foothills.

Evidence of Townsends's big-eared bat day, night, maternity, and late-season roost use was documented within various abandoned mine features distributed throughout Clark County in Year 2. No Townsend's big-eared bats were encountered during winter roost surveys. Townsend's big-eared bat was detected at 33 roost survey locations; 32 (97%) of these detection locations were within areas modeled as unsuitable habitat. Fourteen detection locations were within an MSHCP Amendment Special Management Area, and one was within an MSHCP Amendment Impact Area. The documentation of occupied roosting sites outside predicted habitat should facilitate improvement of habitat suitability models for this species. Additional acoustic and roost survey efforts proposed within unsurveyed areas would likely yield additional occurrence records, which could assist researchers in further refinement of species distribution models for both of these secretive bat species.

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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 bat species: spotted bat (*Euderma maculatum*) and Townsend's big-eared bat (*Corynorhinus townsendii*).

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 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 objectives of the project are to 1) collect acoustic sampling data at strategic locations to determine occupancy of target species and to better characterize foraging habitat within Clark County, and 2) target areas within the proposed MSHCP Amendment Special Management Areas (SMAs) and MSHCP Amendment Impact Areas with a higher likelihood of containing undocumented roost and/or hibernacula (winter roost) sites to determine whether these unique features exist, and characterize any sites located during surveys.

2 Methods and Materials

2.1 Site Selection

In Year 2, SWCA initially selected 298 sites (34 acoustic sites and 264 roost 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 the two target species (Southwest Ecology LLC 2018). SWCA also requested and/or reviewed additional agency and publicly available spatial data for target bat species occurrence records (J. Williams, personal communication with M. Swink, SWCA; NatureServe 2023; Nevada Division of Minerals [NDOM] 2022; Nevada Division of Natural Heritage [NDNH] 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 models for target bat species predict high levels of habitat suitability, or available desktop data analysis suggested potential target bat 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 Area and proposed MSHCP Amendment Special Management Area polygons were prioritized in selection of survey locations for both target bat species. 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), Nevada Department of Wildlife (NDOW), State of Nevada, or National Park Service (NPS). From the 298 potential survey locations, an experienced bat biologist evaluated observed conditions to microsite up to 90 (60 roost and 30 acoustic) survey locations within suitable habitat for target bat species. SWCA coordinated with the County to ensure that survey location selection met overall project goals.

2.1.1 Site Selection Criteria

SWCA used each target species' habitat suitability model and existing detection location data to identify selected sites that fit the prioritization criteria, as described below (see Figure 1). Due to the low-intensity calls emitted by Townsend's big-eared bat, acoustic survey locations prioritized areas identified as foraging and/or roosting habitat for spotted bats. 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 SMA (inside preferred),
- proximity to a road navigable with a truck (≤1 mile [1.6 km] preferred), and
- location on private or public land (public land preferred).

Potential roost sites were selected for Townsend's big-eared bat by the prioritization criteria listed above, as well as the following additional criteria:

- Abandoned Mine Land type: adit, shaft, stope, or incline (adit preferred), and
- degree of documented bat use or potential habitat (higher use/habitat potential values 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 for either species. The result of this selection process was a collection of 90 primary survey locations and an available set of 208 alternative survey locations, which were used if unforeseen access or navigation issues were identified. Thirty-eight of these potential survey locations were within proposed SMAs.

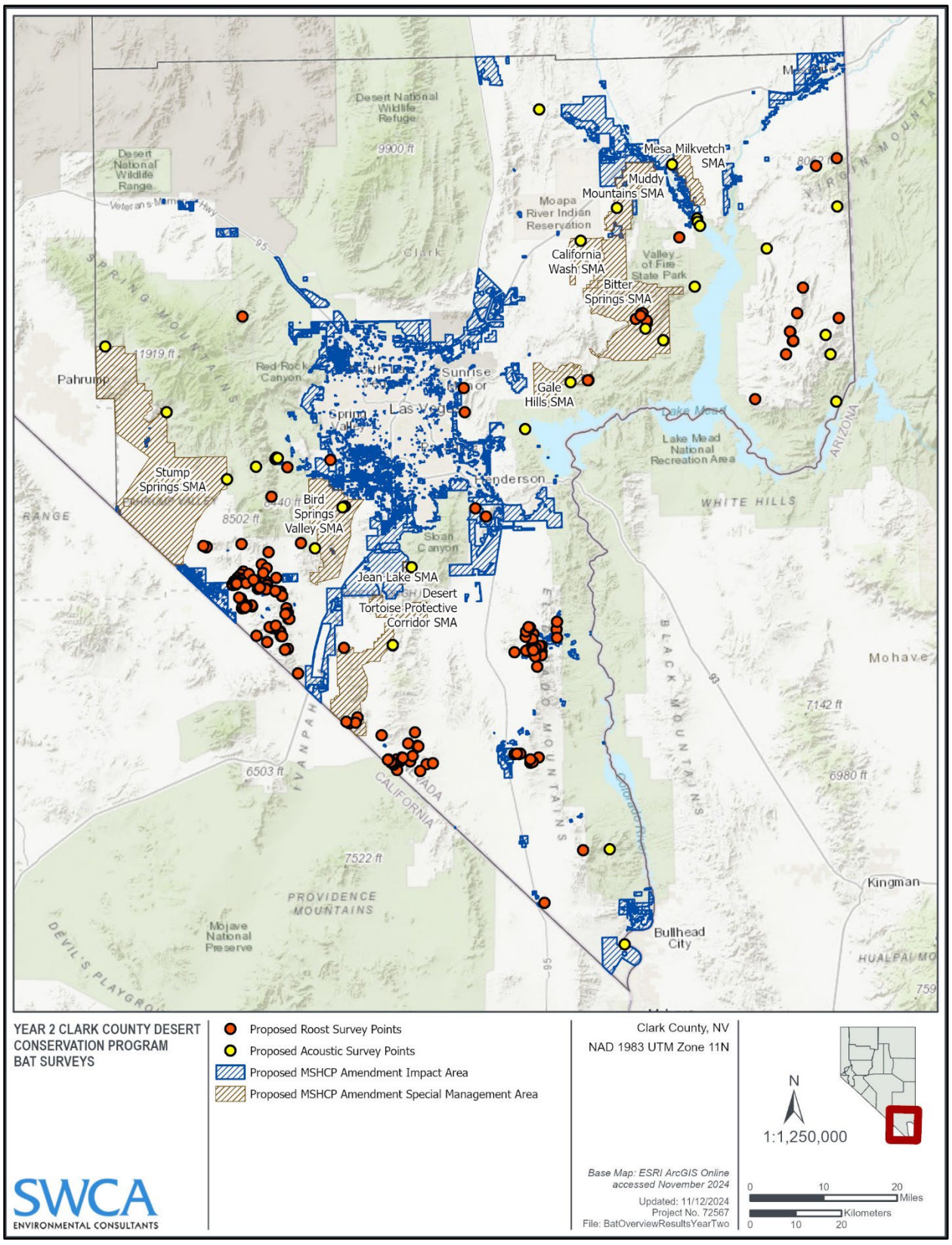

Figure 1. Proposed Year 2 bat acoustic and roost survey locations.

2.2 Surveys

Survey methods described below are based on established bat acoustic (Loeb et al. 2015; Reichert et al. 2018) and roost (Brown 2006; Loeb et al. 2015; Sherwin et al. 2009) survey protocols, which are accepted 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 30 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 the ground surface. Detectors were calibrated to optimize low-intensity acoustic recordings of both target 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. Based on a review of target species occurrence data within Clark County (Bradley et al. 2006; Las Vegas Wash Coordination Committee 2011; NDNH 2024; Southwest Ecology LLC 2018; Williams et al. 2006), acoustic surveys were conducted from May 3 through September 13, 2024, to optimize detection probability during higher bat activity periods associated with breeding and foraging behavior (Table 1).

Table 1. Year 2 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
Connoly 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

Location	Survey Point ID	Land Management*	MSHCP Status†	Deployment Date (2024)	Retrieval Date (2024)	Detector-Nights	Microphone Height (m)
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

2.2.2 Roost Surveys

Based on its known preference for roosting in abandoned mines, SWCA performed internal roost surveys at a total of 64 selected mines to determine Townsend's big-eared bat presence and characterize habitat suitability. SWCA coordinated with the County, NDOM, and NDOW to map the location of known and potential roosting resources within Clark County. As part of this review, SWCA submitted an updated data request to the NDOM for all abandoned mines within the county. Following coordination, a desktop review of available mine attribute data, geographic information system (GIS) and high-resolution digital imagery, and topographic maps was conducted to evaluate selected mines.

A team of bat biologists visited potential summer roosting locations and initially conducted external searches for presence of bats or bat sign (i.e., urine staining, guano, culled insect parts). If the underground extent of each roost resource could not be determined externally, biologists performed internal surveys at those locations. At each mine feature, biologists made entry, when feasible, and noted the presence of bat use or sign, bat species if known, approximate counts, and the type (i.e., day or night roost, maternity roost) and level of use (i.e., low, intermediate, or high). Selected roost sites with hibernaculum use potential were revisited during winter roost surveys to determine species occupancy and habitat suitability. Internal climatic data were recorded at each mine, and an estimate of human disturbance was made on a scale of 0 (none) to 3 (high). Air flow (intake or outflow), if measurable, was recorded using an anemometer.

Within each mine feature, the underground extent that could be safely accessed, and for which entry was not specifically precluded (i.e., vertical workings), was internally surveyed. Air monitors (e.g., Industrial Scientific ITX, LTX 312, 420) that continuously measure oxygen, carbon monoxide, hydrogen sulfide, methane, and particulate levels were worn during internal surveys. Field team leaders properly calibrated and maintained air monitors prior to internal evaluations. Roost surveyors fully trained and experienced in

the use of all safety equipment entered each mine while another team member remained on the surface. Standard and specific safety equipment was worn during all phases of the survey.

Personnel completing internal roost surveys adhered to current NDOW and BLM agency precautions, including use of personal protective equipment and decontamination protocols (surveyor and equipment) related to coronavirus and white-nose syndrome transmission (NDOW 2021; White-nose Syndrome Disease Management Working Group 2020). Day-roosting bats were not handled or captured within roosts to minimize disturbance. Surveyors recorded the presence, number, and location of target species, when observed.

2.2.3 Habitat Data

Surveyors recorded data on selected habitat components and structural metrics at each roost and 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 S22) using ArcGIS Field Maps (version 2024.1.3-2.0).

2.3 Acoustic Data Processing and Analysis

SWCA identified acoustic recordings of target 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, 190,413 acoustic files were recorded during bat acoustic surveys in 2024. 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 131,713 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), both the southeastern and northern Arizona regional classifiers were selected for batch processing and/or manual file vetting to evaluate all the potential bat species identified for the project area.

All files identified by the SonoBat automated classifiers as target bat species were manually reviewed and identified to species or a user-defined category. 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. Due to various factors, including environmental noise, echo, and non-bat wildlife recordings, a subset of manually reviewed files were not identifiable to species. A total of 140 bat echolocation files were manually identified to target 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. For this project, bat activity was calculated as the number of files for each species and survey point location. 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 and relative activity levels 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^2 hemispheroid centered around each survey point location. To summarize each target species' use of an acoustic survey location, it was assumed that bats detected within a certain distance of a detector could be using the habitat within that distance. A circular area around the detection location was chosen based on the use of omnidirectional microphones to document bat echolocation calls, and the assumption of equal probability of movement in any direction from the detection location. 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 collecting acoustic sampling data at strategic locations to determine occupancy of target species, and to better characterize foraging habitat within Clark County, was completed; SWCA recorded multiple acoustic detections of both target species within predicted foraging habitat in Clark County in Year 2, and these data are described in detail in Section 3.3.1. Additionally, the objective of determining current activity and condition of potential target species roosts and/or hibernacula within the proposed MSHCP Amendment SMAs and Impact Area was also completed; SWCA recorded Townsend's big-eared bat roost occupancy at multiple locations, including 15 sites within proposed MSHCP Amendment SMAs and one site within a proposed MSHCP Amendment Impact Area. 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 30 sites within Clark County; 12 of these sites were within a proposed SMA. Acoustic survey locations were on lands administered by Clark County, the BLM, State of Nevada, or NDOW. Acoustic surveys were conducted between May 3 and September 14, 2024, by SWCA bat biologist Michael Swink. Detectors successfully recorded for a minimum of 5 consecutive detector-nights and a maximum of 11 consecutive detector-nights, for a total of 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. Table 1 presents the schedule and location of bat acoustic surveys performed in Clark County in Year 2.

3.2.2 Roost Surveys

In total, 65 bat roost surveys were completed in Year 2 (33 in summer and 32 in winter). The first, or summer, round of roost surveys was completed from August 5 to 8, 2023. The second, or winter, round was completed from February 22 to 25, 2024. Roost surveys were completed at a total of 64 sites within Clark County; one site was surveyed in both summer and winter, 32 sites were surveyed only in summer, and 31 sites were surveyed only in winter. Twenty-four of these sites were located within a proposed SMA, and one was located within a proposed Impact Area. A subset of proposed roost survey locations was not surveyed, due to access routes being inaccessible. As a result, SWCA completed roost surveys at alternate, proposed sites that were accessible and met the site selection criteria described in Section 2.1.1. Roost sites surveyed in Year 2 were on lands administered by either the BLM or the NPS. Table 2 presents the timing and location of bat roost surveys in Year 2.

Table 2. Year 2 Bat Roost Survey Schedule and Locations

Abandoned Mine Land ID	Survey Date	Survey Round	MSHCP Status*	Surface Management Agency	Roost Description
CL-0674	8/5/2023	Summer	SMA	BLM	adit, room and pillar, flat ceilings with cracks showing guano below
CL-0670	8/5/2023	Summer	SMA	BLM	adit
CL-0669	8/5/2023	Summer	SMA	BLM	adit, room and pillar
CL-2310	8/5/2023	Summer	SMA	BLM	adit connecting to shaft
CL-1596	8/5/2023	Summer	SMA	BLM	adit 80 feet long
CL-0897	8/5/2023	Summer	SMA	BLM	adit 500 feet, one long drift with a 70-foot crosscut at 300 feet
CL-0893	8/6/2023	Summer	SMA	BLM	adit
CL-2169	8/6/2023	Summer	SMA	BLM	adit, wood and metal covering entrance, behind house
CL-0888	8/6/2023	Summer	SMA	BLM	decline adit
CL-0886	8/6/2023	Summer	SMA	BLM	adit culvert gate, cut crossbar
CL-0884	8/6/2023	Summer	SMA	BLM	adit culvert gate
CL-0885	8/6/2023	Summer	SMA	BLM	adit culvert gate
CL-1933	8/6/2023	Summer	SMA	BLM	Adit
CL-0394	8/6/2023	Summer	–	BLM	Adit
CL-1836	8/6/2023	Summer	–	BLM	Adit
CL-1636	8/6/2023	Summer	–	BLM	adit culvert gate
CL-0044	8/6/2023	Summer	–	BLM	adit
CL-2275	8/6/2023	Summer	–	BLM	adit
CL-1651	8/7/2023	Summer	SMA	BLM	adit
CL-1849	8/7/2023	Summer	SMA	BLM	adit
CL-1959	8/7/2023	Summer	SMA	BLM	adit
CL-1961	8/7/2023	Summer	SMA	BLM	adit
CL-1963	8/7/2023	Summer	SMA	BLM	decline to adit
CL-1965	8/7/2023	Summer	SMA	BLM	adit
CL-1967	8/7/2023	Summer	SMA	BLM	adit, drift with crosscut
CL-1953	8/7/2023	Summer	SMA	BLM	adit
CL-1955	8/7/2023	Summer	SMA	BLM	adit
CL-2170	8/7/2023	Summer	SMA	BLM	adit

Abandoned Mine Land ID	Survey Date	Survey Round	MSHCP Status*	Surface Management Agency	Roost Description
CL-1957	8/7/2023	Summer	SMA	BLM	adit
CL-1464	8/8/2023	Summer	Impact	BLM	adit
CL-1583	8/8/2023	Summer	–	BLM	adit
CL-1582	8/8/2023	Summer	–	BLM	adit
CL-0737	8/8/2023	Summer	–	BLM	adit, room and pillar
CL-0282	2/22/2024	Winter	–	NPS	adit with large dump 400+ feet
CL-0280	2/22/2024	Winter	–	NPS	adit 200-foot workings
CL-1958	2/22/2024	Winter	–	NPS	adit with bat gate min 250-foot workings, stopped short at Macrotus californicus colony
CL-2023	2/23/2024	Winter	–	BLM	adit culvert gate partially filled in 70 feet
CL-2017	2/23/2024	Winter	–	BLM	adit culvert gate, intact, connects to shaft CL-2015, decline, 150-foot workings
CL-0044	2/23/2024	Winter	–	BLM	adit with shaft connection 100 feet
CL-0246	2/23/2024	Winter	–	NPS	adit 500 feet long, collapse at 50 feet from stope, small gap 1–2 feet high with guano. Large chamber 30 feet h × 20+ feet w
CL-0247	2/23/2024	Winter	–	NPS	adit culvert bat gate 400-foot adit with stope, broken unstable inside
CL-0248	2/23/2024	Winter	–	NPS	adit plastic culvert gate 600-foot workings
CL-0097	2/23/2024	Winter	–	BLM	adit 65 feet no gate or barricade
CL-2049	2/23/2024	Winter	–	BLM	adit with nonremovable bat culvert gate 2 feet
CL-0084	2/24/2024	Winter	–	BLM	adit 150-foot workings 3 feet wide
CL-2140	2/24/2024	Winter	–	BLM	adit with collapsed portal
New-0006	2/24/2024	Winter	–	BLM	adit 120-foot workings, powder magazine
CL-2249	2/24/2024	Winter	–	BLM	adit 30 feet with 3-foot winze
CL-1135	2/24/2024	Winter	–	BLM	adit
CL-1136	2/24/2024	Winter	–	BLM	20-foot open stope
CL-2199	2/24/2024	Winter	–	BLM	adit with shaft
CL-1145	2/24/2024	Winter	–	BLM	adit 120 feet long
CL-1146	2/24/2024	Winter	–	BLM	adit with deep winze
CL-1147	2/24/2024	Winter	–	BLM	adit 6 feet h × 3 feet w, 250-foot workings
CL-1149	2/24/2024	Winter	–	BLM	adit with double decline connects to CL-1150
CL-1150	2/24/2024	Winter	–	BLM	adit with winzes, connects to CL-1149
CL-1144	2/24/2024	Winter	–	BLM	adit 500-foot workings
CL-1759	2/24/2024	Winter	–	BLM	adit, flooded winze, 800-foot workings
CL-1272	2/24/2024	Winter	–	BLM	adit culvert gate, 300 feet adit length.
CL-0479	2/24/2024	Winter	–	BLM	adit with room and pillar
CL-0515	2/25/2024	Winter	–	BLM	adit with room and pillar
CL-0521	2/25/2024	Winter	–	BLM	adit with room and pillar, 65 feet long × 20 feet w
CL-0999	2/25/2024	Winter	–	BLM	adit bat gate not removeable, connects past muck pile 65 feet to open gated stope to south
CL-0996	2/25/2024	Winter	–	BLM	adit no removeable bar, may connect to open stope 33 feet southwest
CL-1428	2/25/2024	Winter	–	BLM	adit nonremovable gate 65 feet

* Impact = MSHCP Amendment Impact Area; SMA = MSHCP Amendment Special Management Area

3.3 Findings

3.3.1 Target Species Detections

Both target bat species were detected acoustically in Year 2 (Table 3; see Sections 3.3.1.1 and 3.3.1.2). Spotted bat was detected acoustically on a total of 76 recordings at eight locations in north-central Clark County. Townsend's big-eared bat was identified acoustically on a total of 64 recordings at 17 survey locations. Both target bat species were detected at five of the acoustic survey locations. Each target species was recorded within several of the proposed SMAs.

Bat roost surveyors documented 34 detections of Townsend's big-eared bat individuals and/or sign within 33 of 64, or 52%, of roost survey locations. Nineteen of these detections were documented during summer roost surveys, whereas 15 detections were documented during winter surveys. Two of these detections consisted of live, roosting individuals, whereas the remaining detections consisted of recent guano deposition. No Townsend's big-eared bats were encountered during winter roost surveys.

A desktop review of available target bat spatial occurrence data in Year 2 resulted in the identification of 11 additional occurrence records; eight of these records were for Townsend's big-eared bat, located during roost surveys within Gold Butte National Monument (NDOM 2022), and three additional records for spotted bat located during acoustic and capture surveys within the Warm Springs Natural Area in north-central Clark County (Williams et al. 2006).

Table 3. Target Bat Acoustic Detections, by Species and Location

Target Species	Site ID	Site Description	MSHCP Status*	Habitat Rating	Number of Files
Spotted bat (*Euderma maculatum*)	BI-01	Bitter Spring	SMA	Foraging	4
	BI-02	West Longwell Ridge	SMA	Roosting	11
	BR-01	Bowman Reservoir	SMA	Water Sources	1
	GB-04	Red Bluff Spring	–	Foraging	17
	MU-01	California Ridge	SMA	Flight Area	2
	OW-02	Overton Wildlife Management Area	–	Foraging	11
	OW-03	Overton Wildlife Management Area	–	Foraging	9
	OW-04	Overton Wildlife Management Area	–	Foraging	21
Townsend's big-eared bat (*Corynorhinus townsendii*)	BI-01	Bitter Spring	SMA	Unsuitable	2
	BR-01	Bowman Reservoir	SMA	Marginal	3
	GB-01	Summit Spring	–	Unsuitable	1
	GB-02	Connoly Spring	–	Unsuitable	1
	KS-01	Kiup Spring	SMA	Suitable	2
	LA-03	Laughlin, Colorado River	–	Marginal	12
	MC-01	McClanahan Spring	SMA	Unsuitable	2
	ML-01	Mule Spring	SMA	Suitable	1
	OW-02	Overton Wildlife Management Area	–	Suitable	8
	OW-03	Overton Wildlife Management Area	–	Marginal	3
	OW-04	Overton Wildlife Management Area	–	Marginal	19
	PS-01	Pipe Spring, Newberry Mountains	–	Suitable	2
	RA-01	Rainbow Spring	–	Suitable	2

Target Species	Site ID	Site Description	MSHCP Status*	Habitat Rating	Number of Files
	SR-01	Spring Mountain Ranch State Park	–	Suitable	2
	SR-02	Spring Mountain Ranch State Park	–	Marginal	2
	SR-03	Spring Mountain Ranch State Park	–	Marginal	1
	VM-03	Cabin Spring, Virgin Mountains	–	Marginal	1
	Total				**140**

* SMA = Proposed MSHCP Amendment Special Management Area

3.3.1.1 SPOTTED BAT

Year 2 bat acoustic surveys resulted in 76 spotted bat recordings at eight locations (Figure 2; see Table 3). These detections were within areas modeled as either water sources, flight area, foraging, or roosting habitat. Multiple spotted bat recordings were collected at most of these sites, which included several feeding trills, suggesting regular foraging use at these locations (Appendix A). No spotted bats were documented incidentally or during completion of roost surveys in Year 2.

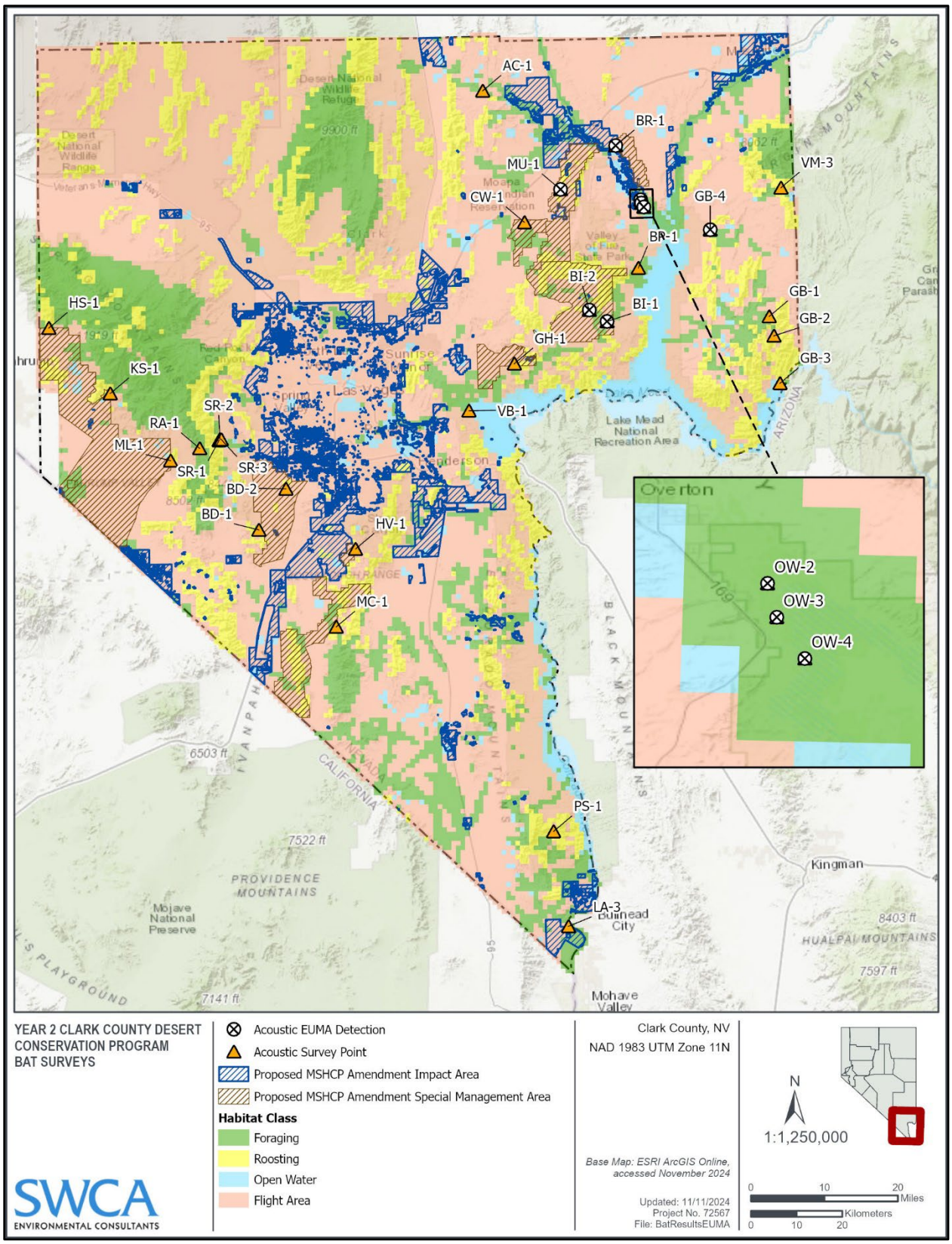

Figure 2. Spotted bat (EUMA) acoustic detections in Clark County in Year 2.

3.3.1.2 TOWNSEND'S BIG-EARED BAT

Townsend's big-eared bat was detected at multiple locations within Clark County in Year 2 during both acoustic and roost surveys (Table 4, Figure 3; see Table 3). A total of 64 acoustic recordings from 17 locations were identified as Townsend's big-eared bat (see Table 3 and Figure 3). Acoustic detections of this species were in areas modeled as either marginal (41%), unsuitable (24%), or suitable (35%). Roost surveys resulted in a total of 34 Townsend's big-eared bat detections at 33 roost sites. Fourteen of these sites were located within an MSHCP Amendment SMA, and one was located within an MSHCP Amendment Impact Area. Thirty-three, or 97%, of these roost survey detection locations were in areas modeled as unsuitable habitat, whereas one detection was in predicted marginal habitat. Nineteen (56%) of the roost survey detections occurred during the summer survey period, and indicated varied bat reproductive and ecological behavior, consisting of day, night, swarming, and/or maternity activity. Several roost sites surveyed during the winter survey period indicated potential for late fall and/or winter Townsend's big-eared bat use, consisting of hibernation, torpor, or late-season roosting; however, since no individuals were observed, this use could not be confirmed.

3.3.2 Non-Target Species

Multiple non-target bat species were detected acoustically at all survey locations throughout the survey period. Acoustic files of non-target bat species were not identified manually or analyzed, but unprocessed raw files, as well as the batch processing and automated classification results of non-target bat species, were collected. Non-target bat species and their sign were detected during internal roost surveys at multiple locations, and consisted of California leaf-nosed bat (*Macrotus californicus*), canyon bat (*Parastrellus hesperus*), smaller *Myotis* species (e.g., California myotis [*Myotis californicus*]), larger *Myotis* species (e.g., cave myotis [*M. velifer*] and/or Yuma myotis [*M. yumanensis*]), and pallid bat (*Antrozous pallidus*), which included observations of live individuals, a single carcass, and maternity guano piles.

Several species of reptiles (speckled rattlesnake [*Crotalus pyrrhus*], western diamond-backed rattlesnake [*Crotalus atrox*], Mojave desert tortoise [*Gopherus agassizii*]), mammals (ringtail [*Bassariscus astutus*], woodrat [*Neotoma* spp.]), and birds (Say's phoebe [*Sayornis sayi*], barn owl [*Tyto alba*]) were also encountered in multiple mines during roost surveys.

3.3.3 Habitat Data

Surveyors recorded data on selected habitat components and structural metrics at each roost and acoustic survey location. In total, 393 photographs (151 photographs at acoustic survey locations and 242 photographs at roost sites) and associated habitat data were recorded. Average vegetation height at each acoustic survey location ranged from 0.5 to 5 m (average = 1.7 m, standard deviation = 1.1 m). Maximum vegetation height at each acoustic survey location ranged from 1 to 20 m (average = 7.4 m, standard deviation = 5 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 14 (47%) of the acoustic survey locations.

Table 4. Townsend's Big-Eared Bat Roost Survey Detection Results by Location and Date

NDOM ID	Survey Date	Human Disturbance	Airflow (Yes or No)	Temperature (degrees Celsius)	Townsend's big-eared bat (*Corynorhinus townsendii*) Sign	Habitat Rating	MSHCP Status*
CL-0674	8/5/2023	high	yes	16	occasional day roosting use	Unsuitable	SMA
CL-0670	8/5/2023	high	yes	16	occasional day roosting use	Unsuitable	SMA
CL-1596	8/5/2023	low	no	24	staging/birthing/weaning site, part of larger population; six pups, six female adults	Unsuitable	SMA
CL-0897	8/5/2023	none	no	23	maternity pile and dispersed guano in first 100 feet	Unsuitable	SMA
CL-0886	8/6/2023	low	yes	22	maternity roost, 20 juvenile and adult bats, still nursing; not a staging site	Unsuitable	SMA
CL-0884	8/6/2023	none	yes	–	Connects with CL-0886, active maternity colony	Unsuitable	SMA
CL-0885	8/6/2023	none	yes	–	Connects with CL-0886, active maternity colony	Unsuitable	SMA
CL-1933	8/6/2023	low	no	23	guano, a couple of smaller maternity piles	Unsuitable	–
CL-0044	8/6/2023	low	yes	20	Scattered guano	Unsuitable	–
CL-1959	8/7/2023	low	no	30	guano, likely night roost use, scattered	Unsuitable	SMA
CL-1961	8/7/2023	low	no	29	guano, likely nonfeeding night roosting use	Unsuitable	SMA
CL-1965	8/7/2023	none	no	30	guano, night roosting use	Unsuitable	SMA
CL-1967	8/7/2023	none	no	33	summer use, scattered guano	Unsuitable	SMA
CL-1953	8/7/2023	none	no	–	scattered guano deposition, no bats at time of survey; likely occasional night use	Unsuitable	SMA
CL-2170	8/7/2023	low	no	33	guano; summer roost	Unsuitable	SMA
CL-1957	8/7/2023	none	no	–	guano	Unsuitable	SMA
CL-1464	8/8/2023	none	no	20	guano on gate	Unsuitable	Impact
CL-1583	8/8/2023	moderate	no	25	guano; consistent multispecies day/night warm-season use; winter use potential	Unsuitable	–
CL-1582	8/8/2023	high	no	28	guano; day, night, possible maternity use	Unsuitable	–
CL-0282	2/22/2024	none	no	19	maternity use just inside portal; internal conditions could support maternity use	Unsuitable	–
CL-0280	2/22/2024	low	no	24	casual warm-season use, too warm for hibernation	Unsuitable	–
CL-1958	2/22/2024	none	no	26	large maternity pile	Unsuitable	–
CL-0044	2/23/2024	low	yes	14	warm-season use; good torpor potential but not observed	Unsuitable	–
New-0006	2/24/2024	low	no	18	scattered guano, warm-season use	Unsuitable	–

NDOM ID	Survey Date	Human Disturbance	Airflow (Yes or No)	Temperature (degrees Celsius)	Townsend's big-eared bat (*Corynorhinus townsendii*) Sign	Habitat Rating	MSHCP Status*
CL-2249	2/24/2024	none	no	14	bachelor warm-season use, scattered guano	Unsuitable	–
CL-1147	2/24/2024	none	no	18	scattered warm-season bachelor day roosting use, culled insect parts	Unsuitable	–
CL-1149	2/24/2024	low	no	18	copious guano, likely maternity use; good hibernation potential	Unsuitable	–
CL-1150	2/24/2024	low	yes	14	maternity use, heavy guano; good fall spring and torpor potential	Unsuitable	–
CL-1759	2/24/2024	MO	no	23	some scattered guano deposition, warm-season use.	Unsuitable	–
CL-1272	2/24/2024	low	no	–	high warm-season use, likely maternity use	Marginal	–
CL-0479	2/24/2024	none	no	17	scattered guano, casual warm-season use	Unsuitable	–
CL-0515	2/25/2024	none	no	15	scattered guano, warm-season use	Unsuitable	–
CL-0999	2/25/2024	none	no	18	guano on gate, torpor and/or night roost potential	Unsuitable	–
CL-0996	2/25/2024	none	yes	20	guano on gate, possible torpor and night roost habitat potential	Unsuitable	–

* Impact = MSHCP Amendment Impact Area; SMA = MSHCP Amendment Special Management Area

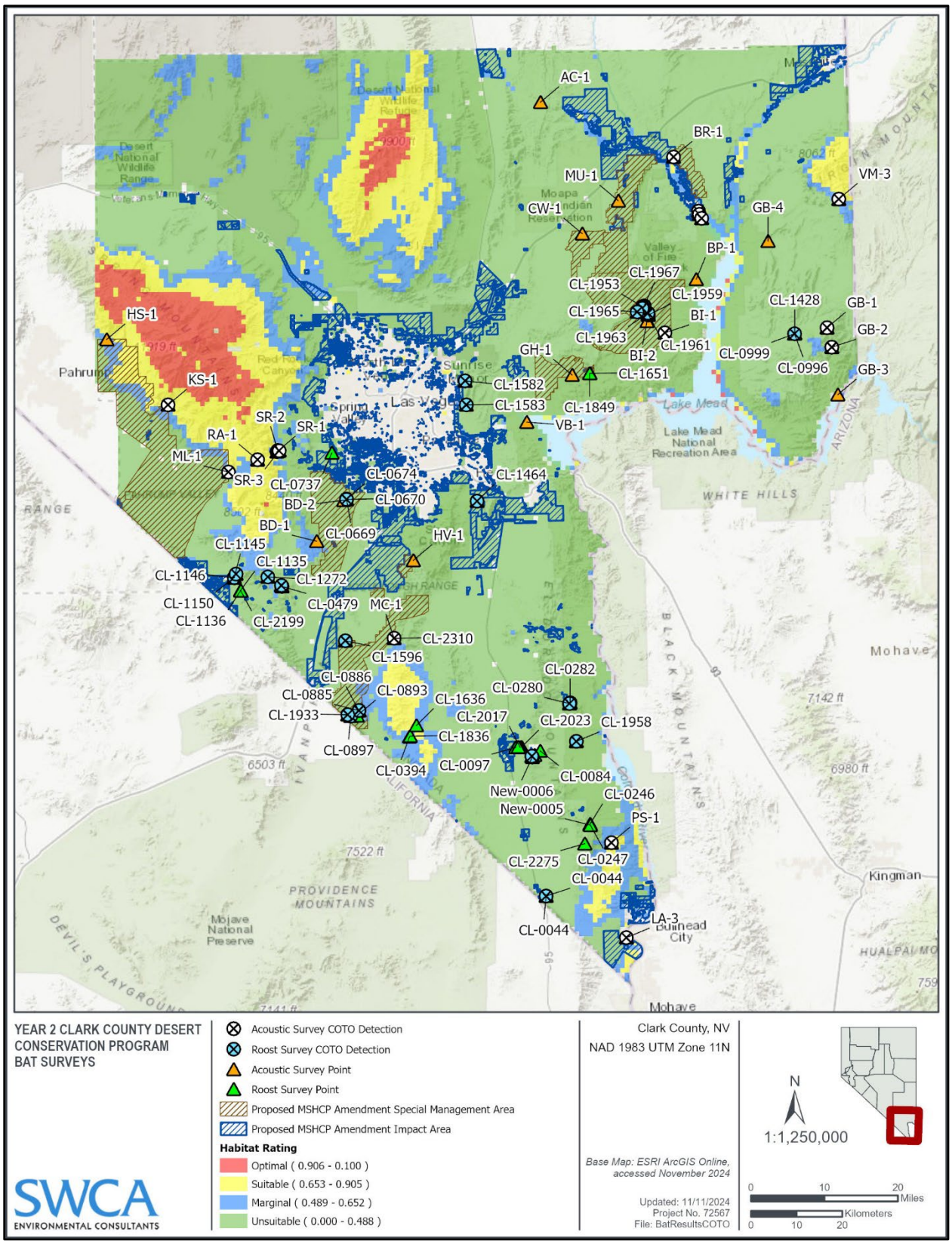

Figure 3. Townsend's big-eared bat (COTO) acoustic and roost detections in Clark County in Year 2.

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. Townsend's big-eared bat is known to use various abandoned mine workings, including shafts, adits, stopes, winzes, and declines. Due to safety and budgetary considerations, however, only adits were surveyed for this project. As a result, this species' use of abandoned mines within Clark County is likely underrepresented by these detection results. 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 target species below are focused on patterns of detections observed in Year 2.

4.1 Spotted Bat

Within its range, spotted bat has been detected within a variety of habitat types, including mesquite bosque, emergent marsh, dry desert canyons, ponderosa pine (*Pinus ponderosa*) woodlands, high-elevation meadows, and even within urban areas, such as Las Vegas, Nevada, where they presumably roost on buildings (Geluso 2000; NDOW 2022; Southwest Ecology LLC 2018; Wilson and Ruff 1999). Williams et al. (2006) detected spotted bat acoustically, primarily within mesquite bosque and emergent marsh within the Warm Springs Natural Area, near the headwaters of the Muddy River. Spotted bat is known to roost in vertical cracks within large, rock cliff features (Pierson and Rainey 1998). Several mountainous areas within the county, including Red Rock Canyon, the Virgin Mountains, the Newberry Mountains, and the Arrow Canyon Range, exhibit extensive examples of potential spotted bat roosting 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).

Multiple spotted bat recordings were collected at acoustic survey locations OW-02, OW-03, OW-04 within the Overton Wildlife Management Area. 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. Acoustic survey locations BI-01 and GB-04 were placed at relatively remote surface water features with low to moderate riparian woodland cover and potential spotted bat roosting habitat within 6 miles (10 km). BI-02 and MU-01 were located in rocky, upland areas along steep canyon walls, forming a narrow, constricted flight corridor for commuting bats. Vegetation at these sites was dominated by creosotebush–burrobush (*Ambrosia dumosa*) desert scrub.

At two acoustic survey locations (BR-01 and MU-01) 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. At the remaining sites (BI-01, BI-02, GB-4, OW-2, OW-3, and OW-4; Figures 4 and 5), the abundance of files, pattern of detections over multiple detector-nights, and several recordings of feeding "trills" suggest repeated foraging use at the survey location. Spotted bats are known to exhibit high foraging site fidelity, returning to productive foraging grounds over successive nights (Wilson and Ruff 1999). The Muddy River channel and agricultural fields adjacent to acoustic

survey locations within the Overton Wildlife Management Area, where 54% of spotted bat acoustic detections were recorded, likely support relatively high densities of flying insect species (e.g., moths) on which spotted bats feed.

Relative to most other North American bat species, spotted bat is difficult to record acoustically; several sources of environmental noise, i.e., those audible to human ears, overlap with the characteristic frequencies that echolocating spotted bats produce. Indeed, published spotted bat acoustic detections within the county are limited to the Las Vegas Valley, the Muddy River drainage, and suitable habitats along the Colorado River and Las Vegas Wash (Bradley et al. 2006; Las Vegas Wash Coordination Committee 2011; NatureServe 2023; NDNH 2024; Southwest Ecology LLC 2018; Williams et al. 2006). Predicted foraging and roosting habitat comprises a much larger portion of the county, however, and this species is likely more locally abundant than these data suggest.

Figure 4. Habitat at acoustic survey location BI-01, where both target species were detected in Year 2.

Figure 5. Habitat at acoustic survey location OW-03, where both target species were detected in Year 2.

4.2 Townsend's Big-Eared Bat

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. This bat was detected acoustically within primarily warm desert and montane riparian habitats in 2024. 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 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 (Figures 6 and 7) were likely associated with foraging or movement between roost and foraging locations.

Townsend's big-eared bat is known to roost primarily within abandoned mines and caves, but it is also occasionally found within abandoned buildings. This species was documented using mines as night roosts, as indicated by the presence of culled moth wings and other prey remains on the ground. Most of the Townsend's big-eared bat detections indicated summer and/or late fall use. Maternity use was documented at nine sites, including discovery of active maternity colonies within CL-0886 and CL-1596. Many of the roost survey detections of this species were within areas with multiple abandoned mine openings, or "mine complexes" (Figures 8, 9, and 10). These mining complexes provide Townsend's big-eared bats with multiple roosting locations from which to select suitable refugia that provide a thermally stable microclimate for various life stages, including maternity and hibernation use (Sherwin, Stricklan, et al. 2000).

Figure 6. Habitat at acoustic survey location KS-01, where Townsend's big-eared bat was detected acoustically in Year 2.

Figure 7. Habitat at acoustic survey location LA-03, where Townsend's big-eared bat was detected acoustically in Year 2.

Figure 8. Roosting habitat at roost survey location CL-1582, where signs of Townsend's big-eared bat day, night, and maternity use were detected.

Figure 9. Roost survey location CL-1596, where a Townsend's big-eared bat maternity colony was detected. A bat biologist uses a thermal camera to measure temperature within different areas of the maternity roost.

Figure 10. A large Townsend's big-eared bat maternity guano pile is visible on the floor of roost survey location CL-1958 during Year 2 surveys.

Townsend's big-eared bat has been documented to spatially and temporally alternate roost sites, and likely requires the structural complexity and vertical stratification available within these complexes to locate preferred microclimatic conditions that support reproduction, social interaction, foraging, and physiological regulation (Sherwin, Gannon, et al. 2000). Most of the roost site detection locations were within mid-elevation mixed desertscrub dominated by blackbrush (*Coleogyne ramosissima*), creosote bush, burrobush, and/or Nevada jointfir (*Ephedra nevadensis*). Given the importance of suitable subsurface roost availability to its natural history, the vegetative composition within the vicinity of roosting sites is likely secondary, or perhaps even unrelated, to the occurrence of Townsend's big-eared bats in these areas. A renewed evaluation of roosting habitat suitability criteria that considers factors such as mine density and connectivity, subsurface complexity, and/or ore production estimates (as a potential surrogate for subsurface habitat extent) would support refinement of roosting habitat suitability modeling for this species in Clark County.

5 CONCLUSION

Both spotted bat and Townsend's big-eared bat were detected at multiple locations in Year 2. Both target species were recorded within the proposed SMAs, and Townsend's big-eared bat was detected within an MSHCP Amendment Impact Area. Additional species-specific conclusions are listed below.

- Spotted bat was detected acoustically at eight locations in north-central Clark County. These detections were at locations modeled as either flight area, open water, foraging, or roosting habitat. A total of 60 spotted bat recordings at survey sites BI-01, BI-02, GB-04, OW-02, OW-03, and OW-04 suggest repeated foraging activity, and/or multiple bats, at these locations across several detector-nights. Relative to the occurrence data used to develop the habitat suitability model (Southwest Ecology LLC 2018), the spotted bat detections from Year 1 (SWCA 2023) and Year 2 surveys provide a 1,200% increase in the sample size of detections within undisturbed, non-urban habitat areas. Predicted foraging and roosting habitat comprises a much larger portion of Clark County than what has been surveyed to date, however, and this species is likely more widespread than these preliminary data indicate.
- Townsend's big-eared bat was detected acoustically at 17 survey locations. These detections were primarily in low- and mid-elevation riparian woodland areas that varied in habitat rating, ranging from unsuitable to suitable. Detections within predicted suitable habitat 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 was detected during both summer and winter roost surveys. Two active maternity colonies totaling approximately 32 individuals were observed during summer surveys. No individuals were observed in hibernation or torpor during winter surveys. Thirty-two of the 33 roost survey locations where Townsend's big-eared bats were detected were modeled as unsuitable habitat; the remaining detection location was modeled as marginal. Given the presence of documented, and additional, potentially suitable roosting sites located outside predicted roosting habitat, it is likely that more habitat is occupied by this species than is currently predicted. Relative to the occurrence data used to develop the habitat suitability model (Southwest Ecology LLC 2018), the Townsend's big-eared bat detections from Year 1 (SWCA 2023) and Year 2 provide a 92% increase in the sample size of detections. In particular, the high proportion of Townsend's big-eared bat detections within areas modeled as unsuitable habitat is anticipated to further aid in the refinement of the habitat suitability model for this species.
- Twelve of the acoustic survey detections and 14 of the roost survey detections of target bat species in Year 2 were located within several of the proposed MSHCP Amendment Special Management Areas. Multiple mines surveyed within the Desert Tortoise Protective Corridor

SMA in Year 2 contained Townsend's big-eared bat sign, including two active maternity colonies. Likewise, acoustic surveys within the Bitter Springs and Mesa Milkvetch SMAs yielded multiple spotted bat detections in Year 2.

- A desktop review of available target bat spatial occurrence data in Year 2 resulted in the identification of 11 additional occurrence records; eight of these records were for Townsend's big-eared bat, located during roost surveys within Gold Butte National Monument (NDOM 2022), and three additional records for spotted bat located during acoustic and capture surveys within the Warm Springs Natural Area in north-central Clark County (Williams et al. 2006).

6 RECOMMENDATIONS

The following recommendations are based on observations from the Year 1 (SWCA 2023) and Year 2 bat surveys and factors discussed in this report. These actions would support the County's goal of refining target bat species habitat suitability models:

- Although Year 2 bat surveys resulted in multiple detections of target species, data gaps regarding their distribution and habitat use within Clark County remain. Additional information on specific foraging and roosting use by spotted and Townsend's big-eared bats is needed to better understand their distribution. In particular, the spatial and temporal extent of spotted bat habitat use in Clark County is still not fully understood, and additional species-specific surveys in these and other previously unsurveyed areas would improve our understanding of their distribution and natural history. Additional years of targeted acoustic and roost studies within unsurveyed and undersurveyed areas would greatly increase the predictive power of habitat suitability models developed for these species.
- 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.

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APPENDIX A

Selected Target Species Call Sequence Spectrograms

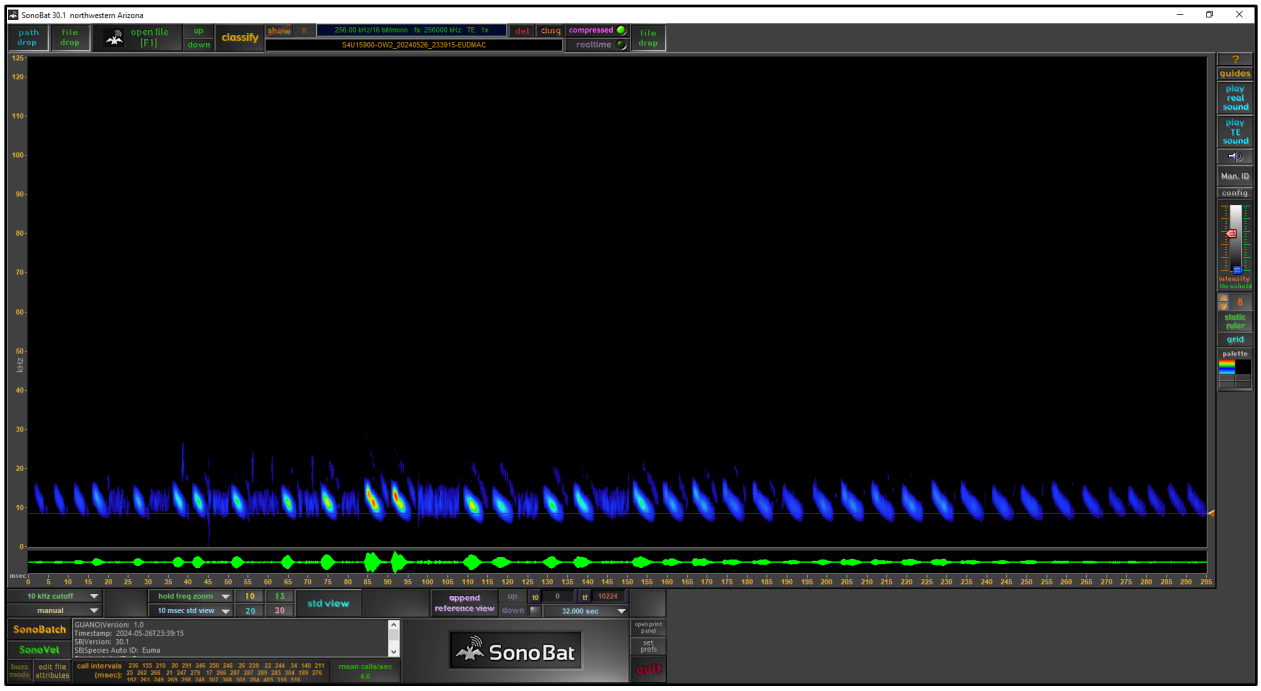

Figure A-1. Spotted bat call sequence from acoustic survey location OW-02, Clark County, May 26, 2024.

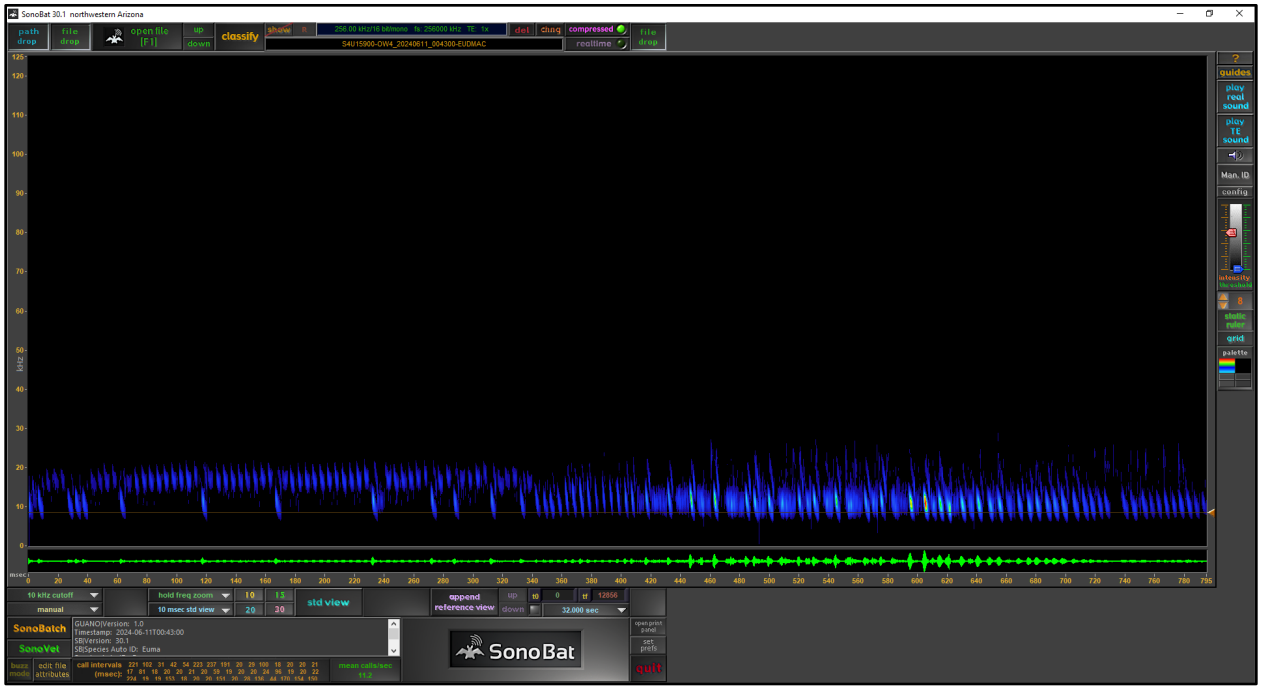

Figure A-2. Spotted bat call sequence, including trills, from acoustic survey location OW-04, Clark County, June 11, 2024.

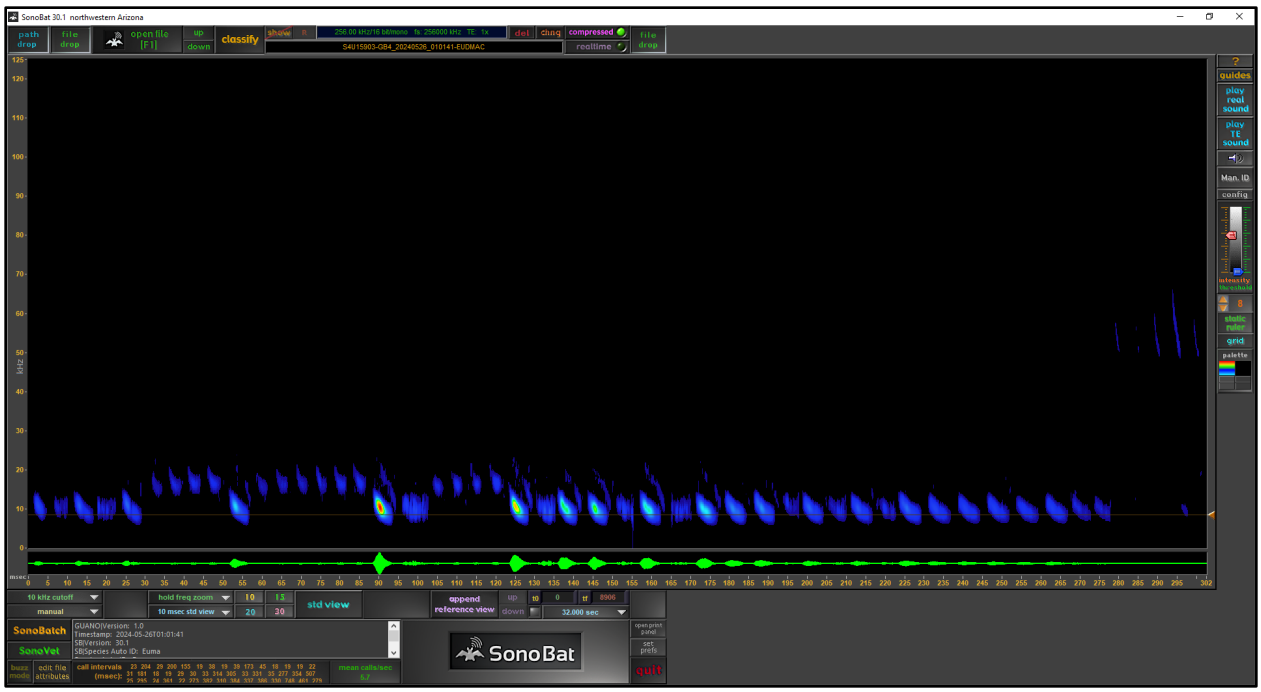

Figure A-3. Spotted bat call sequence, including trills, from acoustic survey location GB-04, Clark County, May 26, 2024.

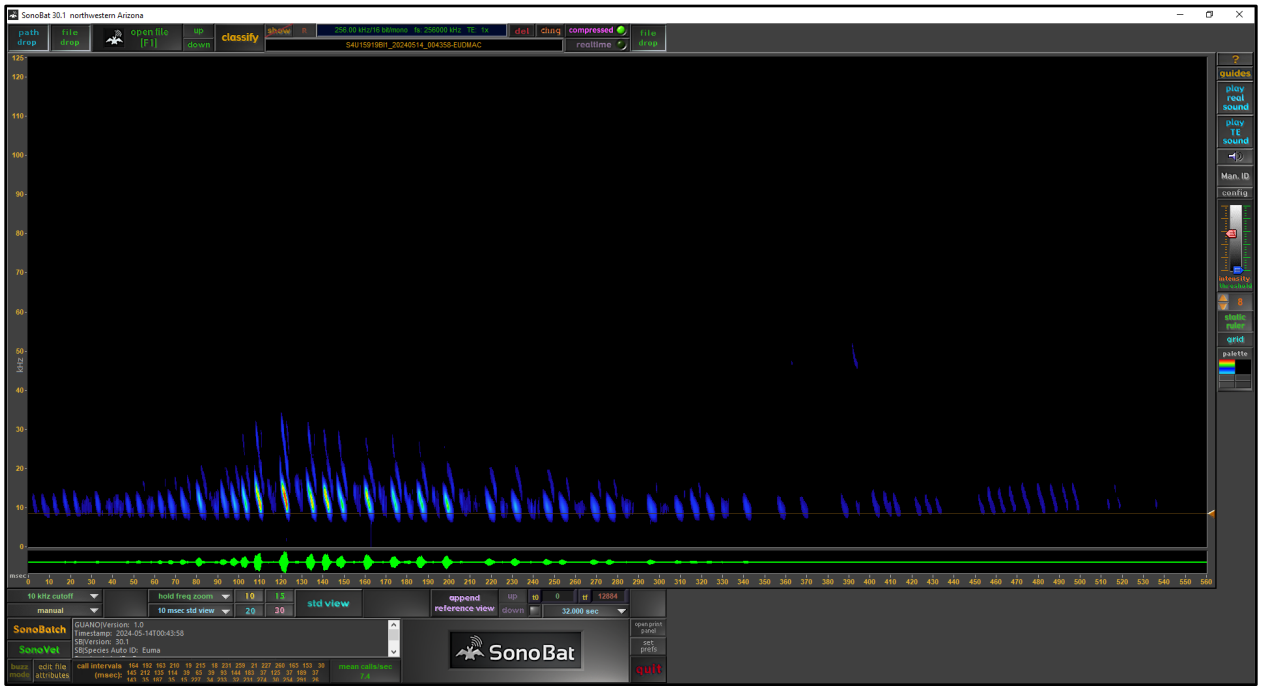

Figure A-4. Spotted bat call sequence from acoustic survey location BI-01, Clark County, May 14, 2024.

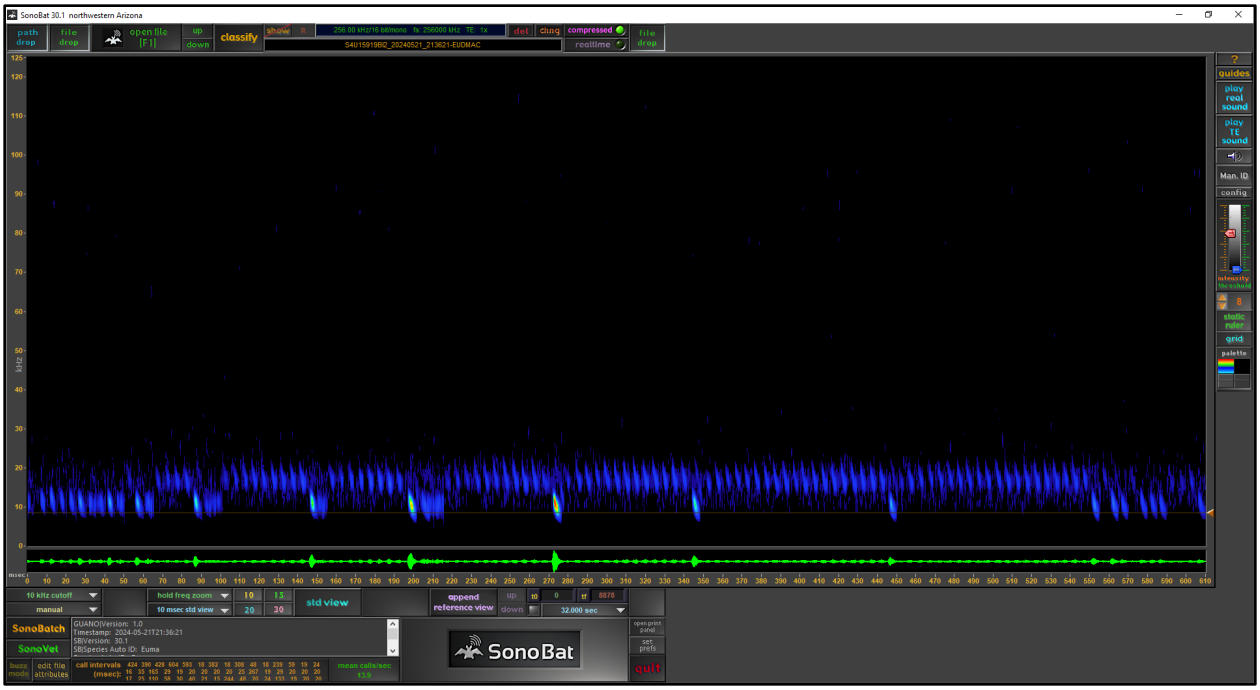

Figure A-5. Spotted bat call sequence, including trills, from acoustic survey location BI-02, Clark County, May 21, 2024.

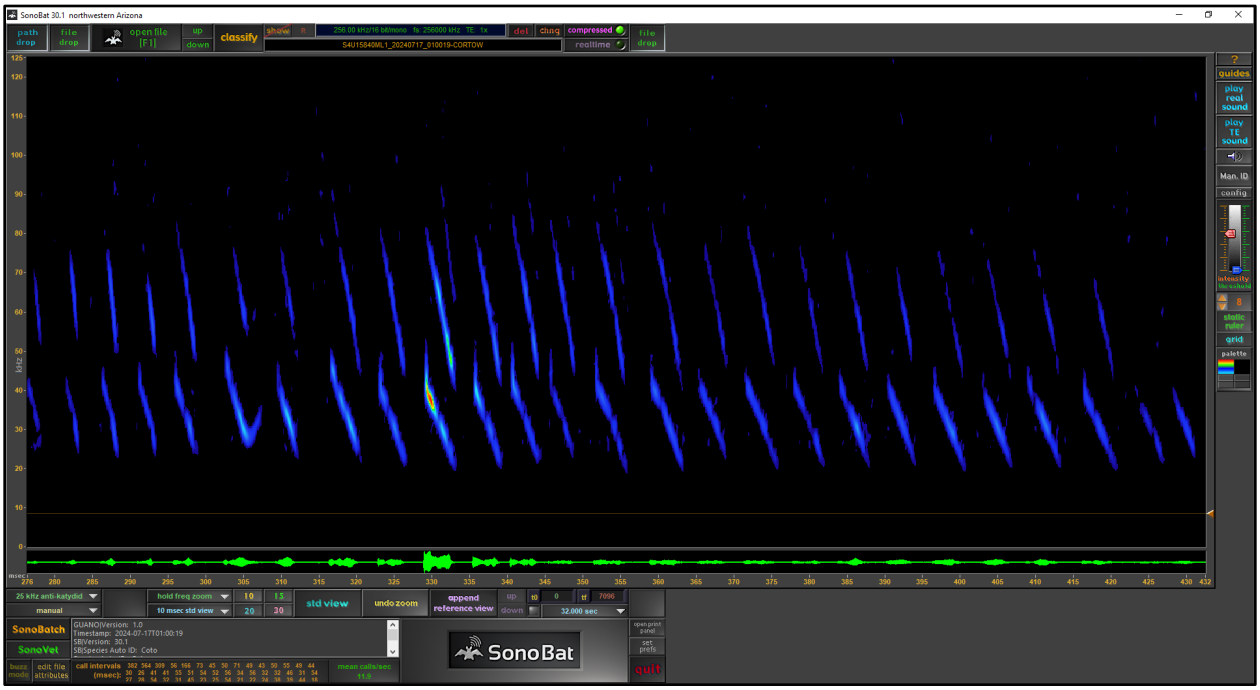

Figure A-6. Townsend's big-eared bat call sequence from acoustic survey location ML-01, Clark County, July 17, 2024.

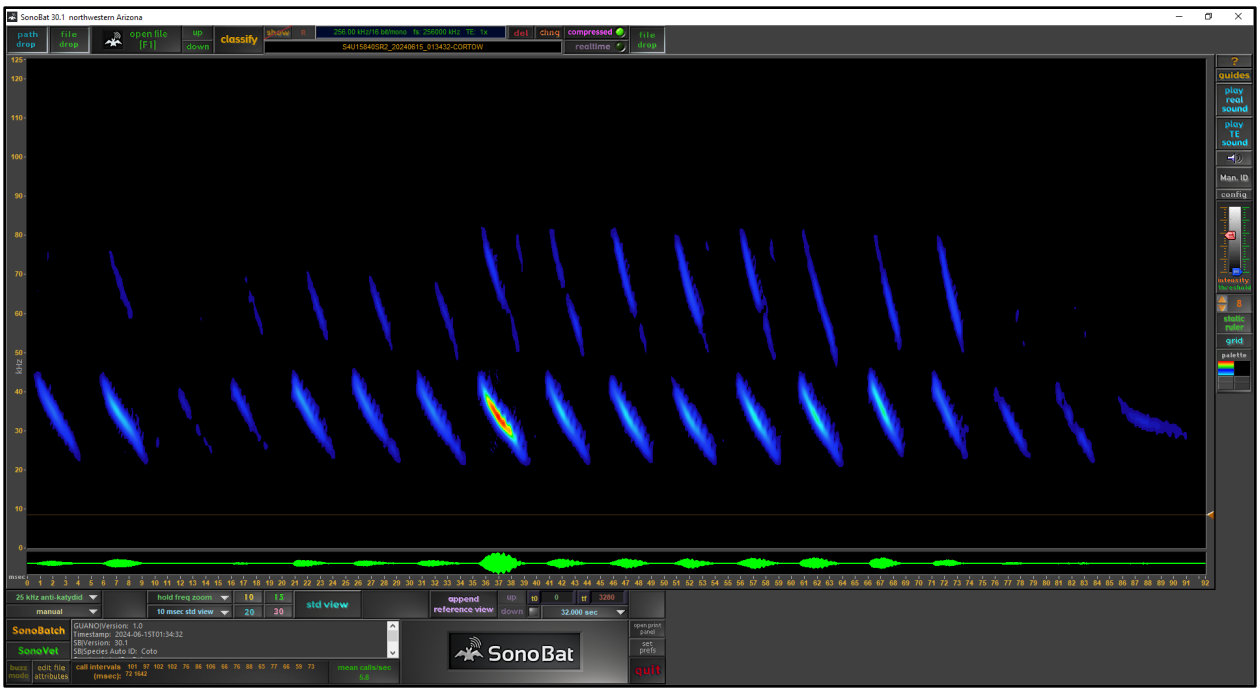

Figure A-7. Townsend's big-eared bat call sequence from acoustic survey location SR-02, Clark County, June 15, 2024.

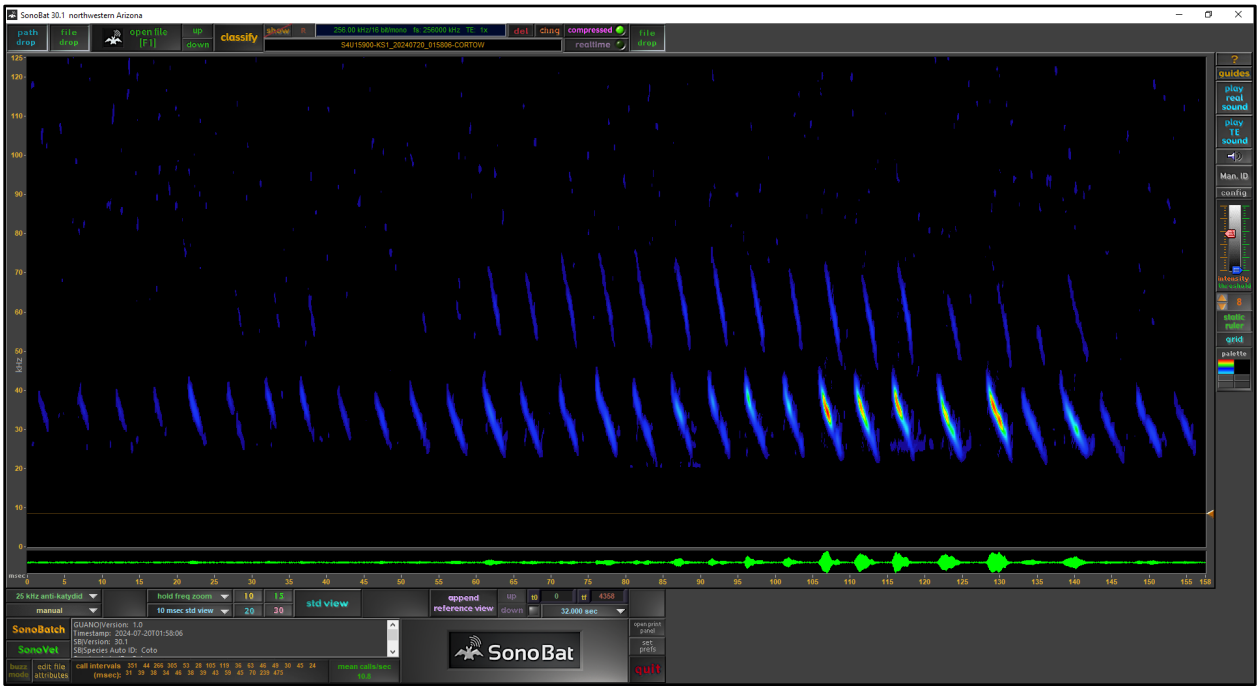

Figure A-8. Townsend's big-eared bat call sequence from acoustic survey location KS-01, Clark County, July 20, 2024.

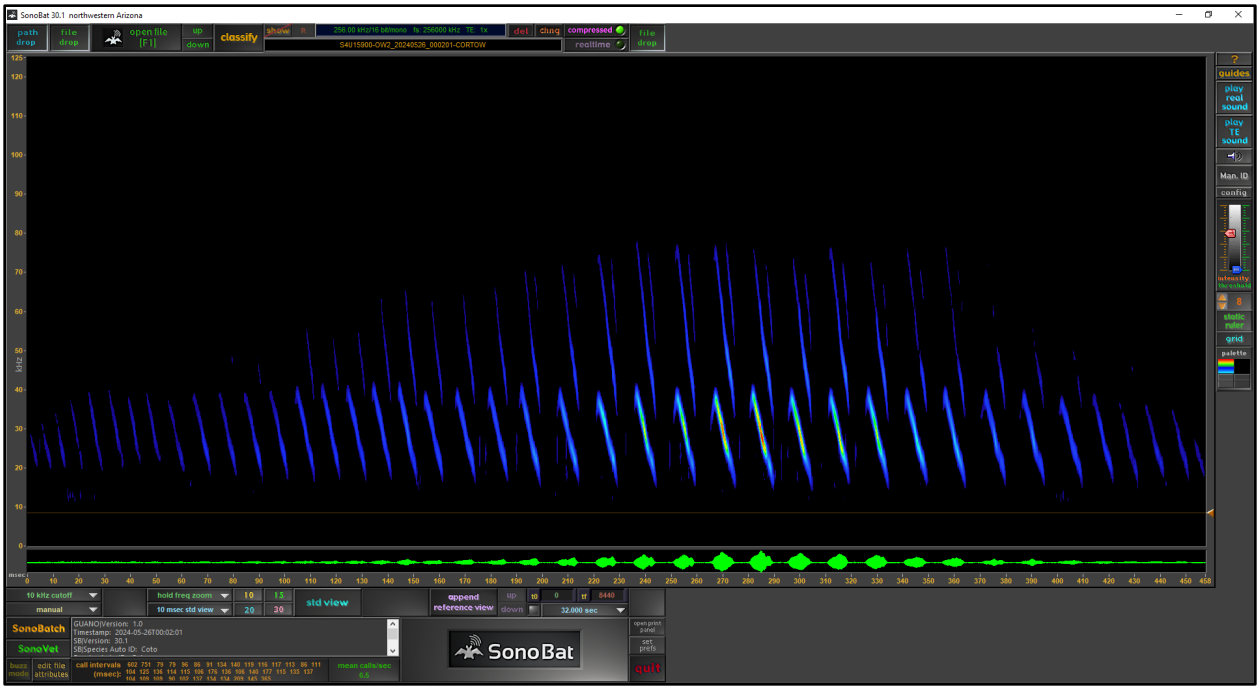

Figure A-9. Townsend's big-eared bat call sequence from acoustic survey location OW-02, Clark County, May 26, 2024.

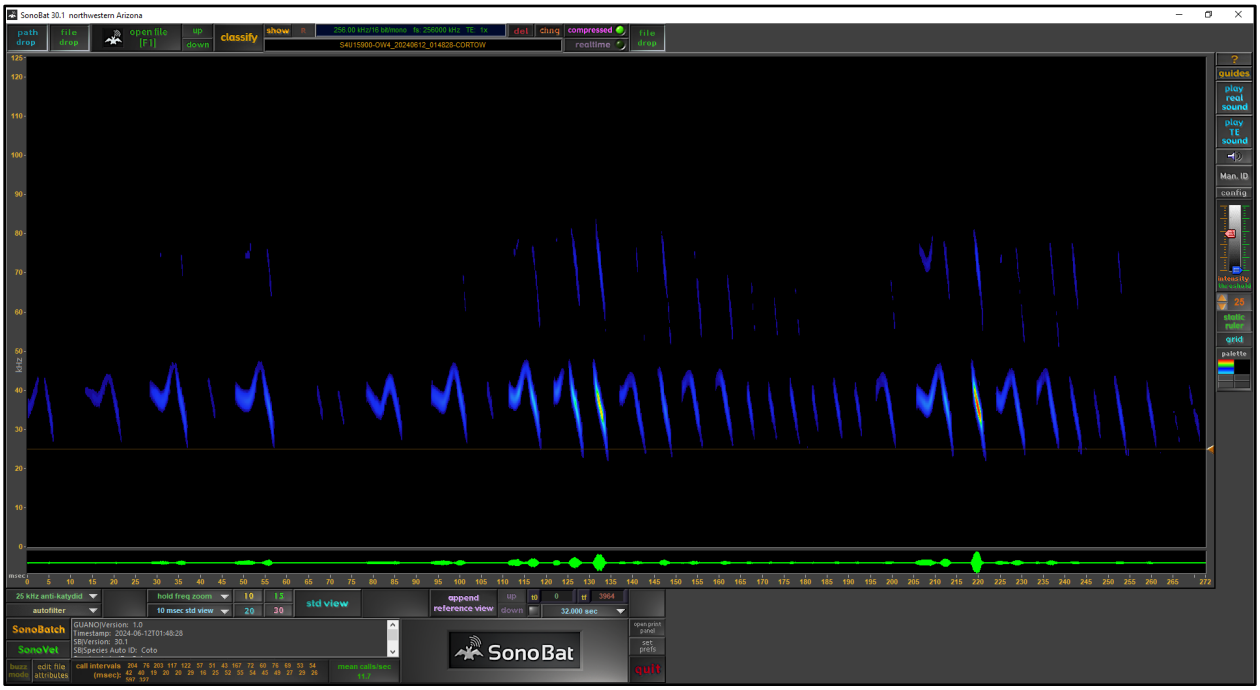

Figure A-10. Townsend's big-eared bat call sequence from acoustic survey location OW-04, Clark County, June 12, 2024.

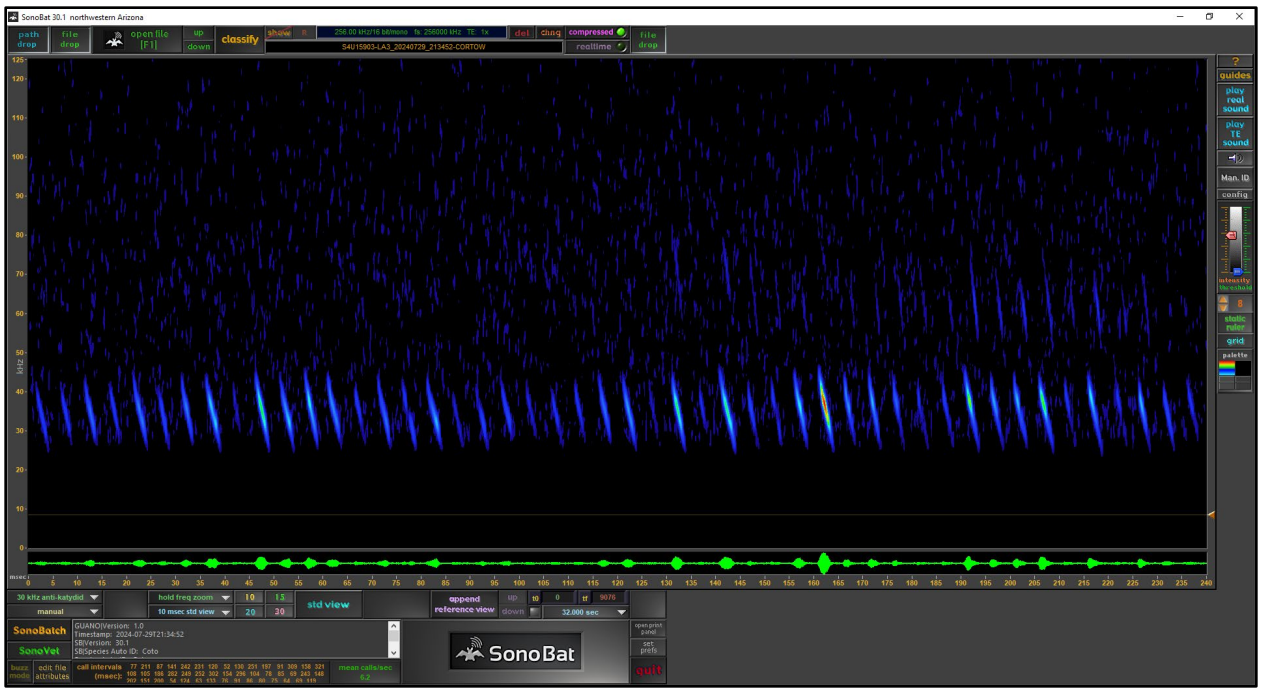

Figure A-11. Townsend's big-eared bat call sequence from acoustic survey location LA-03, Clark County, July 29, 2024.